Gendered choices of labour market integration programmes: evidence from the United States

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Abstract

Purpose – We investigate whether women are more likely than men to choose to pursue a competency-based labour market integration programme, rather than the time-based labour market integration programme. We further investigate whether women with existing but uncertified skills are even more likely to pursue a competency-based labour market integration programme.

Design/methodology/approach – We test our hypotheses using ordinary least squares applied to linear probability models. We discuss the relative advantages of this methodology. We show the robustness of our results through multiple specifications and estimation methods. Finally, we discuss the reasons preventing us from granting our results a causal interpretation and discuss how they are surmountable in future research.

Findings – Women are significantly more likely to enrol into competency-based programmes, relative to time-based. Women with existing but uncertified skills are significantly more likely to enrol into competency-based programmes, whereas women without skills or with college degrees are not significantly different from the baseline. Our findings are robust to various specifications, and we include a comprehensive set of fixed-effect vectors, addressing industrial, occupational and time-varying state specificities.

Research limitations/implications – First, our empirical test of hypothesis H2 is hindered by the construction of the “some college or associate’s degree” variable in RAPIDS data. “Some college” is very different from an associate’s degree. Second we had to choose between omitted variable bias and selection bias. Because of the demonstrated importance of the occupation and industry variables in existing literature, we included those variables at the risk of selection bias. Occupation and industry fixed effects reduce, but do not eliminate, omitted variable bias. Finally, the third limitation of this paper is external validity. Registered Apprenticeship programmes are quite idiosyncratic to the United States.

Social implications – The rollout and expansion of CBRA may thus be an avenue through policymakers may reduce the gender training gap. This may in turn give more women access to the labour market and allow more women to benefit from the “wage premia” of Registered Apprenticeship completion on the labour market (Lou and Hawley, 2019).

Originality/value – This article is the first that applies econometric methods to investigate women’s choices of labour market integration programmes, using Registered Apprenticeship as a case study. We discuss the implications of our findings, highlighting how competency-based programmes may be an approach to better serving more diverse populations in Registered Apprenticeship.

Keywords: Training, Gender, Recognition of prior learning, Labour market integration

Paper type: Research paper

1. Introduction

The United States implemented competency based Registered Apprenticeship (CBRA) in 2008 to address skills mismatches and the chronic gaps traditional time-based Registered Apprenticeship (TBRA) had in serving women and minorities (Kuehn, 2017). In turn,
reducing the gender training gap may help address the underrepresentation and under-
remuneration of women in many areas of the labour market, in male-stereotyped fields (Exley
and Nielsen, 2024). The crucial difference between CBRA and TBRA is that the former
allows certification to be based on the demonstration of adequate skills rather than simply
the completion of a given number of training hours. Both CBRA and TBRA are available in
the same occupations and provide training through the combination of on-the-job training
provides training and certification in a continuous process. On the other hand, CBRA
recognises prior learning before training only the remaining competencies. In this paper, we
thus evaluate whether this flexibility allows CBRA programmes to serve a wider population.
This topic is of strong policy relevance. Post COVID-19 pandemic, amidst tighter labour
markets, women with young children, have not yet fully returned on the labour market (Duval
et al., 2022). The expansion of a flexible programme such as CBRA may accompany the return
to the labour market of these populations.

Berik et al. (2011) and Kuehn (2017) highlight that, prior to the creation of CBRA, women
were underrepresented in Registered Apprenticeship. Accounting for occupation and
training programme characteristics, women still received significantly less training than
their male peers. This observation is becoming increasingly obsolete, as Employment and
Training Administration (ETA) data show that women are increasingly well represented in
Registered Apprenticeship. Indeed, women make up the majority of CBRA participants
despite being dramatically under-represented in Registered Apprenticeship overall (Kuehn,
2017). Olinsky and Ayres (2013) acknowledge efforts to diversify the participants served by
Registered Apprenticeships. However, these authors highlight that Registered
Apprenticeships remain concentrated in classically male occupations, such as construction.

The rollout and expansion of CBRA may thus be an avenue through policymakers may
reduce the gender training gap. This may in turn give more women access to the labour
market and allow more women to benefit from the “wage premia” of Registered
Apprenticeship completion on the labour market (Lou and Hawley, 2019).

However, characteristics associated with CBRA programmes may cause CBRA to yield
lower benefits to women. CBRA programmes mostly serve women in traditionally non-male-
dominated occupation groups, such as education, training, and library occupations. CBRA serve
next to no Registered Apprentices in male-dominated occupation groups, such as construction
and extraction. CBRA may thus not broaden the spectrum of available (high-paying)
occupations for women. CBRA may thus not facilitate access to comparatively higher-paying
jobs to women. We thus further investigate how CBRA serves women, and whether women face
a trade-off when choosing CBRA for its relative flexibility. Furthermore, the quality of the
recognition of prior learning (RPL) component of CBRA impacts the quality of training imparted
during the programme. The signal sent to employers by completers of CBRA programmes may
thus be negative or positive, depending on training programme quality.

We argue that women may be more likely to choose CBRA over TBRA because women
are on average more time constrained (Mattingly and Bianchi, 2003, for the United States). This
is partly because of unequal distribution of household and unpaid care work (Sayer and Fine,
2011). CBRA incurs a lower opportunity cost of time (Anderson, 2018). We test whether women
are more likely to choose CBRA than TBRA and find that they are. We further argue that
women with some degree of uncertified but existing and occupation-relevant skills are more
likely to enrol in CBRA than other groups because they are sensitive to the opportunity cost of
time, have reason to expect the shortest training duration, and need a certification for the
labour market. We find strong empirical evidence supporting this argument.

This paper makes two main empirical contributions to the literature. We are the first to use
econometric strategies to compare CBRA to TBRA. We thus explore the relationship between
CBRA and increased participation of women in Registered Apprenticeship programmes.
We also empirically examine the role of CBRA in facilitating the labour market integration of individuals with pre-existing but uncertified skills. Due to inherent data limitations, we cannot make any causal claims in this paper. Thus, results should be interpreted as indicative rather than causal. They are however, to our knowledge, the best empirical estimation on this subject that is available at the time of writing.

