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DISCUSSION PAPER SERIES

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ABSTRACT

Workforce Development in the US: Recent Trends and Evidence*

In this paper, I examine what we know and don't know about both private and public workforce development in the US. I highlight three of the most important categories of programs and policy: a) Workforce development in accredited higher education institutions, particularly community colleges; b) Other publicly-funded or private training and services, including "sectoral training" that targets specific high-demand sectors of the economy; and c) On-the-job or work-based learning, including apprenticeships. I summarize the theoretical literature on workforce development and a broad landscape of the three key categories. I synthesize the empirical literature on workforce development, beginning with comparisons of different data sources, outcome measures and empirical methods used before reviewing the literature on estimated impacts in each of the three categories. I then consider the international evidence on workforce development, and how public efforts differ between the US and other industrial countries, before concluding.

JEL Classification: J24

Keywords: workforce, training, community college, sectoral, WIOA, apprenticeship work-based learning

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I. Introduction

An important predictor of individual earnings in the United States today, and of earnings inequality, is whether or not an individual has a bachelor's degree (Autor 2014). The rate of return in earnings to bachelor's degrees of arts or science (BA or BS) rose substantially in the 1980s and 1990s and has remained very high by historical standards (Autor et al. 2020).

But less than 40% of US workers earn BA/BS degrees (US Census Bureau 2022); and, for those without degrees, the skill demands of employers can remain very substantial, especially in jobs which pay average or higher compensation (Holzer 2015). For those who will not gain bachelor's degrees, *workforce development* offers alternative routes to skill attainment and higher compensation.

Workforce development is usually defined as job training plus a range of supportive services for workers, like career counseling or job search assistance. I define *Job training* broadly as any postsecondary education that provides workers with skills directly for the labor market, below the level of BA or BS courses/degrees, and excluding the liberal arts (where the latter are defined as math and the natural sciences, the social sciences and humanities). Such training can be generated by a range of providers – including public community or for-profit colleges, community-based or industry-linked organizations, and employers (through on-the-job or incumbent worker training). Support services are often available from these providers and also at local American Job Centers (or AJCs, formerly known as One-Stops) funded by the US Department of Labor.

Workforce development can potentially play a very important role in improving average earnings for workers without BAs, and in reducing inequality between them and those with higher educational attainment. But to what extent is it achieving its potential – and do we understand why or why not? Critical questions include: in what numbers are US workers seeking workforce development and where? What role is played by *public* relative to private funding, and for whom? Of the many sources and categories of workforce development, which appear to be most cost-effective? What more do we need to know to answer these questions?

Past reviews of the publicly-funded job training or workforce development programs and policies include Lalonde (1995) and Friedlander et al. (1997), though much has changed in the time since these papers were written. More recent reviews have been written by McCall et al. (2016), Barnow et al. (2022) and Black et al. (2023), which do an admirable job of reviewing the theory of job training and empirical evaluation work through a strong econometric lens.

In contrast, I focus on three important categories of US workforce development and how they have evolved over time, identifying in each case what we know or don't know from the extant empirical literature. The three categories are: 1) *Higher education* – public community (and, to a lesser extent, private for-profit) colleges; 2) *Training from other public or private providers*,

such as community-based organizations or industry-recognized programs, including many using public funding; and 3) *Work-based learning* or incumbent worker training from employers.

Regarding these three categories of workforce development, I will stress the following:

- Higher education institutions have emerged as the primary source of US workforce development;
- *Sectoral* training, targeting specific high-demand sectors of the economy with well-paying jobs for those without BAs, creates relatively high returns in its best forms, though with questionable scalability; and
- Apprenticeship has emerged as a particularly promising mode of work-based learning which, in the US, seems fairly under-utilized.

But, in each case, major questions remain about what we know or don't know, and how much greater the impacts of our workforce programs and policies could be if we understood more.

My focus on postsecondary education and training leads me to exclude career and technical training in high school, except in certain "pathway" programs which integrate studies in high schools with certificate or associate degree programs in community colleges. Also, I exclude subsidized employment, in the public or private sector, which has not played a large role in recent decades in workforce development in the US, and which might not be viewed as training in any real sense - since most such efforts in the US have little lasting effect on employment or earnings of workers after the subsidy ends (Barden et al. 2018).

I begin with an overview of the labor market theory that emphasizes varying rates of return (and costs) to different workers in different settings, and justifies at least some public funding of job training and related services. I also summarize the complex landscape of workforce development in the US. I synthesize the key data, outcome measures and methods used to estimate workforce development impacts, and then the estimated impacts themselves, highlighting both what we know and what we still need to learn. I will also briefly consider what we learn the European Union (EU) and other industrial countries before concluding.

I find that the many options of training and services available in the US, with their many sources of funding, provide very mixed labor market value for students and trainees - though different options seem more or less cost-effective for different categories of workers. But these many sources of job training and services also generate a fragmented "system," if it can be called a system at all, with limited coordination and some wasteful overlap across agencies; it also creates a limited understanding by the public of which services are available to any given individual and where they can be found. Also, public funding for workforce development, especially outside of higher education in the US, is much lower than in most other industrialized settings, especially the EU. These factors all contribute to a rather unique workforce development setting in the US that generates strong outcomes on some dimensions, like higher education credentials, and weaker ones on others, like earnings for those with no postsecondary experience; and the scalability of the best models remains uncertain.

II. The Theory of Workforce Development: Market Forces and Failures

Workforce development centers on the skill-building choices made by students and jobseekers who are not seeking or obtaining BAs, as well as their potential employers. We can use the standard human capital framework developed by Gary Becker (1968) and Jacob Mincer (1974) to analyze these choices, just as we would any other choice of more or less schooling outside of work and the training that work provides.

In Figure 1, individuals compare compensation on jobs with and without *external* (to firms) non-BA postsecondary training. Both options incorporate internal (or on-the-job) training, beginning with the point at which students leave high school. We abstract away from future training and mobility across jobs, which can be considered part of the pattern of real wage growth in the diagram that workers experience over time.

Employers choose how much external education or training they require at the time of hiring versus how much on-the-job training they provide; we presume that the more *general* training they need, and the larger the magnitude or costs (to employers) of providing it, the more external training they require before hiring. They can also choose to create *specific* work-based learning options (like apprenticeship or internships), which increase the amount of training provided on the job. The costs of external postsecondary training to students include both foregone earnings and direct costs, such as tuition and fees; while on-the-job training reduces up-front wages, due to their lower productivity at that time. All else equal, on-the-job training should raise the rate of wages growth over time, and more specific training (to a firm or industry) should reduce worker turnover and therefore raise employer willingness to help pay for such training (Jovanovic 1979, Neal 1995).

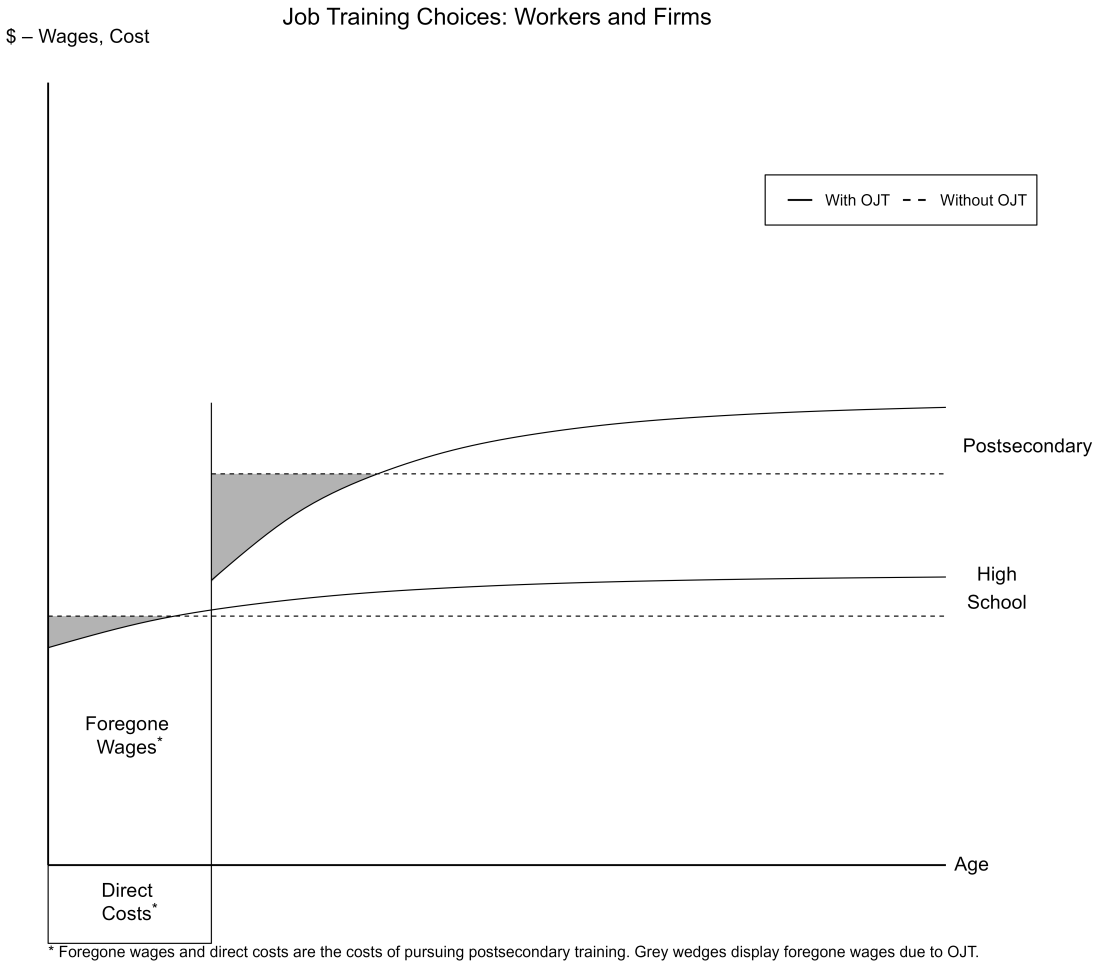
Different workers choose different amounts and kinds of training, above and beyond their preferences across jobs and their nonwage characteristics; the expected returns to training (and probabilities of completing different kinds of programs) likely vary across individuals of different ability levels if there is "dynamic complementarity" between the quality of their K-12 education and postsecondary training (Cunha and Heckman 2010). The costs of attaining skills can also vary across families with different levels of resources (as well as rates of time preference), with more affluent families or individuals facing lower costs net of such resources. Employers can choose to provide more or less training even within the same industries and regions, depending on factors such as the quality of local labor supply, their own financial resources, and any constraints on their choices driven by institutional factors (like unions or local government). And, of course, their choices on whom to hire into particular jobs affect worker access to those jobs and any training provided on them.

