I Z A Institute of Labor Economics
Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 16221

Taking a Chance on Workers: Evidence on the Effects and Mechanisms of Subsidized Employment from an RCT

Tania Barham
Brian C. Cadena
Patrick S. Turner

JUNE 2023

I Z A Institute
of Labor Economics

Initiated by Deutsche Post Foundation

DISCUSSION PAPER SERIES

IZA DP No. 16221

Taking a Chance on Workers: Evidence on the Effects and Mechanisms of Subsidized Employment from an RCT

Tania Barham
University of Colorado

Brian C. Cadena
University of Colorado and IZA

Patrick S. Turner
University of Notre Dame

JUNE 2023

ISSN: 2365-9793

IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Taking a Chance on Workers: Evidence on the Effects and Mechanisms of Subsidized Employment from an RCT*

This paper estimates experimental impacts of a supported work program on employment, earnings, benefit receipt, and other outcomes. Case managers addressed employment barriers and provided targeted financial assistance while participants were eligible for 30 weeks of subsidized employment. Program access increased employment rates by 21 percent and earnings by 30 percent while participants were receiving services. Though gains attenuated after services stopped, treatment group members experienced lasting improvements in employment stability, job quality, and well-being, and we estimate the program's marginal value of public funds to be 0.64. Post-program impacts are entirely concentrated among participants whose subsidized job was followed by unsubsidized employment with their host-site employer. This decomposition result suggests that encouraging employer learning about potential match quality is the key mechanism underlying the program's impact, and additional descriptive evidence supports this interpretation. Machine learning methods reveal little treatment effect heterogeneity in a broad sample of job seekers using a rich set of baseline characteristics from a detailed application survey. We conclude that subsidized employment programs with a focus on creating permanent job matches can be beneficial to a wide variety of unemployed workers in the low-wage labor market.

JEL Classification: J24, J68, I38, H43

Keywords: subsidized employment, active labor market programs, randomized controlled trial

Corresponding author:
Brian C. Cadena
Economics Building
University of Colorado
256 UCB, Boulder, CO 80309
USA

E-mail: brian.cadena@colorado.edu

* This research was supported financially by the Colorado Department of Human Services (CDHS), the University of Colorado Population Center, and the Wilson Sheehan Lab for Economic Opportunities (LEO) at the University of Notre Dame. The authors were contracted by CDHS to design and analyze an independent impact evaluation of ReHire Colorado. We are deeply grateful to our many staff partners at CDHS for their support of the evaluation. We also greatly appreciate the staff of the ReHire service agencies who provided valuable insight into the program implementation. We are indebted to Anne Marie Bryson, Austin Hamilton, Charlie Hanzel, Charlie Law, Ana Miravete, Griffen Rowe-Gaddis, Lauren Schechter, and Lauren Spencer for excellent research assistance. We thank seminar participants at the Institute for Research on Poverty, APPAM Fall Research Conference, SOLE Annual Meetings, the University of Notre Dame, the University of Colorado, the Federal Reserve Board, and the Nebraska Labor Summit for their helpful comments. The opinions and conclusions expressed herein are solely those of the authors and should not be construed as representing the opinions or policies of CDHS or the State of Colorado. The study ID in the American Economic Association's RCT Registry is AEARCTR-0011083.

1 Introduction

Losing a job can negatively affect the trajectory of a worker's career and well-being. Job seekers with recent spells of unemployment face lower call-back rates compared to their peers, and displaced workers suffer substantial earnings losses, primarily through the destruction of valuable worker-employer matches.[1] Moreover, unemployed workers in the low-wage labor market often face a myriad of barriers that make it hard to get back to work: lack of in-demand skills, intermittent work histories, and other observable characteristics that lead employers to believe that they are unlikely to become productive employees. To directly support these workers' re-entry to employment, policymakers have used a class of policy tools known as Active Labor Market Programs (ALMPs)—e.g., job search assistance, training, and subsidized employment. While programs that train job seekers to work in specific high-growth sectors have shown promise, they typically employ rigorous screening criteria for ability and aptitude, making them a potentially poorer fit for many unemployed workers.[2] Subsidized employment programs, in contrast, have proven successful in quickly re-employing certain groups of workers with significant barriers. Less is known, however, about whether these programs foster sustained post-program employment for the broader population, which participants enjoy lasting program impacts, and why.

In this paper, we use a randomized controlled trial (RCT) to determine the effectiveness of a supported work program that pairs access to subsidized employment with wraparound case management services to accelerate participants' return to employment and, ideally, to improve their longer-run labor market outcomes and well-being. ReHire Colorado, administered by the Colorado Department of Human Services (CDHS), places participants in temporary jobs with local employers and pays the full cost of their wages for up to 30 weeks. Case managers are encouraged to match participants to jobs they believe are especially well-suited for the individual, with the explicit goal of having participants transition to unsubsidized employment with the host-site employer after program exit. ReHire also provides financial assistance to address barriers (e.g. lack of transportation or lack of a required certification) and offers coaching toward new career opportunities and preparation of job application materials. The program has operated at scale

[1] A number of audit studies experimentally vary the timing and length of unemployment spells and measure differences in call-back rates (Eriksson and Rooth, 2014; Farber et al., 2019; Kroft, Lange and Notowidigdo, 2013). Beginning with Ruhm (1991), other studies have measured the scarring effects of job dislocation (Arulampalam, 2001; Gangl, 2006; Jacobson, LaLonde and Sullivan, 1993; Stevens, 1997), and Rose and Shem-Tov (2023) explicitly consider the consequences of losing lower-wage jobs. Lachowska, Mas and Woodbury (2020) use administrative earnings data with observable hours worked to show that most of the earnings losses can be attributed to valuable employer-employee matches.

[2] Katz et al. (2022) documents the prevalence of screening in a prominent sectoral training program. Hendren and Sprung-Keyser (2020) provide evidence of cost-effectiveness (large marginal value of public funds) of sectoral training programs like WorkAdvance, YearUp, and Project QUEST.

in multiple counties since January 2014 and recruits and serves a diverse set of participants—eligibility requires only Colorado residency, legal authorization to work in the US, an ability to pass a drug test, household income below 150 percent of the poverty line, and being unemployed or underemployed for at least four consecutive weeks. From July 2015 through December 2018, program access was allocated randomly among applicants on a rolling basis.

Our analysis leverages this randomization to estimate intent-to-treat (ITT) impacts of program access on labor market outcomes and well-being over the two years following program application. We track employment and earnings, benefit receipt, and credit outcomes in high-frequency administrative data, and we measure impacts on job quality and well-being using an 18-month follow-up survey. We estimate treatment effects separately for in-program and post-program time periods, roughly the first and second year after application, respectively. Because the evaluation period overlapped in part with the COVID-19 pandemic, we limit our analysis to individuals whose post-program outcomes were measured prior to 2020 to estimate program effects that were realized during a more typical labor market.

As expected, ReHire increased formal-sector employment and earnings during the in-program period. The quarterly employment rate improved by 11.1 percentage points (21 percent) and quarterly earnings rose by $247 (30 percent). However, there was no effect on benefit receipt (SNAP or TANF).

In the year following program exit, program effects on employment and earning are more modest, but we find that ReHire access led to improvements in other aspects of workers' lives including employment stability, job quality, and well-being. Post-program ITT effects on employment and quarterly earnings are 3.7 percentage point (8 percent) and $157 (7 percent). However, job attachment remained strong, with treatment group members 20 percent more likely to work in every quarter of the post-program year and 30 percent more likely to continue working for their first post-randomization unsubsidized employer through the 18-month follow-up. In addition, the treatment group experienced meaningful improvements in job quality (0.11 SD) and well-being (0.17 SD). The program did not affect other aspects of participants' lives including benefit receipt, employment barriers, soft skills, or credit outcomes.

We use a comprehensive baseline survey to investigate program effect heterogeneity among the diverse set of participants. The baseline survey includes information on multiple dimensions of work readiness (prior work history, employment barriers, and both cognitive and non-cognitive skills) and pre-program formal sector employment and earnings records, which we leverage to explore treatment effect heterogeneity using subgroup analysis and recent advances in machine learning (Chernozhukov et al., 2020). Somewhat surprisingly, we find no evidence for systematic treatment effect heterogeneity.

Beyond establishing ReHire's overall effects, we provide compelling descriptive evidence that the primary mechanism underlying the post-program improvements in employment and earnings is the opportunity for a worker and an employer to learn their match quality, with the host-site employer eventually offering an unsubsidized job to well-matched workers. In theory, ReHire could have led to durable employment gains through any of four mechanisms: lasting removal of employment barriers, improved hard or soft skills from training or work-based learning, improved applicant signal quality from recent verifiable work experience, or by allowing the employer to learn both the participant's overall quality and their productivity in the specific subsidized job. This final possible mechanism is operative in an augmented Diamond-Mortensen-Pissarides search model (Diamond, 1982; Mortensen, 1982; Pissarides, 1990) where the employer-employee match quality is initially noisy and fully revealed only after the employee begins working (Pries and Rogerson, 2005, 2022), with a wage subsidy lowering the equilibrium hiring threshold.

The core of the mechanism analysis is a decomposition of earnings and employment trends by program experience that reveals two key descriptive facts. First, all of the in-program effects on employment and earnings are due to improvements among transitional job recipients; the average labor market outcomes of those who leave the program having received at most supportive services closely match the control group's. Second, all of the post-program employment and earnings impacts are due to improvements among the participants who gain unsubsidized employment at their host site. Participants who complete a transitional job but are not hired by their host site have post-program outcomes that are similar to the outcomes among the control group and among treatment group members without a placement.

These decomposition results are precisely what one would expect if the primary mechanism behind ReHire's effectiveness were incentivizing employers to provide a trial job for participants they otherwise would not have hired, as modeled in the employer learning framework (Pries and Rogerson, 2005, 2022). The similarity of post-program outcomes among transitional job holders who were not hired by their host site and the control group implies minimal long-term returns to any increased human capital or improved signaling from the transitional job work experience. Further, the similarity between treatment group individuals who received only supportive services and the control group suggests a minimal role for the availability of wraparound services alone in the program's impact. We further rule out two alternative reasons why post-program effects occurred only among participants hired by their host site—cream skimming and differences in the transitional job. We find no evidence that case workers assign participants with the highest expected post-program outcomes to placements with higher likelihoods of success, demonstrate that being hired by the host site is not predictable, and show that differences in the size and industry of the host site are not driving results.

Finally, we confirm two key predictions from the augmented search model of how ReHire should affect participants' employment dynamics. First, treatment group members are much more likely to begin a new job after program application compared to the control group, and second, the subsidized matches are more likely to dissolve quickly compared to unsubsidized new jobs among the control group. Overall, multiple pieces of descriptive evidence support the interpretation that ReHire works primarily by encouraging employers to take a chance on a worker they would not have hired otherwise.

This paper makes important contributions to our understanding of the effectiveness of Active Labor Market Programs by evaluating an understudied and increasingly popular program model that addresses unemployment among low-wage workers without lengthy upfront investments in human capital (Barnow and Smith, 2015; Card, Kluve and Weber, 2010, 2018; Heckman, LaLonde and Smith, 1999; Greenberg, Michalopoulos and Robins, 2003). Alternative programs that provide intensive training have been shown to lead to large long-term improvements in employment.[3] However, many programs that train workers to work in specific in-demand sectors have rigorous screening criteria for ability and aptitude that exclude many job seekers.[4] ReHire, in contrast, is a work-first intervention that explicitly welcomes nearly all job seekers and endeavors to get them back to work quickly. While the lifetime gains from sectoral training programs may be larger, the modest experimental post-program impacts estimated in this paper suggest ReHire's cost-effectiveness (Marginal Value of Public Funds of 0.64) is comparable to that of job training interventions serving similar populations without restrictive screening (Hendren and Sprung-Keyser, 2020).[5] Further, the finding that the key mechanism underlying post-program effects is facilitating employer learning through wage subsidies and wraparound services shows that it is possible to improve long-term outcomes among this population even without substantially improving participants' human capital. Programs targeting this same mechanism may be especially valuable for unemployed individuals for whom further investments in

[3] Card, Kluve and Weber (2018) provide a meta-analysis of ALMP evaluations, including a comparison of the effectiveness of different program types. While subsidized employment programs tend to have larger short-term gains in employment, job training programs tend to lead to larger long-term gains.

[4] Recent experimental evaluations of successful sectoral training programs like those from the WorkAdvance model Katz et al. (2022) and Year Up (Fein and Hamadyk, 2018; Fein and Dastrup, 2022) study programs that incorporate upfront screening.

[5] For example, the average MVPF of the job training programs considered in Table 2 of (Hendren and Sprung-Keyser, 2020) is 0.44, which includes estimates of Job Corps (0.15), JTPA Adult Program (1.38), National Supported Work Demonstration for Women (1.48), and National Supported Work Demonstration for Ex-Offender (0.64). Additionally, the average MVPF for Unemployment Insurance system enhancements is 0.61.

human capital have lower lifetime returns, such as older workers.

This paper also contributes to the small but growing literature focused specifically on identifying the impact of subsidized employment programs. Early experimental evidence of these types of programs found that gains in earnings and employment rates faded out once wage subsidies ended (Bloom, 2010). More recent programs, including ReHire, include enhancements to the traditional transitional jobs model by providing more intensive case management, job training and financial support to address employment barriers, and by offering placement with private, for-profit employers with the intent that some of these placements will lead to unsubsidized job offers. Evaluations of programs with similar enhancements targeted at specific sub-populations show stronger and more durable impacts compared to earlier program models (Anderson et al., 2019; Barden et al., 2018; Cummings and Bloom, 2020), and the results from this study are consistent with those findings.[6]

Relative to these other contemporaneously developed studies, this paper is distinct in multiple ways. First, ReHire serves a broader segment of the low-wage workforce—nearly all low-income residents. In contrast, other programs serve specific sub-populations—non-custodial parents or recently incarcerated job-seekers (Barden et al., 2018; Foley, Farrell and Webster, 2018), TANF recipients (Glosser, Barden and Williams, 2016), individuals at high risk of gun violence (Bhatt et al., 2023), or youth (Cummings, Farrell and Skemer, 2018; Davis and Heller, 2020; Gelber, Isen and Kessler, 2016; Heller, 2014; Modestino, 2019). We exploit the broad eligibility requirement to systematically explore heterogeneity using machine learning (Chernozhukov et al., 2020). Our finding of minimal heterogeneity across applicant types demonstrates that differences in target populations are unlikely to explain differential program effects across studies, which helps resolve a key outstanding question when comparing the effectiveness of ALMPs (Katz et al., 2014). In addition, this finding suggests that this type of program need not be narrowly targeted to a particular subset of lower-wage workers. Second, this study deepens our understanding relative to the existing literature by demonstrating that post-program effects are fully concentrated among participants hired by their transitional job host site. This finding both provides an explanation for the fade out seen in prior studies and suggests that transitional job programs are successful to the extent that temporary placements have the possibility of becoming unsubsidized private sector jobs.

Finally, our analysis of the program's mechanisms provides empirical evidence supporting an augmented Diamond-Mortensen-Pissarides search-and-matching model where the productivity of a job match is an

[6] Results from the US Department of Labor's Enhanced Transitional Jobs Demonstration (ETJD) find that treatment group members earned \$700 more than the control group and were 4 percentage points more likely to be working during the final year of a 30-month follow-up (Barden et al., 2018).

experience good that requires an employer to observe a worker's performance on the job (Jovanovic, 1979; Pries and Rogerson, 2005). Moreover, we complement the findings of Dustmann and Meghir (2005) who find that lower-wage workers who continue working at the same employer enjoy much larger wage growth compared to workers who stay in the same type of job but switch employers, leading them to conclude that "unskilled workers benefit most by finding a good match and remaining with it" (p. 79). Transitional job programs or other interventions that encourage firms to take a chance on applicants they would otherwise screen out may therefore be necessary to address unemployment among low-wage workers.

2 ReHire Colorado

2.1 Program Design

ReHire Colorado is a suite of workforce services designed to help the unemployed get back to work. The program began in January 2014 following the passage of the Colorado Careers Act of 2013 and continues to operate throughout the state.[7] ReHire was developed as part of a new wave of subsidized employment programs designed to address persistent unemployment following the Great Recession. Other examples include programs studied through the US Department of Labor Enhanced Transitional Jobs Demonstration (ETJD) and the US Department of Health and Human Services Subsidized Training and Employment Demonstration (STED) (Anderson et al., 2019; Barden et al., 2018; Cummings and Bloom, 2020). CDHS administers ReHire centrally at the state level, but services are provided locally by community organizations located in both urban and rural areas.[8] Workers at these agencies identify clients for whom the program might be a good fit, assess eligibility, work with clients to submit the program application, and provide program services to ReHire participants.

ReHire serves a relatively broad population compared to similar subsidized employment programs that tend to focus on a single target population (e.g., recently-released inmates or TANF recipients). All Colorado adults with a family income lower than 150 percent of the federal poverty level and who have been unemployed or underemployed for at least four consecutive weeks are eligible.[9] The legislation authorizing

[7]ReHire Colorado was modeled after an earlier state program, Hire Colorado, that used TANF emergency funds to place TANF recipients and individuals who had exhausted their unemployment insurance benefits into subsidized work with private or public employers.

[8]Service providers have changed throughout the span of the program and through December 2018 have included Catholic Charities Pueblo, Discover Goodwill of Southern and Western Colorado (Colorado Springs), Goodwill Industries of Denver, Hilltop Community Resources (Grand Junction), Larimer County Workforce Center (Fort Collins), Rocky Mountain Human Services (Denver), Workforce Boulder County, and Colorado Coalition for the Homeless (Denver).

[9]The statutory eligibility specified underemployment as working less than 20 hours a week. To be eligible, an applicant needed to provide self-attestation that they were unemployed or underemployed for at least four consecutive weeks. During

the program identified three priority categories of participants: displaced older workers (aged 50+), non-custodial parents, or veterans. CDHS requires the local service agencies to prioritize these groups when recruiting such that 70 percent of applicants belong to at least one of the categories. Once applicants have been recruited, their membership in a priority group does not affect the likelihood that they are granted access to the program. Finally, eligible applicants must meet at least five items from a standardized 10-item suitability screen to ensure their readiness for the program.[10] Program applications from eligible individuals are processed on a rolling basis.

The program is structured similarly to other enhanced transitional jobs programs that combine placement into temporary subsidized jobs—the program's key feature—with supportive services and case management. Job developers create a bank of local public and private employer sites willing to host program participants, and successfully placed participants can work up to 30 weeks with the full cost of their hourly wages (set at the state minimum wage) paid out of ReHire funds.[11] The host employers are often relatively small (roughly two-thirds have 50 or fewer employees), and placements occur across a variety of industries, with about half in Health and Social Assistance or Retail Trade and the remainder spread across multiple other sectors.[12] Notably, job developers are explicitly encouraged to recruit host-site employers where a successful temporary employee has a strong possibility of being hired into an unsubsidized position.[13] This program feature distinguishes ReHire from some other transitional jobs programs that rely on public-sector positions or provide temporary jobs with no direct pathway to or expectation of permanent employment. The local agency partner serves as the employer of record for the period of subsidized employment and is responsible for all other HR-related costs, such as worker's compensation insurance. The employer host site therefore has no direct monetary costs during a worker's transitional job, but they are responsible for reporting hours to the agency, evaluating the participant, and providing feedback and coaching.

Because a subsidized job placement alone may not be sufficient to lead to long-term labor market success, the program also includes wrap-around supportive services for participants to help address any barriers to work. Case managers work one-on-one with participants to develop an individualized plan with

---

the evaluation period, individuals needed to self-attest that they were eligible to work in the United States.

[10] The 10-item list includes the following items: veteran, outstanding child support order, older worker, receiving SNAP or other public assistance, safe/stable housing, reliable transportation, good health and able to work, able to pass a drug test, have GED or HS diploma, excited about getting back to work.

[11] During the evaluation period, the Colorado state minimum wage increased from \$8.23 to \$12.00. Details are available in Appendix Table A-1.

[12] Table 5 includes a complete breakdown of firm size and industry for the subsidized job placements held by individuals in the analysis sample, described below in Section 3.4.

[13] Even prior to the RCT evaluation, ReHire administrators tracked the share of placements that led directly to permanent positions as a performance metric for the local agencies administering the program.

the goal of identifying areas of development, including any soft skills or needed industry certifications. All plans include meeting with a case manager for at least one hour of coaching each month. Case managers also have access to additional funds to support participants' education and training goals (e.g., to cover the cost of a CDL or cosmetology training), and participants may pursue training prior to or contemporaneously with their placement. Targeted financial assistance is also used to reduce employment barriers faced by the participant—for example, providing bus passes or gas vouchers; purchasing tools, equipment, or uniforms needed for work; or to incentivize positive workforce behaviors, such as consistent on-time attendance.

Given the individualized nature of the ReHire program, a participant's timeline of service receipt can vary substantially depending on which program components they choose to use and for how long. Some participants receive only supportive services and exit the program fairly quickly. Among those who are placed in transitional jobs, program duration depends on both the time to placement and the length of the placement. In the end, most participants exit ReHire within six months of their application, and nearly all stop receiving services within one year.[14]

2.2 Anticipated Mechanisms

The program was designed to improve employment prospects by addressing potential causes of participants' unemployment or underemployment through supportive services and matching those who were struggling to find a job themselves with an employer and subsidizing their wages. The supportive services were included to ensure that participants would be reliable, productive employees during their time in the program. For participants who were especially work-ready, the supportive services alone were expected to be sufficient to lead to re-employment in an unsubsidized job. To the extent that these services improved a participant's soft skills (e.g. mock interviews), permanently removed a barrier (e.g., solved a transportation issue), or helped shorten an unemployment spell, they were expected to improve labor market outcomes even after participants left the program.

In addition to providing short-term employment, the transitional job was expected to affect labor market outcomes after program exit through three primary mechanisms. First, the subsidized job was intended to overcome information frictions that would otherwise have prevented participants from finding employment. Pries and Rogerson (2005, 2022) provide a formal theoretical treatment of how employer-employee matches form when initial signals of match quality are noisy and the true quality is revealed

[14] Appendix Section A.2 provides additional details on service receipt and timing for our analysis sample described in Section 3.4 below.

only after a worker is hired and working. Viewed through the lens of this augmented Diamond-Mortensen-Pissarides framework (Diamond, 1982; Mortensen, 1982; Pissarides, 1990), the temporary subsidized job functions as a screening device that reduces the cost of forming a match that is later revealed to be unprofitable, which lowers a firm's threshold quality signal and allows more hires to occur. The low-cost trial period was expected to be especially helpful for applicants with high-variance signals, such as lengthy periods of non-employment or a criminal history. The availability of supportive services reduces employers' concerns that program participants may leave their placements early due to shocks beyond their control, such as issues with transportation or childcare. Thus, the combination of a wage subsidy and wraparound case management encourages employers and employees to find high-quality matches that would have otherwise gone undiscovered, potentially improving a participant's employment and earnings outcomes even after the employer becomes responsible for paying the employee's wages.

Second, the transitional job provided the participant with recent work history that many participants lacked at application. Even if the transitional job did not lead to an unsubsidized position with the same employer, the additional experience was expected to make participants more attractive to future potential employers by mitigating the negative signal of having been unemployed or underemployed for a long period of time (Eriksson and Rooth, 2014; Farber et al., 2019; Kroft, Lange and Notowidigdo, 2013).

Third, the transitional job was intended to function as work-based learning, with participants able to improve their human capital through employer mentoring. In addition to learning job-specific skills, transitional job holders were expected to learn other soft skills such as communication and resiliency in the face of adversity. This skill improvement was intended to have a lasting impact on participants' performance in future jobs, regardless of the employer.

Because the relative contribution of these various mechanisms has important implications for program design and for understanding the low-wage labor market more generally, we use descriptive analysis and machine learning techniques to tease apart their importance in Section 6.

3 Experimental Impact Evaluation

We partnered with CDHS to design an RCT evaluation of ReHire's impact on participants' in-program and post-program outcomes.[15] From July 2015 through December 2018, applicants to the program completed a

[15]While our evaluation was not guided by a formal pre-analysis plan, an April 2015 update on the evaluation design presented to CDHS prior to the launch of the RCT specified the use of state administrative data in an RCT evaluation of ReHire and the analysis in this paper largely follows that original proposal. In the status update, we report power calculations on the following

baseline survey and were then randomly assigned to either a treatment or control group. Only the treatment group received access to ReHire services, but CDHS tracked outcomes for both groups in administrative data. An 18-month follow-up survey and administrative credit data provide additional outcomes.

3.1 Program Intake and Baseline Survey

Staff at the local agency partners were responsible for recruiting participants and for completing program intake. They worked regularly with individuals who needed help finding employment and would often recommend applying to ReHire as a possible resource. Once a potential participant decided to apply, a case worker verified the applicant's eligibility and suitability and then administered a detailed in-person baseline survey. Case workers then submitted the applicant's information to CDHS, and CDHS informed both the applicant and the case worker of the applicant's random assignment status by text and email message, usually within one business day. Case workers reached out to individuals assigned to the treatment group to begin program orientation, while individuals in the control group could continue accessing other services from the local agency.

All program applicants during the RCT evaluation period ($N = 2,496$) completed the baseline survey, which measured an applicant's existing skills and barriers to employment including their employment and wage history, education, childcare situation, any health difficulties, substance abuse, criminal background, struggles with homelessness or substance abuse, and other economic hardships.[16,17] The survey also included a measure of mental health using the Center for Epidemiological Studies of Depression (CESD) scale, a scale for grit (Duckworth et al., 2007), Big Five personality traits (Donnellan et al., 2006), cognitive ability using the Raven's colored matrices (Raven, Court and Raven, 1984), and a timed math test created for the purposes of the baseline survey.[18] At the end of the survey, the case worker scored the applicant's job readiness along two margins: their "motivation to get back to work" and their "likelihood to overcome employment barriers." We use the baseline data to investigate treatment and control balance, to create regression controls, to examine program effect heterogeneity, and to address attrition issues in

outcomes: annual earnings, annual employment rate, number of quarters worked in a year, quarterly earnings, and quarterly employment. We also specify looking at participation in the Basic Cash Assistance program (TANF) and SNAP, as well as looking at "a full calendar year after [ReHire] participation ends to evaluate labor market effects fully." Finally, the update also notes our plan to use a baseline survey to explore treatment effect heterogeneity. Since that time, the evaluation expanded to include an 18-month follow-up survey and Experian credit data. The April 2015 evaluation progress update, the baseline survey instrument, and the follow-up survey instrument can all be accessed at the AEA RCT Registry (AEARCTR-0011083).

[16] Many of the survey questions regarding previous employment and barriers to future employment were adapted from the Women's Employment Survey (Tolman et al., 2018).

[17] We are missing the baseline survey for one individual, but they can still be linked to administrative data outcomes. They are not included in analysis that relies on the baseline survey (e.g., heterogeneity analysis).

[18] The 3 minute-timed math test included 160 addition, subtraction, or multiplication problems using numbers from 1 to 10.

supplemental data.

3.2 Randomization

Applicants were randomly assigned to either a treatment group who received access to ReHire-funded services or a control group who continued to receive usual services. To ensure that the treatment and control groups were well-balanced within sites and that case workers had a steady workflow, randomization was stratified at the service agency level, and the randomization method ensured that treatment and control assignments were balanced over small sets of arriving applicants.[19] The probability of treatment was set to 50 percent at the start of the RCT and was adjusted to be as high as 66 percent for service agencies in rural areas and during time periods when enrollment was low. Appendix Section A.3 provides more details on the randomization procedure, which produced baseline balance as expected (see Section 3.4 below).

Once placed into the control group, applicants were ineligible to enter the lottery again, and internal controls prevented repeat applications by the same individual, even if they applied through a second service agency. Therefore, treatment assignment completely determines whether an applicant had access to ReHire-funded services. Contamination of the ReHire program in the control group is minimal.[20]

The control group retained access to the usual services provided in the local area and remained eligible for other job assistance programs operating during the RCT time period, including those offered by ReHire service agencies or elsewhere. These programs may have included access to transitional jobs with alternative funding sources, including the Workforce Innovation and Opportunity Act (WIOA).

3.3 Outcome Data

Our analysis relies on multiple administrative data sources and an 18-month follow-up survey. Outcomes from state administrative data are created from unemployment insurance earnings records collected by the Colorado Department of Labor and Employment (CDLE) and SNAP/TANF benefits records from CDHS. The earnings data are available on a quarterly basis from Q1 2010 through Q2 2022, and the benefits data are available on a monthly basis from January 2004 through September 2022. We use these data to construct a balanced panel of outcomes during the three years prior to and two years following an

[19]A possible concern from the randomization procedure is that it induced serial correlation in treatment status among individuals who applied at the same agency around the same time. In Section 5.1.4, we discuss how our results are robust to a randomization-based inference procedure that directly accounts for the specific method of randomization.

[20]Two members of the control group were accidentally entered into ReHire's administrative database as treated and thus received access to services. They remain members of the control group for analysis.

individual's application date, which allows us to examine program impacts both while treatment group members received services and for at least one year after they left the program.

The CDLE data provide quarterly information about earnings from jobs covered by unemployment insurance in Colorado, as well as information on the industry of the employer. Earnings from transitional jobs are included in the CDLE data with the service agency as the employer of record. These data do not, however, capture earnings when individuals worked informally or as an independent contractor, which may be the case for jobs held by applicants before or after their transitional job. In quarters when an individual does not have a wage record, we treat them as having zero earnings that quarter and code them as not being employed. Outcomes based on this data source, therefore, are best interpreted as measuring formal-sector employment and earnings in the state of Colorado. We deflate all dollar values to July 2015 levels using the Consumer Price Index for All Urban Consumers, and winsorize earnings at the 99$^{\text{th}}$ percentile within calendar quarters. In addition to the dollar amount of earnings, we create a variety of outcomes for having any earnings in a given quarter or for earning any amount over a relevant period of time.

A potential limitation to using state-specific administrative data is that earnings and benefit payments are observable only when they occur in the state. To quantify the importance of this concern, we linked ReHire applicants to their address histories as compiled by Infutor Data Solutions to measure directly how often individuals in the sample move out of the state. Appendix Figure A-2a shows that rates of non-Colorado residencies are low overall and are similar between the treatment and the control group in the two years following application. We interpret this result as evidence both that Colorado-specific administrative data is appropriate for measuring key outcomes and that selective interstate migration is unlikely to bias our results.[21]

In order to consider program impacts on a broader set of outcomes, we use data from two additional data sources. First, an on-line follow-up survey was administered roughly 18 months after application,[22] which is approximately one year after the typical participant exited the program.[23] The survey provides a repeated measure of many of the same individual skills and barriers measured in the baseline survey, detailed information on the first unsubsidized job after the respondent applied for ReHire, and information

[21]This analysis is consistent with data from the American Community Survey (Ruggles et al., 2020) that show only 3.5 percent of Colorado residents with less than a bachelor's degree left the state between 2015 and 2016.

[22]Respondents had the option to complete the survey over the phone with an interviewer, but only a handful took up that option. Given the timing of survey implementation (first introduced in December 2017), applicants who applied in the first year of the program would have received the survey up to 2.5 years after application.

[23]Respondents typically completed the follow-up survey 20 months after ReHire application, and the timing between application and response was similar between the treatment and control groups. See Appendix Figure A-3 for the distribution of months since application for treatment and control group survey respondents. When estimating effects on outcomes from the follow-up survey, we include months since application fixed effects.

on the respondent's job at the time of the survey. The survey response rate was roughly 40 percent, with a higher response rate in the treatment than the control groups (45 percent vs 34 percent). Second, we link ReHire applicants to quarterly data about credit score, credit utilization, and credit-seeking behavior provided by Experian. Match rates were similar between the treatment and control groups—roughly 68 percent. We provide additional details about these supplemental data sources, including reweighting procedures to account for nonresponse, in Section 5.2 and Section 5.3 below.

3.4 Analysis Sample and Baseline Balance

In order to eliminate the impact of the COVID-19 pandemic on the analysis, we restrict our analysis sample to the 1,931 applicants who applied prior to January 2018, 1,055 of whom were assigned to the treatment group. Although the entire RCT sample received services prior to the onset of pandemic-related labor market shocks in March 2020, applicants who applied in January 2018 or later were affected by stay-at-home orders and other labor market disruptions within the first full year following the treatment group's program exit.[24] This affected group of applicants comprises roughly one fifth of the entire RCT sample. Section 5.1.4 shows that the key findings are robust to this sample choice.

The analysis sample of ReHire applicants includes a diverse cross-section of lower-income Colorado residents, reflecting the program's broad eligibility criteria. More than two-thirds of applicants received SNAP and roughly three-quarters were covered by Medicaid during the month when they applied. Applicants had notable barriers to re-employment including inconsistent work histories (the typical applicant worked in only 40 percent of the prior 12 quarters), transportation barriers (20 percent did not have a valid driver's licence), felony convictions (22 percent), work-limiting health problems (11 percent), and substance abuse (21 percent). Compared to similar subsidized employment programs that target a single population such as ex-offenders, non-custodial parents, or TANF recipients (Anderson et al., 2019; Barden et al., 2018), the ReHire applicant pool is more diverse, although it includes the target populations from previous evaluations.

Appendix Table A-3 provides a full set of descriptive statistics and demonstrates treatment/control balance across pre-randomization characteristics measured in administrative and survey data. Nearly all characteristics show minimal differences between the treatment and control groups, although men are slightly over-represented in the treatment group (54 versus 49 percent). We therefore include analysis with and without controls for baseline characteristics, as discussed below in Section 4.

[24]See Appendix Figure A-4 for more information on the timing of the COVID-19 pandemic relative to ReHire application.

4 Empirical Strategy

We exploit the RCT design and estimate ITT effects of gaining access to ReHire Colorado using the following linear regression specification:

$$y_{it} = \beta T_i + \gamma_{s(i)} + \epsilon_i, \tag{1}$$

where y_{it} is an outcome for individual i measured at (or during) time t defined relative to an individual's application date ($t = 0$). For outcomes measured in state administrative data, t includes quarterly or monthly time periods for up to 3-years before and 2-years after application. T_i is an indicator that takes the value of 1 for individuals assigned to the treatment group and 0 for individuals assigned to the control group. The vector $\gamma_{s(i)}$ is a set of stratification fixed-effects to account for the fact that randomization occurred separately by local agency and that the treatment probability changed somewhat over the RCT period.[25] In addition to this parsimonious regression, we report additional estimates of β from specifications that use a post-double-selection LASSO procedure (Belloni, Chernozhukov and Hansen, 2014) to select optimal controls from a high-dimensional set of baseline characteristics X_i to address slight baseline imbalances and to improve precision.[26] Results are similar with and without controls.

The parameter β is the causal effect of access to ReHire-funded services relative to the counterfactual set of available services. Thus, the interpretation of β depends on the degree to which the control group has access to services that are similar to ReHire, such as transitional jobs, through other programs offered by the same or other service providers in the area. While the receipt of close-substitute services is not a threat to causal identification, it could reduce the size of ITT effects and lead ReHire to appear less cost-effective (Heckman et al., 2000; Kline and Walters, 2016). We show in Appendix Section A.8 that control group individuals rarely had UI-covered earnings from a ReHire agency—a proxy for working a transitional job—and less than 10 percent of follow-up survey respondents from the control group report

[25] The strata (s) fixed effects allow for treatment-control comparisons within a contiguous block of applicants from the same service agency that faced the same effective randomization probability. Two service agencies had more than one physical location and the randomization was stratified at this sub-agency level to ensure sufficient flow of program participants. The rate of acceptance was also higher for the rural areas. Appendix Section A.3 provides complete details on the randomization procedure and how $\gamma_{s(i)}$ is constructed.

