

Outcomes after Publicly Funded Training: New Measures from Public WIOA Records

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Abstract

Official statistics on publicly funded training report employment and earnings after exit, but say little about the kind of job a trainee reaches, whether it is in the field trained for, or how reliably outcomes differ by training occupation. I build measures of these from the public records of the US Workforce Innovation and Opportunity Act, which follow earnings and industry for a year after exit. They are work in the field against a chance rate, a ladder of job quality on the OECD's low-pay line, the pay of the industry, and outcomes by training occupation shrunk for noise. From 2018 to 2023, 706,348 people left training, 78 per cent of those with a recorded status completed it, and heavy truck driving rose from 15 to 27 per cent of trainees. Employed trainees work in the field 54 per cent of the time against 18 by chance, and adjusted employment differs across training occupations with a standard deviation of 4.3 points that persists between periods. Completers are 15.7 points more likely than comparable untrained participants to be in work above the low-pay line that is held in the second and fourth quarters after exit (standard error 0.7), against 1.9 points (1.2) for non-completers. The gaps are similar in dollars across most groups and smaller for the highest earners before entry, for workers over 55 and for youth. On-the-job training comes with employment 8 points higher than classroom training for the same occupation, partly because it begins with a hire. In the years a local board trains about half as many people again as in its other years, its trainees are similar. Their gaps over comparable untrained participants of the same board and year are smaller among exits of 2018 and 2019, and no smaller among those of 2021 to 2023. All comparisons are descriptive.

1. Introduction

A workforce board, a state agency or an employer that pays for training needs to know what happens to people after it, and in particular after training for a given occupation. Do they find work, is the work in the field they trained for, is it a better job than the one they had before, and how far does the answer depend on the occupation, the person and the way the training is delivered? Yet public training programmes are judged on employment and earnings after exit, which the performance tables of the Department of Labor report by state and programme, and those two figures cannot answer most of these questions, for reasons Section 2 sets out.

I build measures that can, from the public records of the Workforce Innovation and Opportunity Act (WIOA), which follow each participant's quarterly earnings for three quarters before entry and four after exit, and the industry of the employer before entry and in each quarter after exit. Section 3 defines them, starting with whether a trainee works in the field of the training, judged from the industry of the later job against a chance rate. Next come a ladder of job quality on the OECD's low-pay line, a split of earnings into the pay of the industry and pay within it together with the local turnover of the industry, a comparison of the occupation trained for with the one held before, and outcomes by training occupation adjusted for intake and shrunk for noise, with their reliability. The ladder, the kind of job, and employment and earnings after exit are computed in the same way for trainees and for participants in the same programmes who were not trained. By contrast, the field, the occupation trained for and the outcomes by training occupation rest on a training occupation and so apply to trainees alone. All of them can be tabulated by state and programme, and those for trainees also by training occupation.

Section 4 then uses the measures to describe training and trainees from 2018 to 2023, a flow that is large and has narrowed. From 2018 to 2023, 706,348 people with a state recorded left training, between 103,302 in 2020 and 130,411 in 2019, and heavy truck driving rose from 15 to 27 per cent of them.

Sections 5 to 8 apply the measures to four questions a funder asks of training. The first, in Section 5, is which training comes with better jobs, answered with outcomes by training occupation and prior sector, work in the field and the occupation trained for. Section 6 asks for whom, with the ladder, the split of the earnings gap, stability including the shock of 2020, and the gaps by group, while Section 7 compares types of training within the same occupation. Finally, Section 8 asks whether trainees' outcomes hold up when boards train more, comparing each board's years of high and low training, and Appendix A treats boards' training intensity as an instrument, stated under its assumptions.

These questions have a literature behind them. Katz, Roth, Hendra and Schaberg (2022) find that sectoral training programmes raise earnings mostly by moving participants into higher-paying industries and occupations, which makes the kind of job a trainee reaches a matter of substance. Card, Kluve and Weber (2018), in a meta-analysis of more than two hundred evaluations, find larger gains two to three years after exit for programmes that build human capital, and larger gains too for women and the long-term unemployed. Closer to the programme studied here, Jacobson and Davis (2017) compare the returns to training supported by the predecessor programme in Florida by field, gender and education. On the side of measurement, job quality is treated as having separate dimensions of pay, security and conditions (Kalleberg, 2011), and I borrow the OECD's definition of low pay, two thirds of the median earnings of full-time workers (OECD, 2026), to build the ladder.

All of the comparisons are descriptive. The one randomised evaluation of the predecessor programmes found no positive effect of access to training and calls its evidence on training inconclusive (Fortson et al., 2017). Non-experimental estimates on administrative records find moderate positive effects for adults and none for dislocated workers (Andersson et al., 2024), while a matched comparison on the same public files reports higher earnings after exit for trainees than for recipients of job search assistance (Hyman et al., 2025). Two questions a reader may expect cannot be answered from these records. As the files show only the trainee's own employer, they cannot say whether training lowers the turnover of the employers who hire trainees, and as trainees who exit in a year are at most 32 per 10,000 jobs in a state, nor can they say whether it makes a local labour market more stable.

2. The gap in the published figures

Beyond employment and earnings after exit, the performance tables report neither the kind of job a trainee holds nor whether it is in the field trained for, and they do not show how outcomes differ by the occupation trained for once the noise in each figure is accounted for. Yet those are precisely the figures a funder choosing between kinds of training would use.

The public files do carry two fields that bear on the field of the job, but neither can be used as it stands. Among 2023 exits, the case workers' flag for training-related employment ranges from 15 per cent in New Mexico to 100 per cent in Texas. The occupation code of the job after exit is present for only 37 per cent of employed trainees, as Park (2011, 2012) found in Trade Adjustment Assistance records.

Two recent working papers use the same files. Hyman, Lahey, Ni and Pilossoph (2025) match trainees in the 22 per cent of spells with complete occupation codes to participants who received only job search assistance. They report quarterly earnings in the three quarters after exit that are higher by 1,190 dollars for trainees highly exposed to artificial intelligence and by 2,385 dollars for others, in dollars of 2010 (Table A.2). Jacobs and Canedy (2026), for their part, report that 45 per cent of participants return to the industry they left.

3. Data and measures

3.1 Data

I use the WIOA and Wagner-Peyser public use files published by the Employment and Training Administration, the eight annual files from programme year 2017 to 2024. Because the files overlap, each exit is assigned to the latest file that covers its exit year, so that it is counted once with the most mature outcomes. Records are linked across files by the encrypted person identifier and the training start or exit date. The extract reproduces official figures closely: for exits from April 2023 to March 2024 it contains 196,691 adult exiters and 76,159 adult trainees, against 196,790 and 76,205 in the official data book for programme year 2023.

The sample is Title I participants in the adult, dislocated worker and youth programmes who exited from 2018 to 2023. Trainees are those who received training and have a training occupation code, 706,448 people, of whom 100 have no state recorded and are left out of everything that requires one. The comparison group is the 2,170,356 participants in the same programmes who received services without training. For each participant, the files record quarterly earnings from unemployment insurance wage records for the three quarters before entry and the four after exit, the six-digit industry of the employer in the quarter before entry and in each quarter after exit, and the type of training. Where the mapping is one to one, training occupation codes recorded on the 2010 classification are converted to the 2018 classification.

The public files also carry two defects that the record layouts do not document: the programme year 2021 file leaves valid training occupation codes blank for whole occupations, and the programme year 2022 file sets the industry code to unknown for every record in about fifteen states. For the same records, the neighbouring files hold the correct values, and I recovered them by linking on the person identifier. Separately, West Virginia reports no industry code in any year, and Massachusetts and Ohio report one for only part of their later exits.

The files are altered to prevent disclosure (US Department of Labor, 2026): rare industry and occupation codes in a local area are coarsened to their group, and wages are rounded and randomly altered in a way that

preserves their aggregate properties.

Three public sources describe the jobs themselves. The pay of an industry is the average weekly wage in the state and three-digit industry in the Quarterly Census of Employment and Wages for the year concerned, with the national figure where the state's is suppressed. Its local turnover is the quarterly turnover rate of stable jobs in the state and three-digit industry from the Quarterly Workforce Indicators (US Census Bureau, 2026). For the low-pay line I follow the OECD's definition of low pay, earnings below two thirds of the median earnings of full-time workers (OECD, 2026), with inputs and a price index from the Bureau of Labor Statistics. The input is the median usual weekly earnings of full-time wage and salary workers, and the price index, the consumer price index for all urban consumers, puts all earnings in dollars of 2023.

3.2 Comparison and adjustment

Each outcome is compared across three groups: trainees who completed, trainees who did not complete, and participants who were not trained. The adjusted comparisons use a linear regression with fixed effects for state by exit year, the sector of the job held before entry, and twenty bands each of earnings in the third and second quarters before entry. They add indicators for programme, sex, education, age band and employment status at entry, and standard errors are clustered by state. Age is not recorded for exits of 2018 and 2019, so for them it enters as a category of its own. Both the ladder in Section 4 and the analyses of Sections 6 and 7 use the 2,525,661 participants whose completion status is known and whose earnings are recorded in each quarter they need, 598,015 of them trainees.