2. Background: competency-based registered apprenticeships

Registered Apprenticeships in the United States are not part of the formal education system. They comprise two components: on-the-job training, and related technical instruction, sometimes provided by community colleges. The framework of these programmes is designed and regulated by the federal Department of Labor. The federal Office of Apprenticeship and individual State Apprenticeship Agencies are notably involved in the monitoring of the Registered Apprenticeship system, the registration of new programmes, and liaison between employers, prospective participants, and instruction providers. Registered Apprenticeships can therefore be defined as a labour market integration programme. Upon successful programme completion, all Registered Apprenticeship programme participants obtain a nationally recognised certificate of completion, equivalently referred to as National Occupational Credential. This signals that they are fully qualified to perform a certain occupation. In certain occupations, employers may however also deliver interim credentials, as Registered Apprentices master skills included in their programme as the programme is still ongoing.

Companies may sort into training after registering a programme with the relevant authorities – either a state apprenticeship agency, or the federal Office of Apprenticeship – depending on the state. Empirical evidence suggests three main benefits to training companies that sort into Registered Apprenticeships (Helper et al., 2016). First, companies gain the value of productive output produced by Registered Apprentices during training. There is high internal rate of return. Second, participation in Registered Apprenticeship improves employees’ engagement, ability to perform a broader range of tasks, and problem-solving abilities. Third, Registered Apprenticeships serve as a screening mechanism, reduce hiring and firing costs, and create a pipeline of talent for participating companies.

Unions play an important role in Registered Apprenticeship, as programme sponsors. Programmes with union participation are referred to as “joint” (Glover and Bilginsoy, 2005). Joint programmes are often financed by trust funds, increasing their durability as they are not dependent on year-to-year fluctuations in federal or state funding levels. Furthermore, in joint programmes, unions often assume the related technical instruction. Trainers and experts delivering the instruction to Registered Apprentices are often union members (Boren et al., 2022). Unions are particularly active in Registered Apprenticeships within the construction trades. There are fewer unionised programmes in electrical and mechanical trades. In the Registered Apprenticeship framework, unions thus provide financing, instruction and ensure favourable working conditions for workers and Registered Apprentices through collective bargaining (Glover and Bilginsoy, 2005).

Labour market integration programmes provide certifications that indicate competency in an occupation. For TBRA, this involves two linked functions: training and certification. In the first function, training provides skills to individuals, thereby increasing their stock of human capital and helping them find or improve their employment. The certification function recognises individuals’ skills to facilitate employment. In TBRA, certification is an outcome of a pre-set training process. In CBRA, in contrast, programme content is broken up into competencies that can be acquired either through training or through the RPL before the programme starts (Electronic Code of Federal Regulations, 2008). This can potentially provide a shorter route to certification for skilled individuals. Indeed, unlike TBRA, in CBRA, there is no minimum requirement in the number of hours of on-the-job-training to be completed (Jopson et al., 2019).
Recognition or prior learning is the route through which programme length can be shortened for skilled CBRA programme participants. It denotes the recognition of skills and competences acquired by individuals outside of formal education frameworks. The principal goal of RPL processes is to leverage experience acquired by an individual throughout their lifetime, irrespective of the setting in which the learning took place. Recognition or prior learning is carried out by employers in CBRA programme. Programme sponsors identify adequate means to test participants’ competencies. CBRA programmes notably have a checklist, listing job functions and performance criteria to track apprentice progression through the duration of the programme. Mentors subsequently use this checklist to assess Registered Apprentices’ performance (Jopson et al., 2019).

Historically, TBRA programmes serve a relatively narrow, predominantly male, demographic (Kuehn, 2017). CBRA, a more flexible programme, was therefore introduced in 2008 to broaden the scope of Registered Apprenticeship. CBRA requires the demonstrable achievement of manual, mechanical or technical skills and expertise as stipulated by pre-defined occupational standards (Jobs for the Future, 2016). Therefore, participants must successfully prove their skills and knowledge to their programme sponsors (Jopson et al., 2019). CBRA have gained in prevalence since their inception and were available in 168 occupations as at 2020 (Lerman et al., 2020).

Anderson (2018, p. 2) specifies that competency-based education programmes represent “lower cost pathway[s] to degree completion”, while still tailoring the programme’s pace to individual needs. Because CBRA focuses on measurable skill acquisition instead of training hours, apprentices can demonstrate competency through an accelerated process relative to TBRA. In certain states, RPLs may further shorten CBRA, allowing participants to demonstrate mastery of certain skills at the start of their training. Anderson (2018) highlights that in 2017, twenty-six states adopted prior learning statement legislation. Klein-Collins and Wertheim (2013) add that CBRA represents a “natural fit” with these RPL methods as they allow rigorous and frequent learning assessment. CBRA, relative to TBRA, allows closer monitoring of participants during their training (Electronic Code of Federal Regulations, 2008).

One challenge for CBRA is the RPL. In CBRA, existing skills are evaluated by companies, against curricula co-developed with colleges and universities, who often act as related technical instruction providers. Curricula are based on industry and occupational standards. In contrast, the execution of RPL is firm-specific. This approach differs from how Maurer (2021, p. 3) describes the RPL, as a process through which a “designated organisation confirms that a person has acquired certain competencies in informal or non-formal ways.” This kind of centralised RPL is intricate, costly, and difficult to implement effectively (Bohlinger, 2017). It is unclear whether the employer-based approach to recognising prior learning is optimal.

3. Literature review
Extant literature regarding women’s enrolment in CBRA is scarce. CBRA are indeed very young programmes, first created in 2008, and this study is the first to empirically assess women’s choices of labour market integration programme with respect to CBRA and TBRA. The scarcity of literature in this domain has several potential explanations.

Extant literature does suggest the presence of a gender gap in all forms of training, whereby women receive significantly less firm-sponsored training than their equivalently qualified male counterparts (Evertsson, 2004). Furthermore, the training dispensed to women may differ in content relative to training dispensed to men. Evertsson (2004) adds that forms of training in which women take part are more likely to be industry-specific and do not significantly affect their wages a posteriori. Men are more likely than women to partake in
general forms of training, increasing their promotion opportunities and wages. Overall, evidence indicates that women receive less training than their male counterparts, and that training tends to differ in content and be less beneficial for their careers.