[26] The set of potential controls includes: quarterly employment and earnings in the 12 quarters preceding application; summary measures of employment (e.g., any or no work) in the 1, 2, and 3 years before application; SNAP and TANF participation in each of the 24 months preceding application; total SNAP and TANF benefits received in the last 12 and 24 months; and a set of indicators for gender and educational attainment. The LASSO procedure typically selects pre-program work history measures, which is consistent with the slight imbalance in gender and that prior earnings are predictive of future earnings.

working in a subsidized job following application (see Section 5.2). We further show that accounting for access to other transitional jobs programs does not qualitatively change the key findings (see Section 5.1.4).

We focus on ITT estimates because program take-up was high. Among the treatment group, 88 percent met with a case worker to start a ReHire case plan post-randomization, 72 percent received individually-billable direct cost services (supportive services, a transitional job, or both), and 62 percent were placed in a transitional job.[27] Under the assumption that the 27 percent of treatment group members who received no direct-cost services had program experiences similar to the control group, treatment-on-the-treated effects can be calculated by scaling up the ITT effects by 37 percent.[28]

Because the follow-up survey and credit data include many different outcomes, we construct families of similar outcomes from each data source and report the average standardized treatment effect among those outcomes. For each outcome family with K outcomes, we estimate

$$\hat{\tau} = \frac{1}{K} \sum_{k=1}^{K} \frac{\hat{\beta}^k}{\hat{\sigma}_k} \tag{2}$$

where $\hat{\beta}^k$ is the ITT effect of the k-th outcome in the family, which we scale by the standard deviation of that outcome among the control group $\hat{\sigma}_k$. In averaging treatment effects, we re-sign some outcomes so that positive treatment effects represent improvements. We follow Finkelstein et al. (2012) in stacking the data for all K outcomes and jointly estimating the ITT effects in a single regression, clustering standard errors at the individual level.

5 Intent-to-treat Impacts of ReHire Colorado

5.1 Outcomes from State Administrative Data

We estimate Equation (1) using outcome variables measured in administrative data from the State of Colorado during three distinct time periods: (i) the pre-program period that includes three-years prior to application, (ii) an in-program period that includes the first year after application, and (iii) a post-program

[27] Just under one in six individuals randomized into the treatment group received no services through ReHire within twelve months of gaining eligibility. Case notes suggest that approximately one third of these participants (4 percent of all participants) found unsubsidized employment independently before beginning the program, and the remaining two-thirds (8 percent of all participants) either left voluntarily or were deemed not to be a good fit for the program by the case worker.

[28] Scaling the effect this way requires no impact of gaining access to ReHire services among treatment group members who did not receive services, the so-called never-takers (Jones, 2015). This condition could be violated, for example, if the possibility of a transitional job changed an individual's search behavior. Because we do not have any direct evidence of whether this assumption holds, we report ITT effects as our preferred estimates.

period that begins one year after application. The time period, t, is measured relative to an individual's application for ReHire. Time 0 represents the period that contains an individual's application date, which is a different calendar period from applicant to applicant. Pre-period time periods are negative numbers and represent the number of quarters/months prior to application. The typical transitional job placement starts within a month of randomization and lasts 2 to 3 months, but some participants are still working in their transitional job within 12 months of application.[29] Because of this variation in service receipt timing, we consider the in-program period to be quarters 0 through 4 (months 0 through 12) and the post-program period to be quarters 5 through 8 (months 13 through 24) relative to random assignment. We also construct aggregate outcomes measured over the full in-program or post-program periods including, for example, average earnings, an indicator for having any formal sector earnings, an indicator for working every quarter, and the share of quarters worked during the period.

5.1.1 Quarterly Employment and Earnings

Figure 1a depicts trends in formal sector employment in Colorado for the treatment and control groups. The horizontal axis shows quarters relative to an individual's application for ReHire. The portion of the graph to the left of the first dashed vertical line indicates the pre-program period. The portions in between the two vertical dashed lines and to the right of the second line indicate the in-program and post-program periods, respectively. Figure 1b plots coefficient estimates and 95 percent confidence intervals for β from estimating Equation (1).[30]

Prior to the program, roughly 40 percent of applicants worked in any given quarter (Figure 1a), and trends in employment rates were similar in the treatment and control groups.[31] During the in-program period, employment initially rises and then falls for both groups. One quarter after application the employment rate of the control group increased to 57 percent. Control group employment improvements could stem from either (i) participation in other workforce interventions (e.g., job search assistance, resume writing) or (ii) within-person selection whereby individuals apply for assistance when they are particularly motivated to increase their labor market attachment. Despite these improvements among the control group, the treatment group experienced a nearly 20 percentage point larger increase in their employment

[29] Appendix Figure A-1 provides additional details on the distribution of time to placement and time to program exit.

[30] For reference, Appendix Table A-4 provides the exact numerical values of the coefficients and standard errors for the in-program and post-program effects shown in Figure 1b, and shows that results are insensitive to the inclusion of controls selected by the post-double selection LASSO procedure.

[31] The quarterly difference in employment rates is statistically insignificant in all but quarter -4, which is significant at the 5 percent level (see Figure 1b). The p-value from a test of the null that all of the pre-randomization differences are zero is 0.153.

rate, with more than 75 percent employed one quarter after application. Consistent with the timing of transitional job exits (see Appendix Figure A-1 and Appendix Figure A-5), employment rates among the treatment group decline more rapidly than among the control group through quarters 2 through 4, reducing quarterly differences to 13.1 and 7.6 percentage points for quarters 2 and 3, respectively. The differences in quarterly employment rates remain statistically significant at the 1 percent level for each of quarters 0 through 3. By the fourth quarter after application, the gap between the treatment and comparison group falls to 3.4 percentage points and is no longer statistically significant. During the post-program period, employment rates continue to decline for both groups, but a faster decline among the control group yields increasing program impacts including a statistically significant 6.1 percentage-point difference (13 percent over the control group mean) by quarter 8.

Figure 2 provides parallel analysis to Figure 1 using average quarterly earnings (including zeros) in place of quarterly employment rates. Figure 2a reveals a stark downward trend in earnings for both groups prior to application. There was no similar negative trend in quarterly employment, which suggests that these earnings losses occurred through either a loss of work hours, a decline in wage rate, or weeks of non-employment within a quarter with at least some employment. Earnings quickly rebound in the quarter following application for both groups, and, for the treatment group, average earnings exceed pre-program earnings for all eight post-application quarters. Because earnings are a more variable outcome, the quarter-by-quarter effects are not often statistically significant (quarters 0 through 2, which are significant at the 1 percent level, are the exception—see Figure 2b), although they typically represent at least a 10–15 percent increase compared to the mean of the control group and are thus economically meaningful.

5.1.2 Aggregate Outcomes for Employment and Earnings

Because transitions in and out of the labor market are prevalent in this population, measuring quarter-by-quarter changes in employment may mask gains in labor market attachment. To test more directly whether ReHire improved labor market stability, we construct employment outcomes that summarize labor market attachment during the in-program and post-program periods. We also consider aggregate measures of earnings in order to smooth out some of the variability. Table 1 reports effects on five outcomes: any employment during the period; the share of quarters employed; employment during every quarter of the period; average quarterly earnings during the period; and the share of quarters with earnings above 130 percent of the federal poverty level.[32] For each outcome, we report the control group mean (column 1), the ITT effect controlling only for stratification fixed effects (column 2), the ITT effect when additionally controlling for LASSO-selected baseline characteristics (column 3), and the adjusted program effect from column 3 as a percentage of the control group mean (column 4). Panels A and B show the outcomes for the in-program and post-program periods, respectively.

ReHire improved a number of labor market outcomes during the in-program period. Consistent with the quarterly results, the treatment group was 14 percent more likely to work at all (11.5 percentage points) and 30 percent more likely to work every quarter (7.1 percentage points), both of which are statistically significant at the 1 percent level. Earnings were also positively affected. When including controls, the impact on earnings is $247 per quarter and is statistically significant at the 1 percent level.

Some of the impacts persisted into the post-program period. While the treatment group was no more likely to have worked at any point during the period, they worked in 8 percent more quarters ($p < 0.10$) and were 7 percentage points more likely to have worked in every quarter ($p < 0.01$), a 20 percent increase relative to the control group. The treatment group also experienced a $157 increase in average quarterly earnings after controlling for baseline characteristics and a 2.3 percentage-point increase in the likelihood of earning at least 130 percent of the FPL, although neither effect is statistically significant.

Figure 3 provides a more complete picture of the effects on earnings across the earnings distribution. Each panel shows ITT estimates of the impact of ReHire on the probability of having quarterly earnings above a variety of federal poverty line thresholds separately for the in-program (Panel a) and post-program (Panel b) periods. Each point on the graph represents the regression coefficient on treatment group status from estimating Equation (1) using an indicator for having quarterly earnings above the relevant threshold listed on the horizontal axis, and the dashed gold lines provide 95 percent confidence intervals. Panel (a) demonstrates that, during the in-program period, there were statistically significant ($p < 0.05$) and substantial gains in the likelihood of having positive earnings (denoted by 0 on the horizontal axis) and in having earnings above thresholds up to roughly 100 percent of the poverty line. Point estimates in Panel (b) are uniformly positive, although the post-program (Q5–Q8) treatment-control differences are generally not statistically significant. Qualitatively, this figure suggests that ReHire may have increased the likelihood of participants having earnings above thresholds up to around 175 percent of the poverty line in both the in-program and post-program period, but there is no evidence of an increased likelihood

[32] When determining whether an individual earned more than 130 percent of the federal poverty level, we use the HHS poverty guidelines for a single individual for the calendar year of the wage record.

of having earnings above higher thresholds.

5.1.3 SNAP and TANF Receipt

One stated goal of programs like ReHire is to increase participants' incomes enough to allow them to achieve self-sufficiency and to reduce their reliance on future payments from programs such as SNAP and TANF. Because ReHire was targeted to a broad set of low-income participants, many were not eligible for TANF benefits, and only a relatively small share (10 percent) received a TANF payment in the year prior to application. In contrast, more than two-thirds of applicants received at least one SNAP payment over that same time period so there was more scope for ReHire to have an impact on future receipt. As shown in Figure 4, the high SNAP participation rate at program application represents the peak of a steep increase in participation that occurred over the prior 12 months. This increase in participation corresponds with the decline in earnings over the four quarters prior to application (Figure 2a), and these two trends suggest that ReHire applicants often experience a shock to their life circumstances prior to application. Following randomization, however, both groups experience similar declines in SNAP and TANF participation over the next 24 months.

ReHire did not have an appreciable effect on participation in either SNAP or TANF. Table 2 investigates the effect of ReHire on benefit receipt during the in-program (Months 0–12, Panel A) and post-program (Months 13–24, Panel B) periods. For SNAP and TANF separately, we estimate effects on three outcomes: receiving any benefit during the period, the share of months with a positive benefit payment, and the average monthly benefit payment. We find no economically meaningful or statistically significant differences between treatment and control groups in any of these outcomes.

5.1.4 Robustness

We show in Table 1 that the aggregate results on employment and earnings are robust to the inclusion of data from the COVID period, to addressing the possibility that the control group received similar services from other programs, to alternative methods of conducting inference, and to corrections for multiple hypothesis testing.

First, we include the sample that was affected by the COVID-19 pandemic and find qualitatively similar results. The main analysis sample excludes the 22.6 percent of applicants who were randomized in 2018 because some or all of their post-program quarters (Q5–Q8) occurred during the COVID-19 pandemic.

Because of randomization and the inclusion of strata fixed effects, the timing of the COVID-19 pandemic is not a threat to identification. The pandemic, however, was an exceptional time in the labor market and including individuals exposed to the resulting labor market disruptions may lead to estimates that are not representative of post-program effects that would hold in a more typical labor market. Appendix Section A.11.1 shows that our primary results are qualitatively similar when using the full RCT sample, although effects on some post-program outcomes, such as share of quarters worked (3.7 vs. 2.7 percentage points) and worked every quarter (6.6 vs. 4.9 percentage points), are smaller in magnitude.

Second, the type and intensity of services received by the control group potentially affects the interpretation of the estimated ITT impacts. To understand how often the control group accessed other transitional job programs offered by the same service providers, we consider how often they had earnings with a ReHire service agency as the employer of record. This type of arrangement happened only rarely among the control group, less than 5 percent in any given quarter (Appendix Figure A-5a). Control group individuals at one agency, however, were nearly equally as likely to be employed by the service agency during the in-program period as the treatment group (Appendix Figure A-5b). Appendix Section A.11.2 confirms that program impacts are qualitatively similar, though stronger, when dropping all applicants from this provider.

Finally, our results are robust to alternative ways of conducting inference that account for the randomization protocol and for concerns about multiple hypothesis testing. Appendix Section A.11.3 discusses how we construct randomization-based p-values that test the sharp null hypothesis of zero treatment effect among all applicants, and take into account the way treatment assignment occurred. Using these p-values that come from 10,000 iterations of the randomization protocol, we show that the results remain significant after adjusting inference to control for the family-wise error rate among the main employment outcomes in Table 1 using the Westfall and Young (1993) step-down procedure (see Appendix Table A-8).

5.2 Outcomes from 18-Month Follow-up Survey

We take advantage of the broader array of outcomes in the follow-up survey to show that ReHire reduced job turnover and improved job quality and personal well-being. Table 3 reports impacts on employment outcomes (Panel A), as well as standardized treatment effects on job quality (both for an individual's first unsubsidized job after application and their job at the time of follow-up), well-being, employment barriers, workplace behaviors, and expectations about the future.[33] For all outcomes, we report control group means (column 1), ITT effects estimated using Equation (1) (column 2), estimates from a specification that re-weights the sample using inverse propensity score attrition weights (column 3), and estimates that further condition on a set of controls selected using the same LASSO approach as the main analysis (column 4). Appendix Section A.12 provides additional details about the follow-up survey including a description of selection into survey response and details on how we construct the weights used to account for non-response. After re-weighting, the treatment and control respondents have similar baseline characteristics, and estimated program impacts on administrative employment outcomes are similar for the analysis sample and the subsample of follow-up survey respondents. The results in Table 3 are qualitatively similar across specifications, and we focus our discussion on the specification reported in column (4).

The first two outcomes reported in Panel A of Table 3 confirm that service receipt differed between the treatment and control group. The treatment group was 45 percentage points more likely to report working a job where the ReHire service agency paid their salary, and only 9 percent of the control group reported having such a placement. This difference is consistent with the evidence that uses the administrative data proxy for subsidized employment (Appendix Section A.8). Moreover, the treatment group was 10.3 percentage points more likely to be working in a job that ReHire helped them find, compared to 1.3 percent in the control group.

The remainder of Panel A shows that ReHire increased employment during the time since application. Access to ReHire increased the likelihood of any unsubsidized employment since application (6.8 percentage points) and employment at the time of the follow-up survey (7.1 percentage points), and both of these effects are statistically significant at the 10 percent level. These impacts are slightly larger than quarterly effects 5 to 6 quarters after application estimated in the administrative data (Figure 1b). This difference could arise because these survey data capture not only UI-covered employment, but also gig work, contract work, and informal work. As a measure that aligns more closely with the administrative data, we see that the effect on employment in a job that provides a pay stub or other government form is much smaller (less than 1 percentage point). Nevertheless, we find evidence consistent with the administrative data that ReHire reduced job turnover. The treatment group was 8.2 percentage points more likely to be working in the same job as their first post-application unsubsidized job ($p < 0.05$).

We also find evidence that ReHire improved job quality and well-being but did not lead to lasting

[33]For information on the construction of the outcome families see Appendix Section A.12.3. We report impact estimates for the underlying components for the job quality indices in Appendix Table A-12 and for the well-being, employment barriers, workplace behaviors, and expectations indices in Appendix Table A-13.

improvements in soft skills or reductions in employment barriers. Panel B of Table 3 reports standardized treatment effects on six different outcome families. Job quality is measured for an individual's first unsubsidized job following ReHire application and for their current job at the time of follow-up, and the analysis sample for these two outcomes is restricted to respondents with the respective job.[34] ReHire led to a 0.136 standard deviation ($p < 0.01$) and 0.111 standard deviation ($p < 0.05$) increase in the job quality index for the first and current job, respectively.[35] This index includes outcomes like self-reported job satisfaction, wage rate, consistency and availability of hours, and indicators for employer-provided benefits like vacation and sick leave or retirement contributions (see Appendix Table A-12). We also estimate a 0.175 standard deviation increase in well-being ($p < 0.01$), which includes improvements in life satisfaction and self-reported health and reductions in expectations of economic hardship and the depression scale (see Appendix Table A-13). Effects on employment barriers, soft skills measured by workplace behaviors, expectations about future employment, and reliance on government benefits are positive but small and not statistically significantly different from zero.

5.3 Outcomes from Credit Data

Using a panel of administrative credit data for ReHire applicants, we find no evidence that ReHire improved credit outcomes.[36] Appendix Table A-17 reports control group means and ITT estimates on the underlying outcomes. During the year after application, the average credit score in the control group was 596, just below the threshold for a prime credit score. The average control group member had roughly $28,500 in debt, including just over $1,700 in credit card debt, and one in six had a car loan or lease. Many had accounts negatively impacting their credit—one in seven had a delinquent account, one-third had a derogatory account, and nearly two-thirds had some debt in collections. As summarized by the standardized treatment effects reported in Panel C of Table 3, we find no statistically significant differences in post-

[34] In the case that an individual is still working in their first unsubsidized job following ReHire application, these two measures are based on characteristics for the same job. This is the case for the 27 percent of the control group and nearly 35 percent of the treatment group who have remained employed by the same employed (see Panel A).

[35] In the job quality index, we initially planned to include an indicator for whether the job provided a paystub or other government form as a measure of job formality. However, much of the variation in this measure was driven by movements into self-employment. Because it was not clear whether this indicator was measuring improvements or declines in job quality, we removed it from the index and instead report it as an outcome in Panel A, unconditional of whether the individual is working. If we were to include this measure in the index, the magnitude of the job quality index for current employment for the specification reported in column (4) falls to 0.067 and is not statistically significant.

[36] Appendix Section A.13.1 describes the selection into an Experian match (Appendix Table A-14), provides details on how we construct weights to adjust for attrition, and shows that the resulting matched sample is balanced on baseline characteristics between the treatment and control groups (Appendix Table A-15), and estimated program impacts on outcomes that are measured in the administrative data (employment and earnings) are similar for the analysis sample and the credit data subsample (Appendix Table A-16), which reduces concerns about attrition bias in the credit data analysis.

randomization outcomes between the treatment and control groups. The 95 percent confidence interval can reject 0.030 standard deviation and 0.054 standard deviation improvements in in-program and post-program credit, respectively.

6 Mechanisms and Program Impact Persistence

The analysis of state administrative data showed that ReHire had large positive impacts on employment and earnings during service receipt and smaller, but still positive, impacts in the year after program exit. We next provide additional descriptive evidence to examine the relative importance of the anticipated mechanisms discussed in Section 2.2. Recall that there are a number of channels through which ReHire could have lasting impacts on labor market outcomes including i) addressing barriers to employment through supportive services, ii) providing additional human capital through work-based learning, iii) reducing the scarring impact of a lack of recent work history, and/or iv) encouraging an employer to learn the quality of the applicant and of the applicant-employer match. Based on the evidence below, the key mechanism driving post-program impacts is subsidizing employer learning.

6.1 Impacts Are Concentrated Among Participants with a Transitional Job

To unpack the mechanisms, we first split the treatment group into three mutually exclusive subgroups based on their program experience: program exit without a transitional job placement, a placement that did not lead to a permanent job at the host site, or a placement that was followed by an unsubsidized job at the host site.[37] These treatment subgroups are not randomly assigned, and these splits therefore do not reflect the causal impact of these different program experiences. However, comparing trends in employment and earnings for these three treatment subgroups and for the control group (Figure 5) can provide insight into the contribution of the different potential mechanisms.

Figure 5 reveals that these four groups have remarkably similar experiences in the labor market prior to application but begin to diverge following application. First, all four groups have similar levels of pre-application employment—roughly 40 percent in a given quarter—and all experience a similar "Ashenfelter dip" in earnings. In the quarters following application, however, the two treatment subgroups who received a transitional job placement see a large increase in employment relative to the control group. Both the

[37] Appendix Section A.14.1 provides additional details on how we identified successful subsidized to unsubsidized transitions within an employer across ReHire program records and administrative earnings data.

subgroup who eventually transitioned to unsubsidized employment at their host site (solid black line with circles) and those who did not (dotted dark gray line with triangles) were more than 30 percentage points more likely to be employed in the first quarter following random assignment relative to the control group.

In contrast, the post-application trend in the employment rate among individuals who did not receive a transitional job (dashed light gray line with squares) closely mirrors the trend among the control group (dashed gold line with diamonds). There are multiple reasons why someone randomized into the treatment group may fail to be placed in a transitional job. They could choose not to continue participating in the program (recall that only 72 percent of treatment group members receive any direct cost services); they could receive some supportive services but fail to match with an available host site; or, they could receive some services and find unsubsidized employment prior to securing a subsidized placement. The lack of a meaningful gap between this group's outcomes and the control group's outcomes suggests that gaining access to ReHire-funded supportive services alone relative to having access to the standard set of services offered to all job seekers is insufficient to lead to substantial improvements in employment. Instead, nearly all of the positive estimated program impact in the main analysis—during both the in-program and post-program periods—is due to the experiences of the two treatment subgroups who were placed in a transitional job.

6.2 Evidence Supporting Employer Learning

Among those placed in a transitional job, there is a stark difference in the persistence of employment depending on whether a participant's transitional job led to an unsubsidized position with the same employer. After experiencing strong gains immediately following application, employment rates for the group whose transitional job did not lead to an unsubsidized position fell rapidly as their transitional jobs ended. The employment rate for this group converged to the rates for the control group and for the treatment group without a placement by the fourth quarter post-randomization, and the trends after that time are remarkably similar among all three groups. The participants who successfully transitioned to an unsubsidized job with the host employer, however, fared much better. Although the employment rate for this group fell somewhat from the second through the fifth quarter post-randomization, it remained roughly 20 percentage points higher than the rates of the other three groups throughout the post-program period (quarters 5–8). As shown in Figure 5b, this group also experienced substantial and persistent gains in earnings—more than $1,000 per quarter—in quarters 5–8. Figure 5c shows only moderately larger average earnings conditional on employment for this group compared to the other three groups, which suggests that the majority of the earnings differences are due to the higher employment rate rather than earning higher wages or working more hours.

This pattern of results is consistent with the interpretation that the employer learning mechanism is the primary means by which ReHire affects post-program outcomes, with other mechanisms making minimal contributions. Under this interpretation, the supported trial period allows the participants and employers to discover whether a potential match is profitable, and the continuation of the matches that are revealed to have large surpluses leads to persistent employment and earnings gains among a subset of transitional job holders. Importantly, the fact that participants who were not hired by their host site have post-program outcomes that match both the control group and the treatment subgroup who were not placed in a transitional job suggests that two other potential mechanisms— work-based human capital gains and reduced scarring—play a minimal role. If either of these mechanisms were important in ReHire's program impact, participants who held a transitional job but were not hired by their host site would nevertheless experience more positive post-program outcomes. Note that this interpretation does not require that scarring or work-based learning are unimportant in the low-wage labor market more generally. Instead, it is possible that any human capital gained from a short-duration transitional job—including the work experience listed on the resume—did not improve the ReHire participant's signal of quality to subsequent employers. Further, evidence from the follow-up survey showed little difference in employment barriers 18 months after application (Table 3), providing additional evidence that supportive services to address barriers likely had no direct effect on post-program outcomes.

6.3 Alternative Explanations for the Decomposition

There are, however, alternative explanations for the pattern of results in the decomposition of outcome trends among the treatment group. In general, these alternatives require program applicants to have heterogeneous treated outcomes for reasons other than employer learning. Using additional descriptive analysis, we consider and rule out two specific possible sources of such heterogeneity. First, case workers may have assigned the most job-ready participants to transitional jobs with higher likelihoods of leading to permanent employment so as to improve their performance on that criterion (i.e., "cream skimming," see Bell and Orr, 2002; Heckman and Smith, 2011). Second, the differential persistence may reflect differences in features of the placements themselves.

If cream skimming were happening, it would lead to systematic differences in the characteristics of the three different treatment subgroups shown in Figure 5. Instead, we find evidence that these three groups are remarkably similar across a rich set of baseline characteristics observable to the caseworker at the time of application, including the participants' baseline survey responses, job history, and the caseworker's assessment of the participant's likelihood to succeed in the program. The left portion of Figure 5 provides initial evidence of this similarity. Across the three outcomes, all three treatment subgroups and the control group have similar levels and similar trends prior to randomization. While slight differences exist in some quarters, employment rates of all four groups were around 40 to 45 percent (Figure 5a), with meaningful differences appearing only after application. Additionally, average earnings among all four groups followed similar trends in the quarters prior to randomization, with each group's earnings falling in advance of applying for the program (Figure 5b and Figure 5c).

Table 4 further demonstrates that the three treatment groups and the control group had similar observable baseline characteristics that could be related to their ability to find a job (subsidized or unsubsidized). Columns (1) through (4) report the mean characteristics of the control group and of the three treatment subgroups, respectively. Column (5) provides differences in means among the treatment group by transitional job placement, and column (6) reports differences based on subsequent permanent hire among those with a transitional job.[38] A few observable characteristics are statistically different by transitional job placement status (columns 3 and 4 vs. column 2). Participants who are men, have been homelessness, or had a prior felony conviction were less likely to receive a transitional job placement, and a test of the null hypothesis that job placement is unrelated to all of the listed baseline characteristics is rejected ($p < 0.01$). However, few characteristics are different between those who were hired by their transitional job host site and those who were not (column 4 vs. column 3), and we fail to reject the null hypothesis that, among those placed into a transitional job, being hired by one's host site is unrelated to the full set of baseline characteristics ($p = 0.81$). There are small differences in the caseworkers' scoring of an applicant's job readiness such as their "motivation to get back to work" or their "likelihood to overcome employment barriers." Appendix Section A.14.2 provides more detail on how the distribution of caseworker scores relates to transitional job placement rates and subsequent hiring rates (Appendix Figure A-7) and demonstrates that controlling for these two case worker assessments of job readiness does little to change the gap in the post-program employment rate for these two groups (Appendix Figure A-8).

[38] The differences in these two columns control for the same vendor-randomization rate block fixed effects as in the main analysis.

To more carefully determine whether there were systematic differences among these treatment subgroups, we used machine learning tools to test whether the individual characteristics measured in the administrative data and baseline survey are predictive of program experience. Appendix Section A.14.3 provides full details of the methods and results. Although the tools generate large in-sample differences in predicted program experience, these predictions do not perform well when applied to a holdout sample of treatment group individuals not used to form the prediction (see Appendix Table A-18). On the whole, this exercise confirms the qualitative results shown in Table 4, with baseline characteristics being somewhat predictive of transitional job receipt but not of being hired by the host site.

Table 5 examines the final candidate explanation for differences in persistence based on whether a participant with a transitional job is hired by their host site—differences in the placements themselves. All of the analysis in this table is limited to the 651 treatment group members who were placed in a transitional job, and columns (1) and (2) show average characteristics of the placement for the subgroups based on eventual unsubsidized hire status. Panel (A) demonstrates that those eventually hired on were placed in their transitional job somewhat more rapidly (0.26 fewer months) and stayed in their transitional job longer (109 more hours; 2.8 weeks). This second difference is consistent with the interpretation that the higher quality matches persist longer both during and after the subsidized period.

Panel B considers differences in the types of host sites where these two groups were placed. Participants who were hired by the host site following their transitional job were more likely to have placements in larger firms (500+ employees) and in manufacturing, transportation, or warehousing sectors. These differences are relatively small, however, and Appendix Figure A-8 shows that the vast majority of the gap in post-program employment between these two groups remains, even after adjusting for these differences in firm size and industry.

6.4 Understanding Key Features of the Low-Wage Labor Market

The labor market dynamics predicted by a search model augmented with noisy quality signals and employer learning (Pries and Rogerson, 2005, 2022) play out in the absence of a wage subsidy among the population eligible for ReHire. Figure 6 examines employment and earnings trends among individuals in the control group who worked in the quarter following application. The figure splits the sample by whether individuals are still employed by the same employer two quarters later (black line with circles) or not (gold dashed lines with diamonds).

The figure reveals three descriptive facts. First, pre-application levels and trends in employment and earnings are fairly consistent between the two groups, although those who maintain employment with the same employer have slightly higher earnings in the year before ReHire application. Second, a large share of matches end quickly—60 percent of those employed in Q1 are not employed with the same employer two quarters later. Finally, those who do not maintain employment with the same employer return to their long-run employment rate of roughly 50 percent and average earnings of about $2,500 per quarter, whereas those who continue employment with the same employer see lasting employment gains through at least the eighth quarter post-application. This figure therefore implies two key features of the low-wage labor market. First, it is difficult for an employer to predict a worker's fit with a position in advance. Second, match quality is not simply a function of unobserved durable traits of the worker. Instead, it appears to depend on idiosyncratic features of the match between the employer and the employee that are revealed only after the employee is hired but relatively early in the employee's tenure.

Further, the ReHire data allow us to test two additional predictions of how a subsidized and supported temporary job should affect the outcomes of participants based on this augmented search model. First, access to a wage subsidy should increase the likelihood that an individual forms a new match. In the equilibrium of the search model, an employer hires a potential employee if their quality signal exceeds a threshold, which will be lower for applicants who can work for free during a trial period. Second, matches formed without the wage subsidy should be of higher quality and more likely to persist relative to jobs formed with the subsidy. Because the wage subsidy lowers the hiring threshold, formed matches will be drawn from a lower portion of the signal distribution and, in expectation, will be of lower true productivity.

Appendix Section A.14.4 shows that data from the follow-up survey and the timing of transitional job placements are consistent with both of these predictions. Within 9 months of ReHire application, 90 percent of the treatment group who had access to the wage subsidy successfully started a new position—inclusive of transitional job placements—compared to only 60 percent in the control group. The transitional jobs, however, were substantially less likely to persist compared to unsubsidized matches formed among the control group. Only 29 percent of transitional job holders worked at their host-site employer 9 months after starting, whereas 50 percent of new matches among the control group lasted at least that long.

Taken together, the decomposition evidence and the consistency of the data with the model's predictions presented in this section suggest that a key way transitional jobs programs improve labor market attachment is by allowing firms and workers to form matches that otherwise would not have formed and to learn whether they create sufficient surplus. This finding has a clear policy implication that administrators of similar programs should aim to create placements that closely mirror unsubsidized jobs at the same employer. Further, it suggests that alternative policies that provide low-cost ways of allowing firms and workers to reveal their match quality could help address persistent unemployment in the lower-wage labor market more generally.

7 Treatment Effect Heterogeneity

Research on active labor market programs show a wide variety of effects between programs, and, in particular, across different types of target populations (Card, Kluve and Weber, 2018). ReHire has relatively broad eligibility criteria compared to many other transitional jobs programs, which usually target specific populations (e.g., formerly-incarcerated jobseekers or current TANF recipients), providing an opportunity to investigate which types of people benefit most from subsidized employment programs.

We take two approaches to explore heterogeneity. We first present descriptive sample splits that report program effects separately for subgroups of applicants. While the previous section documented that individual characteristics were not successful at predicting program experience, it is possible that different types of participants experienced larger program treatment effects for other reasons. In defining subgroups, we use characteristics that are known to be important in determining labor market outcomes—for example, gender, previous labor market attachment, education, grit, cognitive ability (Raven's), and acquired skills (math). Then, because we did not pre-specify particular subgroups of interest prior to data collection, we complement the subgroup analysis with a data-driven machine-learning approach to provide a more rigorous examination of heterogeneous treatment effects using the rich baseline data.

Figures 7 and 8 present the results of the subgroup analysis for quarterly employment rates and average earnings. Each point in the graph represents the coefficient on treatment status from estimating Equation 1 when limiting the sample to the subgroup listed on the vertical axis. For each subgroup listed, the complementary subgroup(s) also appears in the graph. For example, the figure includes both "Did not work last year" and "Worked last year" as subgroups. For baseline characteristics measured continuously, we show splits based on above-median ("High") or below-median ("Low") values of the characteristic. The solid black vertical line provides the estimated treatment effect using the entire sample, and the dashed vertical line at zero corresponds to no treatment effect.

The figures suggest that some groups fared better than others, which could be the result of actual underlying heterogeneity or because of sampling variability. For example, individuals who did not work in the year before application see the largest impacts on in-program employment. Interestingly, the estimated effects for populations targeted by the most similar programs—TANF recipients, applicants with a felony conviction, and veterans—are among the subgroups with negative estimates of post-program effects on employment and earnings. Across both outcomes and both time periods, however, the distribution of subgroup treatment effects is clustered fairly tightly around the full sample average treatment effect.

Because there are many potential characteristics to stratify on and because many of these measures are correlated, we adopt the method of Chernozhukov et al. (2020) to examine heterogeneity more systematically. This machine-learning-based method, described in more detail in Appendix Section A.15, provides a formal test of the null hypothesis that there is no predictable heterogeneity in treatment effects when using the full set of baseline characteristics as predictors. The results shown in Appendix Tables A-22 through A-26 demonstrate that the data fail to reject this null hypothesis although the confidence intervals are fairly wide. We nevertheless interpret the results of this exercise as reinforcing the conclusion that the treatment effects of ReHire are relatively homogeneous.

8 Discussion

This paper provides new evidence of the impact of an enhanced transitional jobs program on a wide variety of outcomes including employment, earnings, labor market attachment, SNAP/TANF usage, job quality, subjective well-being, credit worthiness, and credit usage. We find that, relative to the control group, the treatment group experienced a large increase in employment and earnings in the first year while receiving services. Although these gains attenuated after services stopped, treatment group members remained somewhat more likely to be employed and had moderately higher earnings compared to the control group during the second year following randomization. Further, 18 months after application, the treatment group also had higher job quality and self-reported well-being. We find no evidence that program access affected government benefit receipt, improved credit worthiness, or changed usage of credit.

In order to understand the cost-effectiveness of ReHire Colorado and to benchmark it against other programs, we construct estimates of the longer-term effects of ReHire and calculate the Marginal Value of Public Funds (MVPF) for expenditures on the program (Hendren and Sprung-Keyser, 2020) (see appendix Appendix Section A.16 for full details). To do so, we combine the previously discussed experimental impacts on 9 quarters of earnings with surrogate analysis using 19 quarters of post-application earnings from individuals who participated in ReHire prior to the RCT evaluation to project the effects of ReHire through 4.5 years after random assignment (Athey et al., 2019). Using these projected earnings effects and an annual discount rate of 3 percent yields an estimated willingness to pay of $3,150 per participant. Under the assumption that none of ReHire's services are available to the control group through other funding sources, the net costs of the program—after adjusting for increased taxes paid out of improved earnings—are $4,989. These estimated benefits and costs combine for an MVPF estimate of 0.64 with a 95 percent confidence interval of $(0.17, 1.24)$.[39] This estimate is well above the MVPF estimate for Job Corps and JobStart and is within the confidence interval of the adult JTPA program. It is also broadly in line with other policies targeting similar adults—unemployment insurance, disability insurance, and the EITC.[40] Overall, we interpret the results of this analysis as suggesting that transitional jobs programs like ReHire Colorado are a valuable policy tool in addressing the needs of unemployed lower-wage workers.

Our analysis also has three important implications for the design and operation of transitional jobs programs. First, the finding in Section 6 that all of the post-program gains in employment and earnings accrued to the 15 percent of the treatment group who both held a transitional job and were subsequently hired by their host site suggests that similar programs should strive to have more participants experience this outcome. ReHire job developers were explicitly encouraged to recruit host sites where successful participants could join as permanent employees. Future programs will likely see the largest post-program effects to the extent that they prioritize the possibility of this outcome when recruiting host sites. To illustrate the quantitative importance of this potential improvement, Appendix Table A-28 includes an alternative MVPF calculation under the assumption that 50 percent more participants (22.5 percent vs. 15 percent) were hired by their host site. The MVPF rises to nearly 1 in this scenario, meaning that a program meeting this objective would be as efficient as a non-distortionary transfer.