3.3 Work in the field of training

In place of the case workers' flag and the occupation code of the later job, I use the industry code of the job after exit, which comes from wage records and is usable for 88 per cent of employed trainees. Let trainee i have trained for occupation o and hold a job in industry j in the second quarter after exit, and let

$$LQ_{oj} = \frac{E_{oj}/E_j}{E_o/E}$$

be the location quotient of the occupation in the industry (Isserman, 1977), from the national industry-specific estimates of the Occupational Employment and Wage Statistics for May 2024. A trainee is in the field when $LQ_{oj} \geq 1$. Large industries employ many occupations, so I set the rate against a chance rate, the rate expected if the industry entered were independent of the occupation trained for, in the manner of Cohen (1960) and Carrington and Troske (1997). In purpose, the measure is closest to indicators of the match between field of study and job for graduates (Robst, 2007), and Grosz (2020) likewise treats work in healthcare as an outcome of a nursing programme.

Across all training occupations, 54.0 per cent of the 498,104 employed trainees with an industry code are in the field in the second quarter after exit (standard error 0.8, clustered by state), against a chance rate of 18.5 per cent. In every exit year the rate stays between 53.1 and 54.9 per cent. Trainees in the field make up 38.1 per cent of all trainees, 58.2 per cent of completers in the denominator and 37.8 per cent of non-completers. The rate survives the checks I could make. It is 0.5 to 1.6 points lower in the fourth quarter, 53.0 per cent without the types of training most often arranged with an employer, and 53.6 to 54.2 per cent when each of the five largest states is dropped in turn. Counting every trainee placed through a temporary help agency as outside the field gives 51 per cent, and the rate lies between worst-case bounds for missing codes, in the sense

of Manski (1989), of 47.7 and 59.3 per cent. In thirteen states that report the occupation of the later job well, 43 to 47 per cent of trainees are recorded in exactly the occupation trained for, and the largest disagreements are trained nurses recorded as nursing assistants in hospitals and care homes. In other words, the measure is one of the field and not of the occupation.

3.4 The ladder of job quality

A job on the ladder is judged on the level of its earnings and on whether it is held in two quarters half a year apart, the two features of a job that wage records show. The first follows the OECD's definition of low pay (OECD, 2026) and the quality of earnings in its framework for job quality. Holding a job in both quarters bears on the risk of losing work, which falls under the framework's dimension of labour market insecurity, although the framework measures that dimension as the risk of unemployment net of insurance (Cazes, Hijzen and Saint-Martin, 2015). Rung 0 is no earnings in the main quarter, rung 1 is earnings in the main quarter that are below the low-pay line, or no earnings in the other quarter, and rung 2 is earnings in both quarters and at or above the low-pay line in the main quarter. After exit, the main quarter is the second after exit and the other quarter the fourth, while before entry the main quarter is the one before entry and the other the third before entry. The low-pay line for a quarter is thirteen weeks at two thirds of the national median full-time weekly wage of that year, which runs from 6,656 dollars in 2012 to 10,045 dollars in 2024. It rose by 7.3 per cent from 2019 to 2020, when the median moved with the loss of low-paid jobs in the pandemic.

The ladder is coarse by design: quarterly earnings cannot separate a low hourly wage from few hours, and the ladder says nothing of conditions at work. Furthermore, the quarter before entry is affected by the fall in earnings that precedes entry into programmes of this kind (Ashenfelter, 1978; Heckman and Smith, 1999), and for that reason the comparisons below hold earnings in the third and second quarters before entry fixed.

Drawing the line higher narrows the difference on the top rung, but it stays positive. Against a difference of 12.6 points between all trainees and comparable untrained participants on the top rung (Section 6.1), raising the line to the full median wage gives a difference of 7.6 points (0.4) on an untrained share of 12.2 per cent. Adding a third condition, that the job be in an industry whose local turnover is below the median of all states and industries, gives 5.6 points (0.5) on a share of 8.7 per cent.

3.5 The kind of job

Two further measures describe the job and not the person. The first is the pay of the industry, the average weekly wage of the state and three-digit industry, with the gap between a person's earnings and the pay of their industry counted as pay within the industry. The other is the local turnover of the industry, the quarterly turnover rate of its stable jobs in the state. Both are averages over everyone in the industry, so they describe the kind of job a trainee moves into, which is the margin Katz et al. (2022) find to matter for sectoral training.

Industry pay is published for the jobs of 1,564,411 participants employed in the second quarter after exit with an industry recorded. The local turnover of an industry, however, would mislead if it did no more than mark out temporary help agencies, which trainees enter less often than other participants. When administrative and support services are left out on both sides, trainees' adjusted move to industries with lower turnover falls from 0.85 to 0.51 of a point (Section 6.3).

3.6 The occupation trained for

For 38 per cent of the sample, 267,931 trainees, the records also name the occupation held before entry, and 212,892 of them trained for a different detailed occupation. For these trainees I compare the occupation trained for with the one held before on national figures. Median annual pay comes from the May 2024 occupational wage survey, and the separation rate and projected growth from the projections of the Bureau of Labor Statistics for 2025 to 2035 (US Bureau of Labor Statistics, 2026). Two benchmarks show what a share of trainees training for better pay would mean. First, assigning each trainee a training occupation at random from those the programme funds gives 71.3 per cent training for a higher national median, so most of the share follows from where trainees start. Second, ordinary changers of occupation leaving the same occupations in the Current Population Survey (Flood et al., 2025; Conway, 2026b) moved to a better-paid one 56.3 per cent of the time, against 73.3 per cent of trainees on the same codes.

3.7 Outcomes by training occupation, with noise accounted for

A body that relies on a table of outcomes by training occupation has to know how much of the spread is noise. Employment in the fourth quarter is adjusted for intake, with the controls of Section 3.2 and state by year effects. Each unit's figure is then shrunk by parametric empirical Bayes (Morris, 1983), with the variance of true differences estimated as the variance of unit means less the average sampling variance. Across the 115 training occupations with at least 1,000 trainees, adjusted employment differs with a standard deviation of 4.3 points and every occupation's figure has a reliability above 0.8. For the 89 occupations with at least 500 trainees in each period, the figures for exits of 2018 to 2020 and 2021 to 2023 correlate at 0.86. States, compared on the same mix of occupations and intake, differ with a standard deviation of 3.2 points and a correlation of 0.69 between periods across 46 states. A training occupation within a state is the least secure figure: across 1,056 such cells the mean reliability is 0.79 and the correlation between periods across 713 cells is 0.53, so local figures should be read shrunk.

4. Training and trainees, 2018 to 2023

Table 1 sets out what the records show by year of exit. Trainees with a training occupation recorded numbered between 103,302 in 2020 and 130,411 in 2019, about three fifths of them in the adult programme, while the dislocated worker programme shrank from 36,872 trainees in 2018 to 21,820 in 2023. Completion is recorded for 693,893 trainees and missing for 12,455. Of those with it recorded, 78.3 per cent completed their training over the six years, or 76.9 per cent of all trainees, with the rate falling from 80.3 per cent in 2018 to 75.7 per cent in 2022. The mix narrowed too: heavy truck driving rose from 14.9 to 27.1 per cent of trainees and the ten largest training occupations from 44.5 to 54.3 per cent. By type, occupational skills training, usually in a classroom, accounts for 61.3 per cent of trainees, youth occupational skills training 12.1, skill upgrading 11.0, on-the-job training 9.6, customised training 2.2 and registered apprenticeship 1.2 per cent.

Table 1. Trainees and participants not trained, by year of exit

	2018	2019	2020	2021	2022	2023
Trainees	127,859	130,411	103,302	124,730	113,126	106,920
Adult programme	73,420	77,971	60,562	67,919	68,077	66,373
Dislocated worker programme	36,872	33,717	27,320	37,307	26,120	21,820
Youth programme	17,567	18,723	15,420	19,504	18,929	18,727

	2018	2019	2020	2021	2022	2023
Completed	80.3	79.4	77.7	78.4	75.7	77.8
Truck driving	14.9	17.1	18.0	20.8	25.8	27.1
Ten largest occupations	44.5	45.9	47.3	48.1	51.9	54.3
Employed at entry	28.4	31.1	30.6	28.4	32.8	34.9
Postsecondary education	39.7	38.1	37.8	35.6	32.1	30.5
Employed, fourth quarter: trainees	79.8	75.7	76.1	78.8	79.5	78.5
Employed, fourth quarter: not trained	68.3	60.8	58.5	68.7	68.7	67.4
Median earnings, second quarter: trainees	8,928	8,686	8,931	9,441	9,534	9,314
Median earnings, second quarter: not trained	7,387	7,426	7,076	7,287	7,771	7,669
Employed trainees in the field	53.1	53.8	54.1	54.0	54.9	54.1

Shares are in per cent of trainees, except employment of participants not trained, and completion is of the trainees whose completion is recorded. Earnings are medians among those employed, in dollars of 2023. In the field is of employed trainees with an industry code, as defined in Section 3.3. Trainees are those with a state and a training occupation recorded, and participants not trained number 2,170,356 over the six years.

Trainees themselves have changed as well: the share with some postsecondary education fell from 39.7 to 30.5 per cent and the share employed at entry rose from 28.4 to 34.9 per cent. Median earnings three quarters before entry, by contrast, stayed between 7,259 and 7,498 dollars of 2023 and mean age, recorded from 2020, between 32.6 and 33.6 years.