The *expected returns to different kinds of training for different kinds of workers, net of costs*, are thus key to understanding the skill-building options they face, the investments they make, and their impacts on worker compensation over time – though differences in worker preferences

across occupations (e.g., by gender) and employer provision of training to different groups might be important too.

But Imperfect information about the many postsecondary options and the characteristics of training on jobs can also limit worker access to workforce development, thereby limiting their wage returns to training and/or raising its costs. Limitations in worker knowledge of labor market opportunities and in their networks or "social capital" (Chetty et al. 2022), especially among those without higher education, can limit the quality of "matches" between workers and jobs, reducing both worker productivity and their access to high-quality on-the-job training. For that reason, most countries provide job-seekers with information about vacant jobs and skill requirements, along with referrals to employers.

Figure 1



* Foregone wages and direct costs are the costs of pursuing postsecondary training. Grey wedges display foregone wages due to OJT.

A number of market failures can also affect the worker's choices of education and training. *Liquidity constraints* and capital market failures limit the resources of those with less liquid wealth and therefore raise the costs of external education and training for them (Attanasio and

Kaufmann 2009). Education and training also have some *public goods* aspects, in that they likely raise worker productivity beyond any individual worker or job (e.g., Glaeser and Resseger 2009) and provide a range of civic benefits as well. Well-educated workers also provide public goods to others through their "social capital;" and there is evidence that well-educated or skilled workers can raise rates of firm-level innovation (Andersson et al. 2009, Deming et al. 2023).

Employer choices can also be influenced by market failures. Acemoglu and Pischke (1996) point out that search frictions such as asymmetric information – where the current employer has more knowledge of a worker's skills and training than alternative employers – generate monopsony power for the employer, who can then modestly raise wages to keep a trained employee when needed. In this situation, the firm also has some incentive to pay for a worker's general training – since the risk of the worker being "poached" by other firms declines – and such training can raise the productivity of workers that justify the higher wages needed to retain them. Importantly, this analysis suggests that some market failures can raise the amount of employer-provided training, while others reduce them.

Other market failures can also affect the firm's provision of training. The Becker-Mincer model implies that Institutions that create downward wage rigidity, like labor unions or minimum wages, reduce general training by making it impossible for workers to pay for such training with lower wages. But if these institutions compress the wage structure more broadly, highly productive workers become relatively more attractive to firms which pay them wages below their productivity; and firms will have some incentive to provide more training to such workers to generate the higher productivity that exceeds their wages (Acemoglu and Pischke 1999). In combination with search frictions or monopsony, incentives to train even less productive workers exist as well.

And apprenticeship is a specific kind of institution in which employers and workers are bound by a contract for the period of training – creating a situation of bilateral monopoly for that time period, but one that is also highly regulated by the public sector. Some employers and workers can presumably benefit from this arrangement; the employer gets well-trained employees whose wages are usually lower during the period of training, while the worker is guaranteed at least some employment and wage growth with this employer (and perhaps broadly in that industry).

As with any kind of schooling, the justifications for the public provision and regulation of workforce development in all of its forms are based both on the range of information limits and market failures cited above, many of which limit private investments below their optimal levels, as well as by equity or distributional concerns. Lower-income students have lower expected returns from more academically rigorous training if their previous skill attainment has been lower, though perhaps higher returns from less rigorous kinds; and they likely face higher financing costs due to more limited liquid assets and imperfect capital markets. They may also perceive fewer potential benefits of obtaining such education or training due to imperfect information or weaker "social capital." Employer discrimination (by race, gender, age and disability) can also limit worker access to on-the-job training (Duncan and Hoffman 1979, Lynch

1992), so public subsidies of on-the-job training (or anti-discrimination efforts) can potentially raise the returns to training for groups facing such bias.

III. The Landscape: An Overview of Workforce Development in the US

Table 1 presents a broad overview of workforce development options in the US. The three rows correspond to the three broad categories of workforce development described above – i.e., higher education, training/services by other (non-higher education) providers, and on-the-job training (or work-based learning); the columns present sub-categories of each, who the providers are, the sources of funding and who is funded.

The providers of such services include a range of "accredited" (approved by public regulators) higher education institutions (public or private, for profit or not-for-profit), public agencies (like local American Job Centers, or AJCs), community-based organizations, and industry-related organizations and employers (public or private). Various programs in higher education can be for academic credit or not, for degrees or certificates, and shorter-term or longer-term in length. Other categories of workforce services include career guidance and job search assistance; and work-based learning includes apprenticeships and internships as well as other forms of on-the-job (or incumbent worker) training. Funding can be private (by students or employers) or public, and the latter can derive from a range of sources – federal, state or local.

The implementation and regulation of public programs and funding at all levels of government is handled mostly by the Departments of Education and Labor. But various General Accountability Office (e.g., 2019) reports over the years note over 40 different federal training programs, outside of higher education, with some wasteful overlap in administrative expenses.

A. Workforce Development in Higher Education

Higher education institutions have become the most important providers of workforce development in the US, as measured both by numbers of students/trainees and dollars spent. A rough estimate of the numbers enrolled in college workforce programs in any given year would be about 8 million.[1] While community college enrollments have generally been declining in recent years, there has been an uptick in workforce enrollments (Inside Higher Education 2024). Older students (above age 25) now constitute about a third of community college students and are especially likely to enroll in workforce programs. Women tend to concentrate more in some fields like health care or cosmetology and in associate degree programs, while men more frequently concentrate in more mechanical fields and certificate programs. Low-income students and those of Color also concentrate in workforce certificate programs, especially those with less math or science content (Feygin et al. 2025). These patterns parallel differences by

[1] Holzer and Baum (2017) note that students in liberal arts or with no declared major account for about 40 percent of the roughly 10 million community or for-profit college students in any given year, so that six out of ten million are in for-credit workforce programs. Data on non-credit programs are less available, though Baum et al. (2020) provide some estimates over time from retrospective questions in American Training and Education Survey data.

race, gender and family income in academic achievement (Reardon et al. 2019) as well as longer-standing occupational patterns by gender.

The public higher education institutions that provide workforce development are primarily community colleges, which have multiple missions – including general education for associate degrees in the liberal arts or transfers to 4-year institutions as well as workforce development. Different colleges put more or less emphasis on each of these two goals; for instance, a subset known as technical colleges (the main community college model in states like Wisconsin, Indiana, and Georgia) focus primarily on providing skills training that is specific to occupations and industries, rather than general education degrees. The private for-profit institutions include those providing a wide range of certificates and degrees, like Strayer and the University of Phoenix. Since the private colleges receive no state funding, tuition costs there are much higher. There are also much smaller proprietary occupational programs in field like cosmetology, culinary services or information technology (IT) that are for profit as well.[2]

Importantly, most community and for-profit colleges are "open access" institutions to anyone with a high school diploma or GED. This means that many students enroll there with weak academic preparation, which likely lowers program completion rates (Baum et al. 2020).[3] Students also come with limited knowledge of their own skills and interests and what is demanded in various fields of study or occupations, and the amount of academic or career counseling they receive is low; so students frequently begin academic associate degree programs but then switch to workforce programs or drop out altogether (Bailey et al. 2015, Holzer and Xu 2021).

Public funding in higher education takes two broad forms: 1) State and local subsidies to public community and technical colleges, to keep tuition and fees relatively low; and 2) Federal financial aid to students at all accredited institutions (including the for-profits) through Title IV of the Higher Education Act – which funds Pell grants (or scholarships to low-income students), federal loans, and work-study programs for on-campus work. Total public subsidies to students at community colleges or to the institutions themselves amount to about $50 billion per year, with about $25 billion or so for workforce students and programs.[4] To ensure that the institutions receiving such aid are generating credentials with labor market value and not exploiting students (who might have too little information about their effectiveness or face limited choices), the federal Department of Education has implemented accountability on

[2] For-profit institutions have accounted for over 40 percent of all certificate enrollees plus some in associate degree programs (Baum et al. 2020), including both for credit and not-for-credit enrollees, though their enrollments have declined in the past decade or so (https://nces.ed.gov/programs/digest/d23/tables/dt23_302.60.asp).

[3] Completion rates average about 60 percent in certificate programs but under 40 percent in associate degree programs, with wide variation across demographic groups and programs within each category, as we note below.

[4] The Community College Research Center (2022) reports that community colleges get .18, .33, and .20 of their revenue respectively from federal, state and local governments, totaling about $50 billion out of the roughly $160 billion that go to public colleges overall. As noted above, roughly 60 percent of total enrollment is in workforce programs over a year, though these shorter programs account for somewhat less of total student hours.

colleges known as “Gainful Employment” regulations; these can limit student access to Title IV financial aid in college occupational programs and in the for-profit sector that that produce too few credentials with value. These regulations were first instituted by President Obama, rescinded by the first Trump administration, and restored under President Biden (in somewhat different form), though they have not been rescinded (as of July 2025) in the second Trump administration.[5]

About half of all students in for-credit certificate programs have Pell grants (Baum et al. 2020). But student eligibility for Pell grants and federal loans in workforce programs was, until recently, limited to those in for-credit programs which meet minimum duration requirements (15 weeks or 600 hours); in the recently passed One Big Beautiful Bill, these were reduced to 8 weeks or 150 hours. But students in not-for-credit and/or shorter-term workforce programs remain ineligible. In the meantime, over two-thirds of students in certificate programs – especially those in for-profit colleges but even some in public institutions – borrow to finance their training (Baum et al. 2020), and face significant risks of default if they do not complete their programs or do not find jobs which reward their training.[6]

Community college workforce programs can be for academic credit or not for credit, though our data on the latter are quite limited.[7] Programs with at least some general education content, which could provide a basis for an associate or even a bachelor’s degree (if students transfer to a four-year college or university), are generally for credit. In contrast, non-credit programs have virtually no general education content (Jacoby 2021) and often are less expensive and take less time to complete; they also do not require the kind of test-based proficiency in math and English that force many for-credit students in associate programs into “developmental” (remedial) classes and cause many students to drop out (Scott-Clayton 2018). And, while students in non-credit programs are not eligible for federal financial aid, these programs have the advantage of being less bureaucratic and requiring less faculty and administrative oversight They can be set up quickly in response to the changing needs of local employers, and therefore can be better aligned with local labor demand than for-credit programs, which are often criticized for lack of responsiveness to demand (Fuller and Raman, 2023). Also, community colleges are beginning to find creative ways to fund students in non-credit programs, and some are allowing them to be “stacked” in limited ways towards associate degrees (Schwartz and Lipson 2023); some states, like Virginia (in its Fast Forward and G3 programs), are also beginning to provide financial aid (Dziesinski,2024).