Second, our results suggest little scope for improving the effectiveness of transitional jobs programs by targeting specific sub-populations. Both the result from Section 6.3 showing that it is difficult to predict which participants will be hired by their host site and the results in Section 7 showing a lack of systematically heterogeneous treatment effects support the policy choice to operate this type of program with broad eligibility.

Third, this study provides an additional piece of evidence supporting the effectiveness of supportive ser-

[39]As expected, the MVPF rises substantially under alternative assumptions about the cost of ReHire services relative to the cost of similar services for the control group. Under the most generous assumption that the control group receives services equivalent to those paid for out of all of ReHire's indirect costs, the estimated MVPF is above 2.

[40]Estimates from Hendren and Sprung-Keyser (2020), Table II. More details are available in Appendix Section A.16.2.

vices as enhancements to subsidized employment programs. Although this study does not directly estimate the impact of wage subsidies alone, earlier evaluations of subsidized employment without wraparound services showed less promising results (Bloom, 2010), suggesting that including both program elements leads to a more positive impact. This interpretation is consistent with other recent evaluations of education (Azurdia and Galkin, 2020; Brough, Phillips and Turner, 2023; Evans et al., 2020; Weiss et al., 2019), housing (Bergman et al., 2020), and anti-poverty (Evans et al., 2023) programs that demonstrate the importance of individualized coaching or intensive case management.

Beyond its significance for transitional jobs programs specifically, the finding that employer learning is the key to ReHire's success has broader implications for the design of many programs supporting lower-wage unemployed workers. The evidence in Section 6.2 suggests that any skills learned during the supported transitional job either were not valued by or could not be credibly signalled to subsequent employers. This finding is consistent with recent experimental evidence among low-wage job seekers in South Africa that highlights the importance of being able to credibly signal skills to potential employers in improving employment and earnings (Carranza et al., 2022). Moreover, sectoral training programs have found success in providing transferable skills alongside industry-recognized certifications, with earnings gains lasting at least 5 years (Katz et al., 2022; Fein and Hamadyk, 2018; Fein and Dastrup, 2022). Together, this recent evidence suggests that programs that aim to improve outcomes through human capital accumulation will be most effective when combining training or work experience with an improved signal of those new skills to potential employers.

Finally, this paper furthers our understanding of the low-wage labor market more generally by providing empirical evidence consistent with a model where employers fully learn a worker's quality only after hiring them. As argued in Pries and Rogerson (2022), this framework implies that recent improvements in screening tools—such as algorithmic resume evaluation—will increasingly lead to workers with lower-quality signals being passed over by hiring managers. Absent interventions to encourage employers to take a chance on riskier applicants, this dynamic will continue to exacerbate inequality in the labor market and leave many workers stuck in cycles of unemployment.

References

Abadie, Alberto, Matthew M. Chingos, and Martin R. West. 2018. "Endogenous Stratification in Randomized Experiments." *The Review of Economics and Statistics*, 100(4): 567–580.

Anderson, Chloe, Mary Farrell, Asaph Glosser, and Bret Barden. 2019. "Testing Two Subsidized Employment Models for TANF Recipients: Final Impacts and Costs of the Los Angeles County Transitional Subsidized Employment Program." OPRE Report 2019-71.

Arulampalam, Wiji. 2001. "Is Unemployment Really Scarring? Effects of Unemployment Experiences on Wages." *Economic Journal*, 111(475): F585–F606.

Athey, Susan, Raj Chetty, Guido W. Imbens, and Hyunseung Kang. 2019. "The Surrogate Index: Combining Short-Term Proxies to Estimate Long-Term Treatment Effects More Rapidly and Precisely." *NBER Working Paper No. 26463.*

Azurdia, Gilda, and Katerina Galkin. 2020. "An Eight-Year Cost Analysis from a Randomized Controlled Trial of CUNY's Accelerated Study in Associate Programs." MDRC.

Barden, Bret, Randall Juras, Cindy Redcross, Mary Farrell, and Dan Bloom. 2018. "New Perspectives on Creating Jobs: Final Impacts of the Next Generation of Subsidized Employment Programs." New York: MDRC.

Barnow, Burt S, and Jeffrey Smith. 2015. "Employment and Training Programs." In *Economics of Means-Tested Transfer Programs in the United States, Volume 2.* 127–234. University of Chicago Press.

Belloni, Alexandre, Victor Chernozhukov, and Christian Hansen. 2014. "Inference on Treatment Effects after Selection among High-Dimensional Controls." *The Review of Economic Studies*, 81(2): 608–650.

Bell, Stephen H, and Larry L Orr. 2002. "Screening (and Creaming?) Applicants to Job Training Programs: The AFDC Homemaker–Home Health Aide Demonstrations." *Labour Economics*, 9(2): 279–301.

Bergman, Peter, Raj Chetty, Stefanie DeLuca, Nathaniel Hendren, Lawrence F. Katz, and Christopher Palmer. 2020. "Creating Moves to Opportunity: Experimental Evidence on Barriers to Neighborhood Choice." *NBER Working Paper 26164.*

Bhatt, Monica P., Sara B. Heller, Max Kapustin, Marianne Bertrand, and Christopher Blattman. 2023. "Predicting and Preventing Gun Violence: An Experimental Evaluation of READI Chicago." *NBER Working Paper 30852.*

Bloom, Dan. 2010. "Transitional Jobs: Background, Program Models, and Evaluation Evidence." New York: MDRC.

Brough, Rebecca, David C. Phillips, and Patrick S. Turner. 2023. "High Schools Tailored to Adults Can Help Them Complete a Traditional Diploma and Excel in the Labor Market." *Working Paper*, Available at SSRN: https://ssrn.com/abstract=3840453.

Card, David, Jochen Kluve, and Andrea Weber. 2010. "Active Labour Market Policy Evaluations: A Meta-Analysis." *The Economic Journal*, 120(548): F452–F477.

Card, David, Jochen Kluve, and Andrea Weber. 2018. "What Works? A Meta Analysis of Recent Active Labor Market Program Evaluations." *Journal of the European Economic Assoication*, 16(3): 894–931.

Carranza, Eliana, Robert Garlick, Kate Orkin, and Neil Rankin. 2022. "Job Search and Hiring with Limited Information about Workseekers' Skills." *American Economic Review*, 112(11): 3547–83.

Chernozhukov, Victor, Mert Demirer, Esther Duflo, and Iván Fernández-Val. 2020. "Generic Machine Learning Inference on Heterogenous Treatment Effects in Randomized Experiments, with an Application to Immunization in India." *Papers 1712.04802, arXiv.org.*

Cummings, Danielle, and Dan Bloom. 2020. "Can Subsidized Employment Programs Help Disadvantaged Job Seekers? A Synthesis of Findings from Evaluations of 13 Programs." OPRE Report 2020-23.

Cummings, Danielle, Mary Farrell, and Melanie Skemer. 2018. "Forging a Path: Final Impacts and Costs of New York City's Young Adult Internship Program." New York: MDRC.

Davis, Jonathan M.V., and Sarah B. Heller. 2020. "Rethinking the Benefits of Youth Employmen Programs: The Heterogenous Effects of Summer Jobs." *The Review of Economics and Statistics*, 102(4): 664–677.

Diamond, Peter A. 1982. "Wage Determination and Efficiency in Search Equilibrium." *The Review of Economic Studies*, 49(2): 217–227.

Donnellan, M. Brent, Frederick L. Oswald, Brendan M. Baird, and Richard E. Lucas. 2006. "The Mini-IPIP Scales: Tiny-Yet-Effective Measures of the Big Five Factors of Personality." *Psychological Assessment*, 18(2): 193–203.

Duckworth, Angela L., Christopher Peterson, Michael D. Matthews, and Dennis R. Kelly. 2007. "Grit: Persverance and Passion for Long-Term Goals." *Journal of Personality and Social Psychology*, 92(6): 1087–1101.

Dustmann, Christian, and Costas Meghir. 2005. "Wages, Experience and Seniority." *The Review of Economic Studies*, 72(1): 77–108.

Eriksson, Stefan, and Dan-Olof Rooth. 2014. "Do Employers Use Unemployment as a Sorting Criterion When Hiring? Evidence from a Field Experiment." *American Economic Review*, 104(3): 1014–1039.

Evans, William N, Melissa S Kearney, Brendan Perry, and James X Sullivan. 2020. "Increasing Community College Completion Rates Among Low-Income Students: Evidence from a Randomized Controlled Trial Evaluation of a Case-Management Intervention." *Journal of Policy Analysis and Management*, 39(4): 930–965.

Evans, William N., Shawna Kolka, James X. Sullivan, and Patrick S. Turner. 2023. "Fighting Poverty One Family at a Time: Experimental Evidence from an Intervention with Holistic, Individualized, and Wrap-Around Services." *NBER Working Paper 30992*.

Farber, Henry S, Chris M Herbst, Dan Silverman, and Till Von Wachter. 2019. "Whom Do Employers Want? The Role of Recent Employment and Unemployment Status and Age." *Journal of Labor Economics*, 37(2): 323–349.

Fein, David, and Jill Hamadyk. 2018. "Bridging the Opportunity Divide for Low-Income Youth: Implementation and Early Impacts of the Year Up Program." OPRE Report #2018-65, Washington, DC: Office of Planning, Research, and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services.

Fein, David, and Samuel Dastrup. 2022. "Benefits that Last: Long-Term Impact and Cost-Benefit Findings for Year Up." OPRE Report #2022-77, Washington, DC: Office of Planning, Research, and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services.

Finkelstein, Amy, Sarah Taubman, Bill Wright, Mira Bernstein, Jonathan Gruber, Joseph P Newhouse, Heidi Allen, Katherine Baicker, and Oregon Health Study Group. 2012. "The Oregon Health Insurance Experiment: Evidence from the First Year." *The Quarterly Journal of Economics*, 127(3): 1057–1106.

Foley, Kimberly, Mary Farrell, and Riley Webster. 2018. "Reducing Recidivism and Increasing Opportunity: Benefits and Costs of the RecycleForce Enhanced Transitional Jobs Program." MEF Associates and MDRC.

Gangl, Markus. 2006. "Scar Effects of Enemployment: An Assessment of Institutional Complementarities." *American Sociological Review*, 71(6): 986–1013.

Gelber, Alexander, Adam Isen, and Judd B Kessler. 2016. "The Rffects of Youth Employment: Evidence from New York City Lotteries." *The Quarterly Journal of Economics*, 131(1): 423–460.

Glosser, Asaph, Bret Barden, and Sonya Williams. 2016. "Testing Two Subsidized Employment Approaches for Recipients of Temporary Assistance for Needy Families: Implementation and Early Impacts of the Los Angeles County Transitional Subsidized Employment Program." New York: MDRC.

Greenberg, David H, Charles Michalopoulos, and Philip K Robins. 2003. "A Meta-Analysis of Government-Sponsored Training Programs." *ILR Review*, 57(1): 31–53.

Heckman, James J, Robert J LaLonde, and Jeffrey A Smith. 1999. "The Economics and Econometrics of Active Labor Market Programs." In *Handbook of Labor Economics*. Vol. 3, 1865–2097. Elsevier.

Heckman, James, Neil Hohmann, Jeffrey Smith, and Michael Khoo. 2000. "Substitution and Dropout Bias in Social Experiments: A Study of an Influential Social Experiment." *The Quarterly Journal of Economics*, 115(2): 651–694.

Heckman, J, and Jeffrey Smith. 2011. "Do the Determinants of Program Participation Data Provide Evidence of Cream Skimming?" *The Performance of Performance Standards*, 125–202.

Heller, Sara B. 2014. "Summer Jobs Reduce Violence Among Disadvantaged Youth." *Science*, 346(6214): 1219–1223.

Hendren, Nathaniel, and Ben Sprung-Keyser. 2020. "A Unified Welfare of Government Policies." *The Quarterly Journal of Economics*, 135(3): 1209–1318.

Imbens, Guido W., and Jeffrey M. Wooldridge. 2009. "Recent Developments in the Econometrics of Program Evaluation." *Journal of Economic Literature*, 37(1): 5–86.

Jacobson, Louis S, Robert J LaLonde, and Daniel G Sullivan. 1993. "Earnings Losses of Displaced Workers." *The American Economic Review*, 83(4): 685–709.

Jones, Damon. 2015. "The Economics of Exclusion Restrictions." *NBER Working Paper 21391*.

Jones, Damon, David Molitor, and Julian Reif. 2019. "What Do Workplace Wellness Programs Do? Evidence from the Illinois Workplace Wellness Study." *The Quarterly Journal of Economics*, 134(4): 1747–1791.

Jovanovic, Boyan. 1979. "Job Matching and the Theory of Turnover." *Journal of Political Economy*, 87(5, Part 1): 972–990.

Katz, Lawrence F, Jonathan Roth, Richard Hendra, and Kelsey Schaberg. 2022. "Why Do Sectoral Employment Programs Work? Lessons from WorkAdvance." *Journal of Labor Economics*, 40(S1): S249–S291.

Katz, Lawrence, Kory Kroft, Fabian Lange, and Matthew Notowidigdo. 2014. "Addressing Long-Term Unemployment in the Aftermath of the Great Recession." *VOX CEPR Policy Portal*.

Kline, Patrick, and Christopher R Walters. 2016. "Evaluating Public Programs with Close Substitutes: The Case of Head Start." *The Quarterly Journal of Economics*, 131(4): 1795–1848.

Kroft, Kory, Fabian Lange, and Matthew J Notowidigdo. 2013. "Duration Dependence and Labor Market Conditions: Evidence from a Field Experiment." *The Quarterly Journal of Economics*, 128(3): 1123–1167.

Kuhn, Max. 2009. "The Caret Package." *Journal of Statistical Software*, 28(5).

Lachowska, Marta, Alexandre Mas, and Stephen A Woodbury. 2020. "Sources of Displaced Workers' Long-Term Earnings Losses." *American Economic Review*, 110(10): 3231–66.

Modestino, Alicia Sasser. 2019. "How Do Summer Youth Employment Programs Improve Criminal Justice Outcomes, and for Whom?" *Journal of Policy Analysis and Management*, 38(3): 600–628.

Mortensen, Dale T. 1982. "The Matching Process as a Noncooperative Bargaining Game." In *The Economics of Information and Uncertainty*. 233–258. University of Chicago Press.

Phillips, David C. 2020. "Measuring Housing Stability With Consumer Reference Data." *Demography*, 57(4): 1323–1344.

Pissarides, Christopher A. 1990. *Equilibrium Unemployment Theory.* Oxford, Blackwell.

Pries, Michael, and Richard Rogerson. 2005. "Hiring Policies, Labor Market Institutions, and Labor Market Flows." *Journal of Political Economy*, 14(1): 260–300.

Pries, Michael J., and Richard Rogerson. 2022. "Declining Worker Turnover: The Role of Short-Duration Employment Spells." *American Economic Journal: Macroeconomics*, 14(1): 260–300.

Raven, John C., John H. Court, and Jean Raven. 1984. *Manual for Raven's Progressive Matrices and Vocabulary Scales. Section 2: Coloured Progressive Matrices.* London: H.K. Lewis.

Rose, Evan K, and Yotam Shem-Tov. 2023. "How Replaceable Is a Low-Wage Job?" *Working Paper*.

Ruggles, Steven, Sarah Flood, Ronald Goeken, Josiah Grover, Erin Meyer, Jose Pacas, and Matthew Sobek. 2020. *IPUMS USA: Version 10.0 [dataset].* Minneapolis, MN: IPUMS.

Ruhm, Christopher J. 1991. "Are Workers Permanently Scarred by Job Displacements?" *The American Economic Review*, 81(1): 319–324.

Stevens, Ann Huff. 1997. "Persistent Effects of Job Displacement: The Importance of Multiple Job Losses." *Journal of Labor Economics*, 15(1): 165–188.

Tolman, Richard M., Sheldon H. Danzinger, Kristine Siefert, Sandra K. Danzinger, Mary E. Corcoran, and Kristin S. Seefeldt. 2018. *The Women's Employmen Study, Genesee County, Michigan, 1997-2004.* Interuniversity Consortium for Political and Social Research [distributor].

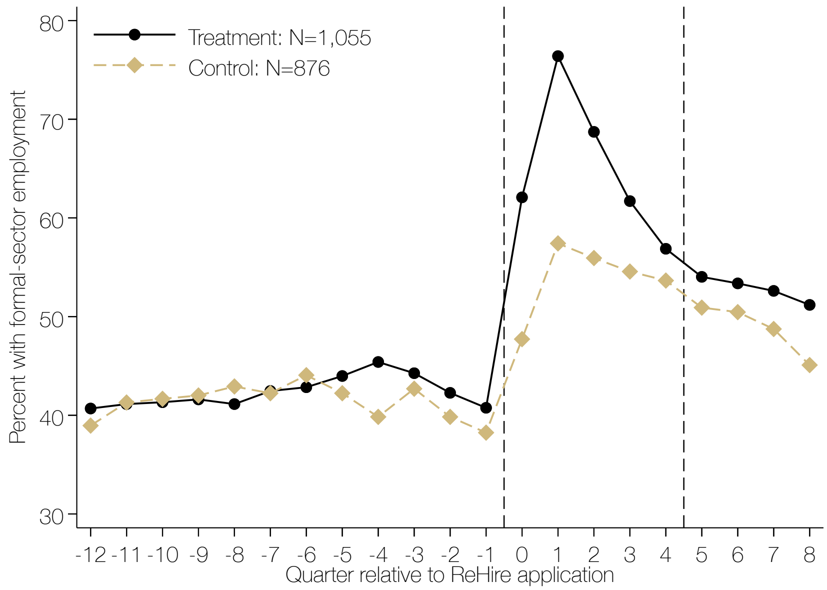
Weiss, Michael J., Alyssa Ratledge, Colleen Sommo, and Himani Gupta. 2019. "Supporting Community College Students from Start to Degree Completion: Long-Term Evidence from a Randomized Trial of CUNY's ASAP." *American Economic Journal: Applied Economics*, 11(3): 253–97.

Westfall, Peter H, and S Stanley Young. 1993. *Resampling-Based Multiple Testing: Examples and Methods for p-value Adjustment.* Vol. 279, John Wiley & Sons.

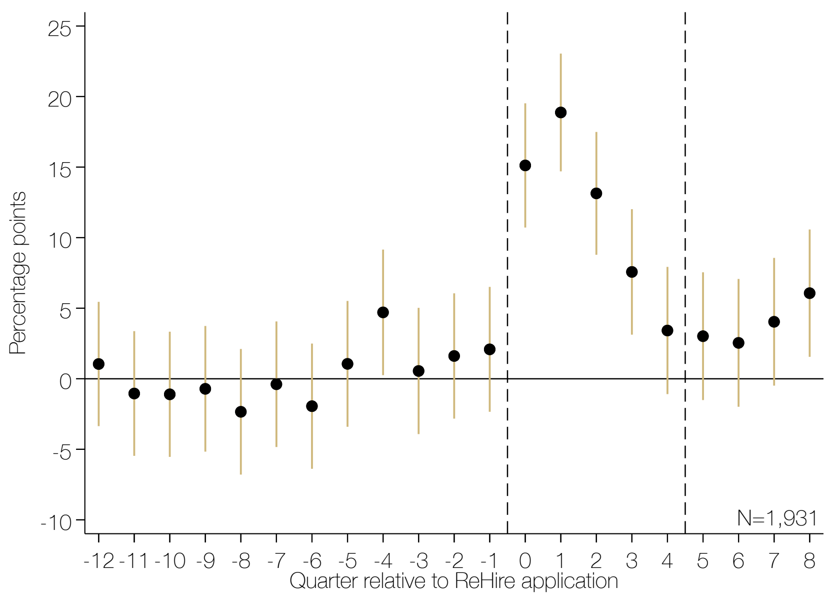
Young, Alwyn. 2019. "Channeling Fisher: Randomization Tests and the Statistical Insignificance of Seemingly Significant Experimental Results." *The Quarterly Journal of Economics*, 134(2): 557–598.

Figure 1: Formal-Sector Employment Rates in Colorado by Treatment Status

(a) Trends



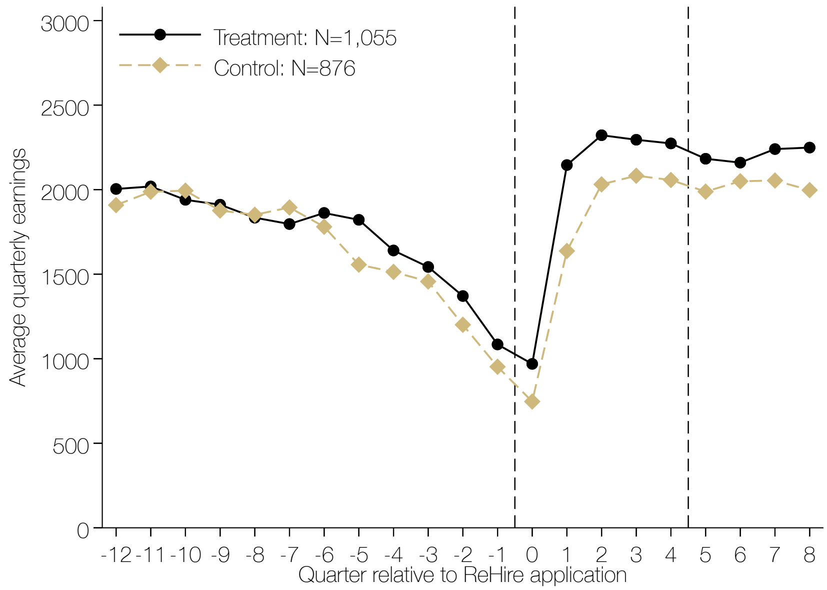
(b) ITT Effects



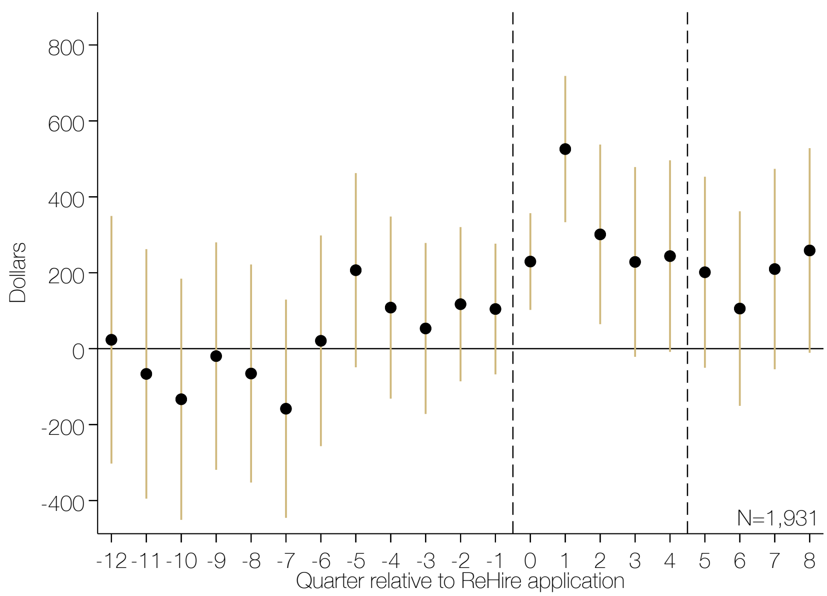
Notes: Data source is administrative UI earnings data from CDLE. The sample includes 1,931 ReHire applicants who applied between 7/2015 and 12/2017. Quarter 0 represents the quarter in which a study participant completed their ReHire application, and is thus a different calendar quarter from person to person. Formal-sector employment is defined as having UI-covered earnings in Colorado greater than $0 in a given quarter. Earnings from a ReHire-sponsored transitional job are covered by the UI system and are thus counted as formal-sector employment. Treatment and control groups are based on an individual's randomly assigned treatment status. The top panel plots the percent of treatment and control applicants with formal-sector employment. The bottom panel plots the treatment-control differences in average quarterly employment, controlling for stratification fixed effects. Gold vertical bars represent the 95 percent confidence intervals constructed using heteroskedasticity-robust standard errors. The p-value from a test that all pre-treatment differences are jointly 0 is 0.153. Point estimates and standard errors for post-application differences are reported in Appendix Table A-4.

Figure 2: Formal-Sector Earnings in Colorado by Treatment Status

(a) Trends



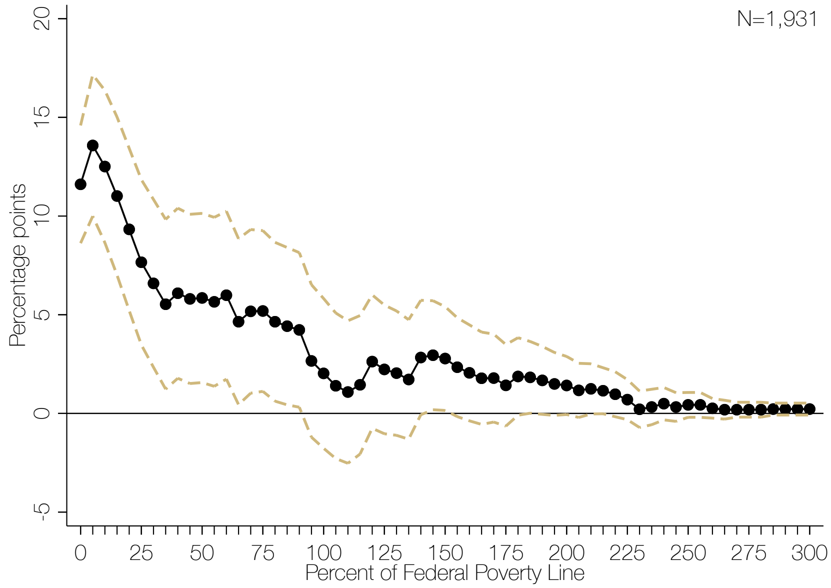
(b) ITT Effects



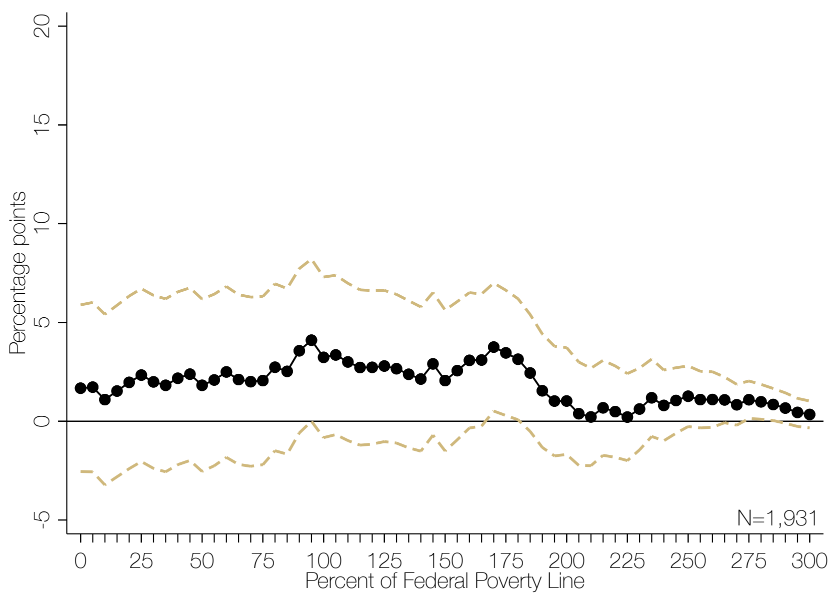
Notes: Data source is administrative UI earnings data from CDLE. The sample includes 1,931 ReHire applicants who applied between 7/2015 and 12/2017. Quarter 0 represents the quarter in which a study participant completed their ReHire application, and is thus a different calendar quarter from person to person. Formal earnings is defined as UI-covered earnings in Colorado in a given quarter. Earnings from a ReHire-sponsored transitional job are covered by the UI system and are thus counted as formal sector earnings. Treatment and control groups are based on an individual's randomly assigned treatment status. The top panel plots the average quarterly earnings in Colorado of treatment and control applicants. The bottom panel plots the treatment-control differences in average quarterly employment, controlling for stratification fixed effects. Gold vertical bars represent the 95 percent confidence intervals constructed using heteroskedasticity-robust standard errors. The p-value from a test that all pre-treatment differences are jointly 0 is 0.170. Point estimates and standard errors for post-application differences are reported in Appendix Table A-4.

Figure 3: ITT Effect of ReHire on the Likelihood That Earnings Exceed Federal Poverty Line Thresholds

(a) In-Program Earnings (Q0–Q4)



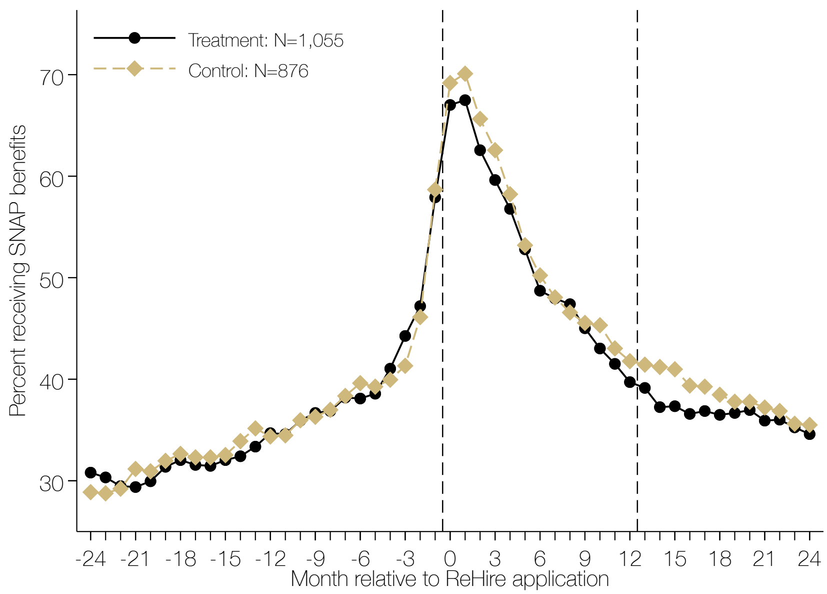
(b) Post-Program Earnings (Q5–Q8)



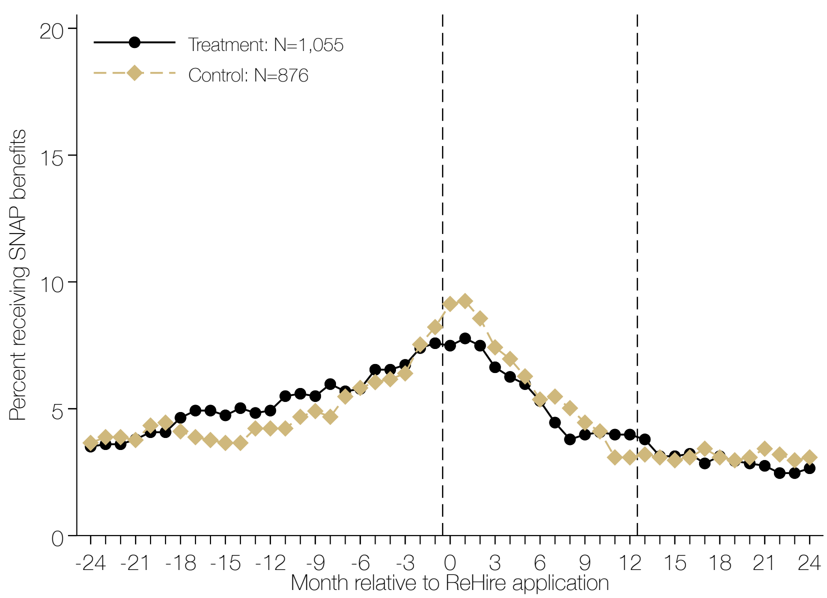
Notes: Data source is administrative UI earnings data from CDLE. The sample includes 1,931 ReHire applicants who applied between 7/2015 and 12/2017. The figure plots the coefficients from regressions where the outcome is an indicator that an individual's earnings exceeded a given percent of the federal poverty line, assuming a single-person household. Earnings in the top panel are measured from the quarter of random assignment through the fourth quarter following random assignment. Earnings in the bottom panel are measured from the fifth quarter following random assignment through the eighth quarter following random assignment. The horizontal axis depicts the threshold. The vertical axis depicts the magnitude of the point estimate in percentage points. Connected black circles represent each of the estimated ITT effects and the dashed gold lines above and below represent the 95% confidence intervals constructed using heteroskedasticity-robust standard errors.

Figure 4: SNAP and TANF Participation in Colorado by Treatment Status

(a) SNAP

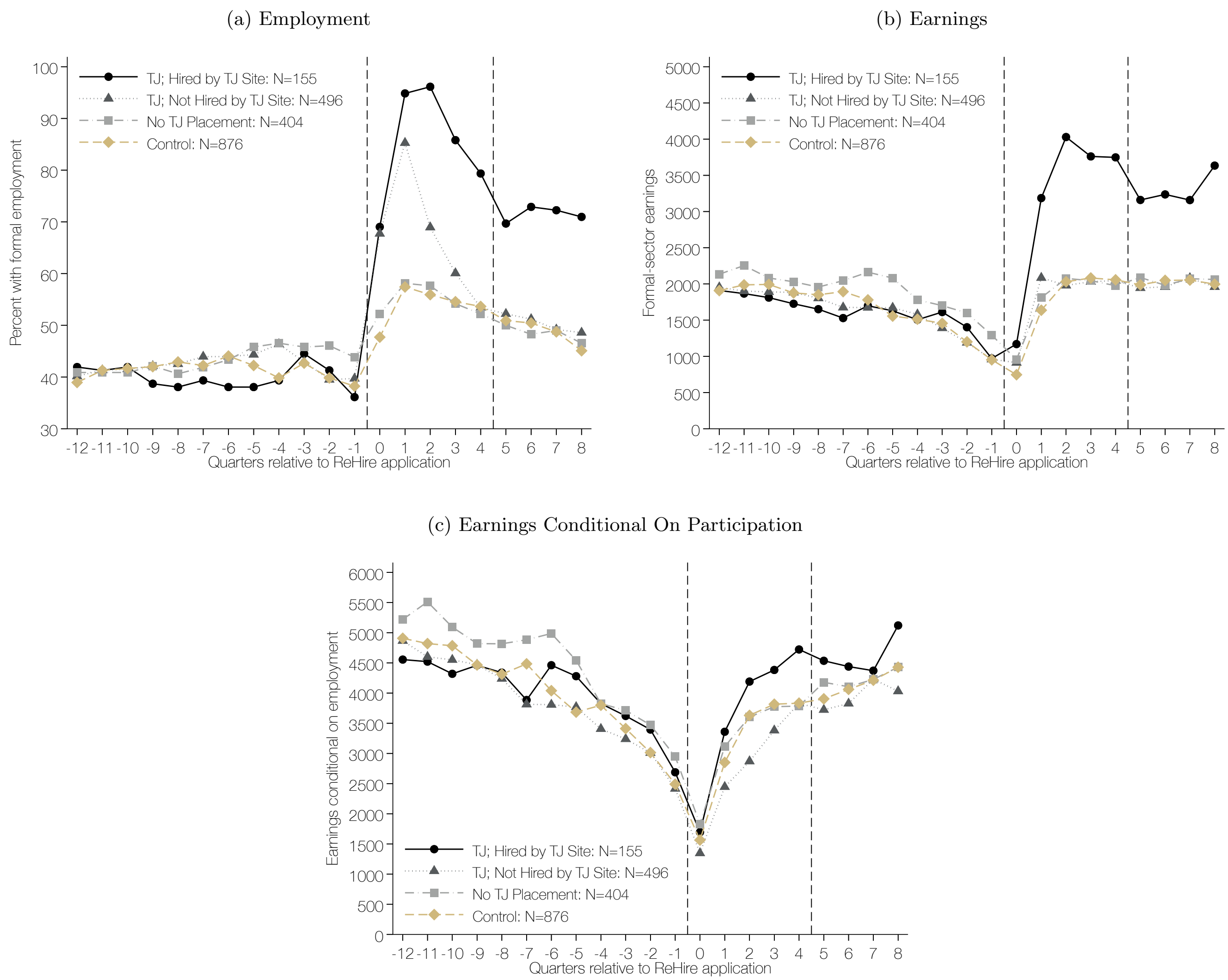


(b) TANF



Notes: Data source is administrative SNAP and TANF data from CDHS. Each monthly sample includes 1,931 ReHire participants who applied between 7/2015 and 12/2017. Month 0 represents the month in which an individual completed their application, and is thus a different calendar month from person to person. Individuals are coded as receiving SNAP/TANF if they were paid a monthly benefit from CDHS; benefits received in other states are not observed and are treated as zero. Treatment and Control groups are based on an individual's results in the randomization process. The top panel plots the percent of treatment and control applicants participating in SNAP in a given month. The bottom panel plots the percent of treatment and control applicants participating in TANF in a given month.