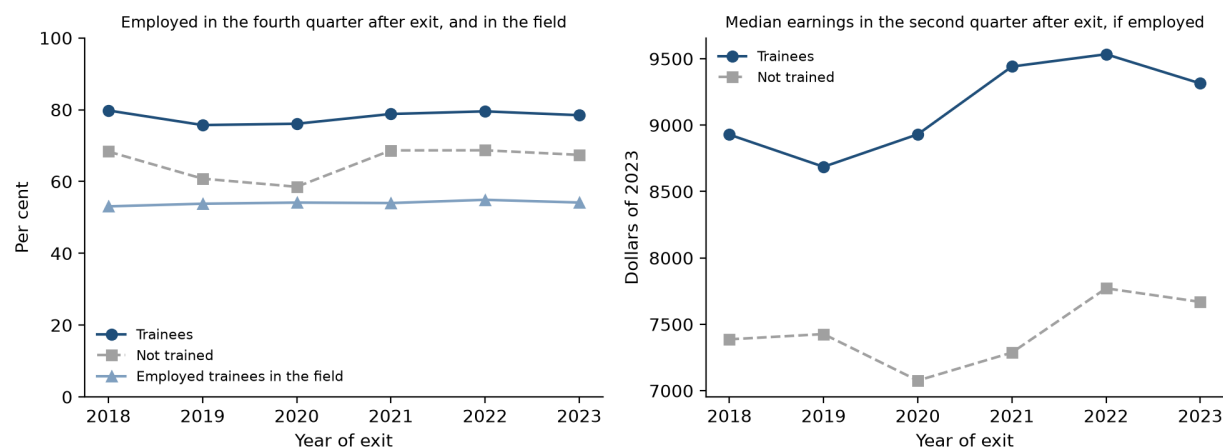


Figure 1: Employment in the fourth quarter after exit and work in the field, and median earnings in the second quarter after exit, by year of exit

Figure 1 shows the outcomes: in every year, trainees are employed in the fourth quarter after exit 76 to 80 per cent of the time, against 58 to 69 per cent of participants who were not trained. The shock of 2020 shows in the exits of 2019 and 2020, whose fourth quarter fell in the pandemic, as employment of untrained participants fell to 60.8 and 58.5 per cent and that of trainees to 75.7 and 76.1. Median earnings of employed trainees rose from 8,928 to 9,314 dollars of 2023 and were above those of untrained participants in every year, while the share of employed trainees working in the field of their training stayed between 53.1 and 54.9

per cent.

The ladder and the kind of job can also be followed by year of exit. Among participants with earnings recorded in each quarter the ladder uses, 38.3 per cent of trainees who exited in 2018 held a job on the top rung after exit, against 24.7 per cent of untrained participants. For those who exited in 2019 and 2020, some or all of whose quarters after exit fell in 2020, the shares were 34.3 and 33.6 per cent against 22.8 and 18.2. They rose again to 39.3 per cent among those who exited in 2021, against 24.3, and to 42.4 and 40.9 per cent among those who exited in 2022 and 2023, against 28.5 and 27.5. As for the kind of job, employed trainees worked in state industries whose average weekly wage, at the median across trainees, was between 1,231 and 1,287 dollars of 2023, close to the figure for untrained participants (1,191 to 1,284). The local turnover of those industries was lower in every year, between 9.4 and 10.6 per cent a quarter against 9.7 to 11.2.

5. Which training comes with better jobs?

A funder choosing what to pay for asks first which training comes with better jobs, by training occupation and by the sector trainees come from.

5.1 Outcomes by training occupation and sector

Outcomes differ far more across training occupations than between trainees and other participants. Table 2 gives them for the largest training occupations and for others at the two ends of the distribution, and the full table for the 115 occupations with at least 1,000 trainees, which hold 85 per cent of the sample, is in the repository. Between the tenth and ninetieth percentiles of those occupations, the share employed in the fourth quarter runs from 67 to 85 per cent and the share losing employment between the two quarters from 6 to 14 per cent. Over the same range the share in the field runs from 33 to 68 per cent, and median quarterly earnings after exit from 5,200 to 11,300 dollars.

Table 2. Outcomes by training occupation, exits 2018 to 2023

Training occupation	Trainees	Completed	Employed, fourth quarter	Lost employment	Same employer	In the field	Trained for better pay	Earnings after	Change in earnings
Heavy truck drivers	144,067	82	76	12	66	62	80	10,084	+33
Nursing assistants	47,796	82	81	10	68	66	62	5,703	+39
Registered nurses	33,727	77	91	4	81	84	98	14,312	+180
Licensed practical nurses	31,079	75	90	4	73	82	94	9,536	+90
Medical assistants	30,299	78	81	9	73	50	72	6,508	+35
Welders	13,829	75	77	11	64	63	83	8,057	+40
Dental assistants	10,454	82	82	9	71	49	84	6,018	+40
Phlebotomists	9,822	79	79	10	71	34	70	6,010	+31
Heating and air conditioning mechanics	8,997	77	78	9	70	38	78	8,729	+24

Training occupation	Trainees	Completed	Employed, fourth quarter	Lost employment	Same employer	In the field	Trained for better pay	Earnings after	Change in earnings
Computer user support specialists	8,641	75	74	10	72	51	61	8,334	+17
Electricians	8,432	79	88	5	78	74	87	10,311	+40
Customer service representatives	8,057	81	71	14	67	47	57	5,025	+32
Security guards	7,965	94	72	15	70	54	42	5,967	+35
Radiologic technologists	1,955	80	90	4	82	76	95	11,199	+178
Barbers	1,647	74	49	21	67	14	54	5,193	+2
Dental hygienists	1,548	86	93	3	80	79	99	12,855	+260
Massage therapists	1,196	75	65	13	72	44	75	5,500	+0
Retail salespersons	1,101	78	64	14	71	31	30	4,468	+30

Shares are in per cent. Lost employment is the share of those employed in the second quarter who are not employed in the fourth. Same employer is in state-years that report it. Trained for better pay is of trainees with a detailed prior occupation that differs. Earnings after are median quarterly dollars in the second quarter after exit, and the change is the median change in log earnings from two quarters before entry, expressed in per cent, among trainees with earnings in both.

Licensed health occupations sit at or near the top on employment, on keeping it and on work in the field, with 91 per cent of trainees for registered nursing employed in the fourth quarter. Heavy truck driving, by contrast, a fifth of all trainees, is at the median on employment and in the lower quarter on keeping it. Barbers, at 49 per cent employed, probably owe something to self-employment outside the wage records. Across the 115 occupations, the share losing employment has a correlation of -0.66 with median earnings after exit and 0.65 with the local turnover of the industries trainees enter. For the 102 occupations with a separation rate, its correlation with the Bureau's rate of exits from the occupation is 0.49. Thus trainees lose work more often in occupations whose workers leave them more often, the exits from work that I measured by detailed occupation in a companion paper on leaving work (Conway, 2026a).

After shrinkage, the lowest are barbers (22.7 points below the average), massage therapists (10.8) and hair-dressers (10.0), all occupations where self-employment outside the wage records is common, and the highest are dental hygienists (9.9 above), electrical power-line installers (7.8) and registered nurses (6.9).

Turning to the sector trainees come from, whose full table is also in the repository, those from accommodation and food services, administrative and support services and retail had earnings of 3,500 to 5,200 dollars a quarter before entry and earn 6,900 to 7,800 afterwards. Notably, heavy truck driving is the largest training occupation from every sector except health care.

5.2 Work in the field

Section 3.3 gives the national rate in the field and its checks, so here I set the rate out by training occupation and compare it with where trainees worked before entry.

Table 3. In the field before entry and after exit, by training occupation

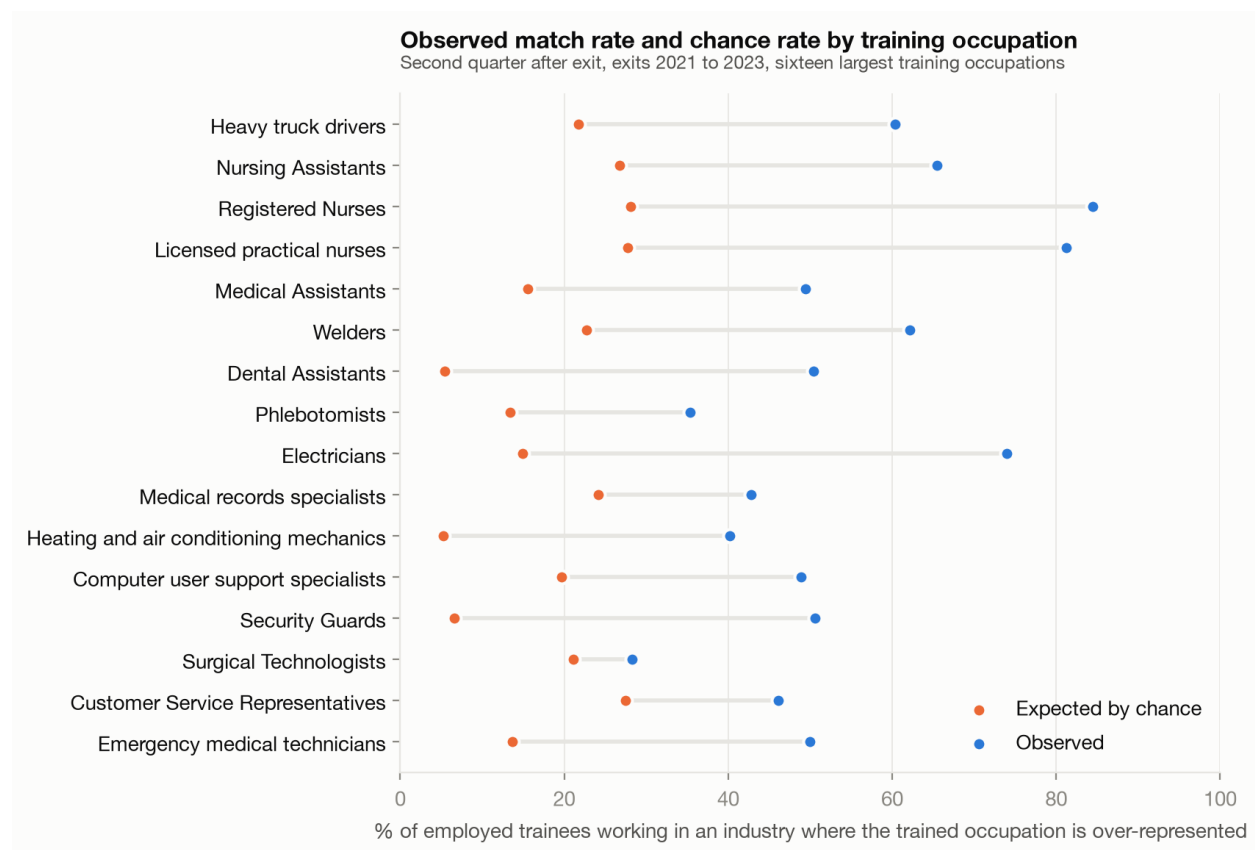


Figure 2: Observed rate in the field and chance rate by training occupation, second quarter after exit, exits 2021 to 2023