[5] For instance, current Gainful Employment regulations require each college to produce credentials which, on average, generate earnings above those of workers with only high school diplomas in their states, and also generate limited student debt payments relative to their incomes. In addition, many states use some form of “outcome-based funding” for higher education in which public college subsidies depend at least partly on the numbers of credentials earned by students and sometimes their labor market value (Dougherty and Reddy 2013).
[6] Baum et al. show that 28 percent of certificate students with debt default within 12 years, and such rates are substantially higher for those in for-profit colleges as well as program non-completers.
[7] Some descriptive empirical work on noncredit programs for a few states is becoming available from the Center for the Study of Higher and Postsecondary Education at the University of Michigan – see Bahr et al. (2025).

Another approach to community college training that is growing more popular is the "pathway" from high school career and technical education straight into certificate or associate degree programs. An example is the P-Tech program in New York for grades 9-14, which began with partnerships between high schools, colleges and IBM; these are now being replicated in other states and industries. More generally, most states have developed curricular CTE pathways from high school to community or four-year colleges for specific occupations and industries (Hoffmann and Schwartz 2017). States are also expanding "dual enrollment" options for high school students in career and technical education, so that they can attain college credits in secondary school (Edmunds et al. 2022).

Interestingly, many community colleges provide a broad range of support services for both workforce and academic students. Such services can include career counseling, case management, coaching, child care and transportation, and even emergency cash to poor students. The extent of service provision varies widely across colleges, depending on student needs and institutional resources.

B. Job Training and Other Workforce Services Outside Higher Education

1. Department of Labor Programs

Outside of higher education, a great many programs and institutions receive federal funding to dispense job training and workforce services. The most important of these programs, in terms of federal support and public use, are the ones funded by the Workforce Innovation and Opportunity Act (WIOA) that are run by the US Department of Labor (DOL).[8] WIOA provides a number of funding streams for job training and other services. The largest include funds for disadvantaged adults, displaced workers (who had significant tenure in jobs which they lost to automation, imports, or workplace reorganizations), and out-of-school youth.[9] These funding streams are distributed to state and local workforce boards which are staffed by appointees of governors and mayors respectively, which in turn make them available to workers for use with approved local skill providers. WIOA also funds about 2500 AJCs which provide "career services" for jobseekers and often house Employment Service (ES) offices, providing more specific services to Unemployment Insurance (UI) recipients.

Total federal funding for WIOA is now about $11 billion, with $7 billion for workforce programs and the rest for vocational rehabilitation. Funding has been quite dramatically reduced over time; at its peak around 1980, funding was about $18 billion (or $65 billion in current dollars), though that figure included the cost of public service employment jobs which were discontinued in the 1980s. The amount of training now provided is very limited; one recent

[8] Previous versions of WIOA include the Comprehensive Employment and Training Act (CETA) of 1973, the Job Training Partnership Act (JTPA) of 1982, and the Workforce Investment Act (WIA) of 1998. As the program has evolved over time, it has become much more decentralized, with state and local workforce boards playing increasing roles in the allocation of funds.

[9] Other programs funded by WIOA include the residential Job Corps program for disadvantaged youth, adult basic education, and vocational rehabilitation programs for the disabled.

estimate suggests that only $.5 billion from the adult and dislocated worker streams is spent on training for only about 200,000 workers per year (Deming et al. 2023). Trainees receive vouchers known as Individual Training Accounts (ITAs) which pay for training from approved local providers, with funding averaging only about $2500 per ITA.

UI recipients can get additional services if they are identified by worker "profiling" models as being at great risk of long-term unemployment, and these services are often provided through a program called Reemployment Services and Eligibility Assessments (RESEA). And attempts by the federal government as well as states to improve the quality of the "labor market information" and the career guidance they provide are important as well.[10] One other notable federal training program – Trade Adjustment Assistance (TAA) – is funded by DOL. Eligibility depends on receiving certification from DOL that the trainee has been permanently displaced by imported goods or services. In FY 2022, approximately 100,000 workers were certified – though far fewer receive training (US Department of Labor 2023). TAA provides income stipends as well as training for certified workers.

Finally, the federal government has funded many one-time competitive grant programs in the past few decades, with varying levels of funding. For instance, the Trade Adjustment Assistance and Community College Career Training (TAACCCT) under the Obama administration provided $2 billion worth of funding to community college-led partnerships to build training programs and regional workforce systems. The Biden Commerce Department's Good Jobs Challenge provided grants to sectoral training programs (described below) with good-paying jobs as a clear criterion, while other funding for training in specific occupational categories was provided in the Inflation Reduction Act, the CHIPS Act, and the infrastructure bill.

2. Other Job Training Models and Programs

Besides the programs directly funded by USDOL, a few others merit some attention. First, of all the many forms of training which are now available – whether provided by colleges or community-based agencies funded by non-profits – a category called *sectoral* training is generating large interest. In this model, specific training is targeted towards high-demand sectors - like health care, IT, and advanced manufacturing - where employers have some difficulty filling jobs that do not require BA/BS (or even AA/AS) degrees and that pay quite well. Intermediaries bring together regional employers and training providers to ensure that training meets the needs of the employers, and "wraparound" support services for trainees (including child care and transportation, basic skill remediation or coaching) are often provided as well. The best known (and most rigorously evaluated) non-profit intermediaries include Per Scholas (or WorkAdvance in some cases), Project Quest, Jewish Vocational Services, the Wisconsin Regional Training Partnership, and Year Up (for youth). While now small, efforts to replicate

[10] For instance, states are building new data capacity and are collaborating to follow workers across state lines to have better information on how geographic mobility can improve employment options (National Association of State Workforce Agencies 2024, Lane 2023).

these intermediaries are underway, though the high costs of the best-known models (as much as $10,000 per student, according to Holzer 2023) often necessitate other funding.

Another noteworthy model is called *career pathways*, which sometimes targets specific sectors and sometimes does not. The key feature of the career pathways model is that it allows trainees to enter and exit training pathways at a range of initial skill levels and program completion points. Workers who need basic skill development can receive it while also pursuing occupational skills training, in an increasingly popular format known as "integrated education and training" (IET). Specific well-known models include Integrated Basic Education and Skills Training (I-BEST), which was first developed and implemented in the state of Washington; and the Accelerated Opportunity model used in Kentucky and a number of other states.

Other modest federal funding sources exist outside of the Department of Labor for these or other kinds of training. These include Supplemental Nutrition Assistance Program Employment and Training (SNAP E&T) and training funded by Temporary Assistance for Needy Families (TANF), among other sources (USGAO 2019). Employment services for formerly incarcerated individuals ("returning citizens") are also available through grants states receive from the Second Chance Act.

C. *On-the-Job and Work-Based Learning*

What we know about on-the-job training in the US has recently been well-summarized by Black et al. (2023). According to them, the current state of on-the-job training in the US can be summarized in several stylized facts:

1) Almost all workers receive informal training on the job, though formal training is received by less than 20 percent of new hires;
2) Despite potential substitution of higher education for such training, employers invest vastly more in training their professional and managerial employees than others;
3) Whereas evidence on the extent to which workers pay for training with lower initial wages is mixed, there is clear evidence that such training raises productivity and wage growth over time; and
4) Public funding for on-the-job training in the US is quite limited at the federal and state levels.[11]

Also, the provision of on-the-job training in the US appears to be declining over time (Waddoups 2018), as the attainment of higher education among workers rises and as the presence of private sectors unions (which traditionally played a major role in running training programs for construction and manufacturing workers) has declined so precipitously.

[11] In the current version of WIOA, local workforce boards can spend up to 20 percent of their adult and dislocated worker funds on incumbent worker training, while state boards can also support them. The largest incumbent worker training program at the state level is the California Employment and Training Panel, where over $1 billion has been spent since the 1980s (Negoita and Goger 2020).

Together, these findings raise questions about the extent to which workers without college attainment have access to on-the-job training and the higher pay which it generates –with college attainment rising over time, non-college attendees increasingly represent the lower part of the basic skills distribution in whom employers might be reluctant to invest.

Perhaps because of these questions, as well as employer concerns about finding and retaining appropriately skilled non-college workers, there has been a renewed interest in the US in various forms of structured work-based learning, and especially apprenticeship. In the US, *registered* apprenticeship constitutes the best-known model for employers and workers. The US Department of Labor and its state-level counterparts regulate registered apprenticeship contracts along a variety of dimensions, as required by the National Apprenticeship Act. There are currently about 700,000 registered apprentices in the US – still a low fraction of all US workers, compared to many other industrialized countries, but rising somewhat over time (Boren et al. 2020).

The federal government has spurred interest through its American Apprenticeship Initiative, beginning in 2015. But states have taken the lead into how apprenticeship can be encouraged and institutionalized in a variety of ways. For instance, South Carolina pays firms a $1-4,000 tax credit per apprentice, while Colorado and Wisconsin have created youth apprenticeships with strong links to high schools and/or postsecondary institutions (Lerman 2022). There are also unregistered apprenticeships in the US, though we have less knowledge of their numbers and quality. Unregistered apprenticeship can be driven by concerns among employers (whether accurate or not) that the registration process is too costly and restricts their options too greatly.