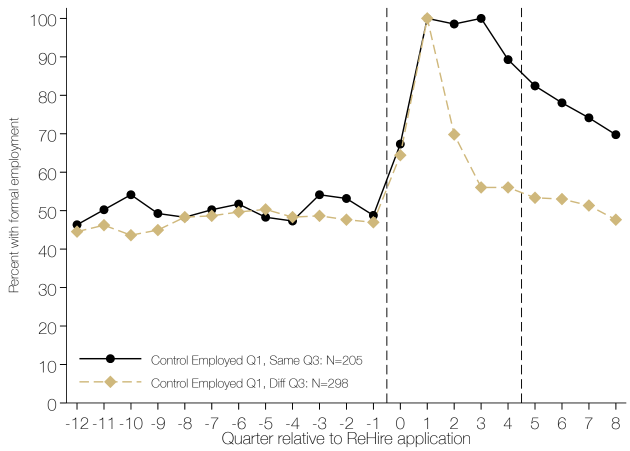
Figure 5: Formal-Sector Employment and Earnings in Colorado
by Treatment Assignment and Transitional Job Completion



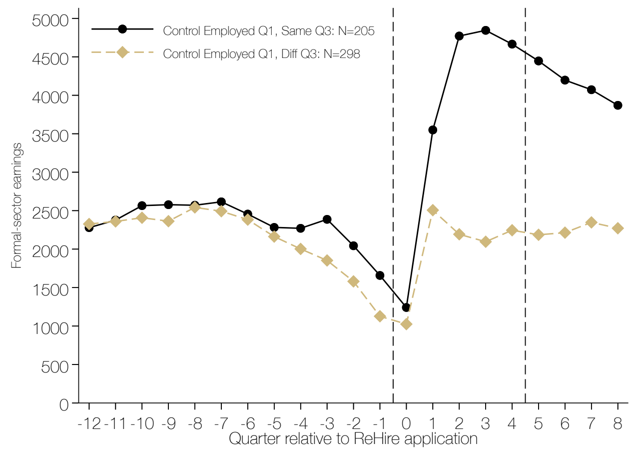
Notes: Data source is administrative UI earnings data from CDLE. The sample includes 1,931 ReHire applicants who applied between 7/2015 and 12/2017. Quarter 0 represents the quarter in which a study participant completed their ReHire application, and is thus a different calendar quarter from person to person. Formal earnings is defined as UI-covered earnings in Colorado in a given quarter. Earnings from a ReHire-sponsored transitional job are covered by the UI system and are thus counted as formal sector earnings. Treatment and control groups are based on an individual's randomly assigned treatment status. The treatment group is further divided based on transitional job (TJ) receipt and whether individuals were hired by their transitional job host site. The figure plots the quarterly employment rates (a), average quarterly earnings (b), and average quarterly earnings among individuals with positive earnings (c).

Figure 6: Control Group Formal-Sector Employment and Earnings in Colorado by Quarter 1 and Quarter 3 Employment

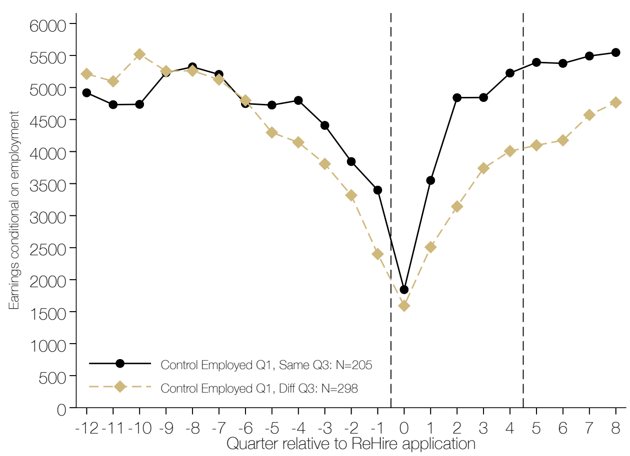
(a) Employment



(b) Earnings



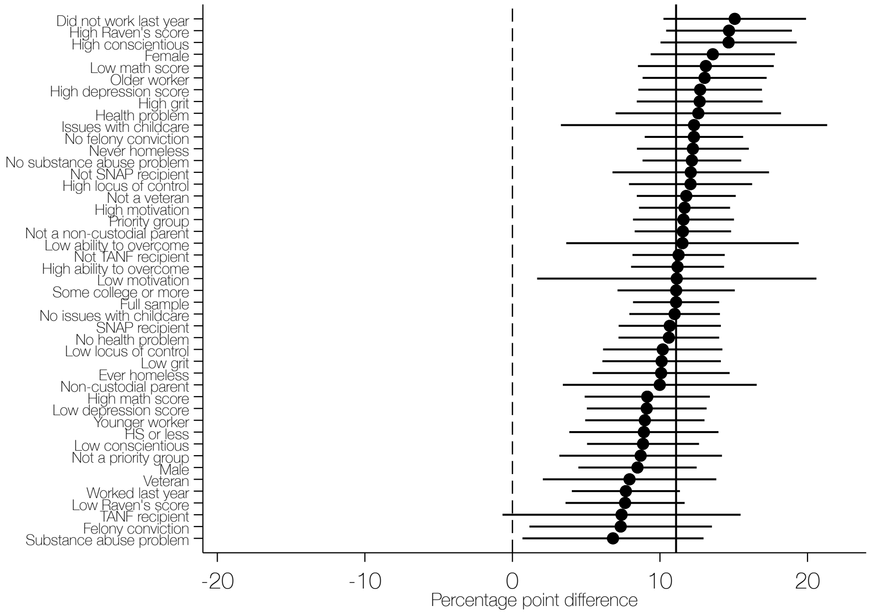
(c) Earnings Conditional On Participation



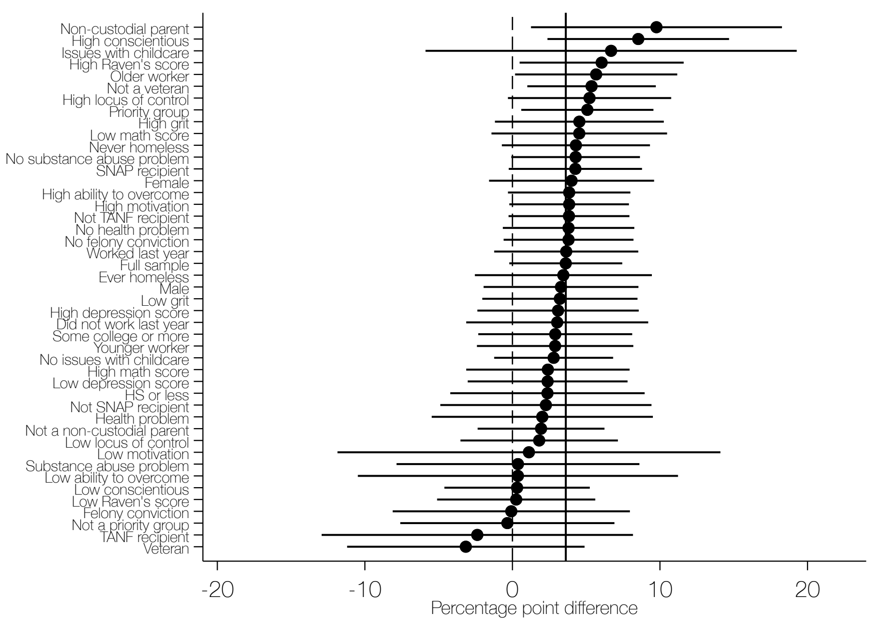
Notes: Data source is administrative UI earnings data from CDLE. The sample includes 503 ReHire applicants who applied between 7/2015 and 12/2017, were assigned to the control group, and were employed in the first quarter following application. Quarter 0 represents the quarter in which a study participant completed their ReHire application, and is thus a different calendar quarter from person to person. Formal earnings is defined as UI-covered earnings in Colorado in a given quarter. Two groups are defined by employment in quarters 1 and 3: worked for the same employer in quarters 1 and 3 (black circles); and worked in quarter 1, but did not work or worked for different employer in quarter 3 (gold diamonds). The figure plots the quarterly employment rates (a), average quarterly earnings (b), and average quarterly earnings among individuals with positive earnings (c) for each group.

Figure 7: Heterogenous Impacts on Employment

(a) In-Program Share of Quarters Worked (Q0–Q4)



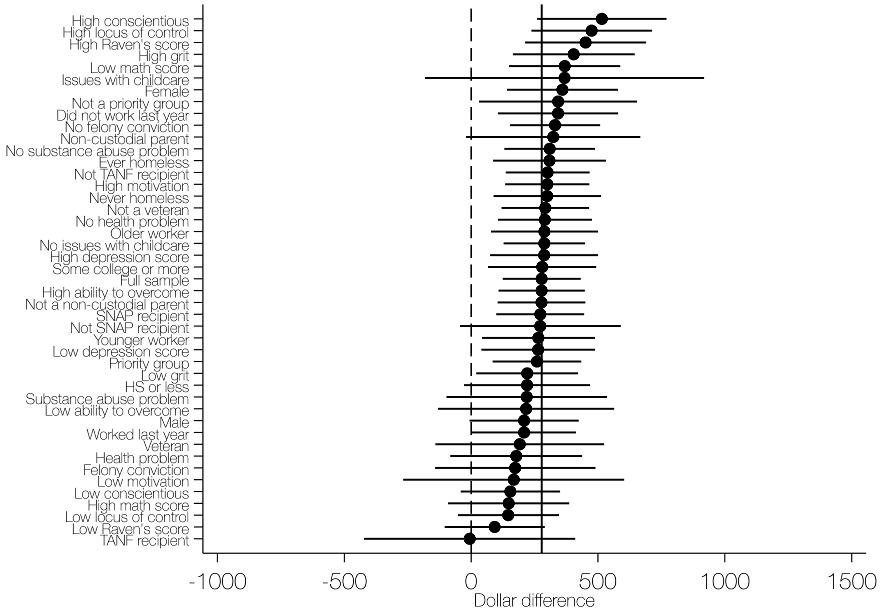
(b) Post-Program Share of Quarters Worked (Q5–Q8)



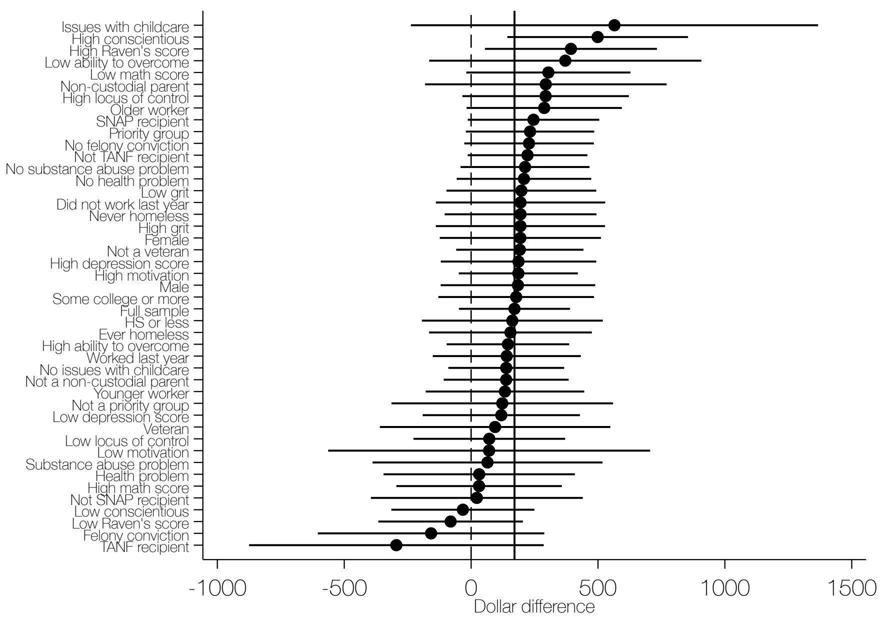
Notes: Data source is administrative UI earnings data from CDLE. The sample includes 1,931 ReHire applicants who applied between 7/2015 and 12/2017. Each figure plots ITT effect estimates for subgroups defined by baseline characteristics. Black circles report the coefficient on a treatment indicator, selecting controls from a high-dimensional set of baseline characteristics using the post-double selection LASSO procedure from Belloni, Chernozhukov and Hansen (2014), where the sample is restricted to individuals who match the criteria listed along the vertical axis. Horizontal black bars represent the 95% confidence intervals constructed using heteroskedasticity-robust standard errors. The solid black vertical line represents the magnitude of the treatment effect in the full sample. The outcomes in Panels (a) and (b) are average quarterly employment rates in the in-program and post-program periods, respectively.

Figure 8: Heterogenous Impacts on Earnings

(a) In-Program Average Quarterly Earnings (Q0–Q4)



(b) Post-Program Average Quarterly Earnings (Q5–Q8)



Notes: Data source is administrative UI earnings data from CDLE. The sample includes 1,931 ReHire applicants who applied between 7/2015 and 12/2017. Each figure plots ITT effect estimates for subgroups defined by baseline characteristics. Black circles report the coefficient on a treatment indicator, selecting controls from a high-dimensional set of baseline characteristics using the post-double selection LASSO procedure from Belloni, Chernozhukov and Hansen (2014), where the sample is restricted to individuals who match the criteria listed along the vertical axis. Horizontal black bars represent the 95% confidence intervals constructed using heteroskedasticity-robust standard errors. The solid black vertical line represents the magnitude of the treatment effect in the full sample. The outcomes in Panels (a) and (b) are average quarterly earnings in the in-program and post-program periods, respectively.

Table 1: ITT Effect of ReHire on Formal-Sector Employment and Earnings in Colorado

	Control Mean (1)	ITT Effect No Controls (2)	ITT Effect Controls (3)	Percent Change (4)
Panel A: In-Program Employment (Quarters 0–4)				
Any employment	0.808	0.119**	0.115**	14%
		(0.016)	(0.015)	
Share of quarters worked	0.539	0.116**	0.111**	21%
		(0.016)	(0.015)	
Worked every quarter	0.237	0.077**	0.071**	30%
		(0.020)	(0.019)	
Average quarterly earnings	$1,812	$288**	$247**	14%
		(95)	(86)	
Share of quarters above 130% FPL	0.192	0.023+	0.018	10%
		(0.013)	(0.012)	
Panel B: Post-Program Employment (Quarters 5–8)				
Any employment	0.627	0.018	0.017	3%
		(0.022)	(0.022)	
Share of quarters worked	0.488	0.039+	0.037+	8%
		(0.020)	(0.020)	
Worked every quarter	0.332	0.071**	0.066**	20%
		(0.022)	(0.022)	
Average quarterly earnings	$2,330	$196	$157	7%
		(144)	(135)	
Share of quarters above 130% FPL	0.261	0.026	0.023	9%
		(0.018)	(0.017)	
Agency-Rate Block FEs		X	X	
Individual Baseline Controls			X	
Observations	876	1,931	1,931	

Notes: Data source is administrative UI earnings data from CDLE. Panels A and B report estimates on in-program and post-program employment outcomes, respectively, for the sample of ReHire applicants who applied between 7/2015 and 12/2017. Quarter 0 represents the quarter in which a participant completed an application, and is thus a different calendar quarter from person to person. Formal employment is defined as having UI-covered earnings in Colorado greater than $0 in a given quarter. Earnings from a ReHire-sponsored transitional job are covered by the UI system and are thus counted as formal sector employment. Column (1) reports the mean for control group applicants. Column (2) reports the coefficient on a treatment indicator, controlling for vendor-randomization rate block (stratification) fixed effects. Column (3) reports the coefficient on a treatment indicator, selecting controls from a high-dimensional set of baseline characteristics using the post-double selection LASSO procedure from Belloni, Chernozhukov and Hansen (2014). Column (4) reports the percent change of the ITT effect in column (3) relative to the control group mean. Heteroskedasticity-robust standard errors in parentheses.

**0.01, *0.05, +0.10 significance levels

Table 2: ITT Effect of ReHire on SNAP and TANF Receipt in Colorado

	Control Mean (1)	ITT Effect No Controls (2)	ITT Effect Controls (3)	Percent Change (4)
Panel A: In-Program Benefits (Months 0–12)				
Any SNAP Receipt	0.769	-0.005	-0.000	-0%
		(0.019)	(0.015)	
Share of months with SNAP	0.538	-0.015	-0.007	-1%
		(0.018)	(0.013)	
Average monthly SNAP receipt	$145.51	-$6.63	-$6.18	-4%
		(8.01)	(4.82)	
Any TANF Receipt	0.111	-0.013	-0.009	-8%
		(0.014)	(0.008)	
Share of months with TANF	0.061	-0.007	-0.005	-8%
		(0.009)	(0.005)	
Average monthly TANF receipt	$26.05	-$2.61	-$2.69	-10%
		(4.10)	(2.50)	
Panel B: Post-Program Benefits (Months 13–24)				
Any SNAP Receipt	0.523	0.001	0.002	0%
		(0.023)	(0.020)	
Share of months with SNAP	0.385	-0.020	-0.018	-5%
		(0.019)	(0.017)	
Average monthly SNAP receipt	$95.07	-$2.31	-$3.34	-4%
		(7.38)	(5.22)	
Any TANF Receipt	0.053	-0.000	0.001	2%
		(0.010)	(0.009)	
Share of months with TANF	0.032	-0.003	-0.003	-10%
		(0.007)	(0.006)	
Average monthly TANF receipt	$14.18	-$2.32	-$2.66	-19%
		(3.19)	(2.70)	
Agency-Rate Block FEs		X	X	
Individual Baseline Controls			X	
Observations	876	1,931	1,931	

Notes: Data source is administrative SNAP and TANF data from CDHS. Panels A and B report estimates on in-program and post-program benefit outcomes, respectively, for the sample of ReHire applicants who applied between 7/2015 and 12/2017. Month 0 represents the month in which a participant completed an application, and is thus a different calendar month from person to person. Benefit receipt is defined as having received any benefit in Colorado greater than $0 in a given month. Column (1) reports the mean for control group applicants. Column (2) reports the coefficient on a treatment indicator, controlling for vendor-randomization rate block (stratification) fixed effects. Column (3) reports the coefficient on a treatment indicator, selecting controls from a high-dimensional set of baseline characteristics using the post-double selection LASSO procedure from Belloni, Chernozhukov and Hansen (2014). Column (4) reports the percent change of the ITT effect in column (3) relative to the control group mean. Heteroskedasticity-robust standard errors in parentheses.
**0.01, *0.05, $^{+}$0.10 significance levels

Table 3: ITT Effect of ReHire on Follow-Up Survey and Credit Outcomes

	Control Group Mean (1)	Unweighted ITT Effect No Controls (2)	Weighted ITT Effect No Controls (3)	Weighted ITT Effect Controls (4)	N (5)
Panel A: Employment Outcomes from Follow-Up Survey					
Worked a subsidized job since application	0.089	0.461**	0.450**	0.450**	777
		(0.029)	(0.030)	(0.029)	
ReHire helped them find current job	0.013	0.127**	0.103**	0.103**	777
		(0.019)	(0.016)	(0.015)	
Any employment since application	0.781	0.066*	0.071+	0.068+	777
		(0.030)	(0.039)	(0.038)	
Currently employed	0.556	0.077*	0.071+	0.071+	777
		(0.037)	(0.043)	(0.042)	
Currently employed in job with paystub	0.523	0.028	0.009	0.009	777
		(0.038)	(0.043)	(0.042)	
Current job same as first job	0.272	0.088*	0.082*	0.082*	777
		(0.035)	(0.037)	(0.036)	
Panel B: Standardized Treatment Effects from Follow-Up Survey (in SD)					
Job quality (first unsubsidized job)		0.116**	0.136**	0.136**	637
		(0.041)	(0.044)	(0.043)	
Job quality (current job)		0.094+	0.111+	0.111*	472
		(0.056)	(0.057)	(0.055)	
Well-being		0.162**	0.166**	0.175**	777
		(0.048)	(0.055)	(0.049)	
Employment barriers		0.048	0.037	0.027	777
		(0.044)	(0.051)	(0.049)	
Workplace behaviors		0.036	0.009	0.009	777
		(0.044)	(0.048)	(0.047)	
Expectations about future		0.047	0.024	0.024	777
		(0.061)	(0.069)	(0.067)	
Panel C: Standardized Treatment Effects from Credit Data (in SD)					
In-program credit outcomes (Q0–Q4)		0.015	0.008	-0.013	1,315
		(0.025)	(0.025)	(0.022)	
Post-program credit outcomes (Q5–Q8)		0.030	0.029	0.011	1,315
		(0.024)	(0.024)	(0.022)	

Notes: Data source is an 18-month follow-up survey (Panels A and B) and administrative credit data from Experian (Panel C). The sample includes ReHire applicants who applied between 7/2015 and 12/2017. Panels A and B include respondents to the follow-up survey. Panel C includes individuals who matched to Experian records in the 5 quarters before and 8 quarters following random assignment. The dependent variables in Panel A are indicators measured in the follow-up survey. Column (1) reports unweighted control group means of these outcomes. Panels B and C report average standardized treatment effects for outcomes from the follow-up survey and credit data, respectively. Estimates are measured in standard deviations (SD). Column (2) reports estimates that come from estimating Equation (1) with only vendor-randomization rate block (stratification) fixed effects. Column (3) reports estimates from the same specification as column (2), but reweights the sample using inverse propensity attrition weights. Column (4) reports estimates that come from a regression that selects controls from a high-dimensional set of baseline characteristics using the post-double selection LASSO procedure from Belloni, Chernozhukov and Hansen (2014), and reweights the sample using inverse propensity attrition weights. When estimating effects for outcomes that are measured in the baseline survey or administrative data prior to application (well-being, employment barriers, and credit), we include these covariates in the control choice set. Column (5) reports the number of individuals in the sample for a given outcome. Heteroskedasticity-robust standard errors in parentheses.
**0.01, *0.05, $^{+}$0.10 significance levels

Table 4: Applicant Characteristics by Transitional Job Receipt and Subsequent Hire

	Control	Treatment Group			Difference in Means	
	Mean	No TJ	Transitional Job		TJ	Hired
		Mean	Not Hired by TJ Mean	Hired by TJ Mean	Take-up (3 & 4) − (2)	by TJ (4) − (3)
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Administrative Data						
Worked last year	0.595	0.646	0.619	0.561	-0.029	-0.051
Employment rate last three years	0.413	0.432	0.424	0.399	0.009	-0.033
Average quarterly earnings in last year	$1,582	$2,243	$1,472	$1,669	-$526*	$73
Received TANF last year	0.110	0.089	0.101	0.097	0.012	0.005
Received SNAP last year	0.680	0.651	0.704	0.639	0.024	-0.055
Panel B: Baseline Survey						
Veteran	0.232	0.228	0.246	0.194	-0.038	-0.021
Non-custodial parent	0.193	0.191	0.192	0.181	-0.016	-0.013
Older worker	0.505	0.453	0.532	0.484	0.031	-0.029
Not in a priority category	0.266	0.285	0.250	0.316	0.034	0.042
Average Age (years)	47.102	45.577	47.210	46.272	0.588	-0.810
Average years of education	13.496	13.495	13.523	13.442	0.095	-0.094
Male	0.489	0.609	0.508	0.490	-0.143**	0.016
Minority	0.381	0.319	0.391	0.374	0.014	0.013
Covered by Medicaid	0.746	0.720	0.744	0.716	0.022	-0.023
Not allowed to drive	0.205	0.231	0.227	0.190	-0.039	-0.007
Difficulty finding childcare	0.091	0.082	0.087	0.085	0.019	0.001
Expect economic hardship	0.317	0.265	0.304	0.251	0.012	-0.034
Health limits work	0.113	0.114	0.117	0.103	0.003	-0.001
Ever homeless	0.410	0.421	0.414	0.390	-0.071*	0.034
Ever convicted of felony	0.221	0.234	0.220	0.208	-0.047+	0.000
Drugs or alcohol have affected life	0.214	0.213	0.231	0.167	-0.009	-0.050
Perceived motivation (out of 10)	8.345	8.411	8.180	8.701	-0.027	0.380*
Likelihood to overcome barriers (out of 10)	7.949	7.989	7.864	8.329	0.105	0.362*
Raven's score (out of 36)	31.056	31.476	31.168	31.737	0.148	0.470
Timed math test, percent correct	61.222	62.327	59.374	61.433	-1.163	1.250
Observations	876	404	496	155	1,055	651
Prob > F					0.003	0.813

Notes: Data come from administrative UI earnings data from CDLE, administrative SNAP and TANF data from CDHS, and baseline survey data collected at application. The sample includes ReHire applicants who applied between 7/2015 and 12/2017. One applicant can be linked to administrative data, but is missing a baseline survey. Estimates of the difference in means control for vendor-randomization rate block (stratification) fixed effects. The final row reports the p-value from the test of the null hypothesis that all characteristics are jointly unrelated to the listed difference in program experience.

Table 5: ReHire Service Receipt and Transitional Job Characteristics
by Transitional Job Receipt and Subsequent Hire

	Any TJ Mean	Not Hired by TJ Mean	Hired by TJ Mean	Conditional Difference in Means (3) - (2)
	(1)	(2)	(3)	(4)
Panel A: All ReHire Services				
Total Direct costs	\$3,066	\$2,806	\$3,897	\$1,034**
Cost of supportive services	\$399	\$367	\$504	\$120+
Hours worked	295.6	268.1	383.6	109.3**
Weeks worked	9.7	9.2	11.4	2.8**
Months until TJ Placement	1.4	1.4	1.4	-0.3*
Panel B: Transitional Job Characteristics				
Firm Size				
Small firm (1–50)	0.663	0.680	0.606	-0.104*
Medium firm (51–500)	0.136	0.138	0.129	-0.016
Large firm (500+)	0.282	0.257	0.361	0.149**
Industry				
Construction	0.029	0.034	0.013	-0.024+
Manufacturing	0.060	0.043	0.116	0.069*
Retail Trade	0.166	0.168	0.161	0.008
Transportation and Warehousing	0.071	0.067	0.084	0.044+
Education	0.034	0.030	0.045	0.005
Health and Social Assistance	0.388	0.399	0.355	-0.045
Accomodation and Food Services	0.034	0.032	0.039	0.006
Other	0.257	0.261	0.245	-0.028
Observations	651	496	155	651

Notes: Data come from participant program records from CDHS. The sample includes ReHire applicants who applied between 7/2015 and 12/2017, were assigned to the treatment group, and were placed in a transitional job (TJ). Two individuals with a transitional job are missing information on their transitional job characteristics, and have values imputed at the sample mean. Estimates of the difference in means in column (4) control for vendor-rate block (stratification) fixed effects. Firm size and industry variables denote whether the individual worked at any transitional job that corresponded to the category. Because some individuals worked at multiple transitional job sites, the shares do not sum to 1 within the column. We can reject the null hypothesis that firm size is the same between those hired (column 3) and not hired (column 2) by their transitional job site ($p = 0.005$), and we can reject the null hypothesis that the industry distribution is the same between those hired (column 3) and not hired (column 2) by their transitional job site ($p = 0.050$).

A Appendix – For Online Publication

A.1 Minimum Wage in Colorado Over Time

ReHire participants were paid the hourly minimum wage when working their transitional job, and the direct cost of wages was covered by the state. While in theory employer host sites had the potential to pay wages above this amount, this did not occur in practice. The following table provides the history of the Colorado minimum wage during the evaluation period.

Table A-1: Colorado State Minimum Wage Over Time

Effective Date	Minimum Wage
January 1, 2014	$8.00
January 1, 2015	$8.23
January 1, 2016	$8.31
January 1, 2017	$9.30
January 1, 2018	$10.20
January 1, 2019	$11.10
January 1, 2020	$12.00

Notes: Information on the history of the Colorade minimum wage comes from the Colorado Department of Labor and employment and can be accessed at: https://cdle.colorado.gov/wage-and-hour-law/minimum-wage

A.2 Value and Timing of Program Service Receipt

This section provides additional details on the dollar value and timing of ReHire program service receipt. Note that the analysis presented here limits the sample to applicants who applied prior to December 2017 and thus imposes the sample restriction described in Section 3.4 to eliminate the impacts of the COVID-19 pandemic on the labor market. Results are very similar when including all applicants who were randomized.

Appendix Table A-2 provides a breakdown of the costs associated with the program and the typical experience of a program participant. The typical participant received more than $2,000 in directly billable services, including nearly $1,675 in transitional job wages (Panel A). Among the 62 percent with a transitional job, the average participant worked almost 300 hours across 10 weeks and earned more than $2,660 in wages through the program (Panel B).

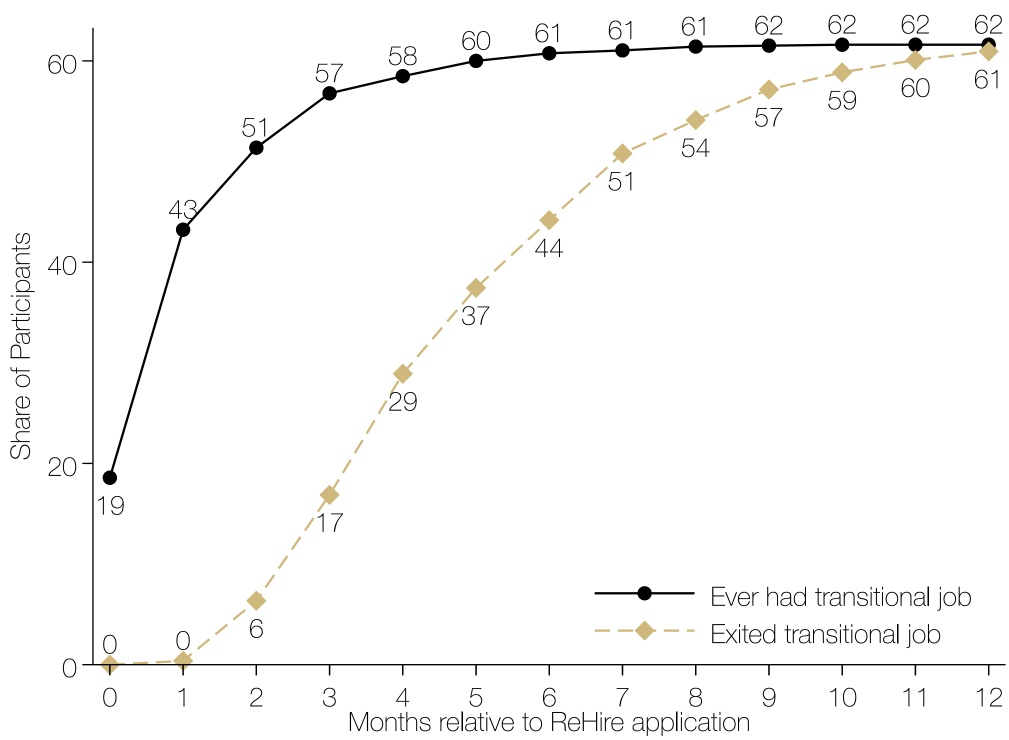
Appendix Figure A-1 shows the timing of transitional job participation over the year following randomization. Month 0 corresponds to the month when a participant completed the ReHire application; months 1–12 are the first through twelfth months following a participant's application. The solid line with circles shows the share of ReHire participants who were placed in a transitional job by the end of the relevant month. More than 40 percent of the treatment group were placed by the end of the month after they applied. An additional 15 percent were placed over the next three months, and a small share were placed more than five months after randomization. The dashed line with diamonds shows the share of all participants whose transitional job placement had ended by the relevant month. For example, 29 percent of all treatment group members (and roughly half of participants who ever receive a transitional job) completed their placement by the fourth month following their application. By month 12, the two lines converge, indicating that nearly all transitional job placements are complete one year after randomization. We therefore interpret outcomes observed after 12 months (or four quarters) as post-program outcomes.

Table A-2: ReHire Program Characteristics

	Mean (1)	SD (2)
Panel A: Treatment Group (N=1,055)		
Cost of supportive services	\$376	\$889
Gross ReHire wages	\$1,674	\$2,169
Total direct costs	\$2,050	\$2,478
Panel B: Transitional Job Recipients (N=651)		
Cost of supportive services	\$399	\$656
Gross ReHire wages	\$2,666	\$2,213
Total direct costs	\$3,066	\$2,435
Hours worked	296	236
Weeks worked	10	7

Notes: Data come from program records maintained at services agencies by ReHire case workers. The sample consists of 1,055 individuals who applied to ReHire between 7/2015 and 12/2017 and were randomly assigned to the treatment group. Panel B restricts the sample to individuals who worked in a transitional job.

Figure A-1: Timing of Transitional Job Entry and Exit



Notes: Sample includes 1,055 participants who applied between 7/2015 and 12/2017 and were assigned to the treatment group. Month 0 represents the month in which a study participant completed their ReHire application, and is thus a different calendar month from person to person. Once an individual has started a transitional job, they are treated as having ever held a transitional job (black circle) in every subsequent month. An individual exits a transitional job in the first month when they do not hold a transitional job in any following month, after having held one (gold diamond). Once an individual has exited, they are treated as having exited a transitional job in every subsequent month. Entry and exit percentages are calculated using all participants in every month.

A.3 Randomization

This appendix section documents the steps taken to conduct random assignment.

Randomization occurred separately for each local service agency. The initial treatment probability at each site was 50 percent. At each site, when the first applicant arrived, a short sequence with an equal number of 0s and 1s was randomly selected in the following manner.

1. Determine the length of the sequence: Draw $x_1 \sim U[0, 1]$.
   - If $x_1 \in [0, 1/3)$, then select a sequence with length 6 including three 0s and three 1s.
   - If $x_1 \in [1/3, 2/3)$, then select a sequence with length 8 including four 0s and four 1s.
   - If $x_1 \in [2/3, 1]$, then select a sequence with length 10 including five 0s and five 1s.
2. Determine the actual sequence:
   - First, populate a list with all $\binom{n}{n/2}$ potential sequences of length $n \in \{6, 8, 10\}$.[41]
   - Draw $x_2 \sim U[0, 1]$.
   - Randomly select row $r = Int\left[x_2 * \binom{n}{n/2}\right] + 1$ from the list of potential sequences.

Once the treatment-control sequence was fixed, the first applicant at that site was assigned their treatment status based on the first number of the selected sequence: 0 indicated the Control Group; 1 indicated the ReHire Treatment Group. As additional applicants arrived at that agency, they were assigned the next unused number in the sequence until every number in the sequence had been assigned. If an applicant arrived and no unused numbers were remaining in the sequence a new sequence was selected following steps 1 and 2 above. At no point in time did the central office program staff have access to the treatment assignment sequence or know how many unassigned treatment statuses remained at any site.