Occupation trained for	Employed trainees, exits 2021 to 2023	In the field after exit, 2021 to 2023	In the field before entry	In the field after exit
Heavy and tractor-trailer truck drivers	54,675	60%	28%	61%
Nursing assistants	14,446	66%	44%	67%
Registered nurses	13,452	84%	59%	84%
Licensed practical nurses	11,208	81%	62%	82%
Medical assistants	10,480	49%	16%	49%
Dental assistants	4,075	50%	6%	46%
Electricians	3,349	74%	61%	77%

The second and third columns cover employed trainees who exited from 2021 to 2023. The last two cover trainees of all years with an industry recorded both before entry and after exit.

Figure 2 shows the rate by training occupation, and Table 3 and Figure 3 compare it before entry and after exit, with the industry before entry showing how much of the rate is new entry. Among trainees with a prior industry, 35 per cent were already in the field and 56 per cent are in it afterwards, so about half of trainees in the field after exit were in it before. Among those whose industry changed, 53 per cent of those who started outside the field are in it afterwards. Dental assisting, medical assisting and truck driving draw people from outside the field, while nursing and the electrical trade are taken largely by people already in hospitals, care homes and electrical contracting. Working in the field also goes with higher earnings and steadier work. Within training occupation, state and exit year, with controls for intake and the prior sector, trainees in the field earn 0.34 log points more in the second quarter after exit (0.011), are 2.1 points less likely to lose employment (0.1) and 4.7 points more likely to keep the same employer (0.4). The earnings difference with the field is mostly a comparison between types of job, however, as the jobs outside the field that trainees hold are a lower-paid mix. With log earnings three quarters before entry added, which differ by 0.015 (0.003), the difference is 0.32.

5.3 The occupation trained for

Table 4 compares the occupation trained for with the one held before, for the trainees described in Section 3.6.

Table 4. The training occupation against the prior occupation

	Trainees	Share for whom the training occupation is better	Standard error
Higher national median pay	182,124	74.8	2.3
Lower official separation rate	182,263	66.3	4.3
Faster projected growth, 2025 to 2035	182,263	63.1	3.1

	Trainees	Share for whom the training occupation is better	Standard error
All three	182,121	43.9	3.5
None of the three	182,121	10.1	1.1

Shares are in per cent. The official separation rate is the Bureau's total separation rate, exits from the labour force plus transfers to another occupational group. Ties count as not better, and the standard errors are clustered by training occupation.

Three quarters of these trainees train for an occupation with a higher national median than the one they held, with a median gap of 27 per cent. The share falls with age, from 84.1 per cent of trainees under twenty-five (1.9) to 60.8 per cent (2.7) at fifty-five and over. Of the 45,829 trainees with a detailed code for the later job, 62.0 per cent (3.1) hold an occupation that pays more than the prior one. Earnings after exit, however, are unrelated to the gap in pay between the two occupations, at 0.01 (0.09). On exposure to automation, the measures of Frey and Osborne (2017) and Felten, Raj and Seamans (2021) give no common answer, with 59.9 (4.0) and 49.9 (4.9) per cent training for a less exposed occupation.

6. Job quality and stability against untrained participants, and for whom

A funder also asks how the jobs of trainees compare with those of comparable participants who were not trained, and for whom the difference is largest.

6.1 Up the ladder

Table 5 places each group on the ladder before entry and after exit. Before entry, 20.9 per cent of completers, 17.0 per cent of non-completers and 31.2 per cent of participants who were not trained held a job on rung 2, so the untrained group actually started higher. After exit the order is reversed for completers, 41.4 per cent of whom are on rung 2, against 25.1 per cent of non-completers and 24.2 per cent of the untrained. Completers moved up the ladder 41.3 per cent of the time and down 13.5 per cent, while participants who were not trained moved up 20.2 per cent of the time and down 28.5 per cent.

Table 5. The ladder of job quality before entry and after exit

	Completed	Did not complete	Not trained
Participants	468,375	129,640	1,927,646
Rung 2 before entry	20.9	17.0	31.2
Rung 0 after exit	17.4	26.8	33.5
Rung 2 after exit	41.4	25.1	24.2
Moved up	41.3	29.6	20.2
Moved down	13.5	18.2	28.5
<i>Adjusted difference from those not trained</i>			
Rung 2 after exit	+15.7 (0.7)	+1.9 (1.2)	
Moved up	+13.0 (0.5)	+1.2 (0.9)	
Moved down	-5.6 (0.5)	-0.4 (0.6)	

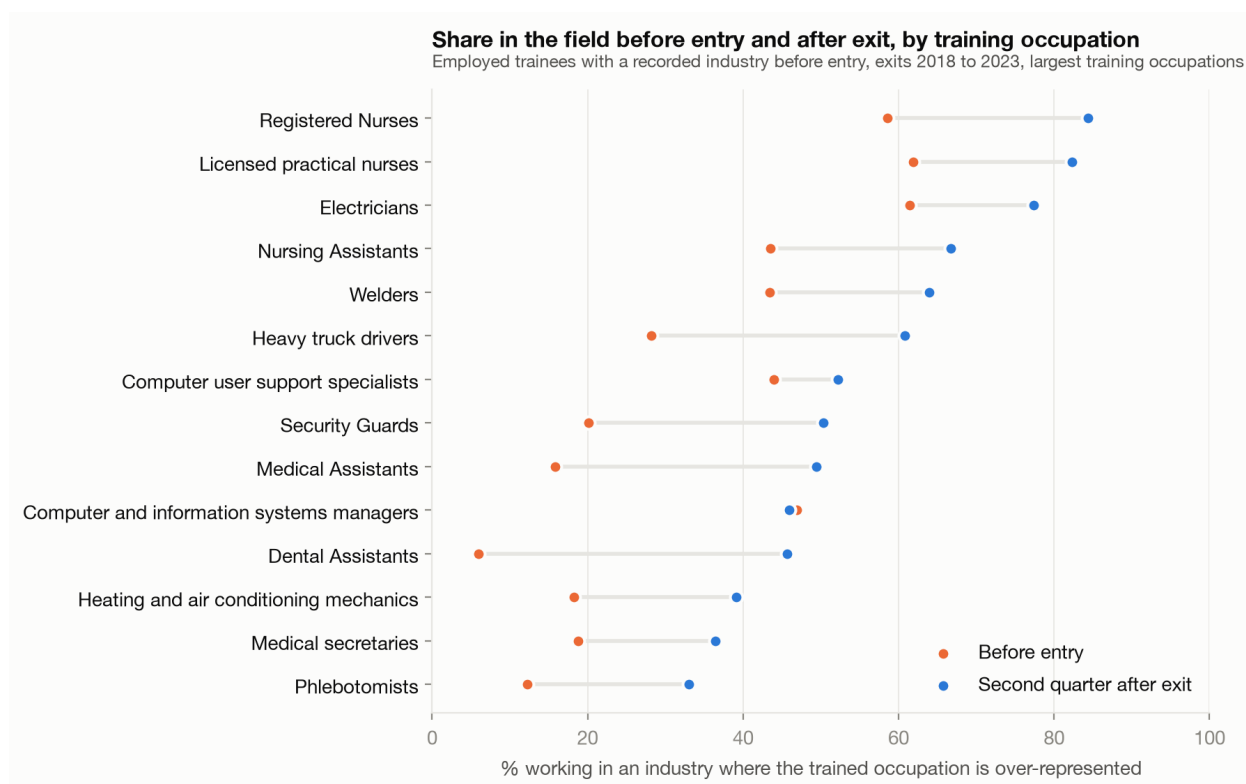


Figure 3: Share of trainees in the field before entry and in the second quarter after exit, by training occupation

Shares and differences are in per cent and points. Rung 2 is earnings above the low-pay line in the main quarter and earnings in both quarters used. The adjusted differences hold fixed state by year, prior sector, earnings in the third and second quarters before entry, programme, sex, education, age, employment status at entry and the rung before entry, with standard errors clustered by state.

With the starting rung and earnings before entry held fixed, completers are 15.7 points more often on rung 2 after exit than participants who were not trained, and non-completers 1.9 points, a difference within two standard errors of zero. For all trainees the difference is 12.6 points (0.6), and it is present from every starting rung. It is 12.3 points (0.6) for participants with no earnings in the quarter before entry and 14.1 (0.6) for those in low-paid or intermittent work, and for those already on rung 2, where the comparison is whether they stay there, it is 9.4 (1.0).