The first potential weakness of CBRA is its RPL procedure. CBRA and TBRA should provide the same level of skill, but while TBRA programmes provide all skills through training and related instruction, CBRA allows for the RPL and then training or related instruction for the remaining skills. Through RPL, CBRA has the capacity to shorten programme duration. In CBRA, the RPL is outsourced to individual companies at their own discretion. This approach makes entry requirements to programmes more flexible, and is conducted directly by the programme sponsor, ideally on a case-by-case basis. In this context, RPL is generally carried out in one of two manners. Learners may possess a portfolio, listing their competencies and their plan to apply the latter to their respective workplaces. Outsourcing the RPL to companies may have negative consequences for the value of a CBRA certification (Assinger, 2022). Bohlinger (2017) underlines how difficult it is for companies to conduct RPL and argues that many companies do not possess the time or financial resources to carry it out effectively.

4. Theoretical framework
Registered Apprenticeship – like all training – is an investment in future productivity (Becker, 1965). Workers invest in training by accepting lower or no wages during the training period (Mincer, 1962) and through the opportunity costs they incur by investing their time (Smith, 1971). Two of the key factors in training decisions are, therefore, budget and time constraints. Individuals maximise expected utility according to a budget for the costs and benefits of training, which is separately constrained by the amount of time they have available to invest in training (Shaw, 1992). This second factor is also referred to as an individual’s cost of time.

Smith (1971) shows that the opportunity cost of time is not simply equal to a worker’s hourly wage. Individual opportunity costs of time increase when alternative uses of time are more valuable and when time more constrained. Alternative uses of time could be work outside the home, work in the home, and leisure activities. All of these may have varying monetary and non-monetary values to the individual and may not be observable. Extreme time constraints may make training impossible, and time constraints are also difficult to observe.

CBRA programmes have the potential to be shorter in duration than their time-based equivalents (Jobs for the Future, 2016). Kelchen (2016) highlights that competency-based education in general is particularly well-suited to individuals wanting to make quick progress towards a certification. Employers must deem that participants demonstrate adequate competency to reduce training time (Electronic Code of Federal Regulations, 2008).

Potential participants are likely to expect that CBRA will be shorter than TBRA. They may hear about CBRA as a shorter option either from other (potential) participants, from employers, or from official information on CBRA that highlights its potentially shorter duration. Publicly available information, under the format of leaflets, booklets or other forms of communication, conveys the possibility of duration reduction in CBRA (see, e.g. Apprenticeship Tennessee, 2020). A Jobs for the Future (2016) report indeed recommends time-constrained prospective participants to choose CBRA programmes over TBRA programmes to “quickly get the apprenticeship to mastery of skills and competencies”. Contrary to TBRA, it is possible to reduce duration in CBRA, representing a powerful signal for time-constrained prospective programme participants. Nonetheless, shortening the duration of CBRA through the RPL can bring disadvantages to programme participants, as reviewed in the above section.
Given that TBRA and CBRA result in the same certification and potential participants have reason to expect a lower time investment with CBRA, we expect that time-constrained individuals may select CBRA over TBRA when the option is available. CBRA programme duration can only be shortened if participants demonstrate relevant skills, so not all participants should rationally expect that CBRA is a shorter path to the same qualification. However, there is a strong signal that CBRA can be shorter. This signal, combined with participants’ incomplete information about the programme’s skills requirements, should drive individuals with larger opportunity costs of time toward CBRA. Therefore, we argue that time-constrained individuals are more likely to sort into CBRA over TBRA to achieve the same certification in a shorter time, even if this effort is not always rational due to their incomplete information.

We therefore expect to observe a shift toward CBRA especially for individuals with a higher cost of time (Anderson, 2018). Women are on average more time-constrained than men in the United States (Sayer and Fine, 2011; Mattingly and Bianchi, 2003) and spend substantially more time than men in unpaid caregiving work (Bustelo et al., 2023), making the opportunity cost of their time when they train or work higher than that for men. In addition, women place more emphasis than men on work-life balance in occupational choices, causing women to value professional flexibility relatively more (Redmond and McGuinness, 2020). Women also value flexibility more than men do in training programmes specifically (Bustelo et al., 2023). This flexibility is exemplified in CBRA programmes through the possibility of adapting the programme to participants’ existing skills. Given that the training itself has the same qualification and therefore should have the same expected value, we expect that women’s relatively higher average time constraint will push them toward CBRA more often.

H1. Women are significantly more likely to choose CBRA over TBRA.

CBRA programmes offer prior learning assessment, and programme duration can be shortened if participants demonstrate existing skills (Electronic Code of Federal Regulations, 2008). Figure 1 shows how skills reduce training time for CBRA: estimated time to

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**Figure 1.**
Relationship between skills and training duration in CBRA

**Source(s):** Authors’ own elaboration
programme completion is a decreasing function of programme-relevant skills that the individual possesses. In the example of Figure 1, individual 1 has a higher skill level, lowering their expected time to completion. In TBRA programmes, unlike CBRA, estimated time to completion is not a function of the level of necessary skills possessed. Estimated time to completion in TBRA would simply be a horizontal line at the y-axis intercept of the diagonal line in Figure 1.

We expect a preference for CBRA among individuals with some cost of time and greater pre-existing skills without formal certification of those skills. Kelchen (2016) states that individuals enrolling in competency-based education typically possess prior work and college experience. Individuals who already have formal certification of their skills can signal those skills to potential employers, but (semi-) skilled and unqualified individuals would benefit from certifications on the labour market (Hungerford and Solon, 1987). Thanks to their existing skills, these individuals can expect the shortest training durations – even partially skilled individuals can expect some reduction in training time. For time-constrained individuals, even small reductions in training time will be important.

These arguments culminate in our second hypothesis H2:

**H2.** Women with existing, uncertified skills are significantly more likely than men at the same skill level or women with either no skills or certifications to choose CBRA.

Figure 2 summarises our hypotheses. Green arrows reflect a positive effect. Hypothesis **H2** is a *moderating* effect: it is empirically tested through an interaction. We test whether the presence of existing but uncertified skills *reinforces* the probability of time-constrained individuals to choose CBRA over TBRA.