In practice, a list of daily applicants was constructed by program staff in the CDHS office. Each applicant was assigned a sequential program ID starting with "A-0001" the moment their record was created. CDHS staff sent the list of newly created IDs to the research team. Within the next business day after program application, treatment assignments were assigned to each ID based on the random sequence. Applicants were separated by site and slotted into the next available 0 or 1 in the sequence in the order of their program ID (i.e., their order of appearance in the database). The list of IDs and treatment assignments were then sent to CDHS. Based on their assignment, the central office program staff then toggled the treatment status in the program database for each applicant, which alerted the local program staff of the treatment determination and sent an email to the applicant regarding their treatment assignment and available next steps.

Treatment Probability

At times, program enrollment slowed causing concerns that all available program dollars would not be spent during a contract period. At various times throughout the implementation of the RCT, the treatment probability for all service agencies, or a subset of service agencies, was adjusted to a 2-1 assignment ratio. To implement this change, the potential lengths of sequences were changed to six, nine, and twelve, with exactly 2/3 of the sequence comprising 1s and 1/3 comprising 0s. Accordingly, the choice of the specific sequence in Step 2 was adjusted to account for the number of potential sequences. Each time the decision to change the treatment probability was made (both from 1/2 to 2/3 and from 2/3 to 1/2), the change was implemented *after* the currently selected sequence of 0s and 1s was fully exhausted.

The following list provides the timeline of when the treatment probability was changed throughout the RCT:

[41] This list was sorted by the first through the last number of the sequence. For example, on the list with sequences of length 6, $\{0, 0, 0, 1, 1, 1\}$ was listed first, then $\{0, 0, 1, 0, 1, 1\}$, and so on, ending with $\{1, 1, 1, 0, 0, 0\}$.

- January 14, 2016: treatment probability was changed from 1/2 to 2/3 for all service agencies
- April 11, 2016: treatment probability was changed from 2/3 to 1/2 for all service agencies
- October 11, 2016: treatment probability was changed from 1/2 to 2/3 for Catholic Charities Pueblo and Hilltop Community Resources
- May 18, 2017: treatment probability was changed from 1/2 to 2/3 for all remaining service agencies
- July 13, 2017: treatment probability was changed from 2/3 to 1/2 for all service agencies except Catholic Charities (note: Hilltop Community Resources was no longer providing ReHire at this time)
- July 11, 2018: treatment probability was changed from 1/2 to 2/3 for all remaining service agencies

Service Agencies with Rural Operations

Two of the social service agencies had applicants coming from both the nearby town and from more rural locations. Hilltop Community Resources operated out of Grand Junction. Some of the applicants to Hilltop were applying from nearby Montrose, CO (about an hour away) and these intake sessions were largely occurring in Montrose rather than Grand Junction. Beginning in December 2015, applicants from Montrose were randomized separately from other Hilltop applicants. Similarly, Discover Goodwill in Colorado Springs, CO sometimes received applicants from the more rural but nearby Teller County. Beginning in September 2016, the few applicants who were living in Teller County were randomized separately from other Discover Goodwill applicants.

Implications for Analysis

Because randomization was stratified by social service agency (and sometimes locations within an agency) and treatment probability changed over time, we conduct all of our analysis using a set of stratification fixed effects that account for the service agency at which an individual applied and the treatment probability they faced. Take, for example, applicants to Catholic Charities. At this service agency, we block applicants into 4 strata based on their application date:

1. Applicants randomized with 1/2 treatment probability beginning 7/1/2015
2. Applicants randomized with 2/3 treatment probability beginning 1/21/2016 (the first date a new sequence was drawn after change)
3. Applicants randomized with 1/2 treatment probability beginning 4/21/16 (the first date a new sequence was drawn after change)
4. Applicants randomized with 2/3 treatment probability beginning 1/26/17 (the first date a new sequence was drawn after change)

In total, there are 23 strata across the 6 service agencies that implemented ReHire.

A.4 Migration out of Colorado

We link our analysis sample to consumer reference data from Infutor Data Solutions to measure Colorado residency during the evaluation period. Infutor creates a residential history for most adults in the US using consumer information like magazine subscriptions or utility bills. The resulting data includes exact addresses and includes start and end dates for each address, and these data have been used to measure moves in low-income populations following natural disasters, after the demolition of public housing, and for households at high risk of homelessness (Phillips, 2020).

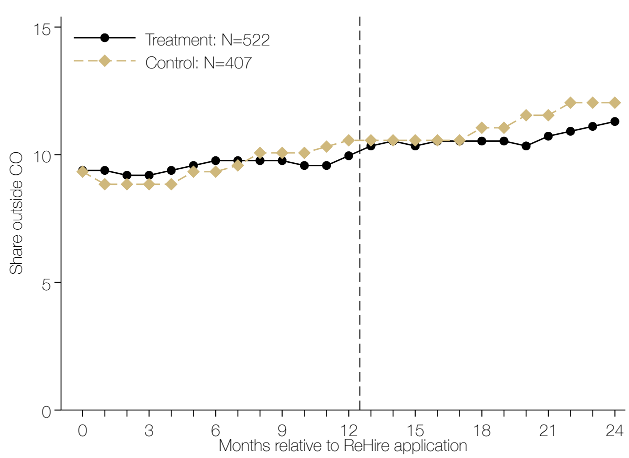
We fuzzy match ReHire study participants to the Infutor data using a number of identifiers including name, address at application, and date of birth. Nearly half of the analysis sample ($N = 929$) match to an Infutor address with a start date that precedes their ReHire application date, and match rates are balanced between treatment and control. For each month, we construct an indicator of whether an individual has a non-Colorado address using the state of their most recent address (based on address start date).

Figure A-2a depicts the share of Infutor-matched study participants who have a non-Colorado address. At the time of application, less than 10 percent have an address outside Colorado. During the 24 months following application, this share grows to 11.3 and 12 percent for the treatment and control groups, respectively.

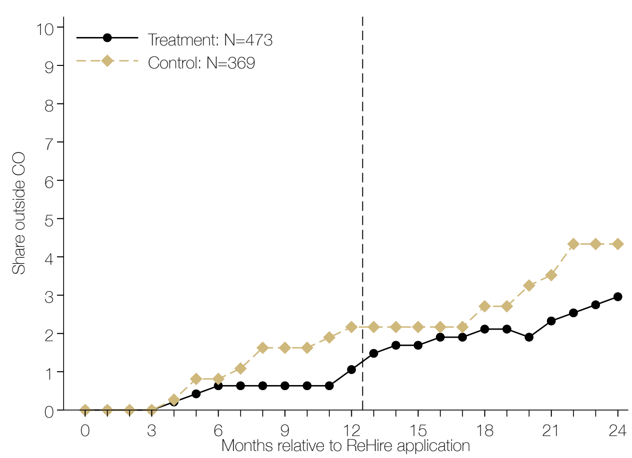
Individuals may have a non-Colorado address at the time of application if they recently moved, or moved into a situation where they did not create a paper trail following them to Colorado (e.g., utility bills in another resident's name). We further investigate differential attrition from Colorado in Figure A-2b by restricting the sample to individuals observed to be in Colorado at the time of application. In the 24 months following application, roughly 3 percent of the treatment group and 4.3 percent of the control group move to an address outside Colorado.

Figure A-2: Non-Colorado Address from Infutor Data

(a) Sample: In Infutor by Application Month



(b) Sample: In CO at Application Month



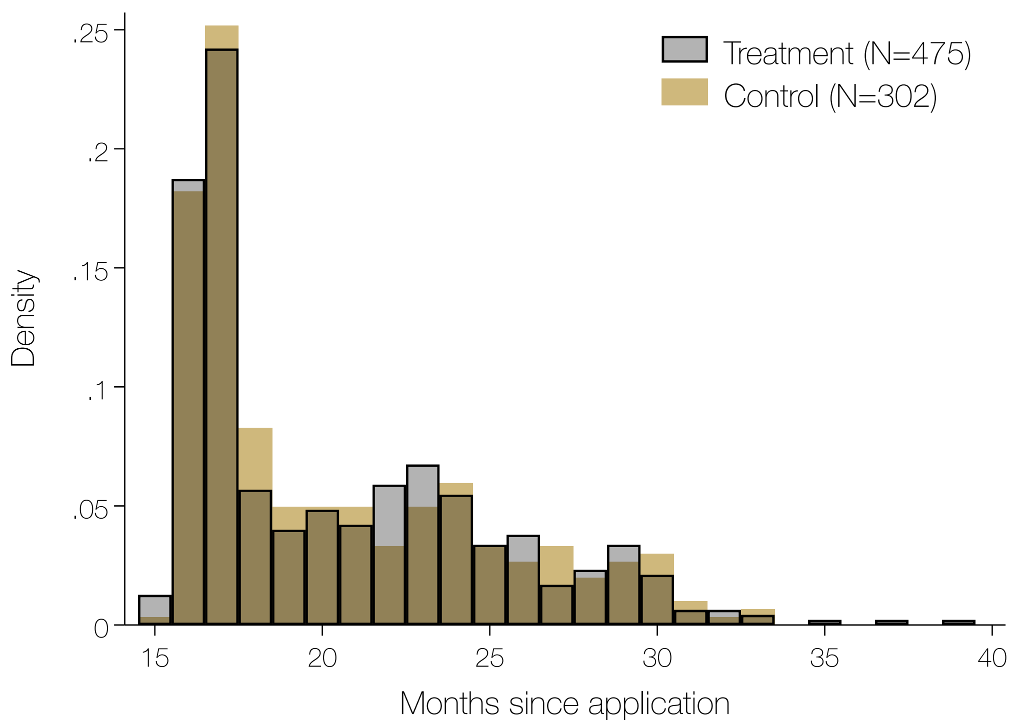
Notes: Data source is address history data from Infutor Data Solutions. The sample includes the 48 percent of ReHire applicants who match to an Infutor address record before ReHire application. Month 0 represents the month in which a study participant completed their ReHire application, and is thus a different calendar quarter from person to person. Panel (a) includes all matched study participants from the main analysis sample. Panel (b) restricts the sample to individuals whose most address start date during the month of application was in CO. The vertical axis plots the share of the same with an address outside Colorado.

A.5 Timing of Follow-up Survey

Beginning in December 2017, an online follow-up survey was fielded to estimate the impact of ReHire Colorado on a broader array of post-program outcomes. Treatment and control respondents were contacted via text and email roughly 18 months after applying for ReHire and were invited to respond to an online survey. Nearly all respondents completed the survey via computer or mobile device, but respondents had the option to respond over the phone.

Most survey respondents completed the follow-up survey 16 to 18 months following application (Figure A-3). Because of the timing of survey implementation, early applicants who applied prior to July 2016 were contacted more than 18 months after application and thus completed their follow-up surveys 18 to 30 months after application. We do not find evidence of differential time from application to follow-up response between treatment and control group participants.[42] Because ReHire participants are in the program for an average of 6 months, the follow-up survey provides results approximately one year after the typical ReHire participant exited the program.

Figure A-3: Months between ReHire Application and Follow-up Survey



Notes: Data source is application and follow-up surveys. Sample includes the 954 ReHire applicants with a complete follow-up survey. The average number of months between application and follow-up survey completion was 20.27 months in the control group and 20.41 months in the treatment group. A Kolmogorov-Smirnov test of the equality of these two distributions fails to reject the null hypothesis that the samples are drawn from the same distribution ($p = 0.937$).

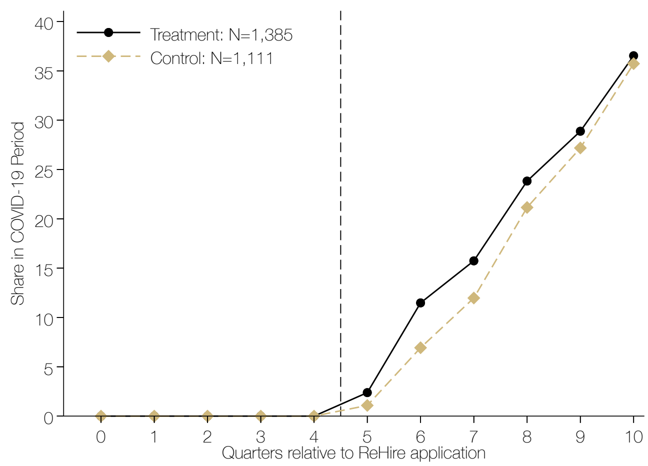
[42]Using a Kolmogorov-Smirnov test, we reject the null hypothesis that the distribution of months since application is the same between the treatment and control group ($p = 0.937$).

A.6 The Timing of COVID-19 in the ReHire Evaluation

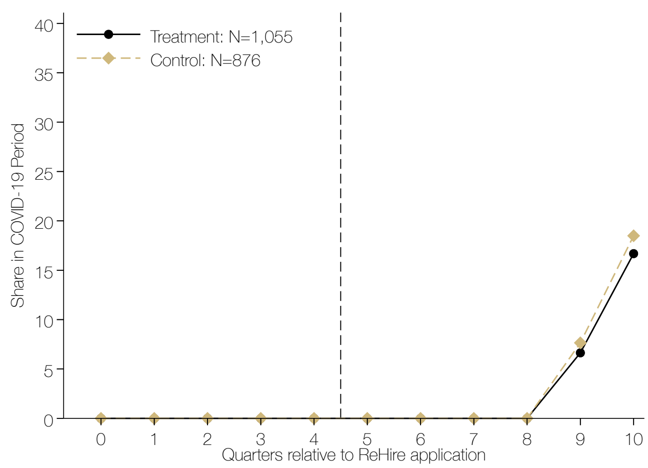
Our main analysis limits the sample to individuals who have 8 quarters of follow-up data available prior to the pandemic-related disruptions to the labor market that began in the first quarter of 2020. Figure A-4 demonstrates that this restriction removes a fairly balanced set of treatment and control applicants. It further shows that, had we not imposed this restriction, a substantial (and increasing) share of person-quarter observations in quarters 5–8 would be affected by the disruptions.

Figure A-4: Share of Applicants Experiencing COVID-related Disruptions by Quarter Relative to ReHire Application

(a) All ReHire RCT Applicants



(b) Analysis Sample



Notes: Data source is ReHire administrative data on the timing of application and treatment assignment. The sample in Panel (a) includes all 2,496 ReHire applicants who applied between 7/2015 and 12/2018. Panel (b) further restricts to applicants who applied by 12/2017. Quarter 0 represents the quarter in which a study participant completed their ReHire application, and is thus a different calendar quarter from person to person. Both lines plot the share of ReHire applicants whose quarter relative to ReHire application was on or after Q1 2020.

A.7 Baseline Balance

Table A-3 investigates the balance in means of baseline characteristics, as measured in both the administrative data (Panel A) and the baseline survey (Panel B). The first two columns provide subgroup means for the control and treatment groups, respectively; column (3) provides the difference in means; and columns (4) and (5) show two separate measures of the magnitude of the difference. The fourth column includes a t-statistic from a test of the null of equal subgroup means. The fifth column provides the normalized differences in means (the difference divided by the standard deviation of the mean for the control group), which is a useful metric because it is not influenced by sample size (Imbens and Wooldridge, 2009). More than 95 percent of baseline survey characteristics are insignificantly different, and all of the normalized differences are less than 0.20, indicating that the randomization balanced these characteristics as anticipated. The t-tests indicate, however, that treatment group members were more likely to be male, and our analysis includes specifications with and without controls, including a male indicator, to account for any imbalance.

Table A-3: Applicant Characteristics and Baseline Balance

	Control Mean (1)	Treatment Mean (2)	Difference (2) – (1) (3)	t-stat (4)	Diff./ SD (5)	N (6)
Panel A: Administrative Data						
Worked last year	0.595	0.621	0.017	0.78	0.04	1,931
Employment rate last three years	0.413	0.423	0.003	0.18	0.01	1,931
Average quarterly earnings in last year	$1,582	$1,796	$133	0.95	0.05	1,931
Received TANF last year	0.110	0.096	-0.014	-0.99	-0.04	1,931
Received SNAP last year	0.680	0.674	-0.003	-0.13	-0.01	1,931
Panel B: Baseline Survey						
Veteran	0.232	0.231	0.004	0.23	0.01	1,930
Non-custodial parent	0.193	0.190	-0.002	-0.11	-0.00	1,930
Older worker	0.505	0.495	-0.012	-0.54	-0.02	1,930
Not in a priority category	0.266	0.273	0.007	0.37	0.02	1,930
Average Age (years)	47.106	46.439	-0.694	-1.28	-0.06	1,895
Average years of education	13.496	13.501	-0.001	-0.01	-0.00	1,679
Male	0.489	0.544	0.056	2.51	0.11	1,931
Minority	0.381	0.361	-0.020	-0.92	-0.04	1,930
Covered by Medicaid	0.746	0.731	-0.017	-0.84	-0.04	1,930
Not allowed to drive	0.204	0.223	0.023	1.25	0.06	1,915
Parents that are single parenting	0.571	0.559	0.009	0.21	0.02	560
Difficulty finding childcare	0.091	0.085	-0.007	-0.51	-0.02	1,920
Expect economic hardship	0.318	0.281	-0.037	-1.72	-0.08	1,895
Health limits work	0.113	0.114	0.002	0.12	0.01	1,881
Ever homeless	0.410	0.413	0.008	0.36	0.02	1,918
Ever convicted of felony	0.221	0.223	0.009	0.50	0.02	1,913
Drugs or alcohol have affected life	0.214	0.214	-0.001	-0.06	-0.00	1,889

Notes: Data come from administrative UI earnings data from CDLE, administrative SNAP and TANF data from CDHS, and baseline survey data collected at application. The sample includes ReHire applicants who applied between 7/2015 and 12/2017. One applicant can be linked to administrative data, but is missing a baseline survey.

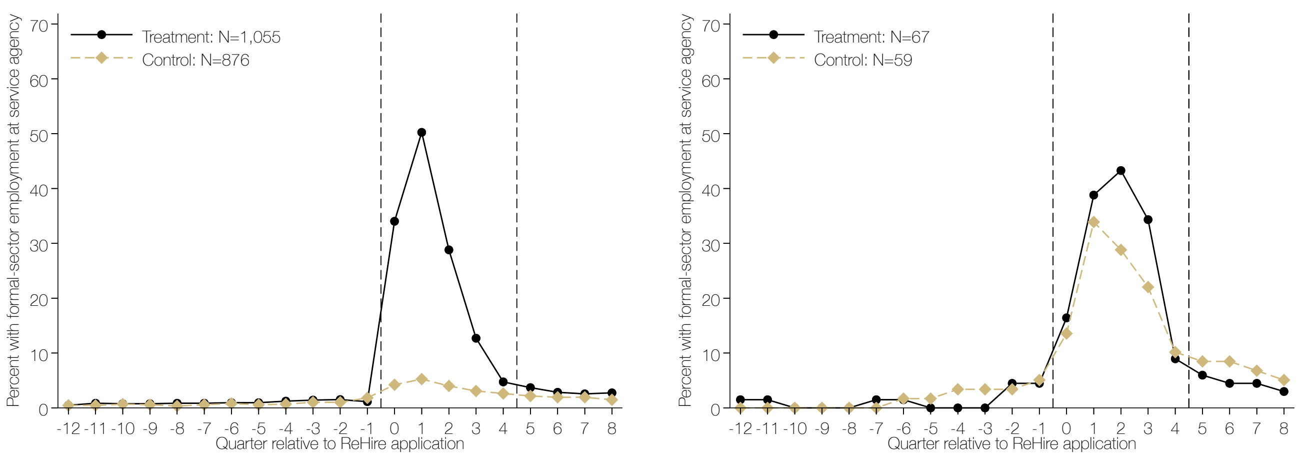
A.8 Control Group Service Access

This section provides supplemental analysis to speak to the question of whether control group members accessed services similar to those provided by ReHire. Control group members were eligible to receive standard employment services offered by the social service provider where they applied for ReHire or by any other service provider. We do not have access to data on other re-employment services the control group accessed, but we can examine how often control group members had positive earnings at a ReHire social service agency, which may indicate a transitional job funded through another program, e.g. WIOA. False positives are also possible because we are unable to distinguish between unsubsidized employment and subsidized employment using the UI data. False positives may be more common at the local agencies that are county workforce offices because they share an employer code with the entire county government.

Figure A-5: Rates of Employment with a ReHire Service Provider by Treatment Status

(a) Analysis Sample

(b) Applicants from Local Service Agency with Highest Rate of Hiring Control Group Members



Notes: Data source is administrative UI earnings data from CDLE. The sample in Panel (a) includes 1,931 ReHire applicants who applied between 7/2015 and 12/2017. Panel (b) further restricts the sample to the 126 applicants at the service agency with the highest rate of hiring control group individuals. Quarter 0 represents the quarter in which a study participant completed their ReHire application, and is thus a different calendar quarter from person to person. Employment at a ReHire service agency is defined as having UI-covered earnings greater than $0 in a given quarter where the employer was a ReHire service agency. Earnings from a ReHire-sponsored transitional job are covered by the UI system and are thus counted as formal-sector employment. Treatment and control groups are based on an individual's randomly assigned treatment status. The figure plots the percent of treatment and control applicants with formal-sector employment at a ReHire service agency.

Figure A-5a shows the share of each group that was employed at a ReHire social service provider for each quarter relative their application dates. Only a small percentage of the control has such employment in any given quarter. We interpret this figure as supporting evidence that the control group did not receive similar services, simplifying the interpretation of the intent-to-treat analysis presented in the main text.

Figure A-5b shows, however, that control group applicants at one local service agency were nearly as likely to be employed by a ReHire service agency as the treatment group was in the quarters following application. Further, both groups experienced similar increasing and decreasing trends in service agency employment, which is consistent with the timing of temporary subsidized employment. In Section A.11.2, we show that ITT effects are similar when excluding applicants from this service agency from the analysis.

A.9 Effects on Employment/Earnings by quarter

Table A-4 provides coefficient estimates and standard errors for the quarter-by-quarter ITT estimates shown in Figure 1b and Figure 2b. Columns (2) and (5) report specifications that include only stratification group fixed effects, while columns (3) and (6) include controls selected by the post-double selection LASSO procedure. The results are insensitive to the inclusion of these controls.

Table A-4: ITT Effect of ReHire on Formal-Sector Employment and Earnings in Colorado, By Quarter

	Any Employment			Earnings		
	Control Mean	ITT Effect No Controls	ITT Effect Controls	Control Mean	ITT Effect No Controls	ITT Effect Controls
	(1)	(2)	(3)	(4)	(5)	(6)
Quarter 0	0.477	0.151**	0.141**	\$746	\$266**	\$212**
		(0.022)	(0.021)		(70)	(57)
Quarter 1	0.574	0.189**	0.183**	\$1,684	\$491**	\$460**
		(0.021)	(0.021)		(103)	(100)
Quarter 2	0.559	0.131**	0.128**	\$2,065	\$346**	\$312**
		(0.022)	(0.022)		(128)	(120)
Quarter 3	0.546	0.076**	0.071**	\$2,229	\$208	\$163
		(0.023)	(0.022)		(139)	(131)
Quarter 4	0.537	0.034	0.028	\$2,335	\$128	\$85
		(0.023)	(0.022)		(147)	(138)
Quarter 5	0.509	0.030	0.027	\$2,351	\$119	\$80
		(0.023)	(0.022)		(154)	(146)
Quarter 6	0.505	0.025	0.024	\$2,323	\$148	\$110
		(0.023)	(0.022)		(153)	(146)
Quarter 7	0.487	0.040+	0.037	\$2,325	\$212	\$176
		(0.023)	(0.022)		(158)	(150)
Quarter 8	0.452	0.061**	0.056*	\$2,320	\$304+	\$269+
		(0.023)	(0.022)		(164)	(155)

Notes: Data source is administrative UI earnings data from CDLE. Each row represents outcomes measured in a different quarter relative to ReHire application. Quarter 0 represents the quarter in which a participant completed an application, and is thus a different calendar quarter from person to person. Formal employment is defined as having UI-covered earnings in Colorado greater than \$0 in a given quarter. Earnings from a ReHire-sponsored transitional job are covered by the UI system and are thus counted as formal sector employment. The dependent variable in columns (1) through (3) is an indicator for formal-sector employment. The dependent variable in columns (4) through (6) is an individual's UI-covered earnings. Columns (1) and (4) report the control group mean. Columns (2) and (5) report the coefficients on a treatment indicator, controlling for service agency-randomization rate block (stratification) fixed effects. Columns (3) and (6) report the coefficients on treatment indicators, selecting controls from a high-dimensional set of baseline characteristics using the post-double selection LASSO procedure from Belloni, Chernozhukov and Hansen (2014). Heteroskedasticity-robust standard errors in parentheses.
**0.01, *0.05, +0.10 significance levels

A.10 Effects on Aggregate Employment/Earnings Outcomes Over a Longer Time Horizon

The primary analysis sample includes individuals who applied to ReHire between July 2015 and December 2017, and for these individuals two years of post-randomization data are available before the onset of the COVID-19 pandemic. In order to look at outcomes over a longer time horizon, Table A-5 reproduces the main results from Table 1 using the sample of ReHire applicants who applied between July 2015 and December 2016 ($N = 1,058$). For these individuals, we are able to estimate effects over the 9$^{\text{th}}$ through 12$^{\text{th}}$ quarter following random assignment (Panel C).

The point estimates that come from the model with added controls during the in-program period (Panel A) and the first year of the post-program period (Panel B) are similar to the results among the primary analysis sample reported in Table 1. In this smaller sample of applicants, however, there are larger differences between the model without controls (column 2) and with controls (column 3). The LASSO-selected characteristics help control for larger imbalances in pre-application characteristics in the smaller sample.

Estimated effects persist in the third year following application (Panel C). Treatment group individuals remain 6.2 percentage points (19 percent) more likely to work in every quarter, and this effect is significant at the 5 percent level. The employment rate is 9 percent higher and average earnings are 12 percent higher among the treatment group, differences that are very similar to those estimated in the previous year.

Table A-5: ITT Effect of ReHire on Formal-Sector Employment and Earnings in Colorado, Sample with Longer Time Horizon

	Control Mean (1)	ITT Effect No Controls (2)	ITT Effect Controls (3)	Percent Change (4)
Panel A: In-Program Employment (Quarters 0–4)				
Any employment	0.797	0.123**	0.121**	15%
		(0.022)	(0.021)	
Share of quarters worked	0.541	0.112**	0.105**	19%
		(0.022)	(0.020)	
Worked every quarter	0.244	0.062*	0.055*	23%
		(0.027)	(0.026)	
Average quarterly earnings	$1,842	$363**	$257*	14%
		(131)	(115)	
Share of quarters above 130% FPL	0.198	0.029	0.016	8%
		(0.018)	(0.016)	
Panel B: Post-Program Employment (Quarters 5–8)				
Any employment	0.647	0.018	0.013	2%
		(0.030)	(0.029)	
Share of quarters worked	0.498	0.047+	0.039	8%
		(0.027)	(0.026)	
Worked every quarter	0.332	0.086**	0.076**	23%
		(0.030)	(0.029)	
Average quarterly earnings	$2,399	$296	$174	7%
		(201)	(186)	
Share of quarters above 130% FPL	0.268	0.038	0.027	10%
		(0.025)	(0.024)	
Panel C: Post-Program Employment (Quarters 9–12)				
Any employment	0.585	0.022	0.013	2%
		(0.031)	(0.030)	
Share of quarters worked	0.457	0.048+	0.039	9%
		(0.028)	(0.027)	
Worked every quarter	0.324	0.070*	0.062*	19%
		(0.030)	(0.029)	
Average quarterly earnings	$2,402	$414+	$282	12%
		(215)	(202)	
Share of quarters above 130% FPL	0.265	0.044+	0.030	11%
		(0.025)	(0.024)	
Agency-Rate Block FEs		X	X	
Individual Baseline Controls			X	
Observations	479	1,058	1,058	

Notes: Data source is administrative UI earnings data from CDLE. Panels A, B, and C report estimates on in-program (Q0–Q4), first year post-program (Q5–Q8), and second year post-program (Q9–Q12) employment outcomes, respectively, for the sample of ReHire applicants who applied between 7/2015 and 12/2016. Quarter 0 represents the quarter in which a participant completed an application, and is thus a different calendar quarter from person to person. Formal employment is defined as having UI-covered earnings in Colorado greater than $0 in a given quarter. Earnings from a ReHire-sponsored transitional job are covered by the UI system and are thus counted as formal sector employment. Column (1) reports the mean for control group applicants. Column (2) reports the coefficient on a treatment indicator, controlling for vendor-randomization rate block (stratification) fixed effects. Column (3) reports the coefficient on a treatment indicator, selecting controls from a high-dimensional set of baseline characteristics using the post-double selection LASSO procedure from Belloni, Chernozhukov and Hansen (2014). Column (4) reports the percent change of the ITT effect in column (3) relative to the control group mean. Heteroskedasticity-robust standard errors in parentheses.
**0.01, *0.05, +0.10 significance levels

A.11 Robustness of ITT effects using State of Colorado Administrative Data

A.11.1 Robustness to Including Individuals Affected by COVID-19 Pandemic After Program Exit

The primary analysis sample includes individuals who applied to ReHire between July 2015 and December 2017, although ReHire applicants throughout 2018 were also randomly assigned to the treatment and control groups. For these individuals, some or all of their post-program outcomes (quarters 5 through 8) occurred in 2020 and were potentially affected by the labor market disruptions caused by the COVID-19 pandemic.

Table A-6 reproduces the main results from Table 1 using the full RCT sample ($N = 2,496$) of ReHire applicants. Effects on in-program outcomes—which were not affected by the COVID-19 pandemic for anyone in the sample—remain very similar when using the larger sample, although the effect on quarters above 130 percent FPL becomes significant at the 5 percent level. Effects on outcomes in the post-program period, however, become slightly attenuated in the larger sample. For example, the effect on share of quarters worked falls from 3.7 percentage points to 2.7 percentage points, and the effect on working every quarter falls from 6.6 percentage points (20 percent increase) to 4.9 percentage points (15 percent increase).

Table A-6: ITT Effect of ReHire on Formal-Sector Employment and Earnings in Colorado, Full RCT Sample

	Control Mean (1)	ITT Effect No Controls (2)	ITT Effect Controls (3)	Percent Change (4)
Panel A: In-Program Employment (Quarters 0–4)				
Any employment	0.805	0.121**	0.116**	14%
		(0.014)	(0.014)	
Share of quarters worked	0.533	0.119**	0.112**	21%
		(0.014)	(0.013)	
Worked every quarter	0.234	0.079**	0.073**	31%
		(0.018)	(0.017)	
Average quarterly earnings	$1,761	$322**	$288**	16%
		(83)	(76)	
Share of quarters above 130% FPL	0.183	0.028*	0.024*	13%
		(0.011)	(0.011)	
Panel B: Post-Program Employment (Quarters 5–8)				
Any employment	0.623	0.022	0.017	3%
		(0.020)	(0.019)	
Share of quarters worked	0.486	0.032+	0.026	5%
		(0.018)	(0.017)	
Worked every quarter	0.326	0.053**	0.049*	15%
		(0.019)	(0.019)	
Average quarterly earnings	$2,251	$188	$146	6%
		(124)	(118)	
Share of quarters above 130% FPL	0.251	0.023	0.021	8%
		(0.016)	(0.015)	
Agency-Rate Block FEs		X	X	
Individual Baseline Controls			X	
Observations	1,111	2,496	2,496	

Notes: Data source is administrative UI earnings data from CDLE. Panels A and B report estimates on in-program and post-program employment outcomes, respectively, for the sample of ReHire applicants who applied between 7/2015 and 12/2018. Quarter 0 represents the quarter in which a participant completed an application, and is thus a different calendar quarter from person to person. Formal employment is defined as having UI-covered earnings in Colorado greater than $0 in a given quarter. Earnings from a ReHire-sponsored transitional job are covered by the UI system and are thus counted as formal sector employment. Column (1) reports the mean for control group applicants. Column (2) reports the coefficient on a treatment indicator, controlling for vendor-randomization rate block (stratification) fixed effects. Column (3) reports the coefficient on a treatment indicator, selecting controls from a high-dimensional set of baseline characteristics using the post-double selection LASSO procedure from Belloni, Chernozhukov and Hansen (2014). Column (4) reports the percent change of the ITT effect in column (3) relative to the control group mean. Heteroskedasticity-robust standard errors in parentheses.
**0.01, *0.05, +0.10 significance levels

A.11.2 Robustness to Excluding Local Service Agency with Highest Rate of Hiring Control Group Members

Section A.8 provides evidence that most individuals in the control group did not receive placement in a transitional job. For one local service agency, however, treatment and control group applicants were nearly as likely to have been employed by a ReHire agency during the in-program period (quarters 0 through 4 following application). While it is possible that control group applicants found unsubsidized work at this employer on their own—some agencies share the same employer ID in the UI data as the broader county government—it is more likely that these individuals were placed in similar transitional jobs given the similar timing of the start and end of these jobs in both the treatment and control groups.

As we note in Section 4, this similarity in program experience is not a threat to causal identification, but it changes the interpretation of the ITT effects as well as the potential policy conclusions drawn about the program's cost effectiveness. To address this interpretation challenge, we re-estimate the main results from Table 1 using a sample that excludes the 126 applicants from the service agency that employed a large share of the control group. Table A-7 shows that results from both the in-program and post-program periods are similar when excluding applicants at this agency from the analysis.

Table A-7: ITT Effect of ReHire on Formal-Sector Employment and Earnings in Colorado, Excluding Service Agency with Highest Rate of Hiring of Control Group

	Control Mean (1)	ITT Effect No Controls (2)	ITT Effect Controls (3)	Percent Change (4)
Panel A: In-Program Employment (Quarters 0–4)				
Any employment	0.805	0.122**	0.120**	15%
		(0.016)	(0.016)	
Share of quarters worked	0.530	0.120**	0.117**	22%
		(0.017)	(0.015)	
Worked every quarter	0.226	0.084**	0.081**	36%
		(0.021)	(0.020)	
Average quarterly earnings	\$1,749	\$280**	\$278**	16%
		(96)	(88)	
Share of quarters above 130% FPL	0.184	0.024+	0.024+	13%
		(0.013)	(0.012)	
Panel B: Post-Program Employment (Quarters 5–8)				
Any employment	0.618	0.017	0.017	3%
		(0.023)	(0.022)	
Share of quarters worked	0.483	0.038+	0.037+	8%
		(0.021)	(0.020)	
Worked every quarter	0.329	0.070**	0.067**	20%
		(0.023)	(0.022)	
Average quarterly earnings	\$2,296	\$162	\$172	8%
		(148)	(138)	
Share of quarters above 130% FPL	0.258	0.025	0.027	11%
		(0.018)	(0.018)	
Agency-Rate Block FEs		X	X	
Individual Baseline Controls			X	
Observations	817	1,805	1,805	

Notes: Data source is administrative UI earnings data from CDLE. Panels A and B report estimates on in-program and post-program employment outcomes, respectively, for the sample of ReHire applicants who applied between 7/2015 and 12/2017, excluding 126 applicants from the service agency that employed a large share of the control group. Quarter 0 represents the quarter in which a participant completed an application, and is thus a different calendar quarter from person to person. Formal employment is defined as having UI-covered earnings in Colorado greater than \$0 in a given quarter. Earnings from a ReHire-sponsored transitional job are covered by the UI system and are thus counted as formal sector employment. Column (1) reports the mean for control group applicants. Column (2) reports the coefficient on a treatment indicator, controlling for vendor-randomization rate block (stratification) fixed effects. Column (3) reports the coefficient on a treatment indicator, selecting controls from a high-dimensional set of baseline characteristics using the post-double selection LASSO procedure from Belloni, Chernozhukov and Hansen (2014). Column (4) reports the percent change of the ITT effect in column (3) relative to the control group mean. Heteroskedasticity-robust standard errors in parentheses.
**0.01, *0.05, +0.10 significance levels

A.11.3 Robustness to Alternative Methods for Statistical Inference

In our primary analysis, we conduct inference using test statistics constructed using heteroskedasticity-robust standard errors. This choice is appropriate given that random assignment occurred at the individual level.