6.2 The parts of the earnings gap

In the second quarter after exit, trainees earn 2,255 dollars of 2023 more than comparable participants who were not trained (standard error 177), on an untrained mean of 6,792 dollars, and completers 2,810 dollars (210). Table 6 splits the gap into two parts: trainees are 7.5 points more often employed in that quarter, and among the employed they earn 2,094 dollars more. How much each part accounts for depends on the order of the weights, the index-number problem of Oaxaca (1973) and Blinder (1973). With untrained earnings as the weight employment accounts for 33 per cent, with trainees' 40 per cent, and earnings in work for the rest. The two parts sum to 2,310 dollars, 56 dollars more than the gap, as each comes from its own adjusted regression. On raw means, without adjustment, the gap is 2,224 dollars and employment accounts for 64 to

71 per cent of it, as trainees' raw advantage in employment is larger than their adjusted one. In other words, once the comparison is adjusted, being in work accounts for a third to two fifths of the gap and earning more in work for the rest.

Table 6. The earnings gap in the second quarter after exit, split by source

Outcome	Mean, not trained	All trainees	Completed	Did not complete
Earnings, dollars of 2023	6,792	+2,255 (177)	+2,810 (210)	+340 (192)
Employed, per cent	66.5	+7.5 (0.7)	+9.4 (0.6)	+0.7 (0.7)
Earnings if employed, dollars of 2023	10,213	+2,094 (199)	+2,516 (228)	+460 (197)
Log earnings if employed		+0.284 (0.013)	+0.346 (0.016)	+0.043 (0.035)
of which log pay of the industry		+0.101 (0.006)	+0.119 (0.007)	+0.034 (0.009)
of which pay within the industry		+0.183 (0.012)	+0.228 (0.014)	+0.009 (0.029)
Local turnover of the industry, per cent a quarter	10.7	-0.96 (0.06)	-1.13 (0.07)	-0.26 (0.09)
Change in log industry pay, before entry to after exit	0.018	+0.090 (0.006)	+0.106 (0.007)	+0.027 (0.009)
Same three-digit industry before and after, per cent	43.3	-7.9 (1.6)	-9.0 (1.8)	-3.9 (1.2)

Differences from participants who were not trained, with the controls of Table 5 except the rung before entry, and standard errors clustered by state. The log rows cover the 1,564,411 participants employed in the second quarter with an industry whose pay is published, and the last two rows the 1,045,817 employed before entry and after exit with industry pay on both sides, with the three-digit industry before entry also held fixed.

Among the employed, the gap in log earnings is 0.284, of which 0.101, or 36 per cent, is the pay of the industry trainees work in and 0.183, or 64 per cent, is pay within that industry. For completers the split is 0.119 and 0.228, and for non-completers 0.034 and 0.009. Starting from the same industry, trainees employed before and after moved to industries whose pay was 0.090 log points higher than the industries comparable participants moved to, and they were 7.9 points less likely to stay in the industry they left. Katz et al. (2022) find the industry central to sectoral programmes, and here it accounts for about a third of the gap among those in work. The rest, pay within an industry, can reflect occupation, hours, tenure or the employer, and the earnings difference with the field in Section 5 suggests that occupation is part of it.

The fall in earnings before entry does not explain the gap. Compared quarter by quarter in current dollars, with earnings in the third and second quarters before entry held fixed, trainees and untrained participants differ by -42 dollars (61) in the quarter before entry, which the controls leave free, and by -106 dollars (84)

when only the third quarter is held fixed.

6.3 Stability

Table 7 gives the measures of stability that the records hold for every participant. Of trainees with a state recorded, 79.7 per cent are employed in the second quarter after exit and 78.1 per cent in the fourth, and 9.6 per cent of those employed in the second quarter are not employed in the fourth. In the state-years that report it, 71.5 per cent of trainees employed in both quarters are with the same employer. Several large states, however, record that field as zero for every participant for years at a time, so I use it only in state-years where more than half of those employed in both quarters carry a positive value, keeping 1,113,566 of 1,734,822 such participants.

Table 7. Outcomes after exit for trainees and for participants who were not trained

	Trainees who completed	Trainees who did not complete	Participants not trained
Participants	543,268	150,625	2,170,356
Not employed at entry	68.3	70.5	85.1
Employed, second quarter	81.7	72.6	65.9
Employed, fourth quarter	79.9	71.5	65.4
Employed in the second quarter and not the fourth	9.0	12.1	14.3
Same employer in both quarters	72.7	66.3	70.6
Median quarterly earnings after exit, dollars	8,672	6,558	6,605
Local industry turnover before entry	10.9	11.4	10.8
Local industry turnover after exit	9.7	10.8	10.7

Shares are in per cent, and each row is a count of exits. Same employer is of those employed in both quarters, in state-years that report it. Turnover is the quarterly rate of stable jobs in the state and three-digit industry, for participants with an industry on both sides.

With state by year, programme, sex, education, age, employment status at entry, the decile of earnings before entry and the sector of the prior job held fixed, trainees are 7.0 points (0.6) more often employed in the fourth quarter than participants who were not trained. They are also 3.1 points (0.2) less likely to lose employment between the second and fourth quarters. Completers are 8.6 points (0.6) more often employed and non-completers 1.0 point (0.7). For trainees as a whole, the difference is 4.7 points among participants employed at entry, 6.6 leaving out New York, 7.2 (0.5) in the adult programme and 7.0 (1.1) in the dislocated worker programme. Within the group of trainees, however, training for a better-paid occupation is not associated with greater stability: within prior occupation the difference is 0.7 of a point (0.7) for employment in the

fourth quarter.

Trainees also move into industries with lower turnover. Those employed before entry and after exit move from industries with a local turnover of 11.0 per cent a quarter to industries with 9.9 per cent, while participants who were not trained move from 10.8 to 10.7. The adjusted difference in the change is 0.85 of a point (0.07). It falls to 0.51 when administrative and support services, which include temporary help agencies, are left out on both sides, as 17.5 per cent of reemployed participants who were not trained work there against 11.8 per cent of trainees. With the controls of Section 3, the turnover of the industry trainees work in after exit is lower by 0.96 of a point (0.06), and by 1.13 for completers (Table 6).

For an employer, the relevant comparison is with other hires. In the state-years that report the employer, 65.8 per cent of trainees employed in the second quarter after exit are with the same employer in the fourth. That lies between two bounds from the Quarterly Workforce Indicators for the same state, industry and year: 51.9 per cent for a quarter's new hires still with the employer two quarters later (Abowd et al., 2009) and 81.2 per cent for all stable jobs. Because a job held after exit is often one begun before or during the programme, only the comparison with other participants informs. With the controls, trainees' margin over new hires is 1.2 points (0.4) larger than theirs, a figure sensitive to the rule that admits a state-year.

6.4 The shock of 2020

The pandemic struck people who had left the programmes months earlier, and for most participants who exited in 2019 some of the four quarters after exit fall in the second to fourth quarters of 2020. I compare each person's employment in those quarters with the same person's employment in earlier quarters after exit, with fixed effects for the person, for the quarter after exit separately for trainees and others, and for state by calendar quarter. Participants who exited in 2018, a cohort that does not overlap, are treated in the same way with a false shock in 2019, and the two cohorts are estimated together. In the shock quarters, trainees' employment fell 1.73 points less (0.22) than that of untrained participants, against 0.96 of a point more (0.31) in the placebo cohort, a difference of 2.68 points (0.30), or 2.94 for completers (0.32) and 1.69 for non-completers (0.36). Of participants employed in the first quarter of 2020, trainees kept their employment into the second quarter 2.5 points (0.4) more often than in the same quarters of 2019, and 1.4 points (0.4) with the three-digit industry of their job held fixed. In essence, trainees' employment held up better through the shock by two to three points, and about half of the advantage in keeping a job goes with the industries they had moved into. Non-completers show about 1.7 points of the advantage in employment, a little over half that of completers.

6.5 For whom?

Table 8 repeats the comparisons of Tables 5 and 6 for groups of participants, each estimated within the group with the same controls. I judge differences between groups against the standard error of the difference, computed from the two independent estimates.