D. *Summary*

In summing up the overall picture of workforce development in the US, a few characteristics stand out. First, there is no single "workforce development system" in the US; instead, we have a complicated set of providers, services, and funders/regulators across different departments and levels of government and also the private sector. Many public programs operate within "silos" that are very specialized and often cut off from one another and not well-coordinated, despite some efforts at local and state coordination, and workers likely have limited information about and difficulty choosing among all of the different options.[12] Second, public funding for workforce development is very asymmetric across these services and institutions. Specifically, federal and state/local funding for higher education institutions – more broadly and specifically for "workforce development" – are dramatically higher than those for other forms of workforce development. Since many students currently enrolled in non-credit or short-term training at community colleges get no funding from Title IV or any other sources, whether and how to expand funding to cover this group is an important current issue.

[12] For instance, higher education institutions have representatives on local and state workforce boards; and higher education students can get services or funding in AJCs, though few appear to do so. Some apprenticeships are coordinated with local community colleges, so apprentices can occasionally earn a college credential. But, in practice, this coordination is very limited.

IV. Returns to Training and Services: What Does the Evidence Show?

A. Data, Outcome Measures and Estimation Methods

Before I present the evidence on the labor market returns to different kinds of training and workforce development programs, I review the data, outcome measures and estimation methods used in a range of evaluation studies, along with their respective strengths and weaknesses.

As is well known, ordinary least square (OLS) estimates of returns to associate degrees are less than half of the magnitudes of bachelor's degree effects (where the latter currently show higher earnings of about 60 percent), relative to those with high school diplomas; and estimated returns to certificates are smaller still – though there is high variance in all of these estimates across fields of study. But unobserved cognitive (e.g., scholastic ability and achievement) and noncognitive (e.g., motivation or "grit") skills are likely positively correlated with school attainment and therefore generate positive biases in such estimates. Eliminating these biases from student selection into the many categories of workforce enrollment is critical for trying to accurately assess workforce program impacts.

Accordingly, researchers use the following empirical strategies in attempting to generate unbiased estimates of earnings and employment impacts:

- Randomized controlled trials (RCTs);
- Natural (Quasi) experiments – mostly Difference-in-differences (DD) or Regression Discontinuity (RD);
- Regressions on panel data with fixed worker/year effects and person-specific time trends; or
- Regressions/Matching with strong control variables for observable skills.

Of course, RCTs constitute the strongest methods to eliminate biases caused by selection into training. But even RCTs have their weaknesses – especially those used to estimate "intent to treat" impacts - if many in the control (or non-treatment) group obtain workforce services that are roughly as good as those which the treatment group is receiving. This can generate a negative bias in estimates of training impacts (though it could also signal a broad availability of alternatives to the training in question). And RCTs on some outcomes, like the effects of enrolling in community college, are not possible (since admission is open to any high school graduate or GED attainer).

Researchers use each of the last three bulleted estimation methods above (after RCTs), which likely have varying degrees of success in eliminating selection biases into training programs, as I discuss below. DD methods assume that, absent a program or policy, pre- versus post-policy differences for target and comparison groups would be roughly the same, while RD estimates make similar assumptions on either side of an arbitrary cutoff that determines eligibility for

some education or training program. Fixed individual student effects control for the time-invariant unmeasured characteristics of those who enroll in college at some point in time in longitudinal data, but may fail to control for time-varying unobservable factors; adding individual-specific time trends as controls (which many of these studies do) lessens this problem to some extent but might not capture all such time-varying factors. For example, the earnings among young students from summer or school-year jobs before they enroll in postsecondary training might tell us little about their ultimate earnings potential, though these are more informative for studies focusing on unemployed or displaced (and somewhat older) workers with more full-time or full-year work experience.

Researchers generally believe that estimates controlling for observables like test scores and/or grade point averages are more credible than those that don't, since they control for usually unobserved measures of cognitive skill, though these estimates likely remain at least a bit upward biased (due to other dimensions of cognitive and non-cognitive skills presumably not captured by them). Alternatively, as argued in Heckman et al. (1999) or Andersson et al. (2022), studies which match treatment and control groups over at least 8 pre-enrollment quarters of work experience and local labor markets, and use the same variables for both groups, can come close to replicating the results of some RCT evaluations of training programs and can be considered fairly strong methods.

Regarding the effects of college enrollment or completion, research during the past two decades has heavily focused on newly available administrative longitudinal data on students in public higher education institutions (and sometimes trainees in other programs), a very rich source of information. For states that make these data available, researchers can get information on all of the courses taken by each student enrolled in *for credit* programs, their grades received, and their credits and awards earned in all public institutions over time (as well as sometimes in the K-12 years).[13] And states can also link these data to quarterly earnings records from the Unemployment Insurance system at the individual level, so that researchers can tie student education and training to subsequent labor market outcomes. Using these data, researchers can estimate DD or RD, fixed effects models and regression or matching studies with strong observables to control for selection.

In addition, researchers have created three different measures of the earnings impacts of training, especially in colleges: a) the expected ex-ante value of earnings associated with enrolling in workforce programs, relative to not enrolling; b) the value of the credentials earned there, relative to those with only high school degrees (or GEDs); and c) the net value of credentials completed, relative to the earnings of college non-completers. The last estimate measures the "sheepskin effect" of credentials – the value of a credential per se – plus any additional credits earned by completers over non-completers. Estimates of a) can be interpreted as "intent-to-treat" measures, including returns to both completion and

[13] The National Student Clearinghouse now makes such data available to researchers as well for all states, though not individual-level earnings. The federal government also collects data for each college on student enrollments and earnings in the College Scorecard, but only for students who have received federal financial aid.

noncompletion by program enrollees, while b) represents a measure of "treatment effect on the treated" and c) represents a restricted version of the latter that conditions on community college enrollment.

To clarify the relationships between these outcomes, let E(Enrollment), PComp, $AWARD, $NETAWARD and $CREDITS represent the expected value of enrollment, the probability of completing a workforce program, the earnings impact of any credential (relative to the earnings of non-enrollment), the net value of the completed credential (relative to earnings of non-completers), and the value of credits earned by non-completers respectively. Then:

1) $NETAWARD = $AWARD - $CREDITS;

2) E(Enrollment) = PComp * $AWARD + (1-PComp) * $CREDITS; or

3) E(Enrollment) = PComp * $NETAWARD + $CREDITS.

Based on these relationships among the measured outcomes, $NETAWARD will clearly understate the value of a workforce credential relative to $AWARD, while both will exceed the E(Enrollment) in magnitude when the credits earned by non-completers or their labor market value are limited.

Still, which outcome is most appropriate to focus on depends on what question the researcher is trying to answer. For instance, to judge the ex-ante effect of enrollment in college workforce programs, studies that net out the credits earned by non-completers in estimating $NETAWARD could well understate the potential value of community college workforce programs or credentials for low-earning non-enrollees (Scott-Clayton and Wei 2018) - even if the estimates themselves are still somewhat upward-biased due to unobserved skills; but this potential value of enrollment, or a similar one for those completing credentials, is often the right one for programs offering to train currently non-enrolled students. And studies that net out the earnings gains of non-completers might also understate the value of workforce certificate programs, if many non-completers start in associate programs and generate as many or more credits than the certificates themselves require. A few studies (e.g., Liu et al. 2015) show negative selection into certificate programs, in which case those estimated returns can be downward biased in studies with incomplete controls for ability.

A few more caveats are noteworthy. Some of the studies reviewed below focus only on workers and workforce programs, but many do not; to infer workforce program impacts, these latter studies must present separate estimates by field of study in associate degree programs, though most certificate programs qualify as workforce (rather than liberal arts). Also, since many students in academic programs at community colleges aspire to (or successfully) transfer to four-year institutions, it is important to include such students and their credentials earned in these studies as well – though the value of associate degrees and certificates are then interpreted as the value of terminal or final awards. Finally, most studies also generate the value of credentials using only quarters with nonzero earnings, thus omitting the usually

positive effects of workforce programs on *employment* from estimated impacts on earnings. Several studies estimate positive impacts on employment separately, but the estimates receiving the most frequent attention usually omit these and thus also understate workforce impacts (while both could be included in one estimate if the researchers include quarters with zero earnings).

As we note below, few studies focus on the determinants of PComp, though this is a hugely important variable in determining the expected value of these training programs. Nationwide completion rates are roughly .6 for workforce certificate programs, though apparently higher in short-term and lower in longer-term or more rigorous programs, while completion rates average .4 (after six years) for associate degree programs (Baum et al., 2020). Completion rates among people of Color and/or those from low-income families are also lower, on average, than among white or higher-income families, limiting expected returns for the former groups.

In contrast to those on community college workforce programs, studies of other forms of training are sometimes based on RCTs, though others use strong matching on observables with administrative data on program enrollment (e.g., Andersson et al. 2022). But there are also no studies of on-the-job training or work-based learning using RCTs and few use natural experiments, so those are based mostly on matching.

The studies that I review with evidence on workforce development in higher education, other programs, and on-the-job, based on these categories of evidence, appear in Table 2. I include only studies that generate at least some outcome measures for workforce programs (rather than college credentials broadly) and that provide credible direct evidence of impacts on earnings.

B. *Evidence on Community or For-Profit Colleges*

The enrollment rates and estimated returns to the many forms of workforce development in higher education vary considerably across levels of credential, fields of study, time needed to complete them, states and demographic groups. The outcomes and methods used in different studies to estimate these results also matter considerably.

The papers that estimate E(enrollment) for unemployed workers at community colleges include Jacobson et al. (2005) and Leung and Pei (2023). The former estimated a DD model using administrative data on college enrollment and earnings for displaced workers who did or did not enroll (with quite limited enrollment by self-selected older workers), controlling for fixed worker effects and individual time trends, and became a model for other papers using community college data. Leung and Pei also estimate a DD model, focusing on workers receiving Unemployment Insurance, using a strong matching approach similar to Heckman et al. or Andersson et al. above. These papers find moderate increases in earnings of 7-10 percent for those who enrolled. Cellini and Turner (2016) use a similar approach (and DD estimates) to compare returns at community v. for-profit colleges, finding larger estimates among the former; comparing each group to non-enrollees, they find impacts between 10 and 15 percent

for community college students and essentially none for those at for-profit colleges – though they do not focus exclusively on unemployed workers or workforce programs.