Two potential concerns remain, however. First, the randomization procedure ensured that the number of treatment and control applicants would be balanced over small periods of time so that case workers would receive a steady inflow of new participants. In practice, this process meant that the number of treated applicants was fixed for each small set of newly arriving applicants (e.g., 4 of the next 8 applicants at an agency would be treated). This design choice meant that an individual applicant's treatment assignment was potentially correlated with others who applied at the same agency around the same time. We randomized the size of the randomization blocks so that service providers would be unable to predict a given applicant's treatment status. See Appendix Section A.3 for more details.

In order to account for any influence this correlation has on the reported estimates, we conducted randomization-based inference that directly incorporates the way treatment and control assignments were made. We re-ran 10,000 iterations of the treatment assignment algorithm; in each iteration, we re-randomized the treatment/control assignments for each small block of applicants within which the number of treatment individuals was fixed. We then re-estimate Equation (1) for all outcomes reported in Table 1 and collect p-values. This set of p-values represents the distribution of p-values under the sharp null hypothesis of zero treatment effect among all applicants.

A second concern is that the probability of rejecting the null for any one outcome is greater than a chosen significance level because we test hypotheses about program impacts on multiple outcomes both within and across the in-program and post-program periods. To address this concern, we use the joint distribution of p-values estimated above to construct adjusted p-values that control for the family-wise error rate (FWER) following the step-down procedure of Westfall and Young (1993).[43]

Table A-8 provides a set of p-values that address these two potential concerns. Column (1) reproduces the main ITT estimates found in column (3) of Table 1. Then for each outcome, we report naive p-values that are based on heteroskedasticity-robust standard errors (column 2), as well as three randomization-based p-values:

- Per comparison p-values that report the share of permutations where the simulated p-value was smaller than the p-value from the actual treatment assignment (column 3);
- Adjusted p-values that control for the FWER among the five outcomes measured during the same follow-up window (in-program vs. post-program) (column 4);
- Adjusted p-values that control for the FWER among all ten outcomes included in Table 1 (column 5).

Because we have strong priors that the impact of ReHire differed during the two follow-up periods, our preferred correction for multiple hypothesis testing is in column (4); we present the results in column (5) for completeness.

We draw two conclusions from the results presented in Table A-8. First, the standard p-values in column 2 and the randomization-based p-values in column 3 are strikingly similar, suggesting that the potential concern of serial correlation in treatment assignment imposed by the randomization procedure does not affect our inference. Second, our main results are robust to concerns stemming from testing multiple hypotheses. All outcomes where effects are significant at the 5 percent level in column (2) remain so even after adjusting for the five hypotheses tested in each panel or the ten hypotheses tested in the table. The

[43] We benefit from the Stata code provided by Jones, Molitor and Reif (2019) and adapt it to rely on the distribution of permutation-based p-values following Young (2019) instead of a bootstrap distribution. See Appendix C in the on-line appendix of Jones, Molitor and Reif (2019) for a detailed description of the step-down procedure.

Table A-8: ITT Effect of ReHire on Formal-Sector Employment and Earnings in Colorado, Inference Robustness

	ITT Effect Controls	Naive p-value	Randomization-Based p-values		
			Per Comparison	Family-Wise	
				By Panel	Full Table
	(1)	(2)	(3)	(4)	(5)
Panel A: In-Program Employment (Quarters 0–4)					
Any employment	0.115	< 0.001	< 0.001	< 0.001	< 0.001
Share of quarters worked	0.111	< 0.001	< 0.001	< 0.001	0.001
Worked every quarter	0.071	< 0.001	< 0.001	< 0.001	0.001
Average quarterly earnings	$247	0.004	0.004	0.007	0.017
Share of quarters above 130% FPL	0.018	0.133	0.132	0.132	0.328
Panel B: Post-Program Employment (Quarters 5–8)					
Any employment	0.017	0.436	0.446	0.446	0.446
Share of quarters worked	0.037	0.059	0.062	0.144	0.181
Worked every quarter	0.066	0.002	0.003	0.009	0.013
Average quarterly earnings	$155	0.249	0.257	0.407	0.407
Share of quarters above 130% FPL	0.023	0.184	0.185	0.351	0.351

Notes: Data source is administrative UI earnings data from CDLE. Panels A and B report estimates on in-program and post-program employment outcomes, respectively, for the sample of ReHire applicants who applied between 7/2015 and 12/2017. Quarter 0 represents the quarter in which a participant completed an application, and is thus a different calendar quarter from person to person. Formal employment is defined as having UI-covered earnings in Colorado greater than $0 in a given quarter. Earnings from a ReHire-sponsored transitional job are covered by the UI system and are thus counted as formal sector employment. Column (1) reports the coefficient on a treatment indicator, selecting controls from a high-dimensional set of baseline characteristics using the post-double selection LASSO procedure from Belloni, Chernozhukov and Hansen (2014). Column (2) reports naive p-values. Columns (3) through (5) report randomization-based p-values that come from permuting treatment assignment 10,000 times and re-estimating effects. Column (3) reports per comparison p-values. Columns (4) and (5) report adjusted p-values that control for the family-wise error rate (Westfall and Young, 1993; Jones, Molitor and Reif, 2019) among outcomes reported within the panel and within the table, respectively.

two point estimates that were significant at the 10 percent level according to unadjusted p-values, however, lose statistical significance when adjusting for multiple hypothesis testing.

A.12 Additional Follow-up Survey Details

A.12.1 Follow-up Survey Response Rates and Reweighting for Selective Response

Among the 1,931 applicants in our analysis sample, 777 individuals completed the follow-up survey. Response rates were higher in the treatment group (45.0 percent) than the control group (34.5 percent). Table A-9 reports average baseline characteristics of those who did not respond to the follow-up survey (column 1) and those who responded to the follow-up survey (column 2). In general, survey respondents were more likely to have received TANF in the prior year, more likely to be female, and had higher levels of education. Respondents were less likely to be a non-custodial parent, to be an older worker, to be allowed to drive, to have ever been homeless, or to report substance abuse. However, the magnitudes of the differences in means relative to the control group standard deviation are less than 0.25 for all characteristics (Imbens and Wooldridge, 2009).

Table A-9: Follow-up Survey Response Selection

	Non-Respondent Mean (1)	Respondent Mean (2)	Within-Strata Difference (3)	t-stat (4)	Diff./SD (5)	N (6)
Panel A: Administrative Data						
Treatment Group	0.503	0.611	0.108	4.65	0.14	1,931
Worked last year	0.613	0.604	-0.019	-0.84	-0.02	1,931
Employment rate last three years	0.412	0.428	0.007	0.40	0.01	1,931
Average quarterly earnings in last year	$1,648	$1,775	$30	0.21	0.01	1,931
Received TANF last year	0.082	0.131	0.038	2.64	0.08	1,931
Received SNAP last year	0.679	0.673	0.012	0.55	0.02	1,931
Panel B: Baseline Survey						
Veteran	0.244	0.214	-0.001	-0.08	-0.00	1,930
Non-custodial parent	0.223	0.144	-0.067	-3.79	-0.11	1,930
Older worker	0.528	0.457	-0.048	-2.09	-0.06	1,930
Not in a priority category	0.227	0.333	0.067	3.32	0.10	1,930
Average Age (years)	47.476	45.661	-1.326	-2.37	-0.07	1,895
Average years of education	13.181	13.985	0.694	7.76	0.24	1,679
Male	0.576	0.434	-0.122	-5.35	-0.16	1,931
Minority	0.371	0.368	0.019	0.84	0.02	1,930
Covered by Medicaid	0.728	0.753	0.031	1.50	0.04	1,930
Not allowed to drive	0.253	0.159	-0.077	-4.21	-0.12	1,915
Parents that are single parenting	0.505	0.622	0.095	2.26	0.14	560
Difficulty finding childcare	0.065	0.120	0.049	3.65	0.11	1,920
Expect economic hardship	0.310	0.279	-0.019	-0.89	-0.03	1,895
Health limits work	0.109	0.122	0.017	1.12	0.03	1,881
Ever homeless	0.461	0.340	-0.089	-4.09	-0.12	1,918
Ever convicted of felony	0.246	0.187	-0.038	-2.02	-0.06	1,913
Drugs or alcohol have affected life	0.248	0.164	-0.081	-4.28	-0.13	1,889

Notes: Data come from administrative UI earnings data from CDLE, administrative benefits data from CBMS, and baseline survey data collected at application. The sample includes all ReHire applicants who applied between 7/2015 and 12/2017. Respondents are individuals with a completed follow-up survey. One applicant can be linked to administrative data, but is missing a baseline survey.

To account for selective survey response, we construct a set of inverse propensity weights to use in our analysis of outcomes from this data source. Separately by treatment assignment, we use a logit specification to predict survey response based on administrative data outcomes measured prior to application and in the months/quarters prior to survey invitation. Specifically, we include 5 indicators for educational attainment (high school; some college; Associate's degree; Bachelor's degree; or flag for missing education), 1 indicator for gender (male), 17 indicators for quarterly employment (12 quarters before random assignment through 4 quarters following random assignment), 39 indicators each for monthly SNAP and TANF participation (24 months before random assignment through 14 months following random assignment), 3 indicators for any employment in the one/two/three year(s) before random assignment, and 3 indicators for having no employment in the one/two/three year(s) before random assignment. We also include 17 controls for quarterly earnings in the 12 quarters before random assignment through 4 quarters following random assignment, 3 controls for average earnings in the one/two/three year(s) before random assignment, and 4 controls for total SNAP and TANF amount received in the one/two year(s) before random assignment. The resulting attrition weight is the inverse of the predicted probability an individual completed the follow-up survey, and we top code the weights at the 99^{th} percentile.

A.12.2 Treatment-Control Baseline Balance Among Follow-Up Sample

Among follow-up survey respondents, baseline characteristics are largely balanced between the control group and treatment group, regardless of whether we apply the weights described above. Table A-10 reports average baseline characteristics of respondents in the control group (column 1) and the treatment group (column 2). Columns (3) and (5) report the unweighted and weighted differences in means, respectively. Corresponding test statistics are reported in columns (4) and (6). In the unweighted sample, the treatment group is more likely to be male and less likely to have difficulty finding child care or to expect economic hardship in the coming months. In the weighted sample, the only statistically significant difference is that the treatment group is less likely to expect economic hardship in the coming months.

Table A-10: Summary Statistics and Baseline Balance, Follow-up Survey Respondents

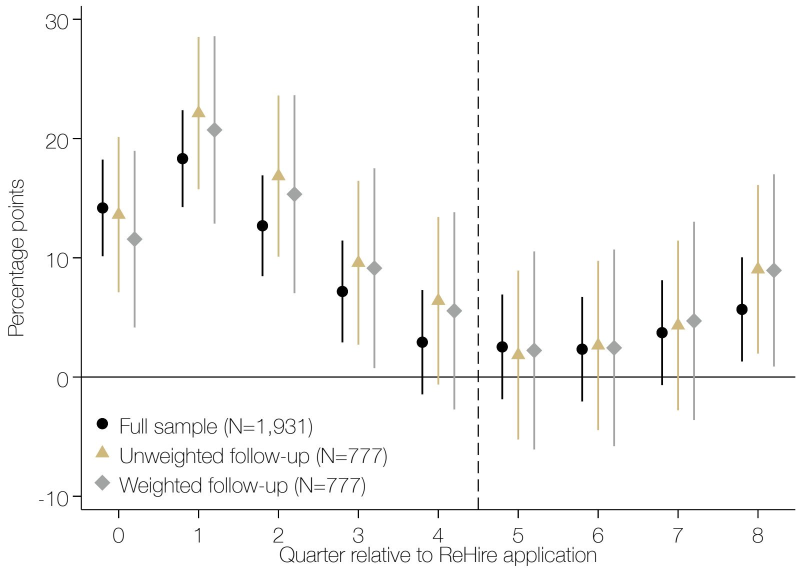
	Control Mean	Treatment Mean	Unweighted Diff.	Unweighted t-stat	Weighted Diff.	Weighted t-stat	N
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Administrative Data							
Worked last year	0.573	0.623	0.041	1.09	0.004	0.10	777
Employment rate last three years	0.402	0.445	0.040	1.45	0.008	0.28	777
Average quarterly earnings in last year	$1,564	$1,909	$224	1.09	$94	0.46	777
Received TANF last year	0.139	0.126	-0.020	-0.78	0.012	0.61	777
Received SNAP last year	0.705	0.653	-0.051	-1.49	-0.011	-0.25	777
Panel B: Baseline Survey							
Veteran	0.219	0.211	0.005	0.17	-0.012	-0.32	777
Non-custodial parent	0.146	0.143	-0.004	-0.17	-0.021	-0.59	777
Older worker	0.447	0.463	0.012	0.33	-0.010	-0.23	777
Not in a priority category	0.334	0.333	-0.001	-0.03	0.012	0.32	777
Average Age (years)	45.816	45.561	-0.295	-0.33	-0.705	-0.65	764
Average years of education	14.094	13.917	-0.178	-1.28	0.117	0.76	663
Male	0.391	0.461	0.083	2.32	0.060	1.39	777
Minority	0.394	0.352	-0.023	-0.67	0.019	0.48	777
Covered by Medicaid	0.765	0.745	-0.020	-0.62	0.018	0.42	777
Not allowed to drive	0.136	0.173	0.041	1.50	0.032	0.88	776
Parents that are single parenting	0.611	0.629	0.056	0.91	0.107	1.65	283
Difficulty finding childcare	0.142	0.106	-0.043	-1.75	-0.015	-0.70	774
Expect economic hardship	0.318	0.255	-0.062	-1.82	-0.101	-2.34	766
Health limits work	0.125	0.119	0.002	0.06	0.009	0.34	757
Ever homeless	0.369	0.321	-0.037	-1.11	-0.040	-0.99	774
Ever convicted of felony	0.189	0.186	0.002	0.06	0.020	0.48	774
Drugs or alcohol have affected life	0.159	0.167	0.004	0.16	-0.041	-1.04	762

Notes: Data come from administrative UI earnings data from CDLE, administrative benefits data from CBMS, and baseline survey data collected at application. The sample includes ReHire applicants who applied between 7/2015 and 12/2017 and completed the follow-up survey. One applicant can be linked to administrative data, but is missing a baseline survey.

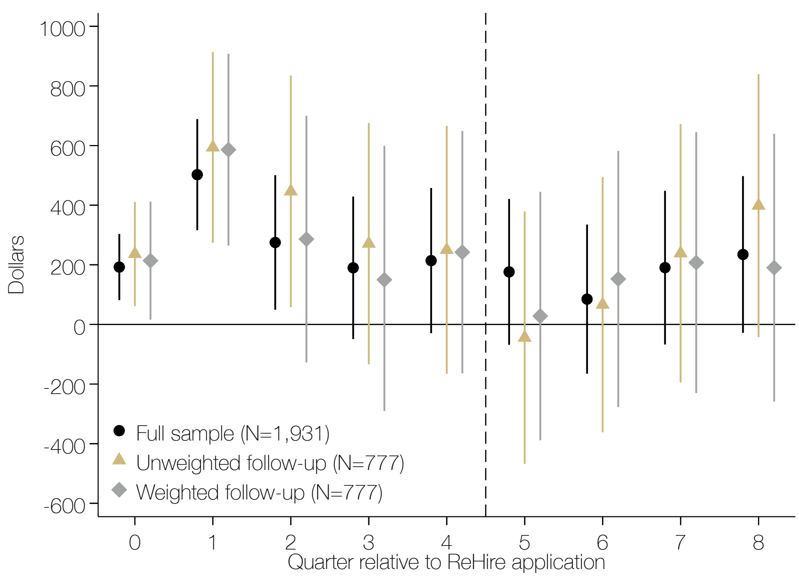
Program impacts on outcomes observed in administrative data are similar between the full sample (N=1,931) and the unweighted and weighted follow-up samples (N=777). Figure A-6 reports quarterly effects on employment (panel a) and earnings (panel b) for the full sample (black circles), unweighted follow-up sample (gold triangles), and weighted follow-up sample (gray diamonds). The figure reports coefficients from a regression of the outcome measured in the quarter relative to ReHire application (x-axis) controlling for stratification fixed effects and selected baseline controls using a post-double selection LASSO procedure (Belloni, Chernozhukov and Hansen, 2014). Vertical bars represent 95 percent confidence intervals. Table A-11 replicates the main effects from Table 1 among the full sample and the weighted follow-up sample. The pattern of results are similar between the full sample and two follow-up samples, albeit with less precision due to the reduction in sample size.

Figure A-6: ITT Effect of ReHire on Quarterly Employment and Earnings, Comparison of Results among All ReHire Applicants and Follow-up Survey Respondents

(a) Employment



(b) Earnings



Notes: Data source is administrative UI earnings data from CDLE. The sample includes 1,931 ReHire applicants who applied between 7/2015 and 12/2017. Time 0 represents the quarter in which a participant completed an application, and is thus a different calendar period from person to person. Formal employment is defined as having UI-covered earnings in Colorado greater than $0 in a given quarter. Earnings from a ReHire-sponsored transitional job are covered by the UI system and are thus counted as formal sector employment. Treatment and control groups are based on an individual's randomly assigned treatment status. The figure plots the treatment-control differences in average quarterly employment (a) and earnings (b), controlling for stratification fixed effects and baseline characteristics selected through a post-double selection LASSO procedure (Belloni, Chernozhukov and Hansen, 2014). Black circles represent estimates using the full sample of ReHire applicants. Gold triangles (gray diamonds) depict estimates from an unweighted (weighted) specification using all 777 follow-up survey respondents. Vertical bars represent the 95 percent confidence intervals constructed using heteroskedasticity-robust standard errors.

Table A-11: ITT Effect of ReHire on Formal-Sector Employment and Earnings in Colorado, Comparison of Results among All ReHire Applicants and Follow-up Survey Respondents

	All Applicants		Followup Respondents	
	Control Mean	ITT Effect Controls	Control Mean	Weighted ITT Effect Controls
	(1)	(2)	(3)	(4)
Panel A: In-Program Employment (Quarters 0–4)				
Any employment	0.808	0.115**	0.829	0.119**
		(0.015)		(0.026)
Share of quarters worked	0.539	0.111**	0.550	0.112**
		(0.015)		(0.029)
Worked every quarter	0.237	0.071**	0.240	0.074*
		(0.019)		(0.034)
Average quarterly earnings	$1,845	$258**	$1,856	$269+
		(93)		(155)
Share of quarters above 130% FPL	0.192	0.018	0.199	0.007
		(0.012)		(0.021)
Panel B: Post-Program Employment (Quarters 5–8)				
Any employment	0.627	0.017	0.625	0.044
		(0.022)		(0.042)
Share of quarters worked	0.488	0.037+	0.495	0.047
		(0.020)		(0.037)
Worked every quarter	0.332	0.066**	0.362	0.037
		(0.022)		(0.040)
Average quarterly earnings	$2,404	$136	$2,384	$142
		(148)		(237)
Share of quarters above 130% FPL	0.261	0.023	0.265	0.016
		(0.017)		(0.030)
Agency-Rate Block FEs		X		X
Individual Baseline Controls		X		X
Observations	876	1,931	302	777

Notes: Data source is administrative UI earnings data from CDLE. Panels A and B report estimates on in-program and post-program employment outcomes, respectively, for the full sample (columns 1 and 2) and the sample of follow-up survey respondents (columns 3 and 4). Columns (1) and (3) report the unweighted control group means. Columns (2) and (4) report the coefficient on a treatment indicator, selecting controls from a high-dimensional set of baseline characteristics using the post-double selection LASSO procedure from Belloni, Chernozhukov and Hansen (2014). Heteroskedasticity-robust standard errors in parentheses.
**0.01, *0.05, +0.10 significance levels

A.12.3 ITT Effects on Components of Follow-up Survey Outcome Indices

In Table 3, we report the average standardized treatment effect of ReHire among groups of outcomes constructed from the follow-up survey: job quality for an individual's first unsubsidized job following ReHire application; job quality for an individual's current unsubsidized job at the time of follow-up; well-being; employment barriers; workplace behaviors; and expectations about the future.

Table A-12 reports effects on the underlying components of the two job quality indices. Columns (1) through (5) includes results based on the job characteristics of an individual's first unsubsidized job following ReHire application. For these columns, the sample is restricted to the 637 follow-up survey respondents who report working an unsubsidized job since they applied to ReHire. Columns (6) through (10) report results based on the job characteristics of an individual's job they were working at the time of survey response. For these columns, the sample is restricted to the 472 indiviuals working at the time of follow-up. Each row in the table represents a different characteristic. The table reports control group means (columns 1 and 6), ITT effects from a regression that controls for stratification fixed effects (columns 2 and 7), estimates from a weighted sample using inverse propensity attrition weights (columns 3 and 8), and estimates that selects baseline controls using a post-double selection LASSO procedure (columns 4 and 9). Columns (5) and (10) report sample sizes for each outcome. For a few respondents, we were unable to construct an estimate of their hourly wage. Results are relatively stable across specifications.

The final row of Table A-12 presents the standardized treatment effect found in Table 3. In constructing the standardized treatment effect, estimates from some of underlying components (worked for hourly wage; would like to work more hours; work hours change a lot or fair amount) are re-signed so that an increase in the outcome represents an improvement in job quality.

Similarly, Table A-13 reports effects on the components of the remaining outcome indices measured in the following up survey: well-being (Panel A); employment barriers (Panel B); workplace behaviors (Panel C); and expectations about the future (Panel D). This table reports the same specifications as Table A-12. In Panels A and B, the set of covariates used to select controls in the post-double selection LASSO procedure includes measures of the outcomes observed at ReHire application. For outcomes in Panels C and D, the respondent was asked the extent to which they agreed or disagreed with the given statement (strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree). We construct indicators for whether an individual responded that they agree or strongly agree with the statement.

The final row of each panel in Table A-13 reports the standardized treatment effect found in Table 3. In constructing this index, some of the outcomes (expect hardship in next 2 months; depression score; and all 5 employment barriers) are re-signed so that increases in the outcomes represent improvements.

Table A-12: ITT Effect of ReHire on Components of the Job Quality Index, Follow-Up Survey Respondents

	First Unsubsidized Post-Application Job					Job at Time of Survey				
	Control Mean	Unweighted ITT Effect No Controls	Weighted ITT Effect No Controls	Weighted ITT Effect Controls	N	Control Mean	Unweighted ITT Effect No Controls	Weighted ITT Effect No Controls	Weighted ITT Effect Controls	N
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Very satisfied with job	0.199	0.164**	0.174**	0.174**	637	0.417	0.068	0.115*	0.115*	472
		(0.037)	(0.040)	(0.039)			(0.050)	(0.053)	(0.051)	
Worked for hourly wage	0.911	-0.035	-0.060*	-0.060*	637	0.857	-0.025	-0.052	-0.052	472
		(0.026)	(0.029)	(0.028)			(0.037)	(0.037)	(0.036)	
Hourly wage	$15.52	0.72	2.13	2.13	630	$14.96	3.40	3.29	3.29	467
		(3.03)	(2.14)	(2.08)			(2.93)	(2.32)	(2.24)	
Non-temporary employee	0.737	-0.006	-0.020	-0.020	637	0.851	-0.008	-0.031	-0.031	472
		(0.037)	(0.043)	(0.041)			(0.038)	(0.039)	(0.038)	
Hours worked per week	30.2	0.5	0.9	0.9	637	32.1	-0.4	0.3	0.3	472
		(1.1)	(1.2)	(1.2)			(1.3)	(1.3)	(1.2)	
Would like to work more hours	0.661	-0.050	-0.069	-0.069+	637	0.673	-0.064	-0.034	-0.034	472
		(0.040)	(0.042)	(0.041)			(0.049)	(0.053)	(0.051)	
Work hours change a lot or fair amount	0.288	-0.035	-0.026	-0.026	637	0.274	-0.027	-0.024	-0.024	472
		(0.039)	(0.045)	(0.044)			(0.045)	(0.051)	(0.049)	
One-way commute time (minutes)	25.8	-0.7	-1.2	-1.2	637	25.7	-3.6	-3.9	-3.9	472
		(1.9)	(2.0)	(2.0)			(2.3)	(2.6)	(2.5)	
Any employer benefits	0.335	0.059	0.053	0.053	637	0.464	0.046	0.056	0.056	472
		(0.041)	(0.043)	(0.042)			(0.050)	(0.052)	(0.050)	
Employer-provided health insurance	0.212	0.027	0.035	0.035	637	0.327	-0.025	-0.005	-0.005	472
		(0.035)	(0.036)	(0.035)			(0.047)	(0.049)	(0.047)	
Employer contributes to retirement	0.136	0.050+	0.048+	0.048+	637	0.232	0.035	0.021	0.021	472
		(0.030)	(0.029)	(0.028)			(0.043)	(0.043)	(0.042)	
Paid vacation days	0.246	0.077*	0.064	0.064+	637	0.405	0.040	0.046	0.046	472
		(0.038)	(0.040)	(0.039)			(0.049)	(0.051)	(0.049)	
Paid sick leave	0.169	0.078*	0.079*	0.079*	637	0.280	0.069	0.073	0.073	472
		(0.035)	(0.033)	(0.032)			(0.046)	(0.047)	(0.045)	
Standardized treatment effect	0.000	0.116**	0.136**	0.136**	637	0.000	0.094+	0.111+	0.111*	472
		(0.041)	(0.044)	(0.043)			(0.056)	(0.057)	(0.055)	

Notes: Data source is an 18-month follow-up survey. The sample includes follow-up survey respondents who applied between 7/2015 and 12/2017. The first four columns report information on the first unsubsidized job worked following ReHire application. The last four columns report information on the job worked at the time of the survey. The dependent variables, given by row labels, are job characteristics, and the sample is limited to respondents who worked in the listed job. The final row reports the standardized treatment effect across all characteristics, which is measured in standard deviations. Columns (1) and (6) report control group means. Columns (2) and (7) report ITT effect estimates controlling for service agency-randomization rate block fixed effects and months since application fixed effects. Columns (3) and (8) reweights the sample using inverse propensity attrition weights. Columns (4) and (9) further select controls from a high-dimensional set of baseline characteristics using the post-double selection LASSO procedure from Belloni, Chernozhukov and Hansen (2014). Columns (5) and (10) report sample sizes. Heteroskedasticity-robust standard errors in parentheses.
**0.01, *0.05, +0.10 significance levels

Table A-13: ITT Effect of ReHire on Other Outcomes, Follow-up Survey Respondents

	Control Mean	Unweighted ITT Effect No Controls	Weighted ITT Effect No Controls	Weighted ITT Effect Controls	N
	(1)	(2)	(3)	(4)	(5)
Panel A: Components of Well-Being Index					
Subjective Well-Being					
Life satisfaction ladder (0–10)	5.116	0.680**	0.606**	0.625**	777
		(0.172)	(0.203)	(0.185)	
Expect hardship in next 2 months	0.301	-0.062+	-0.097*	-0.097*	777
		(0.034)	(0.042)	(0.041)	
Self-Reported Physical and Mental Health					
Very good or excellent health	0.305	0.067+	0.088*	0.090**	777
		(0.036)	(0.038)	(0.035)	
Health improved over last year	0.305	0.048	0.052	0.052	777
		(0.035)	(0.040)	(0.039)	
Depression score	2.206	-0.208+	-0.092	-0.151	777
		(0.123)	(0.136)	(0.121)	
Standardized treatment effect	0.000	0.162**	0.166**	0.175**	777
		(0.048)	(0.055)	(0.049)	
Panel B: Components of Employment Barriers Index					
Lack of childcare affected work	0.189	-0.044	-0.022	-0.019	777
		(0.029)	(0.030)	(0.025)	
Homeless	0.291	-0.074*	-0.061	-0.044	777
		(0.033)	(0.039)	(0.036)	
Convicted of crime	0.036	0.014	0.020	0.020	777
		(0.015)	(0.017)	(0.017)	
Incarcerated	0.023	0.001	-0.002	-0.002	777
		(0.011)	(0.014)	(0.014)	
Substance abuse affected work	0.056	-0.010	-0.023	-0.023	777
		(0.017)	(0.022)	(0.022)	
Standardized treatment effect	0.000	0.048	0.037	0.027	777
		(0.044)	(0.051)	(0.049)	
Panel C: Components of Workplace Behaviors Index					
Ask about opportunities	0.785	-0.061+	-0.078*	-0.078*	777
		(0.033)	(0.035)	(0.034)	
Speak out in group setting	0.695	-0.018	0.003	0.003	777
		(0.035)	(0.044)	(0.043)	
Positive attitude about self	0.772	0.050+	0.022	0.022	777
		(0.030)	(0.030)	(0.029)	
Confident in own abilities	0.844	0.048+	0.045	0.045	777
		(0.026)	(0.029)	(0.028)	
Don't worry about what others think about me	0.540	0.060	0.027	0.027	777
		(0.037)	(0.041)	(0.040)	
Standardized treatment effect	0.000	0.036	0.009	0.009	777
		(0.044)	(0.048)	(0.047)	
Panel D: Components of Expectations About Future Index					
Expect to work	0.808	0.030	0.046	0.046	777
		(0.029)	(0.040)	(0.039)	
Expect to not need government assistance	0.609	0.009	-0.030	-0.030	777
		(0.037)	(0.042)	(0.041)	
Standardized treatment effect	0.000	0.047	0.024	0.024	777
		(0.061)	(0.069)	(0.067)	

Notes: Data source is an 18-month follow-up survey. The sample includes follow-up survey respondents who applied between 7/2015 and 12/2017. Columns (2) reports ITT effect estimates controlling for service agency-randomization rate block fixed effects and months since application fixed effects. Column (3) reweights the sample using inverse propensity attrition weights. Column (4) further selects controls from a high-dimensional set of baseline characteristics using the post-double selection LASSO procedure from Belloni, Chernozhukov and Hansen (2014). Column (5) reports sample sizes. Heteroskedasticity-robust standard errors in parentheses.
**0.01, *0.05, +0.10 significance levels

A.13 Additional Credit Outcomes Details

A.13.1 Experian Match Rates and Reweighting for Selective Matching

Among the 1,931 applicants in our analysis sample, 1,315 individuals matched to a balanced panel of Experian records during the 5 quarters before and 8 quarters after random assignment. Match rates are similar between the treatment group (68.4 percent) and the control group (67.7 percent). Table A-14 reports average baseline characteristics of those who did not match to the Experian data panel (column 1) and those who did match to the Experian data panel (column 2). In general, applicants matched to the Experian data were more likely to have worked in the time leading up to application, earned more money, and had more years of education. Matched individuals were less likely to be covered by Medicaid and faced more employment barriers such as lack of transportation, prior involvement with the criminal justice system, and experience with homelessness.

Table A-14: Experian Match Selection

	Non-Match Mean	Match Mean	Within-Strata Difference	t-stat	Diff./ SD	N
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Administrative Data						
Treatment Group	0.541	0.549	0.014	0.57	0.02	1,931
Worked last year	0.545	0.639	0.089	3.62	0.15	1,931
Employment rate last three years	0.346	0.453	0.100	5.76	0.23	1,931
Average quarterly earnings in last year	$1,110	$1,975	$800	6.46	0.26	1,931
Received TANF last year	0.080	0.113	0.019	1.33	0.05	1,931
Received SNAP last year	0.708	0.662	-0.033	-1.45	-0.06	1,931
Panel B: Baseline Survey						
Veteran	0.259	0.219	0.004	0.19	0.01	1,930
Non-custodial parent	0.221	0.177	-0.033	-1.66	-0.07	1,930
Older worker	0.524	0.488	-0.011	-0.47	-0.02	1,930
Not in a priority category	0.244	0.282	-0.006	-0.30	-0.01	1,930
Average Age (years)	46.613	46.806	0.811	1.37	0.06	1,895
Average years of education	12.896	13.791	0.787	8.29	0.35	1,679
Male	0.615	0.474	-0.106	-4.41	-0.18	1,931
Minority	0.356	0.376	0.052	2.24	0.09	1,930
Covered by Medicaid	0.784	0.716	-0.073	-3.50	-0.14	1,930
Not allowed to drive	0.308	0.171	-0.126	-5.82	-0.24	1,915
Parents that are single parenting	0.508	0.579	0.018	0.35	0.03	560
Difficulty finding childcare	0.044	0.108	0.054	4.54	0.18	1,920
Expect economic hardship	0.332	0.282	-0.036	-1.53	-0.06	1,895
Health limits work	0.097	0.122	0.030	1.95	0.08	1,881
Ever homeless	0.571	0.337	-0.186	-7.92	-0.32	1,918
Ever convicted of felony	0.301	0.185	-0.093	-4.25	-0.17	1,913
Drugs or alcohol have affected life	0.255	0.195	-0.053	-2.50	-0.10	1,889

Notes: Data come from administrative UI earnings data from CDLE, administrative benefits data from CBMS, and baseline survey data collected at application. The sample includes all ReHire applicants who applied between 7/2015 and 12/2017. Match denotes an individual who matched to a credit record in each of the 5 quarters before and 8 quarters following random assignment. One applicant can be linked to administrative data, but is missing a baseline survey.

To account for selective matching to the Experian data, we construct a set of inverse propensity weights to use in our analysis of outcomes from this data source. These weights are constructed analogously to the weights used for outcomes from the follow-up survey. See Section A.12 for details.

Among Experian-matched applicants, baseline characteristics are largely balanced between the control group and treatment group. Table A-15 reports average baseline characteristics of Experian-matched applicants in the control group (column 1) and the treatment group (column 2). Columns (3) and (5) report the unweighted and weighted differences in means, respectively. Corresponding test statistics are reported in columns (4) and (6). In the unweighted sample, the treatment group is slightly younger and more likely to be allowed to drive. This pattern is similar in the weighted sample.

Table A-15: Summary Statistics and Baseline Balance, Experian Sample

	Control Mean	Treatment Mean	Unweighted		Weighted		N
			Diff.	t-stat	Diff.	t-stat	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Administrative Data							
Worked last year	0.632	0.644	0.007	0.25	0.025	0.88	1,315
Employment rate last three years	0.447	0.458	0.005	0.24	0.007	0.32	1,315
Average quarterly earnings in last year	$1,802	$2,118	$219	1.17	$167	1.08	1,315
Received TANF last year	0.115	0.111	-0.002	-0.13	-0.014	-0.82	1,315
Received SNAP last year	0.666	0.659	-0.010	-0.38	-0.001	-0.05	1,315
Panel B: Baseline Survey							
Veteran	0.228	0.212	-0.011	-0.51	-0.013	-0.53	1,315
Non-custodial parent	0.165	0.187	0.022	1.06	0.024	0.98	1,315
Older worker	0.508	0.472	-0.031	-1.15	-0.042	-1.45	1,315
Not in a priority category	0.277	0.287	0.009	0.39	0.012	0.52	1,315
Average Age (years)	47.498	46.230	-1.217	-1.87	-1.263	-1.84	1,287
Average years of education	13.837	13.753	-0.072	-0.69	-0.049	-0.44	1,130
Male	0.447	0.496	0.046	1.68	0.046	1.60	1,315
Minority	0.401	0.356	-0.045	-1.72	-0.048	-1.72	1,315
Covered by Medicaid	0.734	0.702	-0.036	-1.44	-0.031	-1.19	1,315
Not allowed to drive	0.143	0.194	0.053	2.61	0.065	2.79	1,305
Parents that are single parenting	0.567	0.590	0.045	0.95	0.025	0.50	442
Difficulty finding childcare	0.117	0.100	-0.017	-0.99	-0.015	-0.90	1,306
Expect economic hardship	0.302	0.265	-0.040	-1.57	-0.043	-1.60	1,296
Health limits work	0.125	0.120	-0.003	-0.17	0.001	0.06	1,280
Ever homeless	0.341	0.334	-0.007	-0.26	-0.008	-0.28	1,307
Ever convicted of felony	0.184	0.186	0.007	0.31	0.011	0.42	1,302
Drugs or alcohol have affected life	0.197	0.193	-0.003	-0.15	-0.012	-0.49	1,282

Notes: Data come from administrative UI earnings data from CDLE, administrative benefits data from CBMS, and baseline survey data collected at application. The sample includes ReHire applicants who applied between 7/2015 and 12/2017 and linked to a credit record during each of the 5 quarters before application and 8 quarters following application. One applicant can be linked to administrative data, but is missing a baseline survey.