Table 8. Adjusted differences between trainees and participants who were not trained, by group

Group	Trainees	Earnings a quarter after exit, dollars of 2023	Untrained mean	Employed, fourth quarter, points	Rung 2 after exit, points
No earnings before entry	123,595	+2,499 (184)	3,184	+11.4 (0.9)	+12.2 (0.7)
Lowest fifth of earnings before entry	121,191	+2,304 (150)	3,600	+7.7 (0.5)	+12.5 (0.5)
Middle fifth	98,115	+2,268 (142)	5,742	+5.1 (0.6)	+15.3 (0.6)
Highest fifth	60,000	+1,463 (279)	14,219	+3.9 (1.0)	+7.4 (1.3)
Aged under 25	87,424	+2,395 (315)	4,822	+5.0 (0.6)	+13.1 (0.8)
Aged 25 to 34	117,674	+2,577 (186)	6,782	+7.3 (0.8)	+14.2 (0.8)
Aged 45 to 54	49,906	+1,904 (270)	8,215	+6.3 (0.9)	+9.6 (1.0)
Aged 55 and over	28,339	+1,564 (280)	6,070	+6.2 (1.2)	+7.8 (1.2)
Men	291,573	+2,408 (239)	7,445	+7.3 (0.7)	+13.6 (0.6)
Women	303,067	+2,055 (121)	6,018	+6.7 (0.5)	+11.3 (0.8)
No secondary diploma	49,602	+1,894 (169)	4,191	+7.4 (0.9)	+10.0 (0.7)
Secondary diploma	313,734	+2,187 (192)	5,376	+7.3 (0.6)	+12.4 (0.6)
Bachelor's degree or more	69,622	+1,895 (158)	11,042	+5.1 (0.9)	+10.2 (1.0)
Black	115,374	+1,838 (205)	5,699	+3.8 (0.6)	+9.8 (1.0)
Hispanic	74,156	+2,101 (158)	5,955	+6.4 (0.8)	+11.7 (0.9)
White	128,947	+2,585 (408)	7,711	+7.3 (0.7)	+14.2 (0.9)
Adult programme	384,372	+2,360 (169)	5,958	+7.1 (0.5)	+13.4 (0.6)
Dislocated worker programme	172,564	+1,897 (150)	7,717	+6.9 (1.1)	+10.8 (0.8)
Youth programme	41,079	+1,584 (265)	3,406	+3.8 (0.5)	+7.8 (0.7)
Long-term unemployed at entry	75,623	+2,208 (171)	4,727	+8.6 (0.7)	+11.3 (0.5)

Earnings are the mean of the four quarters after exit, in dollars of 2023, and the untrained mean is that of participants not trained in the same group. Each row is a separate regression within the group, with the controls of Table 5 except the rung before entry. Age is recorded for exits of 2020 to 2023 only. The full table, with all fifths, age bands and groups, is in the repository.

The gaps in dollars are of similar size across most groups, so relative to what comparable participants earn they are largest where earnings are lowest, a pattern that follows from that similarity and is not a separate finding. For people with no earnings before entry the gap is 78 per cent of the untrained mean, and 64 per cent in the lowest fifth, against 10 per cent in the highest. In dollars, the gap is smallest in the highest fifth

of earnings before entry, at 1,463 dollars, and the gap in employment falls from 11.4 points for those with no earnings before entry to 3.9 points in the highest fifth. Reaching rung 2 has a gap of a different shape, rising from 12.2 points with no earnings before entry to 15.3 in the middle fifth and falling to 7.4 in the highest, where untrained participants already reach it half the time. For the long-term unemployed at entry, the gaps are 2,208 dollars, 8.6 points in employment and 11.3 points on rung 2, against 2,229 dollars, 6.7 and 12.6 for others, so only the gap in employment differs, by 1.9 points (0.9).

Some gaps are smaller for precisely the groups the programmes are meant to serve. As these are differences in the gaps between trainees and comparable untrained participants of the same group, they can arise from the occupations each group trains for as much as from anything about the training. In dollars, they are smaller at 55 and over than at 25 to 34, by 1,013 dollars (336), and in the youth programme than in the adult one, by 776 dollars (314), with gaps in employment of 3.8 points in the youth programme against 7.1 in the adult. Black trainees have a gap in employment of 3.8 points against 7.3 for White trainees, a difference of 3.5 points (0.9), and a gap on rung 2 of 9.8 against 14.2. Their gap in earnings, by contrast, 1,838 against 2,585 dollars, cannot be distinguished from that of White trainees (difference 747 dollars, standard error 457). Women's gap in earnings, 2,055 dollars, likewise cannot be distinguished from men's, 2,408 (difference 353 dollars, standard error 268), and relative to the earnings of comparable untrained participants it is slightly larger, at 34 against 32 per cent. For a board, then, the gaps are close to a common amount in dollars for most groups, so they are largest relative to earnings for people with little or no recent work. The groups whose gaps fall short of it, youth, workers over 55 and, in employment, Black trainees, are where a closer look at which occupations they train for would start.

7. Through which delivery?

A board also chooses how training is delivered, whether in a classroom or with an employer. The files record the type of training, and most trainees receive occupational skills training, usually in a classroom with a provider chosen from the state's list. That is 398,909 of the 598,015 trainees in this sample, against 73,915 in skill upgrading, 62,253 in on-the-job training, 12,340 in customised training and 7,627 in registered apprenticeship. Of these types, on-the-job training, customised training and registered apprenticeship are arranged with an employer, and skill upgrading often is. On-the-job training places a person with an employer who is reimbursed for part of the wage during training, and it serves mostly people who are out of work, only 28 per cent of whom were employed at entry. Customised training and registered apprenticeship, by contrast, serve mostly people already employed, 69 and 63 per cent of them.

Against participants who were not trained, each type has a positive gap: 2,356 dollars a quarter for occupational skills training, 2,247 for on-the-job training, 3,401 (649) for customised training and 2,863 (370) for registered apprenticeship. In employment in the fourth quarter the gaps are 6.8, 11.2, 8.9 and 11.6 points respectively. But the comparison that bears on the choice of type holds the occupation fixed, and Table 9 therefore compares the types within the same training occupation, state and exit year, against occupational skills training, in the adult and dislocated worker programmes. Of the 546,190 trainees in these five types, 310,513 are in a cell of occupation, state and year that holds more than one type, and the comparison rests on them.

Table 9. Types of training against occupational skills training, within training occupation, state and exit year

Type of training	Earnings a quarter after exit, dollars of 2023	Employed, fourth quarter, points	Rung 2 after exit, points	Same, not employed at entry: employed, fourth quarter
On-the-job training	+1,267 (172)	+8.1 (1.0)	+7.3 (1.1)	+9.6 (0.9)
Customised training	+2,385 (410)	+7.3 (1.0)	+16.7 (2.6)	+6.7 (1.6)
Registered apprenticeship	+1,339 (306)	+4.8 (1.9)	+11.0 (1.9)	+5.9 (2.5)
Skill upgrading	+148 (180)	+0.6 (1.0)	+1.5 (1.0)	+0.3 (1.1)

Differences from trainees in occupational skills training for the same occupation, in the same state and exit year, with the controls of Table 5 except the rung before entry, with standard errors clustered by state. The regression sample is 529,552 trainees (355,830 not employed at entry), and the comparison comes from the 310,513 in cells with more than one type. On-the-job training begins with a hire by the employer who provides it, so its employment after exit partly records a placement made at the start.

For the same occupation, on-the-job training comes with employment 8.1 points higher than classroom training and earnings 1,267 dollars a quarter higher, and among people who were not employed at entry 9.6 points and 1,533 dollars. Registered apprenticeship and customised training show gaps of the same order, and skill upgrading none. The types differ before entry, however. Within the same occupation, state and year and with no other controls, on-the-job trainees earned 1,552 dollars (372) less than classroom trainees three quarters before entry, 1,474 (353) less two quarters before and 1,114 (296) less in the quarter before. Customised trainees earned 1,633 to 2,605 dollars more and were 32.0 points (7.4) more often employed at entry. The controls hold earnings in the third and second quarters before entry fixed, so the comparison in Table 9 is between people with the same recent earnings, but it cannot hold fixed what made an employer take them on.

The placement already shows in the first quarter after exit. Among people not employed at entry, 87.6 per cent of on-the-job trainees are employed in that quarter, against 74.5 per cent of classroom trainees in raw terms, so much of the gap in employment is in place at exit. Only a randomised comparison of the two types would show the outcome of moving a given person from one to the other. For a board, the comparison shows that, for a given occupation and given recent earnings, people who train with an employer are more often employed and better paid afterwards than people who train in a classroom. As nearly nine in ten of those not employed at entry are in work in the first quarter after exit, mostly in the job the employer offered at the start, it is my view that the number of such places a board can fund rests on the employers willing to take trainees on.

8. Do trainees' outcomes hold up when boards train more?

A funder deciding whether to train more people has to know whether those trained when more training is offered fare as well, relative to comparable participants, as those trained now. Local workforce boards, 606 in these files, decide through their budgets, provider lists and practice how many of their participants to train. A board's share trained moves from year to year, with a standard deviation of 14 points around its own mean across 7,742 cells of board, programme and exit year. In the third of cells where a board's share was highest,

on average 13.3 points above its own mean, it trained 0.45 log points more people than in the third where its share was lowest, on average 9.1 points below, while serving 0.20 log points fewer participants.

Within each cell, trainees and untrained participants share the board's budget, caseload and local conditions of that year, and I compare them with the controls of Section 3, on the sample of Appendix A. I then ask whether that gap is smaller in a board's high years than in its low ones, with the gap allowed its own level in each programme and exit year, so that a national trend in training or in outcomes does not enter the contrast. To be fair, the comparison across years can still reflect whatever else changed in a board's high years, and it describes the gaps without measuring what training adds.

Over the whole period, the gaps on job quality and earnings were close to those of the low years. Relative to its low years, a board's trainees in its high years had a gap on the top rung smaller by 0.5 of a point (0.5) and a gap in employment in the fourth quarter smaller by 0.8 of a point (0.4). Their gap in earnings was smaller by 196 dollars a quarter (99), against the gap of 2,255 dollars in Section 6. The trainees themselves were similar in high and low years. Those of high years were 1.5 points (0.4) more often employed at entry, on a mean of 31, and 0.9 of a point (0.4) more often completers, with no difference in earnings before entry, the share without earnings, education or age. Yet the two periods differ. Among exits of 2018 and 2019 the gaps were smaller in high years on all three outcomes, by 3.5 points (0.8) on the top rung, 1.5 (0.7) in employment and 549 dollars (152) in earnings. Among exits of 2021 to 2023 none of the three was smaller, at +1.1 (1.0), -0.1 (0.5) and -77 (241).