Among studies that estimate workforce $AWARDS using administrative data, Backes et al. (2015) provide regression estimates on data from Florida while strongly controlling for observable characteristics, such as test scores and academic grades (and sometimes credits) earned. Completed workforce certificates generate earnings boosts of 20-30 percent, relative to those with high school only, though completion rates in these programs averaged only about 40 percent overall in Florida in the period studied (with high variance across students by family income). Enrollment patterns also vary somewhat, with women enrolling more in most associate degree programs while men have higher enrollments in many technical fields. Those with significant numbers of credits among non-completers also experience earnings gains, which increase with the numbers of credits earned. Expected values of enrollment are thus comparable or a bit higher than those described above, though positive biases due to unobservable factors remain possible in these OLS estimates.

Importantly, Backes et al. find that workforce associate degrees generate larger earnings than those in liberal arts; indeed, terminal degrees in liberal arts (i.e., without transfer to four-year institutions) generate little or no average market returns. This study also finds high variation in certificate values across fields of study. And completion rates in these programs vary as well by field, and are higher in the case of programs that take less time and are not as heavily dependent on cognitive skills as are many STEM certificates.

In contrast, Belfield and Bailey (2017) review eight studies, each of which focuses on a specific state to estimate $NETAWARDS; the samples in these studies include only community college enrollees, and all use fixed effects and person-specific time trends to control for selection into completion.[14] They provide estimates for certificates and associate degrees broadly, not just within workforce fields, though many provide evidence on returns by fields of study that enabler readers to separate workforce from liberal arts programs.

On average, the estimated labor market impacts on earnings of certificates and associate degrees are 5-8 percent and 20-25 percent respectively, with mostly higher values for females than males. These differences in estimated returns are consistent with the fact that women generally have higher academic achievement than men, and accordingly have higher enrollment and completion rates, especially in associate degree programs and in fields like health care; men continue to enroll more heavily in certificate programs in fields like manufacturing. The ongoing gender differences across fields suggest that male and female preferences continue to differ systematically across occupations and industries, though by less than in the past (Blau 2024). The higher estimates for women also suggest that they may face lower barriers to work due to discrimination or family time needs (perhaps because of a greater

[14] The eight studies were all part of a program at the Center for Analysis of Postsecondary Education and Employment (CAPSEE), run out of Teachers College at Columbia University.

availability of paid parental leave or having greater resources for child care) in sectors that require these workforce credentials compared to those that do not.

The lower estimated returns in Belfield and Bailey (relative to Backes et al.) are not surprising, given their focus on $NETAWARDS rather than $AWARDS; also, the former studies compare certificate completers with a broader range of non-completers, including those who pursued associate degrees who might well have had stronger records of achievement than many certificate completers. Another reason for the somewhat lower estimates in Belfield and Bailey is that they omit quarters with zero earnings, which are likely more frequent among non-completers. But they also find differences in estimated returns across states with very comparable data and methods, suggesting a wide range of real values rather than estimation idiosyncrasies.

And Belfield and Bailey show fairly linear impacts of credits attained on earnings, even for non-completers, which average about .4 -.5 percent per credit earned among enrollees. Since they report an average of 20 credits earned for non-completers (out of 60 usually needed for associate degrees), this group earns about 8-10 percent more than non-enrollees, which is netted out of the estimates of $NETAWARDS among both degree and certificate completers.

A look at a few of the best-known individual studies that estimate impacts on $NETAWARD is instructive. For instance, Jepsen et al. (2014) and Stevens et al. (2019) analyze data from Kentucky and California respectively.[15] Jepsen et al. estimate sizable impacts of associate degrees (24 and 56 percent respectively for men and women) and diplomas (21 and 45 percent), which are essentially certificate programs that take a year or more to complete (using 30 credits a year as the standard), but very modest effects of shorter-term vocational certificates taking less than a year (5 and 7 percent respectively for men and women). Importantly, the credits earned on short-term certificates are often as low or lower than those earned by non-completers in associate programs, contributing to their low value as a $NETAWARD.

Stevens et al. estimate fairly comparable impacts to those of Jepsen et al. for associate degrees (39 and 34 percent respectively) and positive effects of descending magnitude for long-, medium- and short-term certificates.[16] In both papers, returns within any credential category vary heavily across fields, with higher returns in workforce and especially more technical fields (like healthcare).[17] But the reason for the greater returns to short-term certificates in California than Kentucky are not clear; perhaps they reflect a greater use of short-term certificates in

[15] The paper of Jepsen et al. is included in the Belfield and Bailey review, while that of Stevens et al. is not, though their data and methods are very sjmilar. Belfield and Bailey include a paper by Peter Bahr on California data which is quite comparable to Steven et al.

[16] Stevens et al. organize certificates into those that take 1-2 years, .5 to 1 year, and <.5. Returns average 25, 17 and 13 percent respectively on these, with higher returns for women in the first two cases and for men in the third. Both the second and third categories would constitute short-term certificates in Kentucky.

[17] Returns to health care certificates in these studies are quite mixed, with low returns to Certified Nurse Assistant or Medical Assistant certificates but much higher ones for other health care technnicians and practitioners.

higher-wage occupations or industries in California than Kentucky, or other regulations regarding skill certification such as licensure requirements that boost earnings for certificate holders in the former.

One paper credibly estimates returns to noncredit programs: an analysis by Xu et al. (2024) of Virginia's Fast Forward noncredit program. Controlling for fixed individual effects and individual-specific time trends, Xu et al. find earnings increases of roughly 10 percent for those earning an industry-recognized credential relative to those enrolled who did not complete one, with high variation across fields and industries. Whether similar results would appear for other noncredit enrollees in Virginia or other states is not known.

Returns to credits earned among both completers and non-completers, relative to their low costs per credit (which average about $100 per credit for state residents in year-long programs worth 20-30 credits) and modest durations of foregone earnings, suggest that private expected returns on risky investments in workforce programs will outweigh their costs at public institutions in many or most cases. This is especially true for those with financial aid or in fields with fairly high expected returns. On the other hands, default rates on loans are not trivial among certificate program enrollees, especially among non-completers, enrollees in credentials and fields with low returns, or those attending expensive for-profit colleges, as we noted above.

On the very important questions of what determines program completion and for whom, a few studies analyze these determinants descriptively (e.g., Scott-Clayton 2011), while Holzer and Xu (2021) use fixed or random person effects, and both show negative effects of too little guidance and too much program switching. More broadly, Holzer and Baum (2017) summarize a mostly descriptive literature which suggests that weak academic achievement and frequent full-time employment also help account for low completion. We have some positive RCT evidence on the impacts of programs that seek to raise completion (summarized in Dawson et al.2020), though these mostly do not separate programs for workforce students from those in academic programs. Differences in completion probabilities by gender (higher for women) no doubt reflect differences in earlier academic achievement, to some extent; and lower completion among Black enrollees or low-income groups, all else equal, do so as well. Different completion rates generate differences in expected returns that likely help account for the relatively lower enrollment of the latter groups in workforce associate degree programs or in STEM.

Popular recent proposals, like those of Bailey et al. (2015) for "guided pathways" in community colleges that would gradually steer students towards programs they can more readily complete, remain rigorously untested to date. But an RCT evaluation of the P-Tech pathways program finds a large (5 percentage point) increase in workforce associate degree attainment, particularly among young men, seven years after students enter high school (Rosen et al. 2023).

Finally, two very specific programs for disadvantaged workforce students at community colleges have been evaluated. First, the sectoral healthcare program Project Quest at Texas community colleges has been evaluated using an RCT, comparing mostly female enrollees in the program to non-enrollees among community college students, and show evidence of strong

and lasting impacts on worker earnings lasting as long as 11 years (Roder and Elliott jnj2021); but the program was small and questions about external validity remain. Second, an evaluation of the Accelerated Opportunity programs for even more disadvantaged students at community colleges (relative to nonstudents) in four states, using matching on observables, generated mixed estimates (Eyster et al. 2018). On the one hand, the program led to increased credential attainment and short-term earnings gains in three of four states; but earnings gains persisted over time in only one. The challenges of training very disadvantaged (or "hard to employ") adults with limited basic skills or work experience at community colleges thus remain large.

C. Evidence on Other (Non-College) Training and Services

In the realm of non-college training or services, we find considerable variation in estimated returns across programs and groups as well.

A number of studies are now available that estimate the returns to WIA-funded training – using either matching on strong observables or RCTs. Among the former, Heinrich et al. (2009) estimate returns to training and to career (core, intensive) services (relative to unemployed workers not receiving services or training) in 12 states using administrative panel data on UI quarterly earnings as well as enrollment in WIA; Andersson et al. (2022) do so using data from two states, focusing only on impacts of training (relative to those receiving career services) but considering firm as well as worker characteristics to help account for estimated returns. The matching methods in both papers use strong observables and can be considered quite credible. Both studies show moderate impacts of training (11-16%) for disadvantaged adults but less (or none) for displaced workers, who are often older and contending with a significant loss of earnings from the elimination of their previous jobs. Heinrich et al. also find smaller but positive and cost-effective impacts for career services as well.

In contrast, an RCT evaluation by Fortson et al. (2017) also finds positive impacts of intensive career services but no significant returns to training in an intent-to-treat evaluation. On the other hand, it is somewhat hard to interpret the latter findings, as the amount of training received by the treatment and control groups differed by very modest amounts.

Overall, then, we can say that WIA (or now WIOA) career services generate small positive and cost-effective impacts on earnings while those of training appear modest at best. Given the very small ITAs that funded training in WIA, the modest estimated impacts of training perhaps make sense.[18]

Regarding workforce services in WIOA for UI recipients, Black et al. (2007) use an RD analysis of predicted scores (from a worker profiling model) and find that the profiling of workers reduced unemployment durations and very modestly raised employment and earnings – though the impacts were driven mostly by workers who chose to leave the rolls before services were

[18] An RCT-based evaluation of WIOA is now underway but results are not yet available. For evidence of impacts under JTPA in the National JTPA Study, see Orr et al. (1997).

provided. Perhaps more positively, evaluations of UI recipients getting RESEA services using RCTs in Nevada (Michaelides and Mian 2021) and in Maryland (O'Leary et al. 2022, using the apparently random assignment to caseworkers with differing proclivities to assign the unemployed to worker profiling alone v. RESEA) generate negative impacts on durations of unemployment and benefit receipt, as well as positive impacts on earnings (in Nevada but not Maryland). And our limited evidence on the impacts of the Employment Service reviewed by Balducci and O'Leary (2018) is mostly positive, in terms of shortening unemployment spells.