Program impacts on outcomes observed in administrative data are similar between the full sample (N=1,931) and the unweighted and weighted credit sample (N=1,315). Table A-16 replicates the main effects from Table 1 among the full sample and the weighted credit sample. The pattern of results are similar between the full sample and two follow-up samples, although effects on earnings are smaller and all estimates are less precise due to the reduction in sample size.

Table A-16: ITT Effect of ReHire on Formal-Sector Employment and Earnings in Colorado, Comparison of Results among All ReHire Applicants and Credit Outcome Sample

	All Applicants		Experian Sample	
	Control Mean	ITT Effect Controls	Control Mean	Weighted ITT Effect Controls
	(1)	(2)	(3)	(4)
Panel A: In-Program Employment (Quarters 0–4)				
Any employment	0.808	0.115**	0.805	0.120**
		(0.015)		(0.019)
Share of quarters worked	0.539	0.111**	0.549	0.106**
		(0.015)		(0.019)
Worked every quarter	0.237	0.071**	0.240	0.075**
		(0.019)		(0.024)
Average quarterly earnings	$1,845	$258**	$1,959	$165
		(93)		(114)
Share of quarters above 130% FPL	0.192	0.018	0.205	0.012
		(0.012)		(0.016)
Panel B: Post-Program Employment (Quarters 5–8)				
Any employment	0.627	0.017	0.640	-0.005
		(0.022)		(0.028)
Share of quarters worked	0.488	0.037+	0.494	0.029
		(0.020)		(0.025)
Worked every quarter	0.332	0.066**	0.345	0.057*
		(0.022)		(0.027)
Average quarterly earnings	$2,404	$136	$2,541	$17
		(148)		(188)
Share of quarters above 130% FPL	0.261	0.023	0.277	0.011
		(0.017)		(0.022)
Agency-Rate Block FEs		X		X
Individual Baseline Controls		X		X
Observations	876	1,931	593	1,315

Notes: Data source is administrative UI earnings data from CDLE. Panels A and B report estimates on in-program and post-program employment outcomes, respectively, for the full sample (columns 1 and 2) and the sample of ReHire applicants linked to the credit outcome panel (columns 3 and 4). Columns (1) and (3) report the unweighted control group means. Columns (2) and (4) report the coefficient on a treatment indicator, selecting controls from a high-dimensional set of baseline characteristics using the post-double selection LASSO procedure from Belloni, Chernozhukov and Hansen (2014). Heteroskedasticity-robust standard errors in parentheses.
**0.01, *0.05, +0.10 significance levels

A.13.2 Additional Credit Outcomes Results

In Panel C of Table 3, we report the average standardized treatment effect of ReHire on credit outcomes measured during the in-program period (Q0–Q4) and post-program period (Q5–Q8).

Table A-17 reports effects on the underlying credit outcomes during those two periods. The sample is restricted to the 1,315 ReHire applicants who match to a credit record for each of the 5 quarters preceeding application through the 8 quarters following application. Each row in the table represents a different outcome averaged over the in-program period (Panel A) or post-program period (Panel B). The table reports control group means (column 1), ITT effects from a regression that controls for stratification fixed effects (column 2), estimates from the weighted sample using inverse propensity attrition weights (column 3), and estimates that selects baseline controls using a post-double selection LASSO procedure (column 4). Column (5) reports sample sizes for each outcome.

The final row of each panel in Table A-17 presents the standardized treatment effect found in Table 3. In constructing the standardized treatment effect, estimates from some of underlying outcomes (total debt, credit card debt, any delinquent accounts, any derogatory accounts, and any accounts in collections) are re-signed such that an increase in the outcome represents an improvement in credit outcomes.

Table A-17: ITT Effect of ReHire on Credit Outcomes, Experian Sample

	Control Mean	Unweighted ITT Effect No Controls	Weighted ITT Effect No Controls	Weighted ITT Effect Controls	N
	(1)	(2)	(3)	(4)	(5)
Panel A: In-Program Credit Outcomes (Q0–Q4)					
Credit score	596.15	-0.18	0.18	-2.31	1,315
		(5.01)	(4.84)	(1.98)	
Total debt	$28,487	-$1,969	-$1,467	$1,490	1,315
		(3,062)	(2,666)	(1,195)	
Credit card debt	$1,740	-$522*	-$359	-$59	1,315
		(259)	(226)	(126)	
Has auto loan or lease	0.161	0.016	0.016	0.016	1,315
		(0.020)	(0.019)	(0.018)	
Any delinquent accounts	0.144	0.013	0.017	0.017	1,315
		(0.015)	(0.017)	(0.016)	
Any derogatory accounts	0.347	0.004	0.012	0.012	1,315
		(0.020)	(0.021)	(0.021)	
Any accounts in collections	0.617	0.004	0.001	0.001	1,315
		(0.024)	(0.025)	(0.025)	
Standardized treatment effect	0.000	0.015	0.008	-0.013	1,315
		(0.025)	(0.025)	(0.022)	
Panel B: Post-Program Credit Outcomes (Q5–Q8)					
Credit score	602.09	2.10	2.37	0.44	1,315
		(4.94)	(4.77)	(2.74)	
Total debt	$30,463	-$3,071	-$3,381	-$834	1,315
		(3,205)	(2,852)	(1,875)	
Credit card debt	$1,616	-$432+	-$305	-$76	1,315
		(229)	(197)	(145)	
Has auto loan or lease	0.178	0.000	-0.005	-0.005	1,315
		(0.020)	(0.020)	(0.020)	
Any delinquent accounts	0.123	-0.012	-0.013	-0.013	1,315
		(0.014)	(0.015)	(0.015)	
Any derogatory accounts	0.291	-0.003	-0.002	-0.002	1,315
		(0.019)	(0.020)	(0.020)	
Any accounts in collections	0.607	0.007	0.002	0.002	1,315
		(0.025)	(0.025)	(0.025)	
Standardized treatment effect	0.000	0.030	0.029	0.011	1,315
		(0.024)	(0.024)	(0.022)	

Notes: Data source is administrative credit data from Experian. Panels A and B report estimates on in-program and post-program credit outcomes, respectively, for the sample of ReHire applicants who applied between 7/2015 and 12/2017 and matched to an Experian record in the 5 quarters before and 8 quarters following random assignment. Quarter 0 represents the quarter in which a participant completed an application, and is thus a different calendar quarter from person to person. Column (1) reports the mean for control group applicants. Column (2) reports the coefficient on a treatment indicator, controlling for vendor-randomization rate block fixed effects. Column (3) reports the coefficient on a treatment indicator, selecting controls from a high-dimensional set of baseline characteristics using the post-double selection LASSO procedure from Belloni, Chernozhukov and Hansen (2014). Column (4) further weights the sample using inverse propensity attrition weights. Column (5) reports the percent change of the ITT effect in column (4) relative to the control group mean. Heteroskedasticity-robust standard errors in parentheses.
**0.01, *0.05, +0.10 significance levels

A.14 Analysis of Mechanisms

This section provides additional details and supporting evidence for the discussion of mechanisms in Section 6 in the main paper.

A.14.1 Identifying Subsidized to Unsubsidized Employment Transitions

One difficulty of measuring within-firm transitions from subsidized to unsubsidized employment is that the employer of record for the transitional job in the administrative earnings data is the local service agency. In order to identify which ReHire participants transitioned from subsidized to unsubidized work with the same employer, we combine information from UI wage records with participant information tracked in the ReHire administrative database. Program records tracked employer names for the transitional job host site, as well as the first unsubsidized employment spell following program participation. We use this information, as well as employer names in UI wage records, to identify participants who transitioned to unsubsidized employment with the same employer host site.

We code successful transitions in the following ways:

1. **Compare employer names within ReHire case notes:** ReHire case records include reports of employment spells while the participant remained on the ReHire caseload. The records include employer names, start and end dates, employer industry, and employer size. The employment records are reported separately for subsidized jobs and unsubsidized jobs. For each participant, we hand-matched names of subsidized and unsubsidized employers and coded a successful transition when the employer names matched.

2. **Compare subsidized employer names from ReHire case notes with employer names in administrative earnings records:** The administrative earnings records from CDLE included employer name and employer industry. For individuals with a recorded transitional job in the ReHire database, we hand-matched names of the employer(s) in the ReHire case notes to all employers linked to the individual in the UI wage records. In some cases, though the name of the employer did not match, we verified through information on-line that the employer name was linked to the given name of the employer in the ReHire case notes as a "d.b.a" name. For example, the ReHire case notes may have had an employer as "ABC Cafe" but the UI records had "XYZ Restaurant Group". When such matches could be verified through an internet search, they were also coded as successful transition.

A.14.2 Explaining Differences in Post-Program Employment Among Individuals with a Transitional Job

Table 4 shows that, among ReHire participants placed into a transitional job, those who successfully transitioned to unsubsidized work at the same employer had slightly higher baseline assessments from the ReHire caseworker. As shown in Table 4, this difference was the only substantive difference in baseline characteristics between these two groups. This section provides additional analysis of how well these ratings predict program experience and shows that controlling for these ratings has minimal impact on estimated treatment effects.

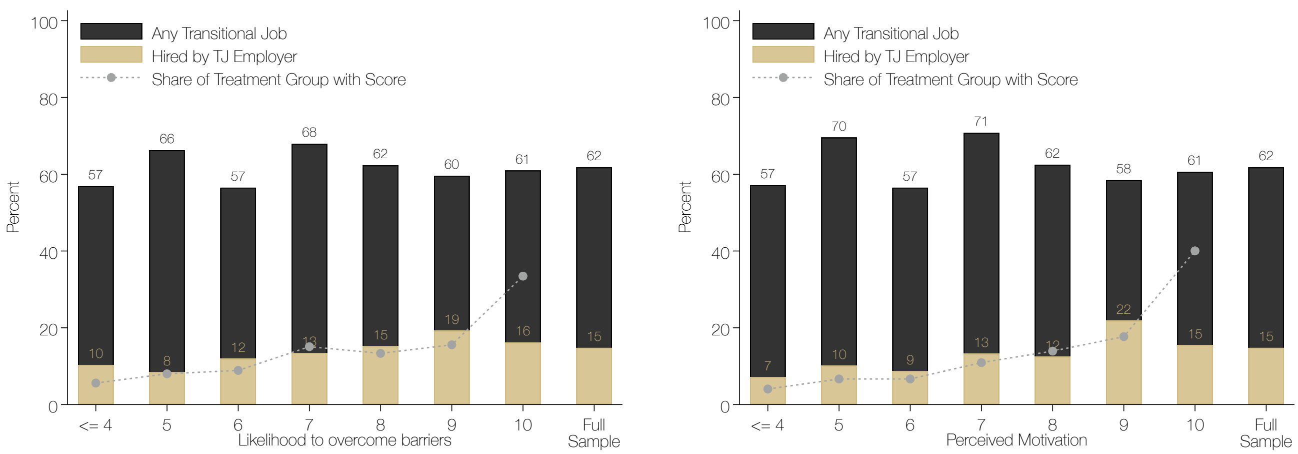
At the time of application, after completing the approximately 45-minute baseline survey with the applicant, case workers were asked to rate the individual on a scale of 1–10 on their perceived motivation and likelihood to overcome barriers. Specifically, the program training manual stated: "These questions ask you to provide your personal feelings about the respondent's likelihood of success in the program (i.e., moving from subsidized to unsubsidized employment) and their ability to overcome the barriers to employment they have faced in the past."

Figure A-7 shows how program experience varies across the entire distribution of caseworkers' assessment of the applicant's likelihood to overcome barriers (Figure A-7a) and their motivation to obtain and maintain employment (Figure A-7b). In each panel, the horizontal axis divides the sample based on the assessment of the case worker, grouping individuals with a score of 4 or lower into one group, and showing the information for the full sample in the final bar. Grey circles connected by a dotted line shows the share of the treatment group with a given score. For both assessments, the modal score was a 10 out of 10. The height of the vertical black bar reports the share of the group who were placed into a transitional job. While some groups were more or less likely to have been placed, across both figures, there is not a consistent increasing or decreasing pattern of placement. Finally, the height of the gold bar reports share of each group who were placed into a transitional job and then was subsequently hired on by that employer. In both figures, successful transition rates are slightly increasing in the caseworker assessment, consistent with the differences reported in Table 4.

Figure A-7: Transitional Job Take-up and Subsequent Hire by Case Worker Assessment at Intake

(a) Likelihood to Overcome Barriers to Employment

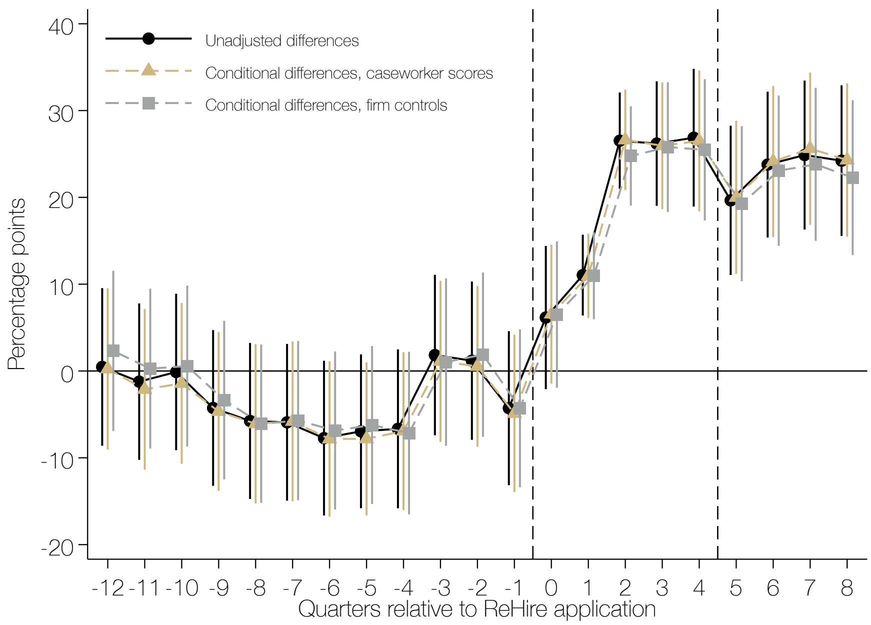
(b) Motivation to Obtain and Maintain Employment



Notes: Data source is the baseline survey, ReHire program records, and administrative UI earnings data from CDLE. The sample includes 1,034 ReHire applicants who applied between 7/2015 and 12/2017, were scored by assessment after their intake, and were assigned to the treatment group. Panel (a) divides the treatment group based on a scale of how motivated the individual was to obtain and maintain full-time employment. Panel (b) divides the treatment group based on a scale of the likelihood that the individual would overcome obstacles to full-time employment. For each score designated on the x-axis, the figure plots the share of the treatment group that was placed into a transitional job (black bar) and was placed into a transitional job and were subsequently hired by the same employer (gold bar). The gray circle and dashed line shows the distribution of scores across the sample.

Figure A-8 shows that the differences in caseworker assessment scores reported in Table 4 and the differences in placement characteristics reported in Table 5 do not explain the large gaps in post-program employment rates between transitional job recipients who were and were not hired by their employer host site. Black circles report differences in quarterly employment rates for the two groups, controlling for strata fixed effects. Gold triangles and grey squares report conditional differences in employment rates after controlling for caseworker assessment scores and industry and firm size, respectively. Across all quarters, conditional differences are very close to the unconditional differences. Taken together, the evidence in this figure suggests that the differences in individual characteristics or placement characteristics do not explain the large differences in post-program employment between these two groups.

Figure A-8: Differences in Employment Rates among Transitional Job Recipients, Hired by Employer Site versus Not Hired by Employer Site



Notes: Data source is administrative UI earnings data from CDLE. The sample includes 651 ReHire applicants who applied between 7/2015 and 12/2017 were assigned to the treatment group and were placed into a transitional job. The figure plots differences in quarterly employment rates between TJ recipients who were and were not hired by their employer host site controlling for strata fixed effects. Black circles report the coefficient on an indicator for hire in a regression without any additional controls. Gold triangles report the coefficient on an indicator for hire in a regression that flexibly controls for the two caseworker assessments. Grey squares report the coefficient on an indicator for hire in a regression that controls for host site firm size and industry. Vertical black, gold, and grey bars represent the 95% confidence intervals constructed using heteroskedasticity-robust standard errors.

A.14.3 Using Machine Learning to Predict Program Experience and to Estimate Heterogeneity Across Predicted Program Experience

The primary component of ReHire is placement into a transitional job. Roughly 62 percent of treatment group members are placed into a transitional job, and about 15 percent of the treatment group go on to work in an unsubsidized job with the same employer. Table 4 shows some selection on baseline characteristics into who is placed into a transitional job, although characteristics are very similar when comparing TJ workers who are subsequently hired on by their host site to those who are not.

We combine machine learning methods with a repeated split-sample (RSS) procedure motivated by Abadie, Chingos and West (2018) and Chernozhukov et al. (2020) to more rigorously explore whether baseline characteristics are predictive of program experiences. Let T_i^j be an indicator for whether individual i had one of two program experiences j: take-up of a transitional job (T_i^1) or take-up of a transitional job and then transition to unsubsidized work with the same employer (T_i^2). In this exercise, we aim to predict T_i^j using either OLS, logit, or one of four machine learning methods—elastic net, boosted trees, neural network with feature extraction, and random forest—following Chernozhukov et al. (2020).[44] We then use these predictions to ask how the predicted probability of having these program experiences relates to the size of an individual's program impacts for the outcomes Y reported in Table 1.

We adapt the estimation and inference methods of Chernozhukov et al. (2020) who estimate target parameters among a sample stratified by a proxy for the conditional average treatment effect, rather than predicted program experience. For a given prediction target T^j and prediction method, the adapted RSS estimation procedure proceeds as follows:

1. Randomly partition the treatment group into two, creating an auxiliary sample, A, which includes half of the treatment group, and a main sample, M, which includes the remaining treatment group members and all control group members.
2. In sample A, estimate a model that predicts T^j using a set of baseline characteristics X.
3. In sample M, predict the likelihood of T_i^j for each individual $\hat{p}_i^j$.
4. Stratify sample M into quartiles based on $\hat{p}_i^j$.
5. In each quartile sample, calculate estimates, as well as the upper and lower bounds of the 95 percent confidence interval of the estimates, of the following:
    (a) The share of the treatment group who were actually placed into a transitional job
    (b) The share of the treatment group who were actually placed into a transitional job and then transitioned to unsubsidized work with the same employer
    (c) The impact of ReHire on all outcomes $y \in Y$ from a regression with an indicator for treatment assignment, as well as stratification fixed effects.
    (d) The mean of all outcomes $y \in Y$ among the control group and treatment group
    (e) The average of each baseline characteristic $x \in X$
6. Calculate the difference between the top and bottom quartile for each of the estimates from step 5, as well as the upper and lower bounds of the 95 percent confidence interval around the difference.
7. Repeat steps 1 through 5 1,000 times and calculate the median of each set of estimates, including the median of the upper and lower bounds of the confidence intervals.

[44] Specifically, we use glmnet, gmb, pcaNNet, and rf from the caret package (Kuhn, 2009) to implement the elastic net, boosted trees, neural network, and random forest, respectively. Tuning parameters for the first three methods are chosen to maximize the mean squared error estimates using 2-fold cross validation. For random forests, we grow 25,000 trees and randomly select a third of the available predictors when identifying nodes.

We use a number of potential baseline characteristics measured in the baseline survey and administrative data to predict take-up and subsequent transition.[45] The variables include:

- **Employment and Earnings:** Total earnings in the year before randomization; total earnings in the two years before randomization; earnings in each of the eight quarters before randomization; number of employers in each of the eight quarters before randomization

- **Government Benefit Receipt:** Total SNAP receipt in the year before randomization; total SNAP receipt in the two years before randomization; SNAP receipt in each of the 24 months before randomization; total TANF receipt in the year before randomization; total TANF receipt in the two years before randomization; TANF receipt in each of the 24 months before randomization

- **Demographics:** An indicator for being male; age in years and an indicator for missing age; six educational attainment indicators (less than high school, high school diploma or GED, some college, associate's degree, bachelor's degree, missing); three indicators for the ReHire priority groups (veteran, non-custodial parent, older worker); four indicators for self-reported race (white, not-white, black, hispanic); seven indicators for marital status (married, divorced, partnered, married living apart, single, separated, and widowed); six indicators for housing type (owned, jointly owned, owned by another resident, renting, transitional, homeless)

- **Barriers to Employment:** Indicators for having a prior felony (yes, no, missing); ability to drive (yes, no, missing); issues with childcare (yes, no, missing); work-limiting health problems (yes, no, missing); ever experienced homelessness (yes, no, missing); expect economic hardship in future (yes, no, missing); alcohol has ever affected work (yes, no, missing); self-identify as alcoholic (yes, no, missing); marijuana has ever affected work (yes, no, missing); self-identified marijuana addiction (yes, no, missing); other drugs have ever affected work (yes, no missing); self-identified drug addiction (yes, no, missing; any reported substance abuse (yes, no, missing);

- **Case Worker Assessment:** Motivation to get back to work assessed by case worker (1–10) and indicator for missing; likelihood of overcoming barriers assessed by case worker (1–10) and indicator for missing

- **Skills:** Score on Raven's progressive matrices (0–36) and indicator for missing; score on timed math test (0–100), number of attempted answers on math test (0–160), and indicator for missing; grit (1–5) and indicator for missing; locus of control (1–5) and indicator for missing; and component scores of Big Five—extraversion, agreeableness, conscientiousness, neuroticism, imagination (1–5) and an indicator for missing

- **Mental Well-Being:** Life satisfaction ladder (0–10) and indicator for missing; and CESD depression scale (0–7) and indicator for missing.

We first explore whether our rich set of baseline covariates is predictive of program experience. Table A-18 reports actual transitional job placement rates (Panel A) and rates of hire by transitional job sites (Panel B) for treatment group individuals, as well as rates of hire by transitional job sites when making predictions only among treatment group individuals placed in a transitional job (Panel C). For each panel, the target for prediction is the program experience considered in that panel. Column (1) and (2) report the actual program experience rate among those who were predicted to be least likely (bottom quartile) and most

[45] For continuous measures with missing values, we impute missing values at the sample median and include a dummy that the variable was missing. The variable with the most observations missing was the results of the math test. Individuals completed the timed math test on a piece of paper that was to be scanned into the ReHire program database. In some instances scans were not attached to individuals in the database. In total, 1,729 complete tests were scanned into the program database and subsequently scored.

likely (top quarter) to have that program experience, respectively. Column (3) reports the difference in rates across the two groups, and column (4) reports the 90 percent confidence interval around that estimate. All come from the median estimate among the 1,000 repeated split samples.[46]

While each predictive model generates differences in predicted likelihoods, no model is able to generate large differences in actual take-up/transition. When predicting transitional job placement, OLS does best. According to this method, 59 percent of those predicted to be least likely to be placed in a transitional job did so versus 65 percent among the most likely group. The estimated 5.3 percentage point difference, however, is not statistically significant and the 90 percent confidence interval is wide. When trying to predict successful transitional job placements, no method generates large differences and random forest does best in generating differences between the most and least likely groups (2.1 percentage points). Finally, when making predictions about hiring by the transitional job site among those who worked a transitional job, neural network and random forest create the largest difference among the groups predicted to be most and least likely (3.6 and 4.7 percentage points, respectively). In every case, 90 percent confidence intervals for the estimated difference between the two groups are wide.

[46]As noted in step 5 above, the estimation procedure collects the upper and lower bound of the 95 percent confidence interval for each estimate. Chernozhukov et al. (2020) note that the "price of splitting uncertainty is reflected in the discounting of the confidence level from $1 - \alpha$ to $1 - 2\alpha$" (see page 19). Similarly, p-values reported come from the median of the estimated p-values and are doubled (and top-coded at 1, if necessary) to account for this uncertainty.

Table A-18: Predicting Program Experience,
Comparison of ML Methods

	Bottom Quartile (1)	Top Quartile (2)	Difference (3)	Confidence Interval (4)
Panel A: Transitional Job Take-up				
OLS	0.591	0.646	0.053	[-0.066, 0.171]
Logit	0.615	0.622	0.007	[-0.112, 0.124]
Elastic Net	0.602	0.622	0.016	[-0.105, 0.138]
Boosting	0.619	0.611	-0.008	[-0.140, 0.123]
Neural Network	0.595	0.626	0.032	[-0.088, 0.152]
Random Forest	0.623	0.617	-0.004	[-0.123, 0.115]
Panel B: Hired by Transitional Job Rate				
OLS	0.122	0.123	-0.000	[-0.097, 0.097]
Logit	0.119	0.124	0.005	[-0.101, 0.110]
Elastic Net	0.149	0.145	-0.003	[-0.090, 0.085]
Boosting	0.138	0.154	0.018	[-0.067, 0.103]
Neural Network	0.143	0.155	0.010	[-0.075, 0.098]
Random Forest	0.138	0.160	0.021	[-0.065, 0.108]
Panel C: Hired by Transitional Job Rate Conditional on Take-up				
OLS	0.244	0.226	-0.013	[-0.150, 0.114]
Logit	0.235	0.237	0.000	[-0.129, 0.135]
Elastic Net	0.220	0.244	0.025	[-0.105, 0.156]
Boosting	0.222	0.250	0.025	[-0.106, 0.158]
Neural Network	0.218	0.253	0.036	[-0.097, 0.166]
Random Forest	0.215	0.260	0.047	[-0.087, 0.177]

Notes: The data come from the ReHire baseline survey, program records, and administrative data from CDLE and CBMS. The sample includes 1,931 ReHire applicants who applied between 7/2015 and 12/2017. The table compares the ability of six machine learning methods to predict transitional job take-up (Panel A), the likelihood that a ReHire client takes-up a transitional job and is then hired on without the subsidy by that employer (Panel B), and the likelihood that a ReHire client is hired on without the subsidy by the employer host site conditional on transitional job placement (Panel C). All estimates comes from the median of 1,000 sample splits where half of the treatment group is used to train the machine learning model and the remaining half is used to predict the program outcome and stratify the sample. The table reports the share of the treatment group in the hold-out sample that actually had the given program experience. Column (1) includes treatment group individuals who were predicted to be least likely to have the program experience (bottom quartile. Column (2) includes treatment group individuals who were predicted to be most likely to have the program experience. Column (3) reports the estimate of the differences between these two groups. Column (4) reports the 90 percent confidence interval.

Section 6 decomposes program impacts by program experience to show that all in-program effects are concentrated among individuals placed in transitional jobs, and that all lasting program impacts are concentrated among individuals who worked a transitional job and were subsequently hired on. We next explore whether we can identify a similar heterogeneity in program impacts among the subgroups stratified by the machine learning predictions of program experience. We focus this analysis on the two methods that generated the largest out-of-sample differences in actual program experience: OLS for predicting transitional job placement and random forest for predicting placement and transition into unsubsidized work with the same employer.

Table A-19 and Table A-20 report group average control group means and treatment effects among those predicted to be least likely (columns 1 and 2) and most likely (columns 3 and 4) to be placed in a transitional job or be hired by their transitional job host site, respectively. As noted above, estimates in this table come from the median estimate among 1,000 repeated split samples, and rather than reporting standard errors we report confidence intervals. Column (5) reports differences in treatment effects between the most likely and least likely groups. When stratifying by predicted tranisitional job placement (Table A-19), those predicted to be most likely to be placed have larger program impacts. For example, the group in the top quartile experienced an increase in average quarterly earnings during the in-program period of $524, as opposed to the $76 treatment effect among the bottom quartile. While no differences in treatment effects are statistically significant, this pattern of results is consistent with the decomposition depicted in Table 5. These procedures do a worse job generating heterogeneity in treatment effects across groups when stratifying by predicted transitional job placement and subsequent hire. Results in Table A-20 show that treatment effects are roughly similar between the top and bottom quartiles, which is consistent with the similarity in actual program experiences between these two quartiles (14 vs 16 percent).

Table A-19: ITT Effect of ReHire on Formal-Sector Employment and Earnings in Colorado, By Predicted Transitional Job Take-up using Ordinary Least Squares

	Bottom Quartile		Top Quartile		Difference
	Control Mean	ITT Effect No Controls	Control Mean	ITT Effect No Controls	
	(1)	(2)	(3)	(4)	(5)
Panel A: In-Program Employment (Quarter 0–4)					
Any employment	0.83	0.09	0.81	0.12**	0.04
		[0.02, 0.16]		[0.05, 0.20]	[-0.07, 0.14]
Share of quarters worked	0.57	0.08	0.53	0.14**	0.06
		[0.00, 0.15]		[0.06, 0.21]	[-0.05, 0.16]
Worked every quarter	0.27	0.03	0.21	0.11	0.07
		[-0.06, 0.13]		[0.01, 0.20]	[-0.06, 0.21]
Average quarterly earnings	$1,928	$76	$1,512	$524	$445
		[-310, 464]		[132, 916]	[-108, 998]
Share of quarters above 130% FPL	0.20	0.00	0.16	0.05	0.05
		[-0.06, 0.06]		[-0.01, 0.11]	[-0.03, 0.13]
Panel B: Post-Program Employment (Quarter 5–8)					
Any employment	0.66	-0.01	0.60	0.05	0.06
		[-0.11, 0.09]		[-0.05, 0.15]	[-0.08, 0.21]
Share of quarters worked	0.51	0.02	0.47	0.06	0.04
		[-0.07, 0.12]		[-0.03, 0.16]	[-0.09, 0.17]
Worked every quarter	0.35	0.06	0.32	0.08	0.02
		[-0.04, 0.17]		[-0.02, 0.19]	[-0.12, 0.17]
Average quarterly earnings	$2,177	$64	$1,860	$391	$334
		[-466, 591]		[-147, 924]	[-424, 1,090]
Share of quarters above 130% FPL	0.25	0.01	0.21	0.05	0.05
		[-0.07, 0.08]		[-0.03, 0.13]	[-0.06, 0.16]
Agency-Rate Block FEs		X		X	X
Actual TJ Take-up Rate		0.59		0.65	

Notes: Data source is administrative UI earnings data from CDLE. Panels A and B report estimates on in-program and post-program employment outcomes, respectively, for the sample of ReHire applicants who applied between 7/2015 and 12/2017. Quarter 0 represents the quarter in which a participant completed an application, and is thus a different calendar quarter from person to person. Formal employment is defined as having UI-covered earnings in Colorado greater than $0 in a given quarter. Earnings from a ReHire-sponsored transitional job are covered by the UI system and are thus counted as formal sector employment. The sample is stratified by predicted likelihood of receiving a transitional job. Half of the treatment group is used to predict TJ receipt. The remaining treatment group and the full control group are divided into quartiles based on predicted likelihood of transitional job placement. Treatment effects are estimated within each quartile, controlling for vendor-randomization rate block fixed effects. Reported coefficients come from medians of the estimates across 1,000 repeated sample splits. 90 percent confidence intervals are reported in brackets, and p-values used to denote significance levels are double to account for splitting uncertainty (see Chernozhukov et al., 2020).
**0.01, *0.05, +0.10 significance levels

Table A-20: ITT Effect of ReHire on Formal-Sector Employment and Earnings in Colorado, By Predicted Transitional Job Transition using Random Forest

	Bottom Quartile		Top Quartile		Difference
	Control Mean	ITT Effect No Controls	Control Mean	ITT Effect No Controls	
	(1)	(2)	(3)	(4)	(5)
Panel A: In-Program Employment (Quarter 0–4)					
Any employment	0.77	0.15**	0.83	0.10	-0.04
		[0.07, 0.23]		[0.03, 0.18]	[-0.15, 0.06]
Share of quarters worked	0.51	0.13**	0.57	0.10	-0.03
		[0.05, 0.20]		[0.02, 0.17]	[-0.14, 0.08]
Worked every quarter	0.22	0.10	0.24	0.07	-0.02
		[0.00, 0.19]		[-0.02, 0.17]	[-0.16, 0.11]
Average quarterly earnings	$1,617	$256	$1,863	$228	$-32
		[-133, 647]		[-164, 624]	[-589, 529]
Share of quarters above 130% FPL	0.17	0.03	0.20	0.01	-0.02
		[-0.03, 0.09]		[-0.05, 0.07]	[-0.10, 0.07]
Panel B: Post-Program Employment (Quarter 5–8)					
Any employment	0.62	0.03	0.65	-0.01	-0.04
		[-0.07, 0.13]		[-0.11, 0.10]	[-0.18, 0.11]
Share of quarters worked	0.48	0.04	0.50	0.02	-0.03
		[-0.05, 0.14]		[-0.08, 0.11]	[-0.16, 0.11]
Worked every quarter	0.32	0.10	0.33	0.04	-0.07
		[-0.00, 0.20]		[-0.07, 0.14]	[-0.21, 0.08]
Average quarterly earnings	$1,999	$237	$2,045	$89	$-148
		[-294, 767]		[-450, 626]	[-913, 614]
Share of quarters above 130% FPL	0.24	0.04	0.23	0.01	-0.03
		[-0.04, 0.12]		[-0.07, 0.09]	[-0.14, 0.08]
Agency-Rate Block FEs		X		X	X
Actual TJ Take-up Rate		0.14		0.16	

Notes: Data source is administrative UI earnings data from CDLE. Panels A and B report estimates on in-program and post-program employment outcomes, respectively, for the sample of ReHire applicants who applied between 7/2015 and 12/2017. Quarter 0 represents the quarter in which a participant completed an application, and is thus a different calendar quarter from person to person. Formal employment is defined as having UI-covered earnings in Colorado greater than $0 in a given quarter. Earnings from a ReHire-sponsored transitional job are covered by the UI system and are thus counted as formal sector employment. The sample is stratified by predicted likelihood of receiving a transitional job. Half of the treatment group is used to predict program experiance. The remaining treatment group and the full control group are divided into quartiles based on predicted likelihood of being placed into a transitional job and subsequently being hired on. Treatment effects are estimated within each quartile, controlling for vendor-randomization rate block fixed effects. Reported coefficients come from medians of the estimates across 1,000 repeated sample splits. 90 percent confidence intervals are reported in brackets, and p-values used to denote significance levels are double to account for splitting uncertainty (see Chernozhukov et al., 2020).

**0.01, *0.05, $^{+}$0.10 significance levels

The fact that these methods are unable to generate large differences in actual transitional job placement across the top and bottom quartiles (65 percent vs. 59 percent) suggests that it would be challenging to target the program based on baseline characteristics. Nevertheless, to get a sense of what characteristics are correlated with predicted transitional job placement, we explore difference in characteristics across groups. Table A-21 reports estimates of the average characteristics among the individuals least likely (column 1) and most likely (column 2) to have been placed in a transitional job. This analysis suggests that individuals with a weaker labor market history (lower earnings and employment rates), women, racial minorities, and older workers are more likely to receive a transitional job placement. Those in the most likely group were also more likely to have a limiting health problem, are less likely to have a prior felony, and do worse on the timed math test.