Appendix A discusses the further question of what training adds for the people a board trains only when it trains more, treating the share trained among a participant's peers as an instrument (Frölich and Lechner, 2010). Its estimates are close to the adjusted comparisons, but they depend on how the cells are built, move with the board's intake and caseload and differ between periods, so I report them under their assumptions and do not read them as an effect of training. A design built on the funding formula, which moves a board's budget by thresholds and limits on year-to-year change that can be computed from published inputs, could measure it, and I leave that design to later work.

For a funder, then, across the range over which boards actually vary their training, about half as many trainees again in their high years, the gaps between trainees and comparable untrained participants that Sections 5 to 7 report were only slightly smaller when boards trained more. The shortfall was clear in 2018 and 2019 but absent in the exits of 2021 to 2023, so in the recent years these files cover, a board that trained a larger share of its participants saw no erosion in how its trainees fared against comparable participants.

9. Limitations

None of the comparisons in Sections 4 to 8 is an estimate of what training caused. Participants who were not trained are a different population, 44 per cent of them in New York and 67 per cent in four states that enrol users of job centres at large, against 19 per cent of trainees, and 85 per cent not employed at entry. Case workers and participants also choose who trains. The controls for earnings before entry, the starting rung and the prior sector remove the differences the records show, and no dip in earnings before entry is detectable beyond that of comparable participants. But motivation and the judgement of case workers are not recorded, and non-completers, chosen in the same way as completers, show differences close to zero on almost every outcome.

The ladder uses quarterly earnings, which cannot separate the wage from hours, and two quarters of employment, which cannot show whether a job lasts beyond a year, and it says nothing of conditions at work, benefits or the security of a contract. Industry pay and turnover are state averages for everyone in the industry,

so they describe the kind of job and not the particular one, and they are observed only for people employed with a recorded industry, itself an outcome. To prevent disclosure, earnings in the public file are altered at random, which leaves means of large groups close to their true values but makes individual changes noisy. Because employment is taken from wage records, it misses self-employment and work in another state where records are not shared, which lowers the rates of occupations such as barbering.

The analyses of Sections 6 and 7 require earnings in each quarter they use, which keeps 2,525,661 of 2,864,249 participants with a known completion status. Throughout, the unit is an exit, and 6.0 per cent of trainee exits belong to a person with more than one in the state, but keeping only first exits leaves the adjusted difference in employment unchanged at 7.0. By group and by type of training, the comparisons rest on the controls of Section 3, and the types of training differ in how places are filled in ways the records do not show. For the test of 2020, which compares the same people over time, a placebo cohort measures the drift of trainees' employment against that of others, on the assumption that the drift was the same for the cohorts of 2018 and 2019. The instrumental-variable estimates use a board's leave-one-out share of trainees among participants who exited in the same year, so the instrument is defined on exits. Their sample keeps trainees without a recorded training occupation, 620,015 trainees against 598,015 in the descriptive comparisons. Section 8's comparison of high and low years uses the same sample and cells of at least 30 participants. Part of the movement in a small board's share trained is idiosyncratic change in its caseload, which weakens the contrast between high and low years and so works towards a steady gap. A gap that holds steady could reflect changes in who is left untrained as well as in who is trained.

The measure of the field identifies the field and not the occupation, and it uses a national staffing matrix for a single year. Furthermore, the file mixes vintages of the industry classification, and carrying every code forward through the Census Bureau's concordances first leaves the national rate at 54.0 per cent, with nine of the 144 occupations with at least 500 trainees moving by more than one point. In Section 5, the comparison of occupations rests on the prior occupation, which programme staff record for 38 per cent of the sample and for few youth. Finally, the outcomes by occupation in Table 2 are not adjusted for who trains for each occupation, and the shrunk figures of Section 5 are adjusted only for recorded intake. Their reliability treats trainees as independent within an occupation and so is on the high side, as the persistence between periods shows for cells within states.

10. Conclusion

The official figures on WIOA training report employment and earnings after exit. To these the measures I built here add the field of the job, its place on a ladder of job quality, the pay and local turnover of its industry, the occupation trained for against the one held before, and outcomes by training occupation with their reliability. All come from public records, and the ladder and the kind of job are computed alike for participants who were not trained.

Seen through these measures, the public records of WIOA show a training system that moved between 103,000 and 130,000 people a year through training from 2018 to 2023, completed by about four in five. Training also became increasingly concentrated on a few occupations, with heavy truck driving more than a quarter of trainees by 2023. In every year, trainees are employed a year after exit more often than other participants, and they earn more when employed.

The answers to the four questions are descriptive. On the first, which training comes with better jobs, outcomes differ far more across training occupations than between trainees and other participants, and they persist from one period to the next once adjusted for intake. Licensed health occupations lead while personal-service trades trail, so a funder can use the national tables with some confidence and should read local figures

shrunk towards them. Employed trainees work in the field of their training 54 per cent of the time against 18 by chance, about half of them having been in it before. On the second, for whom, completers are 15.7 points more often than comparable untrained participants in work above the low-pay line held across the year after exit. Their earnings gap comes from being in work, from the pay of the industry and from pay within it, and their employment held up two to three points better through the shock of 2020. Non-completers, by contrast, show little of the gap on the ladder or in earnings and a little over half of the advantage through 2020. The gaps are similar in dollars across most groups and smaller for the highest earners before entry, for workers over 55, in the youth programme and, in employment, for Black trainees. On the third, through which delivery, on-the-job training comes with employment about eight points higher than classroom training for the same occupation, a gap that partly records the hire with which it begins.

On the last question, whether trainees' outcomes hold up when boards train more, in the years a board trains about half as many people again as in its other years its trainees are similar. Their gaps over comparable untrained participants of the same board and year were smaller among exits of 2018 and 2019 and no smaller among those of 2021 to 2023. A design built on the funding formula could measure what training adds for the people a board trains only when it trains more. The comparisons here show where that answer would matter most: for people with little or no recent work, for the youth programme, and for the choice between classroom training and training with an employer.

The measures can be tabulated from the public files for a state, a programme or a training occupation, which is how a board or funder would use them, and the tables by training occupation and prior sector are in the repository.

References

- Abowd, J. M., Stephens, B. E., Vilhuber, L., Andersson, F., McKinney, K. L., Roemer, M. and Woodcock, S. (2009). The LEHD infrastructure files and the creation of the Quarterly Workforce Indicators. In T. Dunne, J. B. Jensen and M. J. Roberts (eds), *Producer Dynamics: New Evidence from Micro Data*, 149 to 230. Chicago: University of Chicago Press.
- Anderson, T. W. and Rubin, H. (1949). Estimation of the parameters of a single equation in a complete system of stochastic equations. *Annals of Mathematical Statistics*, 20(1), 46 to 63.
- Andersson, F., Holzer, H. J., Lane, J. I., Rosenblum, D. and Smith, J. (2024). Does federally funded job training work? Nonexperimental estimates of WIA training impacts using longitudinal data on workers and firms. *Journal of Human Resources*, 59(4), 1244 to 1283.
- Ashenfelter, O. (1978). Estimating the effect of training programs on earnings. *Review of Economics and Statistics*, 60(1), 47 to 57.
- Blinder, A. S. (1973). Wage discrimination: reduced form and structural estimates. *Journal of Human Resources*, 8(4), 436 to 455.
- Card, D., Kluve, J. and Weber, A. (2018). What works? A meta analysis of recent active labor market program evaluations. *Journal of the European Economic Association*, 16(3), 894 to 931.
- Carrington, W. J. and Troske, K. R. (1997). On measuring segregation in samples with small units. *Journal of Business and Economic Statistics*, 15(4), 402 to 409.
- Cazes, S., Hijzen, A. and Saint-Martin, A. (2015). Measuring and assessing job quality: the OECD Job Quality Framework. OECD Social, Employment and Migration Working Papers 174. Paris: OECD Publishing.

Official working paper, not peer reviewed.

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement*, 20(1), 37 to 46.

Conway, A. (2026a). Realised Exits from the Labour Force by Detailed Occupation in the United States: A Measure, with Three Applications. Unpublished working paper. Not peer reviewed.

Conway, A. (2026b). An Occupational Flow Account for the United States, 2009 to 2025: Mobility, the Sources and Destinations of Each Occupation's Workers, and the Industry Shock of 2020 and 2021. Unpublished working paper. Not peer reviewed.

Dahl, C. M., Huber, M. and Mellace, G. (2023). It is never too LATE: a new look at local average treatment effects with or without defiers. *Econometrics Journal*, 26(3), 378 to 404.

Dobbie, W., Goldin, J. and Yang, C. S. (2018). The effects of pretrial detention on conviction, future crime, and employment: evidence from randomly assigned judges. *American Economic Review*, 108(2), 201 to 240.

Felten, E., Raj, M. and Seamans, R. (2021). Occupational, industry, and geographic exposure to artificial intelligence: a novel dataset and its potential uses. *Strategic Management Journal*, 42(12), 2195 to 2217.

Flood, S., King, M., Rodgers, R., Ruggles, S., Warren, J. R. and others (2025). IPUMS CPS: Version 13.0. Minneapolis: IPUMS. <https://doi.org/10.18128/D030.V13.0>

Frölich, M. and Lechner, M. (2010). Exploiting regional treatment intensity for the evaluation of labor market policies. *Journal of the American Statistical Association*, 105(491), 1014 to 1029.

Frey, C. B. and Osborne, M. A. (2017). The future of employment: how susceptible are jobs to computerisation? *Technological Forecasting and Social Change*, 114, 254 to 280.