Regarding training outside WIOA, RCT evaluation evidence on several sectoral programs – summarized by Katz et al. (2020) – is the most encouraging. The authors show training impacts of about 30% in the best programs, like WorkAdvance (a version of Per Scholas and other programs), which last for 5-9 years. But, as noted earlier, these programs are expensive, fairly small in scale, and screen out lots of workers with weak skills or other barriers to successful employment.[19] Schaberg (2020) also emphasizes that not all such programs are successful, and that replicating the success of the best programs in other contexts can be challenging.

Indeed, past efforts to scale promising sectoral programs, like the Center for Employment Training (CET) in the 1990s, generated disappointing results (see the RCT evaluation by Miller et al. 2005). On the other hand, our understanding of the key ingredients that make sectoral training successful in these cases is growing, and efforts are underway to build them into a broader range of programs; for instance, Katz et al. and Amin et al. (2024) argue that strong connections between training providers and employers as well as wraparound services are key to understanding the strong impacts they find in these programs.

Impacts of a range of other career pathway programs – mostly outside of community college – have also been estimated using RCTs comparing enrollees (to non-enrollees) in the Pathways for Advancement in Careers and Education (PACE) program sponsored by the Department of Health and Human Services. Ten programs were evaluated over six years; the results are summarized in Juras et al. (2022). Of the ten, three generated lasting increases in credential attainment but just one – the sectoral program Year Up for youth – generated lasting earnings impacts.

The success of the sectoral youth program Year Up in Katz et al. is noteworthy, given the generally disappointing track record of programs for out-of-school youth. The oldest such program, the residential Job Corps, began as part of the original War on Poverty programs by Lyndon Johnson. Long-term RCT evaluations by Schochet et al. (2008) find initially positive impacts on earnings which fade away for teenagers but persist for young adults in their early 20s. Given the great expense of the program (well over $20,000 per enrollee per year), overall impacts are not cost-effective, though those for young adults appear to be.

[19] For instance, Per Scholas does not admit students who are reading and doing math below the 9th or 10th grade levels, as these students tend to struggle in their IT training classes.

Finally, while earlier evaluations of TAA impacts (e.g., D'Amico and Schochet 2012) were not very positive, more recent analysis by Hyman (2018), using quasi-random assignments of workers to TAA administrators, found total impacts of $50,000 (or over $60,000 in current dollars) over a subsequent 10-year period. Hyman et al. (2024) also find that, for older dislocated workers in TAA, wage subsidies encourage acceptance of lower-wage jobs, creating an effective alternative to training for these workers.

D. *On-the-Job Training/Work-Based Learning*

As noted earlier, a lengthy literature using survey data and a range of methods to measure the impacts of on-the-job training shows evidence of positive impacts on earnings growth over time, as expected (Black et al. 2023) – though questions persist about the endogeneity of training with respect to other unobserved worker skills and expected turnover.

But evidence on other work-based learning approaches – especially apprenticeship – has grown. Using credible methods that match treatment and control groups on strong observable characteristics, Reed et al. (2012) estimate impacts of apprenticeship in 10 states and Hollenbeck and Huang (2017) do so in the state of Washington. Both show large impacts on earnings – of 30-40 percent - and Reed's impacts last for at least nine years. More recently, Katz et al. (2022) analyze data on earnings after 10 quarters from the American Apprenticeship Initiative, matched to data from the Quarterly Workforce Indicators, and find 27 percent greater earnings after 10 quarters; and Kuehn et al. (2022) show descriptive data indicating returns for employers as well. Of course, these estimates might still be positively biased by the unobserved skills of workers or characteristics of employers. Also, other policy efforts by states to subsidize firms for providing on-the-job training have demonstrated some positive effects for employers in a difference-in-difference study (Holzer et al. 1993) or more descriptive studies on worker productivity at firms (Hollenbeck 2008, Negoita and Goger 2020) but not yet rigorous estimates of earnings gains for workers.

And our knowledge of how to raise employer investments in training or work-based learning remains quite limited, with little rigorous evidence on the impacts of the different state-level efforts to expand apprenticeship.

E. *Summary: What We Know and Don't Know*

Researchers have generated a great deal of evidence of what works and doesn't work in workforce development during the past few decades – some of which is based on RCT studies but more of which uses the newly available administrative longitudinal datasets on students in public postsecondary education and their subsequent quarterly earnings, with often credible quasi– or non-experimental methods.

At least three broad definitions of outcomes (or expected labor market value) have been used to estimate the returns to programs in community or for-profit colleges, including workforce programs – and results vary across these outcomes. We know that community college training

generates moderately positive expected impacts on earnings for enrolled unemployed or dislocated workers, in the ballpark of 7-10 percent, and up to 15 percent for a broader pool of enrolled students, relative to being non-enrolled, though similar estimates show little to no impacts for enrolling in the average for-profit college. Among those who complete community college credentials, returns are clearly higher.

We also know that attaining terminal associate degrees in workforce fields is better compensated in the labor market than attaining similar degrees in liberal arts, especially the workforce degrees in more technical fields (like healthcare). The returns to completion of longer-term certificates are also quite positive, while those for short-term certificates (programs of less than a year in length) generate more uneven returns which, on average, are positive but smaller. Given the low tuition costs and modest durations of foregone earnings for those enrolling in these programs in public community colleges, expected private benefits generally outweigh costs – though there are significant downside risks of default for those taking out loans who do not complete their programs or are in low-return programs – especially at expensive for-profit colleges.

Estimated impacts are heterogeneous across demographic groups as well as programs and states. Women earn higher returns to associate degrees and many certificate programs than men, though men enroll more in certificate programs and mechanical (or technical) fields. Though completing credentials is important, there is some return to credits earned among those who don't complete their programs; completion rates also vary by students' family income and race. We also have at least some rigorous evidence on support programs that raise completion.

Outside of community college, we know that some public programs for unemployed workers on UI like RESEA generate important reductions in unemployment duration or higher earnings, and that career services at job centers are cost-effective as well. The best sectoral programs generate large and lasting earnings gains for enrollees. TAA generates larger impacts than we previously thought, while Job Corps gains persist only for older youth. And apprenticeship also appears to generate strong returns to workers (and perhaps their employers), though these have not yet been very rigorously tested.

Yet there remains much we do not know. Positive biases due to unobserved skills likely still characterize some estimates of workforce programs in community colleges while negative ones remain in others (like those comparing certificate completers to enrolled non-completers in associate programs).[20] Importantly, we know very little about outcomes in and returns to not-for-credit programs, which appear to constitute a large fraction of certificates attained in the US.

[20] Interestingly, there have been no studies using regression discontinuity methods of returns to workforce programs at 2-year colleges of the type used by Zimmerman (2014) at a 4-year university – perhaps because there are few really strict grade-point cutoffs on admissions to community college programs.

Given the strong returns to and modest costs of enrolling in many workforce programs, why do so many people either not enroll in or not complete them? How much of low enrollment and completion is due to inadequate guidance, competing family pressures for full-time workers, inadequate academic preparation or other barriers to success (like substance abuse issues or criminal records), and what interventions could improve completion rates in fields where labor market value is strong?

Many students would almost certainly have higher completion rates in shorter or non-credit certificate programs where general academic content is limited. This suggests that guidance to students about labor market returns to different programs and their own chances of completing them could be crucial to achieving greater cost-effectiveness, and students generally receive little such guidance now. And what explains the large variation in returns, both across fields and even across states in the same fields and with the same data and methods, remains somewhat unclear.

Outside of community colleges, many questions remain as well. The evidence remains mixed on the value of training in WIA or WIOA for disadvantaged adults (and generally lower for displaced workers) – with strong matching studies suggesting positive impacts while the most recent RCT showed no impacts – perhaps because so many control group members receive training anyway in "intent-to-treat" evaluations. This might imply that there already exist enough alternatives to WIOA training for those who want it to get it; or it could suggest that WIOA resources for training remain too limited to have much impact.

We also do not fully understand why the best sectoral programs are so successful, and how to make others better. Students with very weak academic skills or other barriers to work are often screened out. Whether we can scale the best programs remains very uncertain, especially given public budgetary constraints; similarly, we don't know how to encourage more take-up of apprenticeships or other incumbent worker training, especially among employers. Our knowledge of what works well for out-of-school youth, outside of Year Up, is particularly limited.

One final caveat is needed. A range of *general equilibrium* effects could mean that actual job training impacts fall short of estimated partial effects, particularly if employer demand for workers with higher skills is somewhat inelastic (which is likely true in the short or medium runs). This will especially be true if training occurs at scale, where increasing the supply of workers with certain kinds of skills training could generate diminishing returns relative to demand for those skills, and rising wages among the non-trained. Positive externalities on the non-skilled associated with increasing the supply of skills might also have some effects.

A few examples are illustrative here. First, the newly-trained workers could easily displace those who already had those skills, thereby reducing the social value of successful training (Davidson and Woodbury 1993, Lise et al. 2004, Smith and Sweetman 2015). Second, the greater supply of workers with particular skills, at scale, would likely reduce the equilibrium wages associated with those skills, further reducing the social value of training, while wages of

the nontrained might rise (as their supply grows more limited). On the other hand, if there are positive externalities associated with workforce skills and training, as there appear to be with education (Biasi et al. 2021) for general worker performance (Andersson et al. 2009) or firm innovation, the general equilibrium effects of training at scale will be less negative, and potentially even positive.

Generally, we know quite little about the magnitudes of these potential biases in our estimates of the social value of workforce programs. The negative effects could also be less serious in situations where a range of skills that the labor market rewards are in low enough supply to generate ongoing spot shortages of important job market skills (Barnow et al. 2013, National Academy of Sciences 2017).

But, as Smith and Sweetman note, there is still important value of well-designed studies that measure partial equilibrium effects of training, in the absence of the structural models that capture more of the general equilibrium effects. We simply need to interpret the former more cautiously, as we consider the effects of scaling them.