We test both hypotheses. We do not follow Registered Apprentices after graduation due to data availability limitations. We therefore do not formulate hypotheses regarding the labour market outcomes of CBRA and TBRA programme completers. We also do not postulate any comparative effect of CBRA relative to TBRA regarding training companies’ performance or firm-level outcomes.

**Note(s):** We test both hypotheses. We do not follow Registered Apprentices after graduation due to data availability limitations. We therefore do not formulate hypotheses regarding the labour market outcomes of CBRA and TBRA programme completers. We also do not postulate any comparative effect of CBRA relative to TBRA regarding training companies’ performance or firm-level outcomes.

**Source(s):** Authors’ own elaboration
5. Data

5.1 Data source
We employ administrative data from the Registered Apprenticeship Partners Information Systems (RAPIDS; ETA). Our sample is a repeated cross-section of participants over 2000–2023. The data contain apprentice-level and programme-level information. In certain specifications, we include industry and occupation fixed effects. Industry information is on a two-digit level sourced from the North American Industry Classification System. Occupational information uses the US Department of Labor’s O*Net Soc Code System. Occupation is on a two-digit level, with 23 distinct occupation groups. Industry is also on a two-digit level, with 24 distinct industry groups in the sample.

5.2 Summary statistics
In H2, we argue that women with existing but uncertified skills are more likely to choose CBRA than men with similar skills or women with certifications. We cannot directly observe skill levels in the data, instead proxying with education levels. The education level we use to proxy existing but uncertified skills is “some college or associate’s degree”. The fact that individuals who have attended college without earning a degree are pooled with individuals holding associate’s degrees is a limitation of the RAPIDS database. These two situations are different, as people with associate’s degrees have a form of certification, unlike people having attended college but who left without a degree. However – especially given the importance of a bachelor’s degree in the US labour market – it is the best proxy available. The education level we use to proxy qualified skills is a bachelor’s degree or higher.

Table 1 shows descriptive statistics for control variables. 25.47% of our sample identified races or ethnicities we aggregate into the minority category. 91.36% of participants have a high school diploma or a higher academic qualification. 6.93% have an associate’s degree or “some college”, and 2.66% have a university degree. 53.10% of Registered Apprenticeships in the sample are dispensed by multiple, unionised employers. Conversely, only 7% of participants pursue programmes dispensed by individual unionised employers, (individual joint). Finally, 12.02% of participants have related technical instruction at a community college.

Average programme duration (time elapsed between start date and expected completion date) is 3.217 years in our pooled sample, 1.411 years in CBRA and 3.249 in TBRA, on average. Consequently, CBRA programmes are on average approximately two times shorter than TBRA programmes. This corroborates our narrative that CBRA is on average shorter than TBRA, and therefore prospective programme participants can, on average, expect a shorter programme when pursuing CBRA rather than TBRA.

Table 1 shows that women represent 55.52% of participants pursuing CBRA, but only 7.98% in TBRA. CBRA serves a much higher proportion of individuals with “some college or associate’s degree”. Although individuals served by CBRA and TBRA are of comparable ages, more individuals in CBRA have university degrees and “some college or associate degree” compared to TBRA participants.

Further information on apprentices’ socio-demographic characteristics is unavailable in the RAPIDS dataset. We may only postulate that age, which we control for, may partially reflect time constraints. Indeed, women in CBRA are slightly older on average (30.86 years) than women in TBRA (29.19 years). This difference is small, but it goes in the direction we would expect that older women – more likely to have children and other commitments that constrain their time – are also more represented in CBRA.

Variables pertaining to marital status or parity, or variables pertaining to time use, would have permitted a more direct test of hypotheses set forth in our theoretical framework. Both parity and marital status affect women’s time constraints (Mattingly and Bianchi, 2003), and
may represent an important exogenous factor driving the selection of women in CBRA over TBRA. The availability of these instruments would have also allowed us to specify an endogenous switching two-step model for causal results, using marital status or parity as an excluded instrument in the "first-step" selection equation. We recommend the RAPIDS database to incorporate this information in future, and thus leave this analysis to future research.

6. Methods

6.1 Baseline

We execute the following linear probability model (LPM) as baseline equation, applying OLS to equation (1):

\[ \text{CompetencyBased}_{i,m,t} = \alpha + \theta_1 \text{Woman}_i + \varphi_{s,t} + \mu_{m} + \delta_{\text{ind}} + \gamma_{o} + \chi'_{t} \theta_{2} + \chi'_{p} \theta_{3} + \varepsilon_{i,m,t} \] (1)

The dependent variable assumes the value of 1 if the Registered Apprenticeship is CBRA, 0 otherwise. Indices refer to apprentice i, industry ind, state s, occupation o, calendar month m and year t. \( \varphi_{s,t} \), \( \delta_{\text{ind}} \) are respectively vectors of state-by-year and industry fixed effects, \( \chi_{t} \) a vector of programme-level covariates, and \( \chi'_{p} \) a vector of registered apprentice-level controls, all described above in Table 1. \( \mu_{m} \) and \( \gamma_{o} \) are respectively calendar month and occupation fixed effects. \( \varepsilon_{i,m,t} \) is the error term. \( \theta_1 \) is of primary interest. It directly captures the average