Fortson, K., Rotz, D., Burkander, P., Mastri, A., Schochet, P., Rosenberg, L., McConnell, S. and D'Amico, R. (2017). Providing public workforce services to job seekers: 30-month impact findings on the WIA Adult and Dislocated Worker programs. Washington, DC: Mathematica Policy Research. Evaluation report for the US Department of Labor.

Grosz, M. (2020). The returns to a large community college program: evidence from admissions lotteries. *American Economic Journal: Economic Policy*, 12(1), 226 to 253.

Heckman, J. J. and Smith, J. A. (1999). The pre-programme earnings dip and the determinants of participation in a social programme: implications for simple programme evaluation strategies. *Economic Journal*, 109(457), 313 to 348.

Hyman, B., Lahey, B., Ni, K. and Pilossoph, L. (2025). How retrainable are AI-exposed workers? NBER Working Paper 34174, August 2025, revised August 2026. Not peer reviewed.

Imbens, G. W. and Angrist, J. D. (1994). Identification and estimation of local average treatment effects. *Econometrica*, 62(2), 467 to 475.

Isserman, A. M. (1977). The location quotient approach to estimating regional economic impacts. *Journal of the American Institute of Planners*, 43(1), 33 to 41.

Jacobs, J. and Canedy, J. (2026). Did US worker retraining reduce participant automation exposure? arXiv 2605.03767. Not peer reviewed.

- Jacobson, L. and Davis, J. (2017). The relative returns to Workforce Investment Act-supported training in Florida by field, gender, and education and ways to improve trainees' choices. *Journal of Labor Economics*, 35(S1), S337 to S375.
- Kalleberg, A. L. (2011). *Good Jobs, Bad Jobs: The Rise of Polarized and Precarious Employment Systems in the United States, 1970s to 2000s*. New York: Russell Sage Foundation.
- Katz, L. F., Roth, J., Hendra, R. and Schaberg, K. (2022). Why do sectoral employment programs work? Lessons from WorkAdvance. *Journal of Labor Economics*, 40(S1), S249 to S291.
- Manski, C. F. (1989). Anatomy of the selection problem. *Journal of Human Resources*, 24(3), 343 to 360.
- Morris, C. N. (1983). Parametric empirical Bayes inference: theory and applications. *Journal of the American Statistical Association*, 78(381), 47 to 55.
- OECD (2026). Incidence of low and high pay (dataset DSD_EARNINGS@PAY_INCIDENCE), OECD Data Explorer. Low-paid workers are defined as the share of full-time workers earning less than two thirds of gross median earnings of all full-time workers.
- Oaxaca, R. (1973). Male-female wage differentials in urban labor markets. *International Economic Review*, 14(3), 693 to 709.
- Park, J. (2011). Does occupational training by the Trade Adjustment Assistance program really help reemployment? Success measured as matching. Employment and Training Administration Occasional Paper 2011-09, US Department of Labor. Agency paper, not peer reviewed.
- Park, J. (2012). Does occupational training by the Trade Adjustment Assistance program really help reemployment? Success measured as occupation matching. *Review of International Economics*, 20(5), 999 to 1016.
- Robst, J. (2007). Education and job match: the relatedness of college major and work. *Economics of Education Review*, 26(4), 397 to 407.
- US Bureau of Labor Statistics (2025). Occupational Employment and Wage Statistics, May 2024, national industry-specific estimates.
- US Bureau of Labor Statistics (2026). Employment Projections 2025 to 2035, Tables 1.2 and 1.10. Also Current Population Survey, median usual weekly earnings of full-time wage and salary workers (series LEU0252881500), and consumer price index for all urban consumers (series CUUR0000SA0), both from the Bureau's public data interface. Quarterly Census of Employment and Wages, annual state files, 2017 to 2024.
- US Census Bureau (2026). Quarterly Workforce Indicators, state by three-digit industry, latest release. Longitudinal Employer-Household Dynamics programme.
- US Department of Labor, Employment and Training Administration (2024). PY 2023 WIOA and Wagner-Peyser Data Book.
- US Department of Labor, Employment and Training Administration (2026). WIOA Performance Records Public Use File, record layout, PY2024 Q4. Dated January 2026.
- Workforce Innovation and Opportunity Act (2014). Public Law 113-128, 128 Stat. 1425, sections 132 and 133 (allotments to states and allocations to local areas).

Appendix A. Board training intensity

Local workforce boards, 606 in these files, decide through their budgets, provider lists and practice how many of their participants to train, and a board's training intensity varies over time. Following Frölich and Lechner (2010), who use regional differences in participation in Swiss programmes, I treat the share of other participants in the same board, programme and exit year who were trained as an instrument for a participant's own training. Cells hold at least 30 participants, and the model has fixed effects for board by programme and for state by programme by year, the controls of Section 3, and standard errors clustered by board. Under its assumptions, that a board's intensity affects outcomes only through training and that no one is less likely to be trained when the board trains more, it identifies an average effect for participants whose training depends on their board's intensity (Imbens and Angrist, 1994). The sample is 2,540,632 participants in 577 boards, 620,015 of them trained.

The first stage is strong, at 0.873 (0.007) with a clustered F statistic of 15,050. An instrument built from the other random half of each cell, which does not share any record with the half it is used on, gives the same estimates, so the result does not rest on how the leave-one-out share is formed. Table A1 sets out what the design gives. However, four findings stand against reading it as an effect of training.

Table A1. Training and outcomes after exit, least squares and instrumental variables within boards

Specification	Top rung, points	Employed, fourth quarter, points	Earnings, second quarter, dollars of 2023
Least squares	+11.2 (0.5)	+5.9 (0.3)	+1,965 (81)
Instrument, exit-year cells of at least 30	+11.9 (1.1)	+7.7 (1.0)	+2,691 (393)
Instrument from the other half of the cell	+11.8 (1.1)	+7.6 (1.0)	+2,681 (401)
Exit-year cells, entries of 2018 to 2021	+12.2 (1.4)	+8.7 (1.4)	+3,006 (698)
Entry-year cells, entries of 2018 to 2021	+15.7 (1.3)	+12.3 (1.6)	+3,694 (594)
Exit-year cells of at least 300	+13.8 (2.6)	+8.5 (1.7)	+2,295 (506)
Caseload and intake of the board held fixed	+10.2 (1.2)	+6.4 (1.1)	+2,223 (365)
Exits of 2018 and 2019	+15.6 (3.1)	+9.2 (2.9)	+3,210 (791)
Exits of 2021 to 2023	+9.1 (1.9)	+3.5 (2.2)	+2,748 (1,012)

Standard errors clustered by board. Untrained means are 24.2 points on the top rung, 65.8 per cent employed and 6,792 dollars. The Anderson-Rubin set (Anderson and Rubin, 1949) for employment in the main specification is 5.8 to 9.7 points, and for exits of 2021 to 2023 it is -0.8 to 7.7.

The first is sensitivity to how the cells are built, as a board's intensity can be measured among participants who exited in a year or among those who entered in it. On the same participants, those who entered from 2018 to 2021 so that each entry cohort is complete in the files, and with state by programme by year effects matched to each definition, entry-year cells give 15.7 points for the top rung, 12.3 for employment and 3,694 dollars. Exit-year cells give 12.2, 8.7 and 3,006, although the two instruments correlate at 0.974. The entry-year estimate for employment is 1.83 times least squares on the same sample and for earnings 1.74 times.

Restricting the main sample to cells of at least 300 moves the top rung to 13.8, so the result depends on choices the design does not settle.

The second is imbalance. Characteristics fixed before entry should not move with the instrument. Yet per participant induced into training, employment at entry is 11.8 points (1.7) higher on a mean of 19, the share without a secondary diploma 4.8 points (1.2) lower and the share of women 4.2 points (1.7) lower. Age is 4.7 years (0.5) lower, measured on the exits of 2020 to 2023 for which age is recorded and with the first stage of those rows. Earnings in the quarter before entry, by contrast, differ by only -313 dollars (403). In other words, years where a board trains more are years where it serves a different intake.

The third concerns exclusion. WIOA allots funds for adults and dislocated workers to states and local areas by formulas that rest on local unemployment (Workforce Innovation and Opportunity Act, 2014, sections 132 and 133), so a board's budget, and with it its training intensity, moves with local conditions that also bear on outcomes. Indeed, a board's share trained falls by 0.066 (0.007) for each log point of its number of participants and rises by 0.34 (0.05) with the share of them employed at entry. Holding the board's caseload and intake in the year fixed moves the estimates by 14 to 18 per cent, which shows that they are confounded with these, and the controls cannot bound what they do not measure.

The fourth is instability across periods. The estimate for employment is 9.2 points for exits of 2018 and 2019 and 3.5 for exits of 2021 to 2023, where its Anderson-Rubin set includes zero, while least squares falls from 7.2 to 4.5 points. For the top rung the estimate falls from 15.6 to 9.1 while least squares stays at 11.5 and 11.2. Monotonicity, too, is supported only weakly: built from the complementary group within each cell, the first stage is 0.72 for men, 0.68 for women, 0.65 for those employed at entry and 0.52 for those who were not, positive throughout but well below the main first stage (Dobbie, Goldin and Yang, 2018). Monotonicity itself can be weakened to a local condition (Dahl, Huber and Mellace, 2023).

On this evidence, the design does not separate any effect of training from the local conditions and intake that move with a board's training intensity. By contrast, the randomised evaluation of the predecessor programmes is free of selection, as access to training was assigned at random in 28 local areas. It found no positive effect on earnings or employment over thirty months, although it produced a difference of only 9 percentage points in enrolment and so measured an effect of training imprecisely (Fortson et al., 2017).