V. International Evidence

How different is workforce development policy and practice in the EU or other OECD countries from that in the US? And do any such differences lead to different labor market outcomes?

The term "active labor market policy" (or ALMP) is frequently used to describe a mix of policies abroad that are designed to incentivize workers to take jobs, help match them with employers, improve their human capital, and create more jobs for them to fill (either directly in the public sector or through subsidies to private employers). As noted, the US does little such direct public or private job creation, though it has its own versions of the other efforts; one can thus consider ALMP to be a broader kind of workforce development than what we do here.

When considering such policies here and abroad, one fact stands out: virtually all other countries in the EU and more broadly in the OECD spend much higher percentages of their GDP on ALMPs, even outside of job creation (https://goingdigital.oecd.org/en/indicator/42). The exact mix of policies and programs varies across these countries, though the greater relative reliance on them abroad is striking – even in countries like Britain, Australia and New Zealand, whose labor markets more closely resemble those of the US in their decentralization and private sector focus.

A closer look reveals another pattern: many other countries emphasize vocational training or apprenticeship in high school and non-college versions beyond that, while the US puts relatively greater emphasis on higher education. Indeed, the percent of adults in the US with a degree (associate or higher) is about 50 percent, while the EU average is 38 percent, according to the

OECD.[21] On the other hand, vocational training abroad surpasses that in the US or the UK (Ryan 2019). These data might suggest some validity to concerns that vocational education can deter students from pursuing higher education, though the reality is more complicated and depends on exactly which population groups have which opportunities to pursue (Cowan et al. 2019, Matthewes and Ventura 2022).

One particular model of job training that is stronger abroad is apprenticeship. The "dual apprenticeship" approach in Austria, Germany, Switzerland, and Denmark, in which secondary school students receive a mix of classroom training and on-the-job work experience, is one model. But students must choose as early as the 9th grade between university or "technical" tracks. Since such tracking in the US has been associated with race and class discrimination, it has largely been discontinued here. A mix of other approaches to apprenticeship and vocational training appears in other EU or OECD countries. Because rates of union membership and collective bargaining are much higher in these countries, their unions tend to be quite involved in the administration of apprenticeships and vocational education (European Trade Union Commission: https://www.etuc.org/en/issue/apprenticeships).

But a closer look at the countries above with more comparable labor markets to ours also suggests a few patterns. According to the OECD data, New Zealand spends the largest share of its GDP on ALMP of any OECD country, though it does so primarily on employment incentives for both employers and workers (Finance Ministry of New Zealand, 2010). Australia, while having union membership rates nearly as low as those in the US, has very high levels of apprenticeship per capita, at almost 3 percent of their population (Colborn and Lerman 2025, OECD 2017). Australia also has higher education attainment that is close to the US level, suggesting that it offers a wide range of skill-building opportunities that each might have more or less appeal to different groups, without much competition or substitution among them.

And evidence from Britain relative to the US also paints a mixed picture. Higher education attainment in Britain is close to that in the US. While other forms of institutional vocational training there lag behind what is available in EU countries (Ryan 2019), Britain ranks highly on "job-related" or employer-provided training, either at work or elsewhere (Li et al. 2020) – though much of this training appears to be short-term. Machin et al. (2020) note the recent development of "university technical colleges" which strengthen vocational options to secondary students and beyond.

And Britain also has a relatively high number of apprenticeships, at 2.6 percent of their population (Colborn and Lerman 2025), compared to just 0.3 percent in the US. While the rapid growth in apprenticeships in Britain has slowed somewhat in recent years, their duration and quality are rising (Cavaglia et al. 2022), as measured by a ranking of apprenticeship "levels" (of 1-7, ranging from very low-skill programs to those requiring university degrees). An

[21] https://www.oecd.org/en/topics/sub-issues/education-attainment.html#:~:text=On%20average%20across%20OECD%20countries%2C%2040%25%20of%20adults%20(25,obtained%20an%20upper%20secondary%20education.

"apprenticeship levy" on large businesses that was implemented in 2017 appears to be raising its incidence there, especially in higher-level apprenticeships (Conlon et al. 2021).

In sum, other industrial countries all spend more on ALMP and invest more in vocational and work-based learning than the US, even where their labor markets otherwise look like ours; but their specific modes of doing so vary a lot, and they find ways to do so that presumably seem most appropriate in their particular labor market, institutional and political settings.

What do we know about the cost effectiveness of these policies in the EU and elsewhere? The best summaries of workforce development internationally are those by Card et al. (2010, 2018). In the latter, they survey roughly 200 programs in dozens of countries. Another useful survey is by McCall et al. (2016), though they focus more deeply on the US and five other EU countries (Britain, France, Germany, Denmark and Sweden).[22]

Card et al. summarize all of their evidence as follows: 1) Workforce education and training programs generally produce significant positive impacts, but with a lag of 2-3 years; 2) The estimated impacts are heterogeneous across groups, with larger effects for females and the unemployed; 3) Job search assistance alone has positive effects in the short-term that fade over time; 4) Subsidized employment generates more lasting employment in the private than public sector; and 5) Impacts are more positive during recessions than at business cycle peaks.

McCall et al. do not find greatly different patterns in training effectiveness between the US and other countries, though they emphasize the heterogeneity in impacts even more and suggest a few additional patterns - such as stronger impacts in on-the-job than classroom training or when participation is voluntary and participants are better matched to programs. They note the much higher (albeit somewhat declining) incidence and public support in secondary schools for apprenticeship in German-speaking and Scandinavian countries, with generally positive evidence on its earnings impacts. And recent descriptive evidence on new approaches to workforce development, like "Flexicurity" in Denmark – where there are high levels of income support and assistance for workers who retrain but without job security in declining sectors - has been positive (Kreiner and Svarer 2022.).

Overall, Card et al. and McCall et al. both imply that positive impacts overseas may be found somewhat more consistently than here, especially outside of college (though McCall et al. do so to a lesser extent). Perhaps our greater focus here on disadvantaged workers and our lower provision of work-based learning generates lesser impacts, though even for other groups (like dislocated workers) the evidence here has been more discouraging, with a few clear exceptions (e.g., Jacobson et al., Hyman, Leung and Pei).

But if the returns to workforce development are not greatly different between the US and abroad, what accounts for the greater support for workforce development overseas? Among other reasons, it likely results from:

[22] See also a rigorous review of many ALMP programs in the OECD by Crepon and van den Berg (2016).

- A long tradition of more support for public sector involvement in the labor market in other countries (especially the EU) than here, and a greater skepticism here about its positive impacts;
- A widespread perception in the US that training programs, among others, disproportionately benefit minority rather than majority residents (Mettler 2018), if they work at all;
- Higher rates of collective bargaining in the EU, with unions playing a greater role in lobbying for and administering on-the-job training; and
- A possibly higher variance in basic skill attainment across individuals and groups here than abroad, which might render training relatively more ineffective for more people at the bottom of the skill distribution in the US (Chmielewski and Reardon 2016, Broecke 2016).

These factors then raise the question of whether greater skepticism of publicly-funded workforce in the US can ever be eased, and what it would take to accomplish this. The long-standing and entrenched nature of these factors here suggests that doing so would be difficult. Furthermore, many of the more effective sectoral programs in the US are relatively expensive, and our large and growing federal fiscal shortfalls (which will worsen as Baby Boomer retirement programs swell) plus anti-tax politics of the US make this more difficult.

Still, a growing acceptance at the state and local levels of our need for effective workforce development as a condition for successful economic development perhaps suggests greater possibilities for future consensus on greater investments (National Governors Association, 2024) – as long as we have clearly cost-effective efforts which serve the interests of both workers and employers over time.

VI. Conclusion

Workforce development in the US has evolved over the past several decades. Among the most important trends over time: 1) Public community colleges, and to a lesser extent private for-profit colleges, have become the largest providers of workforce development in the US; 2) "Sectoral" training that targets high-demand sectors and actively engages employers in curriculum development and hiring is growing rapidly and generating great interest; and 3) Work-based learning, including apprenticeship among other models, has also grown more popular, as a way for employers to meet specific skill needs while increasing access for less-educated workers to on-the-job training.

At the same time, the US continues to spend much fewer public funds on workforce development, especially outside of higher education, than most other countries abroad, and a range of vocational and technical programs as well as apprenticeships get more support abroad as well. Our approach is thus relatively strong in generating college credentials but weak on delivering improved earnings for those who have not enrolled in college. Workforce development in the US is also fragmented across public agencies and institutions, with limited

coordination and wasteful overlap in some cases that also generate unfamiliarity or confusion to potential users; accordingly, it hardly constitutes a "system" in any real sense.

Still, rigorous evidence on workforce impacts finds much that appears cost-effective, including:

- Enrolling in workforce programs at public community colleges – but not private for-profit colleges - generates positive average impacts, especially for those who complete them – which are greater on average for workforce than liberal arts associate degrees, for workforce degrees than certificates, and for longer than shorter certificate programs;
- The best sectoral programs – like Per Scholas (or Work Advance), Project Quest, and Year Up for youth – generate large and lasting earnings impacts for workers, though the estimated impacts of Workforce Investment Opportunity Act (WIOA) training overall are smaller and not always positive;
- A range of supports and services, such as career or labor market counseling and reemployment services as well as various supports (like child care or emergency cash), have cost-effective impacts on worker outcomes (by raising the odds of program completion or training in fields with labor market value); and
- Apprenticeship (among other forms of one-the-job training) appears to generate quite positive impacts for workers and employers, though to date our evidence is not terribly rigorous.

At the same time, completion rates in high-return college programs remain fairly low, especially for minority or lower-income groups, and enrollments in what appear to be low-value programs remain fairly high. The best sectoral programs are expensive and hard to scale, and often exclude students with weak basic skills; and employer take-up of apprenticeships and other modes of work-based learning remain quite low.