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean pooled sample</th>
<th>Mean competency-based</th>
<th>Mean time-based</th>
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<tbody>
<tr>
<td><strong>Dependent variable</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competency-based</td>
<td>1.73%</td>
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<tr>
<td><strong>Apprentice-level regressors</strong></td>
<td></td>
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<tr>
<td>Veteran</td>
<td>9.38%</td>
<td>7.79%</td>
<td>9.4%</td>
</tr>
<tr>
<td>Less that high-school diploma</td>
<td>7.95%</td>
<td>2.31%</td>
<td>8.05%</td>
</tr>
<tr>
<td>High-school diploma</td>
<td>81.77%</td>
<td>59.93%</td>
<td>82.15%</td>
</tr>
<tr>
<td>Some college or associate degree</td>
<td>6.93%</td>
<td>25.01%</td>
<td>6.62%</td>
</tr>
<tr>
<td>University degree</td>
<td>2.66%</td>
<td>11.19%</td>
<td>2.51%</td>
</tr>
<tr>
<td>Age</td>
<td>29.22</td>
<td>30.86</td>
<td>29.19</td>
</tr>
<tr>
<td>Women</td>
<td>8.81%</td>
<td>55.52%</td>
<td>7.98%</td>
</tr>
<tr>
<td>Minority individual</td>
<td>25.47%</td>
<td>31.35%</td>
<td>25.36%</td>
</tr>
<tr>
<td>Asian</td>
<td>1.42%</td>
<td>4.86%</td>
<td>1.36%</td>
</tr>
<tr>
<td>Non-Hispanic whites</td>
<td>69.10%</td>
<td>66.69%</td>
<td>69.13%</td>
</tr>
<tr>
<td><strong>Programme-level covariates</strong></td>
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<tr>
<td>Individual non-joint</td>
<td>21.77%</td>
<td>54.75%</td>
<td>21.19%</td>
</tr>
<tr>
<td>Individual joint</td>
<td>7.14%</td>
<td>1.59%</td>
<td>7.24%</td>
</tr>
<tr>
<td>Group non-joint</td>
<td>16.82%</td>
<td>40.32%</td>
<td>16.41%</td>
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<tr>
<td>Group joint</td>
<td>53.10%</td>
<td>1.03%</td>
<td>53.99%</td>
</tr>
<tr>
<td>Related technical instruction provider is community college</td>
<td>12.02%</td>
<td>23.89%</td>
<td>11.81%</td>
</tr>
<tr>
<td>Average programme duration (in years)</td>
<td>3.217</td>
<td>1.411</td>
<td>3.249</td>
</tr>
<tr>
<td>Number of observations</td>
<td>1,460,601</td>
<td>25,265</td>
<td>1,435,336</td>
</tr>
</tbody>
</table>

**Note(s):** “Minority individual”, “Asian” and “Non-Hispanic Whites” do not sum to 100% because of missing observations in the “Race” variable of our dataset. For average programme duration, we winsorize the top and bottom 1% of values to remove coding errors in the raw data.

**Source(s):** Authors’ own elaboration

Table 1. Descriptive statistics
marginal effect of apprentice i being a woman on the probability of choosing CBRA, after conditioning on remaining regressors:

\[
P(C_{\text{CompetencyBased}} = 1 \mid \text{Woman} = 1, \varphi_{s,t}, \mu_m, \delta_{\text{ind}}, \gamma_o, X_i^t \theta_2, X_j^t \theta_3) = \theta_1
\]

6.2 Heterogeneity
We further investigate whether having unrecognised competences (proxied through the “some college or associate degree” variable) exacerbates the probability that participants choose CBRA over TBRA, given that they are women:

\[
C_{\text{CompetencyBased},i,m,t} = \alpha + \beta_1 \text{Woman}_i + \beta_2 \text{Woman}_i \times \text{HighSchoolDiploma}_i
\]

\[
+ \beta_3 \text{Woman}_i \times \text{SomeCollegeAssociateDegree}_i
\]

\[
+ \beta_4 \text{Woman}_i \times \text{UniversityDegree}_i + \beta_5 \text{Woman}_i + \varphi_{s,t} + \mu_m
\]

\[
+ \delta_{\text{ind}} + \gamma_o + X_i^t \beta_5 + X_j^t \beta_6 + \epsilon_{i,m,t}
\]

Vectors \(X_i\) and \(X_p\) remain identical to equation (1). We are now additionally interested in \(\beta_3\), which, if positive and significant, would indicate that women with “some college or an associate’s degree” are more likely to pursue CBRA. To assess \(H_2\), we therefore compare the likelihood of women within the “some college or associate’s degree” category of choosing CBRA over TBRA, to the likelihood of women with less than a high school diploma of choosing CBRA over TBRA, \(\text{ceteris paribus}\).

6.3 Statistical model limitations
The LPM can yield fitted values outside the \([0;1]\) bound, especially when the base rate of the outcome is low. Horrace and Oaxaca (2006) suggest a trimmed estimator. The researcher initially estimates the coefficient, and then uses the estimate to predict values of the dependent variable. The researcher then removes observations whose predicted values are out of the \([0;1]\) bounds and runs the estimation again, on the trimmed sample. We follow this procedure on equation (1), and find qualitatively similar results, notably regarding our regressor of interest (“Woman”), which keeps its sign, significance level and remains of comparable magnitude (results can be produced upon request).

We conduct a Monte Carlo simulation to compare bias in logit and LPM marginal effects (evaluated at observed value of covariates). We are interested in the marginal effect of the “Woman” variable. We conduct 10,000 replications with 1,000 observations. The latent model is given by:

\[
y^* = 0.03 + 0.4 \times \text{age} - 0.02 \times \text{age}^2 + 3 \times \text{highschool} - 0.06 \times \text{union} + 5 \times \text{Woman}
\]

\[
y = y^* + \epsilon_i > 0 \text{ where } \epsilon_i \text{ follows a logistic distribution with mean 0. The average of the outcome is } 0.171. \text{ Age follows a uniform distribution on the (18–65) interval. Highschool, union, female each follow binomial distributions with success probabilities of 0.8, 0.3 and 0.1 respectively. 20% of the simulated sample is Black, 10% is Hispanic and 70% is white. Simulation results were omitted for brevity (producible upon request) but both LPM and logit perform very well. LPM has an infinitesimally smaller bias on average.}
7. Results
7.1 Baseline results
The results of equation (1) are shown in columns (4) and (5) of Table 2. In column (5), education is specified as high school diploma, some college or associate degree, and at least a university degree. The base group’s education level is less than high school.

Our estimation sample comprises almost 1.5 million observations, which is particularly large. As Lin et al. (2013) show, p-values may become meaningless in this context. Assuming our estimators are consistent, and the true population parameter we are trying to estimate is in fact not exactly 0, then as the number of observations grows large, the probability value will tend towards zero. On the one hand, this gives us higher statistical power and lowers the risk of type II error. On the other, basing our interpretation only on statistical significance is suboptimal. We therefore interpret point estimates’ magnitudes and analyse confidence intervals.

In all five first specifications depicted in Table 2, we find that women are significantly (at the 5% level) more likely than men to choose CBRA over TBRA. This supports H1. The probability value associated with the coefficient “Woman” in column (5) of Table 2 is 0.009. Applying Bonferroni correction, we multiply this coefficient by 5, as we test the same hypothesis 5 times in different specifications. The Bonferroni correction keeps the family-wise error rate below 5%. The adjusted p-value is 0.045, still significant at the 5% level, after adjusting for multiple hypothesis testing.

In column (5), our preferred and most demanding specification, the point estimate of the “Woman” coefficient is 1.42%. Being a woman increases the conditional probability of being enrolled in a CBRA over TBRA programme by 1.42% points relative to being a man. The 95% confidence interval of this point estimate ranges from 0.38% to 2.5%. This relatively small increase is partially due to the. Considering the low prevalence of CBRA in our sample (1.73%), this increase is especially large, and of economic significance.

<table>
<thead>
<tr>
<th>Dependent variable: CBRA</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woman</td>
<td>0.0892***</td>
<td>0.0828***</td>
<td>0.0783***</td>
<td>0.0146***</td>
<td>0.0142***</td>
</tr>
<tr>
<td></td>
<td>(0.0219)</td>
<td>(0.0215)</td>
<td>(0.0208)</td>
<td>(0.00538)</td>
<td>(0.00531)</td>
</tr>
<tr>
<td>High school diploma or more</td>
<td>0.00196</td>
<td>0.00184</td>
<td>0.00103</td>
<td>0.00337**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.00310)</td>
<td>(0.00258)</td>
<td>(0.00196)</td>
<td></td>
<td>(0.00134)</td>
</tr>
<tr>
<td>Only high school diploma</td>
<td></td>
<td></td>
<td></td>
<td>0.00511***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.00156)</td>
<td></td>
</tr>
<tr>
<td>Some college or associate's degree</td>
<td>0.0106*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.00543)</td>
<td></td>
</tr>
<tr>
<td>University degree (bachelor or more)</td>
<td>0.0280</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.0314)</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>1,460,601</td>
<td>1,460,601</td>
<td>1,460,601</td>
<td>1,460,601</td>
<td>1,460,601</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.092</td>
<td>0.105</td>
<td>0.191</td>
<td>0.468</td>
<td>0.470</td>
</tr>
<tr>
<td>Individual-level covariates</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Programme-level covariates</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>State-by-year FE</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Industry and occupation FE</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Note(s): The Table shows OLS coefficients and robust standard errors clustered by state in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1. FE, fixed-effects. CBRA is the dependent variable in all columns. Individual-level and programme-level covariates are listed in Table 1. Our base group are non-minority, non-veteran, non-Asian males with less than a high school diploma, pursuing a Registered Apprenticeship dispensed by a single non-unionised employer and whose RTI provider is not a community college. All specifications include calendar month FE and year FE.

Source(s): Authors’ own elaboration

Evidence-based HRM: a Global Forum for Empirical Scholarship
7.2 Heterogeneity analysis results

We now show results of heterogeneity analysis (equation (4)), to investigate hypothesis H2. Table 3 displays results of equation (2) in column (2). Adding occupation and industry fixed effects in column (2), relative to column (1), causes the coefficient on “Woman” to substantially decline in magnitude and become insignificant. In all columns of Table 3, this coefficient now represents the effect of being a woman with less than a high school diploma on the probability of choosing CBRA over TBRA. On the other hand, the coefficient on the “some college or associate’s degree” and “woman” interaction term supports H2. Women with “some college or associate’s degree” – existing, uncertified skills – are significantly more likely to enrol in CBRA than men or women with less than a high school diploma. This holds for all columns of Table 3. The “some college or associate’s degree” regressor does not have significant impact on the probability of choosing CBRA by itself. Because of the interaction term, that coefficient now denotes the impact of holding “some college or associate’s degree” on the probability of choosing CBRA for men.

Based on our discussion in Section 6.2, Column (2) of Table 3 shows our preferred specification. Column (2) shows that women with some college or an associate’s degree have significantly higher probability of enrolling in CBRA programmes than women with less than high school diploma. Less than high school diploma proxies the absence of skills to be certified. This provides evidence that possessing an associate degree or having attended but not completed college significantly increases the probability that women choose CBRA. The “some college or associate degree” and “woman” interaction term also significantly positively affects the probability of choosing CBRA over TBRA in column (1), in which we compare

<table>
<thead>
<tr>
<th>Dependent variable: CBRA</th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woman</td>
<td>0.0776**</td>
<td>0.0163</td>
</tr>
<tr>
<td></td>
<td>(0.0366)</td>
<td>(0.0106)</td>
</tr>
<tr>
<td>Only High School Diploma * Woman</td>
<td>0.0128</td>
<td>-0.00295</td>
</tr>
<tr>
<td></td>
<td>(0.0241)</td>
<td>(0.00584)</td>
</tr>
<tr>
<td>Some College or Associate’s Degree * Woman</td>
<td>0.133***</td>
<td>0.0670***</td>
</tr>
<tr>
<td></td>
<td>(0.0434)</td>
<td>(0.0202)</td>
</tr>
<tr>
<td>University Degree (Bachelor or More) * Woman</td>
<td>0.0787</td>
<td>0.0496</td>
</tr>
<tr>
<td></td>
<td>(0.0970)</td>
<td>(0.0602)</td>
</tr>
<tr>
<td>Only High School Diploma</td>
<td>-0.00500***</td>
<td>-0.00466***</td>
</tr>
<tr>
<td></td>
<td>(0.00165)</td>
<td>(0.00146)</td>
</tr>
<tr>
<td>Some College or Associate Degree</td>
<td>0.00450</td>
<td>0.00225</td>
</tr>
<tr>
<td></td>
<td>(0.00450)</td>
<td>(0.00393)</td>
</tr>
<tr>
<td>University Degree (Bachelor or More)</td>
<td>0.0353</td>
<td>0.0180</td>
</tr>
<tr>
<td></td>
<td>(0.0268)</td>
<td>(0.0178)</td>
</tr>
<tr>
<td>Observations</td>
<td>1,460,601</td>
<td>1,460,601</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.203</td>
<td>0.472</td>
</tr>
<tr>
<td>Individual-level covariates</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Programme-level covariates</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>State-by-year FE</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Industry and occupation FE</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Note(s): The Table shows OLS coefficients and robust standard errors clustered by state in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. FE, fixed-effects. CBRA is the dependent variable in all columns. Individual-level and programme-level covariates are listed in Table 1. Our base group are non-minority, non-veteran, non-Asian males with less than a high school diploma, pursuing a Registered Apprenticeships dispensed by a single non-unionised employer and whose RTI provider is not a community college. All specifications include calendar month FE and year FE (through state-by-year FE)

Source(s): Authors’ own elaboration
individuals across occupations and industries. Consequently, we find strong evidence in favour of hypothesis H2.