A lot of open research questions remain. For instance, we don't fully understand what drives much of the heterogeneity in estimated returns to training (or in program completion rates) across demographic groups, and we know even less about why the returns to the same programs in similar data differ across states (and even different community college programs within states).[23] Some of this could be driven by unobserved differences in student quality or in more disaggregated fields of study; and differences in how certificates are used to assess worker skills across industries and labor markets across states could also play some role of this. A better understanding of what personal factors – such as basic skills, limited income or time outside of work, or imperfect information - drive enrollment choices and completion in various programs of study could be very important as well for understanding workforce development outcomes across groups; and the determinants of employer provision of on-the-job training or work-based learning need more analysis as well. Given the fairly high enrollments but very

[23] In ongoing work with Gordon Hanson and colleagues at the American Institutes for Research, we have measured the completion rates and earnings generated in workforce programs at each public community college in the US, and there is high variance between and within states across these colleges in measures of success.

limited returns (especially relative to cost) in private for-profit colleges, better understanding the sources of their relative weakness in generating returns is important too.

Improving the availability and quality of data used to estimate these returns could help shed light on these questions. The public administrative data on higher education linked to quarterly UI earnings, that have been used to estimate the returns to community college workforce programs, could be improved in a number of ways: by getting states to add occupation or hours of work to the quarterly earnings data; by adding outcomes on non-wage compensation, like health benefits or paid time off; and by linking data across states to follow workers who move across state borders.[24] Linking administrative data on education or training to other federal data on program participation or even corrections would enable researchers to analyze a wider range of training impacts. We clearly need more data on non-credit programs at community colleges, which are starting to become available in certain states (https://www.edpolicyresearch.org/noncredit).[25] Gaining better data on other forms of skill certification, such as licensing, might also help us better understand the heterogeneity in training impacts that remains unexplained to date (Bae et al., 2025).

And new sources of firm-level data in the private sector are beginning to become more available, which potentially could generate more rigorous research on work-based training and its impacts. Some of these involve gaining access to firm-level human resource data, including data on training; others involve "scraping" from online sources or using machine learning to infer the nature of training and support activities in the private sector.[26] Some of these data are quite new, but could potentially be important to future research on the incidence and impacts of workforce development efforts, if economists use them more often and can figure out how to make causal inferences in the process.

Improving our base of knowledge would help us devise better policies to achieve our workforce goals. Understanding exactly what drives the success of the best sectoral programs, and how to reduce their costs or expand their reach, is critical, as is understanding how to improve employer take-up of apprenticeships (and which state models are most effective in expanding them). Whether it could be cost-effective to provide more funding for participants in shorter-term or non-credit programs – perhaps by expanding the reach of Pell grants – with appropriate quality guardrails could also become clearer. Measuring the impacts of "Gainful Employment" rules on student outcomes could be an important priority. And ideas about how to streamline

[24] For instance, the Coleridge Institute has been building a Multistate Data Collaborative and Administrative Data Research Facilities to pursue these goals.

[25] For instance, the US Department of Education collects extensive data from all accredited colleges and universities on for-credit programs through its Integrated Postsecondary Education Data Systems (IPEDS) data, but does not collect data on non-credit programs.

[26] Important effort on data acquisition in the private sector include the Jobs and Employment Data Exchange (JEDx) of the US Chamber of Commerce Foundation (https://www.uschamberfoundation.org/solutions/workforce-development-and-training/jedx) and the Lightcast data on worker skills, job vacancies and skill requirements (https://lightcast.io/products/data/overview).

the many different workforce development programs and policies and improve coordination across them at the state or regional level should also be piloted and rigorously evaluated.

To address some of the limitations in workforce program scope and success noted above, a great deal of innovative workforce activity is now being undertaken at our community colleges, though most are too recent to have been seriously evaluated (Schwartz and Lipson 2023). Colleges are working harder to engage with local employers, and to set up curricula that meet their needs, to expand the number and quality of their sectoral offerings. Much of this occurs in non-credit programs, but colleges are creatively finding new funding sources (often from employers) and ways of creating pathways from non-credit to for-credit programs, and state funding for non-credit college programs is growing.

Innovative funding models for trainees, like "lifelong learning accounts" funded by payroll deductions (Fitzpayne and Pollack 2018); and "income share agreements" or "outcome-based loans," where repayment of loans for training occurs only after trainees have achieved some pre-determined level of labor market success, are encouraging as well (Holzer and Socolow 2025). "Skills-based hiring," where employers try to directly assess workers' skills rather than their credentials, could also make trainees who don't complete credentials more successful in the job market, though the ability of employers to assess such skills to date remains quite limited (Burning Glass Institute 2024). Rigorous research on the cost-effectiveness on all of these innovations, and their usefulness in expanding the reach of the most successful workforce programs into the currently low-wage workforce, should be a high priority.

Going forward, several labor market trends might make it even more imperative that we scale up cost-effective public workforce development efforts. On the demand side of the market, ongoing automation – especially in the form of *artificial intelligence* – will likely generate major worker dislocations, even while it raises national productivity and living standards. We do not yet know exactly for whom such automation will complement (or "augment") workers' skills while substituting for others (Acemoglu et al. 2025), and who will be displaced; and, among the latter, we don't really know who can benefit from training or other services. New research into these questions is critical, especially using newer data where such developments can be tracked in real time. [27]

And, on the supply side of the labor market, the ongoing retirements of Baby Boomers and low birthrates in recent decades (Kearney and Levine 2022) might increase replacement demand for skilled workers in particular – especially if immigration among highly-skilled workers declines in the next several years because of perceived anti-immigrant sentiment in the US. Although worker absences and wage pressure during the "Great Resignation" of 2022-23 were greatest among the lowest-wage workers (Autor et al. 2023), recent data also suggest that demand is

[27] New efforts to measure workforce dynamics in nearly real-time use quarterly Unemployment Insurance wage records at specific firms linked to data on workers' postsecondary education and training, to measure the effects of hiring workers who have studied AI in college. Improving the quality of data on occupational tasks, such as the Department of Labor's O-Net data, could help us understand how AI is changing the task content of jobs and how training is changing in response.

rising most rapidly for highly-skilled workers (Deming et al. 2025), even in categories where BAs are not always required.

In short, key economic and labor market trends will make it more critical to develop and scale effective workforce development beyond our current capacities. The evidence reviewed above provides critical evidence on how to do so, though many questions concerning scale, funding and employer engagement remain unanswered. Generating more high-quality research evidence on these issues should thus be a top priority.

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Table 1: An Overview of Workforce Development in the US

Categories	Sub Categories	Providers	Federal Funding	State/Local Other Funding	Funding: For Whom
Higher Education	• Degree Programs • Certificates • For Credit or Not • Short/Long Term • Micro-Credential • Non-Credential	Accredited Colleges: • Public 2-Year • Private Non-Profit • Private For-Profit	Higher Education Act (Title IV)	Institutional Subsidies	• Students, Institutions
Non-HED Training & Workforce Services	• Career Services • Training: Classroom, On the job	• American Job Centers • Community-Based Organization • Proprietary • Industry-Related	• Workforce Innovation and Opportunity Act (WIOA), Trade Adjustment Assistance	• Varied	• Workers
Incumbent Worker Training & Work-Based Learning	•Apprentice/ Internships • Other	Employers			•Employers, Workers

Table 2: Estimated Impacts of Workforce Development on Earnings

Studies	Type of Training/Target	Data	Estimation Method	Estimated Impacts
A. Community/For-Profit Colleges				
Jacobson et al.	Community College, Displaced Workers	Admin.	Fixed Effects	Approx. 10% per year for for enrollees
Leung and Pei	Community College, OH Unemployed Workers	Admin.	Fixed Effects	7% for Enrolled
Cellini and Turner	For-Profit v. CC Colleges	Admin.	Fixed Effects/DD	CC enrollees earn 10-15%, Little in For-Profits
Backes et al.	Community College, FL	Admin.	Regression, Strong Controls	20-30% for Certificates, Higher for AS/AAS, not AA Relative to Not enrolled
Belfield and Bailey.	Community College, 8 States	Admin.	Fixed Effects/ Enrolled Only	5-8% for Certificates, 20% for Associates, Higher for Workforce
Jepsen et al.	Community College, KY	Admin.	Fixed Effects/ Enrollees Only	5-7% for Certificates, Larger for Degrees/Diplomas, Higher for Health/Vocational
Stevens et al.	Community College, CA	Admin.	Fixed Effects/ Enrollees Only	14%+ for Certificates, Larger for Degrees/Long Certificates
Roder and Elliott	Project Quest	Admin.	RCT, Enrollees Only	Earnings Gains of 15-20%
Eyster et al.	Acc. Opportunity	Admin.	Matching, Strong Controls	Education Gains, Not Earnings
B. Other Externally-Provided Training/Services				
Heinrich et al.	WIA Training/Services. 12 States	Admin.	Strong Matching	Training: 16% gain for Adults/ Less for Displaced Core/Intensive: Yes
Andersson et al.	WIA Training 2 States	Admin.	Strong Matching	Training: 11% gain for Adults/ No Gain for Displaced
Fortson et al.	WIA Training/Services.	Admin./ Survey	RCT	Training: No Earnings Gain Core/Intensive: Yes
Katz et al.	Sectoral Programs	Admin./ Survey	RCT	20-30% for Best Programs/ Persistent Gains

Hyman	TAA	Admin.	Random Treatments	$50K earnings gain over 10 Years
Juras et al.	Career Pathways 10 Programs	Admin.	RCT	3 Programs Raise Education/ 1 Raises Earnings after 6 Years
Schochet	Job Corps	Admin.	RCT	Lasting Impacts for Older Youth
Black et al.	WPRS, UI Claimants	Admin.	RD	Reduces Unemployment Duration
Michaelides et al.	RESEA, UI NV	Admin.	RCT	Reduces Unemployment Dur. Earnings gain 13-18%
O'Leary et al.	RESEA, UI, MD	Admin.	Random Treatments	Reduces Unemployment Dur.
Miller et al.	Sectoral (CET)	Admin.	RCT	Few Impacts on Earnings
Schochet et al.	TAA	Admin.	RCT	Few Impacts on Earnings

C. On-The-Job/Work-Based Learning

Hollenbeck	Apprenticeship, WA	Admin.	Strong Matching	40% Earnings Gain after 7 qtrs
Reed et al.	Apprenticeship, 10 States	Admin.	Strong Regression	30-40% Earnings Gain for 9 yrs
Katz et al.	Apprenticeship	Admin.	Matching	27% Earnings Gains