We have conducted two statistical tests that are not perfectly dependent of each. Consequently, the risk of committing a type 1 error has risen above 5%. Further, in large samples, Lin et al. (2013) adjusting the threshold for significance downwards. In order to keep the family-wise error rate below 5%, we apply the Holm (1979) correction. The probability value associated with “Some College or Associate’s Degree * Woman” in column (2) is 0.002. Dividing the p-value threshold of 0.05 for 5% level significance by 2, we find that the probability value associated with “Some College or Associate’s Degree * Woman” in column is still statistically significant at this adjusted level.

In column (2) of Table 3, our preferred specification, the point estimate on the “Some College or Associate’s Degree * Woman” is 6.7%. Its 95% confidence interval is [0.027; 0.107]. Being a woman and having “Some College or Associate’s Degree”, relative to being a man with less than a high school diploma, increases the conditional probability of choosing CBRA over TBRA by 6.7% points. Plugging in the upper bound of the 95% confidence interval, this amounts to an increase in the conditional probability of 10.7% points. Again, considering the extremely low prevalence of CBRA in the estimation sample, this point estimate is economically significant. The presence of existing but uncertified skills (as proxied by the “Some College or Associate’s Degree” indicator), for women, significantly exacerbates the probability of choosing CBRA over TBRA.

8. Discussion
Given that our results indicate women choose CBRA over TBRA, we must ask whether that selection is a good thing. Essentially, CBRA may have lower costs for women than TBRA, but does that come at the price of programme benefits? The main benefit of training programmes – especially labour market integration programmes like Registered Apprenticeship – is increased employability. However, programmes do not always achieve this goal. In the UK for example, evidence suggests that for women, the returns to apprenticeship can be low or non-existent relative to no training (Tan et al., 1991; McIntosh, 2005) [2].

In the worst case, certification might reduce employability instead of improving it – this negative signal comes down to two main issues: negative selection of individuals into the programme and poor training quality. In certain circumstances, a negatively selected certification can deter employers from hiring because they know that only individuals with no other options would have that certification. However, we observe that the selection of women into CBRA is driven by those with “some college or an associate’s degree”. Therefore, we argue that the selection of women into CBRA is due to partially skilled participants’ opportunity for shorter programme duration, not negative selection of the lowest achievers.

The first potential weakness of CBRA is its RPL procedure, as discussed in Section 4; our theoretical framework. This feature of CBRA may enable the deterioration of training quality. The second potential weakness of CBRA is that its employer-driven approach to might bias skills content towards firm-specific skills. CBRA should have the same balance of general and firm-specific skills as TBRA, ideally benefitting both employers and participants.

Another potential weakness of CBRA is that these programmes are concentrated in occupations groups in which the average hourly wage is relatively low. This may be the trade-off that women face when choosing CBRA: higher flexibility in terms of time, but lower wage prospects (Bustelo et al., 2023). CBRA therefore yields a lower benefit for women, partly due to this trade-off. Consequently, while CBRA may facilitate labour market access to many women, it may not serve to reduce the gender wage gap.

Our results indicate that women, especially those with some prior skills, select into CBRA over TBRA when pursuing Registered Apprenticeship. This could present a risk for
programme participants if CBRA is worse for employability outcomes compared to TBRA. This potentially comes from two sources: negative selection of individuals into the programme or worse training quality. We find no sign of negative individual selection into CBRA – women are not choosing the programme because they cannot access TBRA. However, the specific features of CBRA – specifically its outsourcing of the RPL to companies and its potential shorter duration – do put participants at risk for lower training quality in CBRA than TBRA. Companies may not be able to adequately recognise prior learning, especially for non-firm-specific skills. The shorter duration of CBRA, especially when combined with subsidies on a per-apprentice basis, may incentivise lower training quality and attract companies that cannot provide high-quality training. These factors cast doubt on the idea that women entering Registered Apprenticeship via CBRA is always a good thing.

Based on our results, policymakers must focus on ensuring the quality of CBRA programmes. This is to ensure that CBRA programme completers do not trade-off shorter programme duration for lower quality, subsequently impeding their labour market entry and harming their labour market outcomes. One approach would be for RPL procedures to be managed at least at a state level and independently of training companies. This makes RPL more consistent and removes the conflicts of interest and moral hazard issues which occur when companies themselves conduct RPL. RPL processes are costly and time-consuming (Assinger, 2022), so this would require dedicated resources. These processes could be organized through the Department of Labor, state apprenticeship agencies, or a third-party organization designated by those authorities.

The Urban Institute has already begun to publish competency-based occupational frameworks in occupations with higher average wages. Our results indicate that CBRA does lift barriers to entry for women. Future research could indicate whether competency-based occupational frameworks facilitate and increase the inception of CBRA programmes. If this is true, then the expansion of competency-based occupational frameworks to occupations with higher average wages would give more women access to these occupations, increasing female labour force participation and reducing the gender wage gap. These frameworks could have the additional benefit of synchronizing competency requirements at the occupational level, further facilitating RPL and increasing the value of Registered Apprenticeship programmes in occupations with frameworks.

Both policy recommendations tie into ongoing federal efforts to mitigate the gender pay gap and promote access to high-paying jobs for women. For example, the Broadband Equity, Access, Deployment grant programme aims to ensure job opportunities are available to a diverse pool of workers, including women. Furthermore, the Department of Commerce has launched an initiative (CHIPS Incentives Program) whereby grantee companies in the semiconductor industry must provide access to childcare for their employees. This is intended to enable parents – especially mothers – to obtain and remain in jobs in this crucial industry. The ultimate goal of all Registered Apprenticeship programmes is successful and lasting labour market integration. Therefore, it is crucial to ensure that women not only start programmes but complete them with a valuable qualification that enables them to access and keep good jobs in key occupations.

9. Conclusion
The introduction of CBRA has broadened the spectrum of populations served by Registered Apprenticeship. We argue that time-constrained individuals are sensitive to programme duration. Therefore, they are more able to pursue training when they can expect an even slightly shorter investment period. This is exacerbated when potential participants have some degree of pre-existing skills but no certification. Relative to men, women are significantly more likely to enrol in CBRA over TBRA. This finding is robust to a wide range
of various specifications and estimation methods. We further find evidence that this effect is
driven by women with uncertified skills, specifically with some college or associate degrees.
Women with only a high school diploma or less and those with college degrees are not
different from men in their choice of CBRA. Our findings indicate that women with
unqualified skills choose CBRA over TBRA, which we explain by their higher cost of time
and the shorter duration of the CBRA programme.

Ideally, CBRA offers an alternative format for an established programme that facilitates
participation among a broader and more diverse group of individuals. The competency-based
format should support time- or otherwise-constrained individuals by providing a shorter
programme for individuals who already have skills. This is especially important for
situations like migrants coming from another labour market with unqualified skills,
individuals who have worked but not had time to pursue formal or non-formal training, and
individuals who started to pursue formal or non-formal training but had to stop for any
reason. CBRA can also allow for a slower pace of training for individuals who learn more
slowly for any reason (Anderson, 2018), which further enables a broader scope and greater
equity. Our findings support the argument that CBRA is better suited to broader training
provision, with time-constrained women and skilled-but-unqualified individuals two groups
that appear to be better served by CBRA.

However, it is not obvious that the increased participation of women in Registered
Apprenticeship through CBRA is necessarily beneficial. CBRA programme participants may
be trading off CBRA’s additional flexibility against programme quality. Two main factors
may impede CBRA programme quality: poorly performed RPL, and lack of national curricula
and harmonised RPL structure. Employers have a great deal of leeway to offer lower skill
levels and more firm-specific skills due to the very minimal regulations over RPL procedures.
This may undermine the signal sent to labour markets by CBRA programme completers. In
turn, this diminished programme quality may be reflected in lower post-programme wages.
In addition, the shorter programme duration combined with per-apprentice subsidies for
training companies can incentivise low-quality training. Increased participation in CBRA
among already marginalised groups may not benefit their employment outcomes if CBRA is a
lower quality program.

This paper makes two main empirical contributions to the literature. We are the first to
empirically compare CBRA and TBRA using econometric strategies. CBRA is a relatively
new programme, and it has not been possible to rigorously evaluate its effects. We stop short
of causality in this analysis, but this is the first attempt in that direction. Our second
contribution is to investigate whether inherent characteristics of CBRA increase the
probability that women – a demographic underserved by registered apprenticeships – choose
to enrol in the programme. We show that CBRA also attracts individuals with uncertified
skills who can expect a shorter programme duration. This has important implications
because Registered Apprenticeship is a labour market integration programme. Increasing
employment is therefore one of its key goals.

We also argue that CBRA’s ability to serve a broader population is due to its separation of
the training and certification functions. Because CBRA allows for certification with less
training – when prior skills are present – it can serve a more diverse population more
efficiently. Finally, we demonstrate how the ability of CBRA to serve a historically
underserved population may become a risk if training quality is not ensured. Training quality
is at least partially reflected in post-Registered Apprenticeship wages. Consequently,
identifying the causal impact of CBRA programme completion, relative to TBRA or no
programme completion, on earnings, would quantify and represent a good proxy for
programme quality [3]. Given that post-programme completion data is unavailable to us at
the time of writing, and the absence of panel data, we leave this to future research. To
surmount endogeneity concerns, an exogenous but relevant instrument for CBRA could be a
reform that affected the prevalence of CBRA without affecting wages of completers through alternate pathways.

This study has three sources of limitations. First, our empirical test of hypothesis H2 is hindered by the construction of the “some college or associate’s degree” variable in RAPIDS data. “Some college” is very different from an associate’s degree. Individuals with some college are more interesting from a policy standpoint since their skills are truly uncertified. It is not strictly correct for us to categorise associate degrees as uncertified, but with this formulation it is unavoidable.

Second, and partially due to the first limitation, our empirical test of H2 is not completely conclusive. We had to choose between omitted variable bias and selection bias. Because of the demonstrated importance of the occupation and industry variables in existing literature, we chose to prioritise including those variables at the risk of selection bias. Occupation and industry fixed effects reduce, but do not eliminate, omitted variable bias. Although our study has limitations, we include a wide range of covariates as well as fixed effects vectors to account for a variety of confounding factors. The results are robust across different specifications. Women select into CBRA, especially when they have some pre-existing skills.

Finally, the third limitation of this paper is external validity. Registered Apprenticeship programmes are quite idiosyncratic to the United States. Although other programmes with similar names exist, Registered Apprenticeship is not comparable to programme and institutional setting in other countries. Although the challenges of effectively delivering RPL, program quality, and consistency are valid across contexts, but the way they appear in this paper is specific to the United States. Consequently, we may not extrapolate our results to other labour market integration programmes, potentially located in other countries. We leave this to future research.

Notes
2. Tan et al. (1991) highlight that returns to formal training in the United States is substantially higher than returns to training in the United Kingdom. In the United Kingdom, returns to training are comparatively lower than returns to e.g. schooling, making formal training relatively unattractive (Tan et al., 1991). The authors postulate that this may be because labour market institutions (for example unions or minimum wage agreements) in the United Kingdom have had an inhibiting effect on training.
3. Lou and Hawley (2019) document that relative to similar individuals, Registered Apprenticeship programme completers earn significantly and substantially higher wages up to nine years post-enrolment. However, these results are descriptive rather than causal.

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