Table A-21: Average Characteristics of Most and Least Affected Groups, Transitional Job Takeup, Ordinary Least Squares

	Stratify by Predicted TJ Takeup				
	Least Likely (1)	Most Likely (2)	Difference (3)	Confidence Interval (4)	p-value (5)
Employment and Benefit Receipt					
Average quarterly earnings last year	$1,790	$1,138	$-658**	[-982, -329]	0.000
Share of quarters worked last year	0.66	0.60	-0.06	[-0.13, 0.01]	0.159
TANF recipient	0.10	0.12	0.02	[-0.03, 0.07]	0.813
SNAP recipient	0.60	0.64	0.05	[-0.03, 0.12]	0.431
Demographics					
Age	43.98	47.76	3.75**	[2.00, 5.51]	0.000
Male	0.64	0.35	-0.29**	[-0.36, -0.22]	0.000
Racial minority	0.31	0.46	0.15**	[0.08, 0.22]	0.000
Less than high school credential	0.14	0.18	0.04	[-0.01, 0.10]	0.288
High school graduate	0.17	0.17	0.00	[-0.05, 0.06]	1.000
Some college	0.28	0.29	0.01	[-0.06, 0.07]	1.000
Associate's degree	0.10	0.10	-0.01	[-0.05, 0.04]	1.000
Bachelor's degree	0.11	0.16	0.05^{+}	[0.00, 0.11]	0.062
ReHire Target Populations					
Veteran	0.22	0.20	-0.02	[-0.08, 0.04]	0.920
Non-custodial parent	0.21	0.20	-0.02	[-0.08, 0.04]	1.000
Older worker	0.37	0.55	0.18**	[0.11, 0.26]	0.000
Barriers to Employment					
Stable housing	0.61	0.60	-0.01	[-0.08, 0.06]	1.000
Not allowed to drive	0.24	0.19	-0.06	[-0.12, 0.00]	0.115
Issue with childcare	0.10	0.11	0.01	[-0.04, 0.05]	1.000
Limiting health problem	0.22	0.31	0.09**	[0.03, 0.16]	0.009
Experience with homelessness	0.44	0.40	-0.04	[-0.11, 0.03]	0.565
Felony	0.27	0.18	-0.09*	[-0.15, -0.03]	0.010
Alcoholic	0.11	0.13	0.02	[-0.03, 0.07]	0.729
Drinking has affected life	0.18	0.17	-0.01	[-0.07, 0.05]	1.000
Addicted to marijuana	0.04	0.03	-0.01	[-0.04, 0.02]	1.000
Smoking marijuana has affected life	0.05	0.04	-0.00	[-0.03, 0.03]	1.000
Addicted to drugs	0.11	0.11	-0.01	[-0.05, 0.04]	1.000
Drug use has affected life	0.11	0.05	-0.05*	[-0.09, -0.01]	0.013
Any substance abuse problem	0.23	0.23	0.00	[-0.06, 0.06]	1.000
Cognitive skills					
Math Score (out of 100)	64.02	58.26	-5.87**	[-8.16, -3.57]	0.000
Number of math questions attempted (out of 160)	105.57	95.89	-9.65**	[-13.31, -5.99]	0.000
Raven's score (out of 36)	31.56	30.95	-0.58	[-1.23, 0.06]	0.152
Non-cognitive characteristics					
Locus of control (1–5)	4.06	4.09	0.03	[-0.05, 0.11]	0.993
Grit (1–5)	3.85	3.92	0.07^{+}	[0.01, 0.14]	0.065
Extraversion (1–5)	3.18	3.08	-0.10	[-0.22, 0.01]	0.163
Agreeableness (1–5)	3.88	4.01	0.13**	[0.04, 0.21]	0.006
Conscientious (1–5)	3.98	4.01	0.04	[-0.05, 0.12]	0.848
Neoroticism (1–5)	2.52	2.43	-0.08	[-0.18, 0.01]	0.182
Imagination (1–5)	3.10	3.05	-0.05	[-0.12, 0.01]	0.242
Life satisfaction ladder (0–10)	5.53	5.61	0.09	[-0.21, 0.38]	1.000
Depression scale (0–10)	1.59	1.47	-0.12	[-0.32, 0.08]	0.448
Caseworker Assessment					
Motivated to get back to work (1–10)	8.55	8.15	-0.39**	[-0.66, -0.12]	0.009
Likely to overcome barriers (1–10)	7.99	7.86	-0.13	[-0.43, 0.17]	0.788

Notes: Data source is a baseline survey and administrative data from CDLE and CBMS. The sample includes ReHire applicants who applied between 7/2015 and 12/2017 The table reports differences in average baseline characteristics among individuals who are predicted to be least likely (column 1) and most likely (column 2) to receive a transitional job placement using ordinary least squares. Estimates of the difference across groups is reported in column (3) and 90 percent confidence intervals are reported in brackets in column (4). The p-values for the hypothesis that the parameter is equal to zero are reported in column (5). All estimates come from the median value across 1,000 random splits of the data. See Section A.14.3 for details on the estimation procedure.

A.14.4 Verifying Predictions of Search Model with Employer Learning

Section 6.4 discusses additional predictions of how a subsidized and supported temporary job should affect participants' outcomes based on an augmented Diamond-Mortensen-Pissarides search model that incorporates noisy signals from job seekers and ex post employer learning (Pries and Rogerson, 2005, 2022). To explore these predictions, we use data from ReHire program records on the timing of transitional job placement and data from the 18-month follow-up survey on the start and end months of post-application unsubsidized employment to demonstrate that both of two key predictions from the model occur within the ReHire study population.

The first key prediction of the model is that access to ReHire should increase the likelihood that a job seeker is able to form an initial match with an employer. In the equilibrium of the search model, employers will choose to hire a potential worker if the value of the productivity signal exceeds some threshold. The 100 percent wage subsidy that the state provides to employers during the period of transitional job employment lowers the threshold above which potential employees are hired. Figure A-9a uses data from the follow-up survey to report the share of the treatment group (black circles) and of the control group (gold diamonds) who had started a job—inclusive of transitional job placements—by a given month after ReHire application, depicted on the horizontal axis.[47] Unsurprisingly, access to the ReHire wage subsidy meant the treatment group was more likely to have found a job relative to the control group. During the month of ReHire application, 23 percent of the treatment group had found a new job compared to 9 percent in the control group. This gap widens over time such that within 9 months 90 percent of the treatment group had found a job compared to only 60 percent in the control group.

The second prediction of the augmented search model is that matches formed without a wage subsidy should be of higher quality and more likely to persist compared to jobs formed with the subsidy. Because the wage subsidy shifts down the hiring threshold, the average match formed with the subsidy will be drawn from a lower portion of the signal distribution and thus, in expectation, will be of lower true quality as well. Therefore, once the worker's true productivity and other aspects of match quality have been revealed, these matches will be more likely to dissolve relative to matches formed without the subsidy.

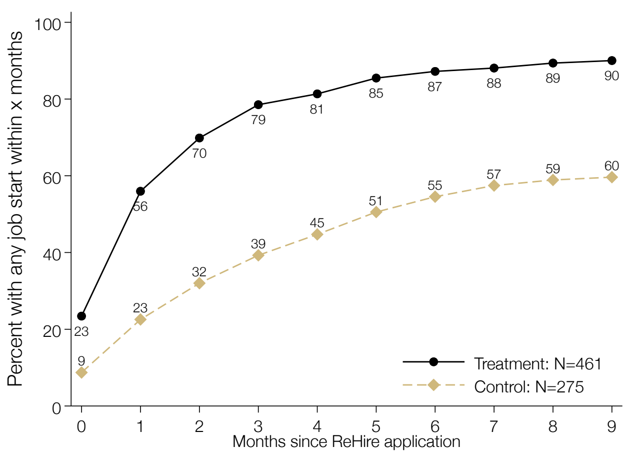
This prediction plays out in the ReHire data. Figure A-9b considers transitional job matches among the treatment group and new unsubsidized job matches among the control group that formed within 3 months of ReHire application. The vertical axis measures the share of these matches that were still ongoing at each month since the start of the job, measured on the horizontal axis. Black circles report the share of transitional job recipients who are still working for their host-site employer, either in the subsidized position or as an unsubsidized employee following the end of the transitional job.[48] Gold diamonds report the share of the control group who were still employed in their first post-application job by the month depicted on the horizontal axis. Employment persistence is similar during the first 2 months after job start. Two months after the job began, 92 percent of transitional job workers were still employed by their host site and 95 percent of the control group were still working in their first post-application job. After this period, however, differences in employment arise, such that 9 months after these jobs started, 50 percent of matches formed without a wage subsidy (the control group) persisted compared to 29 percent of matches formed with the subsidy.

[47] This analysis removes follow-up survey respondents who reported a start month for post-application employment that preceded their application month.

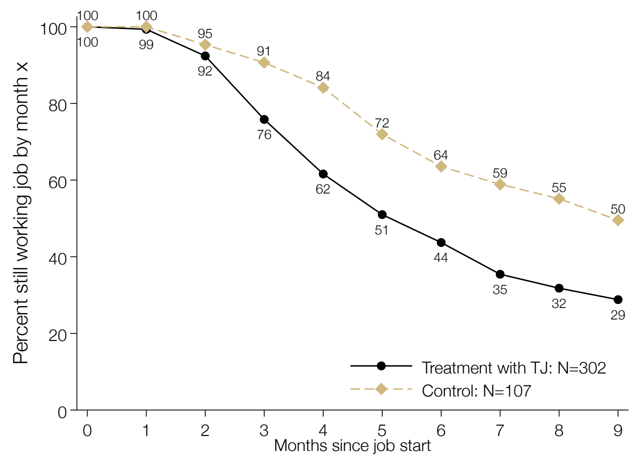
[48] In this sample of follow-up survey respondents who started a transitional job within 3 months of ReHire application, the subsidized-to-unsubsidized transition rate is 26.8 percent. Given data limitations in identifying end months for the unsubsidized position at the employer host site, we assume these transitioning workers are employed for at least 9 months in these positions. Thus, the transition rate gives the lower bound for the line plotted in the figure.

Figure A-9: Timing of New Employment Since Application and Duration of Employment

(a) First Post-Application Employment



(b) Duration of First Post-Application Employment



Notes: Data source is ReHire administrative data and an 18-month follow-up survey. Timing of transitional job placement is measured in administrative program data from CDHS and start and end dates of unsubsidized employment are measured in the 18-month follow-up survey. The sample in Panel (a) excludes individuals with post-application employment who reported an invalid start date—either the start date preceded ReHire application or was reportedly later than the survey date. The horizontal axis in Panel (a) depicts months since ReHire application where month 0 is the calendar month an individual applied for ReHire. The vertical axis reports the share of the treatment group (black circles) or control group (gold diamonds) who started a job within the given number of months. For individuals placed into a transitional job, start months are based on transitional job placement. For individuals without a transitional job, start months are based on unsubsidized jobs reported in the follow-up survey. The sample in Panel (b) is restricted to individuals in treatment group who were placed into a transitional job and control group members. The horizontal axis in Panel (b) depicts months since job start where month 0 is the calendar month the individual started the job. The vertical axis reports the share of the treatment group still working in their transitional job or who has transitioned to unsubsidized employment with their employer host site (black circles) or the share of the control group still employed in their first ubsubsidized job since ReHire application by the given month.

A.15 Using Machine Learning to Test for Heterogeneity

The literature exploring the effects of active labor market programs has found mixed results across program models and types of clients served (Card, Kluve and Weber, 2018). Even within the transitional jobs literature, results have varied across locations and target populations (Barden et al., 2018; Foley, Farrell and Webster, 2018; Cummings and Bloom, 2020). Relying on ReHire's broad eligibility criteria and the breadth of information collected on applicants at baseline, we explore whether individual heterogeneity might reconcile the mixed results found across the literature. One concern for this analysis, however, is that there are many potential ways to construct sub groups to explore heterogeneity and the number of additional hypotheses tested means that we might detect heterogeneity by chance. To address this concern, we rely on a data driven approach to guide this analysis.

We use machine learning tools to test whether a high-dimensional set of baseline characteristics are predictive of treatment effect heterogeneity among the primary outcomes reported in Table 1. In an ideal setting, we would be able to estimate directly a Conditional Average Treatment Effect (CATE) function that would map baseline characteristics Z to an estimated treatment effect $\tau(Z)$. Given the large number of potential characteristics that could be included in Z and the possibility that various characteristics could interact to affect the CATE in linear and nonlinear ways, estimating such a complex function is difficult.

Given this complexity and high-dimensionality, we follow Chernozhukov et al. (2020) and construct a proxy estimate of each individual's CATE and use that proxy to ask whether it is predictive of underlying treatment effect heterogeneity. Their split-sample approach proceeds in two stages and is related to the estimation procedure detailed in Appendix Section A.14.3. First, we randomly select an auxiliary sample with half of the treatment and control group applicants. Using control group applicants in the auxiliary sample, we train a machine learning method using baseline characteristics Z to predict the outcome in the untreated state Y^C. Similarly, we use treatment group applicants in the auxiliary sample to predict the outcome in the treated state Y^T. Then, with the remaining half of the sample (main sample), we use the two estimates to predict $\hat{Y^C}(Z_i)$ and $\hat{Y^T}(Z_i)$ in both the treatment and control group. Finally, for each applicant in the main sample we construct a proxy of their own CATE: $\hat{S}(Z_i) = \hat{Y^T}(Z_i) - \hat{Y_i^C}(Z_i)$.

The methods in Chernozhukov et al. (2020) provide an empirical test for whether the proxy CATE, $\hat{S}(Z_i)$, predicts meaningful heterogeneity. To implement this test, we estimate the following regression using weighted least squares:

$$Y_i = \alpha' X_1 + \beta_1(D_i - p(Z_i)) + \beta_2(D_i - p(Z_i))(\hat{S}(Z_i) - E(\hat{S}(Z_i))) + \epsilon \tag{3}$$

where D_i is an indicator for whether an individual was randomly assigned to receive access to ReHire services, X_i includes vendor-rate fixed effects, and $p(Z_i)$ is an individual's treatment propensity, which is known from the randomization protocol. The regression is weighted by $w(Z_i) = 1/[p(Z_i)(1-p(Z_i))]$. Under this specification, Chernozhukov et al. (2020) show that $\hat{\beta}_1$ provides an estimate of the Average Treatment Effect (ATE) and that $\hat{\beta}_2$ provides an estimate of the slope of the Best Linear Predictor of the CATE. To deal with uncertainty that stems from sample splitting, we repeat this procedure across 1,000 random splits of the data and report the median estimates of $\hat{\beta}_1$ and $\hat{\beta}_2$, as well as median p-values, and upper and lower bounds of the 95 percent confidence interval. To account for uncertainty induced by randomly splitting of the sample, the confidence intervals reported in tables below are discounted to be 90 percent confidence intervals, and p-values are doubled (or set to the maximum value of 1, if neccessary).

We also estimated the group average treatment effects (GATES) following Chernozhukov et al. (2020). Using the proxy CATE, $\hat{S}(Z_i)$, we divide the main sample into quartiles and define an indicator G_k for each quartile k. We then estimate the following regression:

$$Y_i = \alpha' X_1 + \sum_{k=1}^{4} \gamma_k \cdot (D_i - p(Z_i)) \cdot 1(G_k) + \nu \tag{4}$$

The vector of estimates γ represent the average treatment effect within each of the groups. Testing the null hypothesis that the difference between $\gamma_4 - \gamma_1$ is zero provides another test for heterogeneity in program impacts.

We construct three sets of characteristics (Z) to assess the added value of characteristics not typically measured in the literature: (i) a baseline set to mirror the types of characteristics that have been used to target the program; (ii) a skills set that further incorporates age and measures of cognitive and non-cognitive skills; and (iii) an extended set that provides higher-frequency information on employment, earnings, and benefit usage, as well as including information on employment barriers. The sets include the following measures:[49]

1. **Baseline:** Earnings in the year before randomization; SNAP benefit receipt in the month before randomization; TANF benefit receipt in the month before randomization; an indicator for being male; six educational attainment indicators (less than high school, high school diploma or GED, some college, associate's degree, bachelor's degree, missing); three indicators for the ReHire priority groups (veteran, non-custodial parent, older worker); three indicators for having prior felony (yes, no, missing)

2. **Add Skills and Experience:** All variables in the "Baseline" set; age in years and an indicator for missing; motivation scored by case worker (1–10) and indicator for missing ; likelihood of overcoming barriers assessed by case worker (1–10) and indicator for missing; score on Raven's progressive matrices (0–36) and indicator for missing; score on timed math test (0–100), number of attempted answers on math test (0–160), and indicator for missing; grit (1–5) and indicator for missing; locus of control (1–5) and indicator for missing; and component scores of Big Five—extraversion, agreeableness, conscientiousness, neuroticism, imagination (1–5) and an indicator for missing.

3. **Extended Predictors:** All variables in the "Add Skills and Experience" set; earnings in each of the eight quarters before randomization; total earnings in the two years before randomization; number of employers in each of the eight quarters before randomization; SNAP receipt in each of the 24 months before randomization; total SNAP receipt in the year before randomization; total SNAP receipt in the two years before randomization; TANF receipt in each of the 24 months before randomization; total TANF receipt in the year before randomization; total TANF receipt in the two years before randomization; four indicators for self-reported race (white, not-white, black, hispanic); seven indicators for marital status (married, divorced, partnered, married living apart, single, separated, and widowed); six indicators for housing type (owned, jointly owned, owned by another resident, renting, transitional, homeless); ability to drive (yes, no, missing); issues with childcare (yes, no, missing); work-limiting health problems (yes, no, missing); ever experienced homelessness (yes, no, missing); expect economic hardship in future (yes, no, missing); alcohol has ever affected work (yes, no, missing); self-identify as alcoholic (yes, no, missing); marijuana has ever affected work (yes, no, missing); self-identified marijuana addiction (yes, no, missing); other drugs have ever affected work (yes, no missing); self-identified drug addiction (yes, no, missing; any reported substance abuse (yes, no, missing); life satisfaction ladder (0–10) and indicator for missing; and CESD depression scale (0–7) and indicator for missing.

We follow Chernozhukov et al. (2020) in considering four different machine learning methods—elastic net, boosted trees, neural network with feature extraction, and random forest—using the caret package (Kuhn, 2009). Specifically, we use glmnet, gmb, pcaNNet, and rf to implement the elastic net, boosted trees, neural network, and random forest, respectively. Tuning parameters for the first three methods are chosen to minimize the mean squared error estimates using 2-fold cross validation. For random forests, we grow 25,000 trees and randomly select a third of the available predictors when identifying nodes.

[49] For continuous measures with missing values, we impute missing values at the sample median and include a dummy that the variable was missing.

Table A-22 reports estimates of the criteria used to pick the best performing machine learning method (see Chernozhukov et al. (2020) for details). Columns (1) through (4) provide estimates when targeting the BLP. Columns (5) through (8) provide estimates when targeting the GATES. For in-program outcomes, elastic net seems to perform best when targeting the BLP, and all are comparably similar when targeting the GATES. For post-program outcomes, random forest seems to perform best in both cases. Given these results, we report estimates of the BLP using the elastic net and random forest.

Table A-22: Predicting Conditional Average Treatment Effects, Comparison of ML Methods

	Best BLP (Λ)				Best GATES ($\bar{\Lambda}$)			
	Elastic Net	Boosting	Neural Network	Random Forest	Elastic Net	Boosting	Neural Network	Random Forest
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Limited Predictors								
In-Program Employment (Quarter 0–4)								
Any employment	**0.029**	0.014	0.021	0.014	**0.016**	0.015	0.016	0.015
Share of quarters worked	**0.016**	0.016	0.016	0.013	**0.015**	0.015	0.014	0.014
Worked every quarter	**0.022**	0.018	0.016	0.015	**0.008**	0.008	0.008	0.008
Average quarterly earnings	57	72	**78**	63	117,555	117,991	**127,309**	118,076
Share of quarters above 130% FPL	**0.013**	0.010	0.012	0.011	0.001	0.001	**0.001**	0.001
Post-Program Employment (Quarter 5–8)								
Any employment	0.022	0.019	**0.025**	0.017	0.003	0.003	**0.003**	0.003
Share of quarters worked	0.015	0.016	0.014	**0.022**	0.003	0.004	0.004	**0.004**
Worked every quarter	0.016	0.017	0.015	**0.018**	0.008	**0.008**	0.008	0.008
Average quarterly earnings	114	93	104	**207**	110,159	108,425	114,676	**134,709**
Share of quarters above 130% FPL	0.015	0.014	0.021	**0.031**	0.002	0.002	0.003	**0.003**
Panel B: Add Age and Skills								
In-Program Employment (Quarter 0–4)								
Any employment	**0.036**	0.017	0.012	0.013	**0.016**	0.015	0.015	0.015
Share of quarters worked	0.018	**0.023**	0.019	0.019	0.014	**0.015**	0.015	0.015
Worked every quarter	**0.022**	0.017	0.014	0.016	**0.008**	0.008	0.007	0.008
Average quarterly earnings	65	74	67	**99**	116,105	127,693	**128,072**	120,229
Share of quarters above 130% FPL	0.010	0.011	0.010	**0.019**	0.001	0.001	0.001	**0.001**
Post-Program Employment (Quarter 5–8)								
Any employment	0.017	0.018	0.017	**0.018**	0.002	0.003	0.003	**0.003**
Share of quarters worked	0.017	0.017	0.017	**0.018**	0.003	0.004	**0.004**	0.004
Worked every quarter	**0.021**	0.019	0.017	0.017	0.008	**0.008**	0.008	0.008
Average quarterly earnings	86	97	99	**105**	96,097	106,733	**116,697**	111,083
Share of quarters above 130% FPL	0.013	0.013	**0.017**	0.016	0.002	0.002	0.002	**0.002**
Panel C: Extended Predictors								
In-Program Employment (Quarter 0–4)								
Any employment	**0.038**	0.014	0.014	0.013	**0.016**	0.015	0.015	0.015
Share of quarters worked	0.014	**0.022**	0.014	0.013	0.014	**0.015**	0.014	0.014
Worked every quarter	**0.027**	0.017	0.016	0.018	**0.008**	0.008	0.007	0.007
Average quarterly earnings	73	65	**74**	65	120,218	118,983	**125,430**	115,872
Share of quarters above 130% FPL	**0.012**	0.011	0.010	0.011	**0.001**	0.001	0.001	0.001
Post-Program Employment (Quarter 5–8)								
Any employment	**0.029**	0.022	0.023	0.017	**0.004**	0.003	0.003	0.003
Share of quarters worked	0.018	0.018	**0.020**	0.019	0.004	0.004	0.004	**0.004**
Worked every quarter	0.018	**0.020**	0.017	0.016	0.008	**0.008**	0.008	0.007
Average quarterly earnings	80	**110**	103	80	104,192	107,366	**115,310**	104,455
Share of quarters above 130% FPL	0.014	0.014	**0.018**	0.013	0.002	0.002	**0.002**	0.002

Notes: Data source is the baseline survey and administrative data from CDLE and CBMS. The sample include ReHire applicants who applied between 7/2015 and 12/2017. The table compares the ability of four machine learning methods to produce proxy predictors of CATE. Estimates comes from the median of 1,000 sample splits. Columns (1)–(4) and (5)–(8) present estimates of Λ when choosing the optimal machine learning method for BLP and GATES, respectively. See Chernozhukov et al. (2020) for details. For each outcome and target (e.g., BLP or GATES), the maximum estimate is in bold to indicate the optimal method.

Table A-23 and Table A-24 report results from estimating the BLP of treatment heterogeneity using the elastic net and random forest, respectively. In each table, columns (1), (3), and (5) report estimates of the ATE when using limited predictors, adding age and skills as predictors, and adding detailed information on labor market and benefit histories and employment barriers, respectively. Estimates of the heterogeneity parameter, β_2, are reported in columns (2), (4), and (6). 90 percent confidence intervals are reported in parentheses and p-values that test the null hypothesis that the parameter is zero are reported in brackets.

ATE estimates are consistent with the results reported in Table 1. For example, the first estimate of 11.8 percentage points in column (1) of Table A-23 is similar to the 11.9 percentage point effect estimated effects in Table 1 when only including stratification fixed effects. This similarity is the case across the set of baseline characteristics used as predictors and across machine learning methods.

The heterogeneity parameter, β_2, shows how estimated treatment effects change with a one unit change in the predicted CATE. A value of 1 for this parameter would show that a 1 unit increase (e.g., percentage point or dollar) in the predicted treatment effect is associate with a 1 unit increase in the actual treatment effect. In this scenario, baseline characteristics are perfectly predictive of treatment effect heterogeneity. A value of 0 indicates that the predicted CATE is not related to any underlying heterogeneity.

We find no strong evidence that baseline characteristics are predictive of underlying heterogeneity. Across all outcomes and both machine learning methods, there are no scenarios where we are able to reject the null hypothesis, and most p-values are at or close to one. The most significant result is in estimating heterogeneity on whether an individual had any employment during the in-program period using elastic net (Table A-23). When using the full set of predictors, the point estimate on the interaction term is 0.699 and the p-value is 0.167.

Table A-23: Best Linear Predictor of Formal-Sector Employment and Earnings, Elastic Net

	Limited Predictors		Add Age and Skills		Extended Predictors	
	ATE (β_1)	HET (β_2)	ATE (β_1)	HET (β_2)	ATE (β_1)	HET (β_2)
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: In-Program Employment (Quarter 0–4)						
Any employment	0.118	0.562	0.115	0.757	0.116	0.699
	(0.076, 0.160)	(-0.319, 1.538)	(0.073, 0.157)	(-0.162, 1.737)	(0.075, 0.158)	(-0.087, 1.532)
	[0.000]	[0.434]	[0.000]	[0.213]	[0.000]	[0.167]
Share of quarters worked	0.114	0.226	0.113	0.233	0.113	0.095
	(0.071, 0.157)	(-0.989, 1.453)	(0.070, 0.156)	(-0.677, 1.271)	(0.071, 0.154)	(-0.677, 0.871)
	[0.000]	[1.000]	[0.000]	[1.000]	[0.000]	[1.000]
Worked every quarter	0.076	-0.589	0.076	-0.551	0.074	-0.504
	(0.020, 0.131)	(-2.322, 1.103)	(0.019, 0.132)	(-2.201, 1.070)	(0.019, 0.128)	(-1.512, 0.503)
	[0.016]	[0.952]	[0.017]	[0.966]	[0.017]	[0.672]
Average quarterly earnings	$281	0.012	$281	-0.057	$286	-0.038
	(55, 506)	(-0.538, 0.564)	(55, 507)	(-0.428, 0.320)	(59, 512)	(-0.216, 0.134)
	[0.030]	[1.000]	[0.030]	[1.000]	[0.028]	[1.000]
Share of quarters above 130% FPL	0.021	-0.522	0.021	-0.047	0.021	-0.280
	(-0.013, 0.055)	(-2.183, 1.028)	(-0.013, 0.055)	(-1.091, 0.949)	(-0.013, 0.055)	(-1.208, 0.668)
	[0.445]	[1.000]	[0.445]	[1.000]	[0.441]	[1.000]
Panel B: Post-Program Employment (Quarter 5–8)						
Any employment	0.017	-0.462	0.015	0.070	0.015	0.440
	(-0.044, 0.078)	(-2.059, 1.043)	(-0.046, 0.076)	(-1.057, 1.248)	(-0.045, 0.076)	(-0.523, 1.393)
	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[0.783]
Share of quarters worked	0.038	-0.174	0.037	0.154	0.037	0.195
	(-0.018, 0.093)	(-1.600, 1.310)	(-0.019, 0.092)	(-0.964, 1.268)	(-0.018, 0.093)	(-0.721, 1.130)
	[0.372]	[1.000]	[0.396]	[1.000]	[0.370]	[1.000]
Worked every quarter	0.071	-0.106	0.070	-0.204	0.070	-0.145
	(0.010, 0.133)	(-1.550, 1.378)	(0.009, 0.132)	(-1.586, 1.198)	(0.010, 0.132)	(-1.297, 1.017)
	[0.047]	[1.000]	[0.049]	[1.000]	[0.047]	[1.000]
Average quarterly earnings	$180	-0.214	$187	-0.057	$192	0.006
	(-141, 499)	(-0.833, 0.421)	(-133, 507)	(-0.420, 0.316)	(-129, 514)	(-0.155, 0.165)
	[0.544]	[1.000]	[0.508]	[1.000]	[0.476]	[1.000]
Share of quarters above 130% FPL	0.028	-0.337	0.027	-0.164	0.028	-0.302
	(-0.018, 0.074)	(-2.209, 1.365)	(-0.018, 0.073)	(-1.494, 1.196)	(-0.018, 0.074)	(-1.661, 0.981)
	[0.473]	[1.000]	[0.482]	[1.000]	[0.453]	[1.000]
Predictors						
Typical Target Populations	X		X		X	
Age and Skills			X		X	
Quarterly Earnings, Monthly Benefits					X	
Employment Barriers					X	
Agency-Rate Block FE	X		X		X	
Observation	1,930		1,930		1,930	

Notes: See Table 1 for sample construction and details on outcome variables. The table reports estimates from Equation 3 using three specifications that vary the set of predictor variables: columns (1)–(2), columns (3)–(4), and columns (5)–(6). Columns (1), (3), and (5) report estimates of the average treatment effect (ATE) and columns (2), (4), and (6) report estimates of the slope on on conditional average treatment effect (HET). 90 percent confidence intervals are reported in parentheses. The p-values for the hypothesis that the parameter is equal to zero are reported in brackets. All estimates come from the median value across 1,000 random splits of the data. See Appendix Section A.15 for details on the machine learning procedure as well as the baseline characteristics included across the three specifications.

Table A-24: Best Linear Predictor of Formal-Sector Employment and Earnings, Random Forest

	Limited Predictors		Add Age and Skills		Extended Predictors	
	ATE (β_1)	HET (β_2)	ATE (β_1)	HET (β_2)	ATE (β_1)	HET (β_2)
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: In-Program Employment (Quarter 0–4)						
Any employment	0.116	0.032	0.117	0.036	0.118	0.068
	(0.074, 0.158)	(-0.192, 0.255)	(0.075, 0.160)	(-0.281, 0.344)	(0.076, 0.159)	(-0.328, 0.451)
	[0.000]	[1.000]	[0.000]	[1.000]	[0.000]	[1.000]
Share of quarters worked	0.113	0.029	0.115	0.147	0.113	0.111
	(0.070, 0.156)	(-0.204, 0.263)	(0.073, 0.157)	(-0.204, 0.496)	(0.071, 0.154)	(-0.314, 0.537)
	[0.000]	[1.000]	[0.000]	[0.818]	[0.000]	[1.000]
Worked every quarter	0.076	0.024	0.075	-0.032	0.073	0.101
	(0.021, 0.132)	(-0.223, 0.271)	(0.018, 0.130)	(-0.411, 0.342)	(0.018, 0.128)	(-0.351, 0.561)
	[0.015]	[1.000]	[0.019]	[1.000]	[0.019]	[1.000]
Average quarterly earnings	$287	0.026	$286	0.141	$290	-0.046
	(59, 516)	(-0.206, 0.261)	(60, 511)	(-0.196, 0.496)	(66, 512)	(-0.509, 0.399)
	[0.027]	[1.000]	[0.027]	[0.845]	[0.022]	[1.000]
Share of quarters above 130% FPL	0.022	0.036	0.022	0.187	0.022	-0.071
	(-0.013, 0.057)	(-0.204, 0.279)	(-0.013, 0.056)	(-0.166, 0.545)	(-0.012, 0.056)	(-0.532, 0.385)
	[0.431]	[1.000]	[0.436]	[0.615]	[0.408]	[1.000]
Panel B: Post-Program Employment (Quarter 5–8)						
Any employment	0.017	0.014	0.020	-0.101	0.018	-0.028
	(-0.044, 0.079)	(-0.230, 0.258)	(-0.041, 0.081)	(-0.507, 0.309)	(-0.042, 0.079)	(-0.518, 0.464)
	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]
Share of quarters worked	0.038	0.088	0.040	0.071	0.037	0.146
	(-0.018, 0.094)	(-0.151, 0.327)	(-0.016, 0.095)	(-0.326, 0.470)	(-0.019, 0.092)	(-0.339, 0.623)
	[0.367]	[0.940]	[0.325]	[1.000]	[0.383]	[1.000]
Worked every quarter	0.072	0.038	0.072	-0.011	0.070	-0.054
	(0.010, 0.133)	(-0.208, 0.286)	(0.010, 0.134)	(-0.428, 0.413)	(0.009, 0.131)	(-0.547, 0.447)
	[0.048]	[1.000]	[0.045]	[1.000]	[0.049]	[1.000]
Average quarterly earnings	$190	0.148	$190	0.082	$180	-0.003
	(-130, 513)	(-0.083, 0.380)	(-128, 506)	(-0.303, 0.459)	(-137, 498)	(-0.470, 0.475)
	[0.490]	[0.420]	[0.477]	[1.000]	[0.531]	[1.000]
Share of quarters above 130% FPL	0.029	0.152	0.029	0.120	0.027	0.092
	(-0.018, 0.075)	(-0.080, 0.382)	(-0.017, 0.076)	(-0.266, 0.512)	(-0.018, 0.074)	(-0.377, 0.563)
	[0.460]	[0.393]	[0.440]	[1.000]	[0.484]	[1.000]
Predictors						
Typical Target Populations	X		X		X	
Age and Skills			X		X	
Quarterly Earnings, Monthly Benefits					X	
Employment Barriers					X	
Agency-Rate Block FE	X		X		X	
Observation	1,930		1,930		1,930	

Notes: See Table 1 for sample construction and details on outcome variables. The table reports estimates from Equation 3 using three specifications that vary the set of predictor variables: columns (1)–(2), columns (3)–(4), and columns (5)–(6). Columns (1), (3), and (5) report estimates of the average treatment effect (ATE) and columns (2), (4), and (6) report estimates of the slope on on conditional average treatment effect (HET). 90 percent confidence intervals are reported in parentheses. The p-values for the hypothesis that the parameter is equal to zero are reported in brackets. All estimates come from the median value across 1,000 random splits of the data. See Appendix Section A.15 for details on the machine learning procedure as well as the baseline characteristics included across the three specifications.

Because we find weak evidence that baseline characteristics are predictive of treatment effect heterogeneity in having any in-program employment, we report GATES for all outcomes from Table 1 when stratifying the sample on those most affected (top quartile) and least affected (bottom quartile). Table A-24 reports control group means (columns 1 and 3) and effects estimated using stratification fixed effects (columns 2 and 4) when stratifying the sample by predicted CATE. Because we construct a proxy of the CATE for each outcome separately, the stratified sample (i.e., those grouped into the most and least affected groups) can and will vary by outcome.

Consistent with the BLP results presented above, the only outcome for which the GATES in the most affected group are meaningfully larger than the least affected group is whether the individual had any employment during the in-program period. Among those in the group predicted to be most affected, the effect on any employment is 17.6 percentage points (column 4). Those predicted to be least affected, however, only experienced a 7 percentage point increase in employment. The estimated difference of 10.9 percentage points is large and the lower bound of the 90 percent confidence interval on this estimate is -1 percentage point. Interestingly, the control group mean of this outcome is substantially lower in the most affected group (68.6 percent) relative to the least affected group (90.9 percent). This makes sense, as ReHire has only a limited ability to improve the employment prospects of individuals who would have had an easier time finding employment on their own.

Table A-25: ITT Effect of ReHire on Formal-Sector Employment and Earnings in Colorado, By Predicted Conditional Average Treatment Effect using Elastic Net

	Bottom Quartile		Top Quartile		Difference
	Control Mean	ITT Effect No Controls	Control Mean	ITT Effect No Controls	
	(1)	(2)	(3)	(4)	(5)
Panel A: In-Program Employment (Quarter 0–4)					
Any employment	0.909	0.070	0.686	0.176**	0.109
		[-0.015, 0.154]		[0.092, 0.260]	[-0.010, 0.228]
Share of quarters worked	0.640	0.102	0.469	0.113	0.013
		[0.018, 0.186]		[0.029, 0.197]	[-0.106, 0.132]
Worked every quarter	0.275	0.093	0.287	0.026	-0.069
		[-0.017, 0.203]		[-0.085, 0.136]	[-0.224, 0.086]
Average quarterly earnings	$1,772	$335	$1,684	$171	$-148
		[-125, 794]		[-284, 626]	[-802, 493]
Share of quarters above 130% FPL	0.177	0.027	0.222	-0.006	-0.035
		[-0.041, 0.096]		[-0.074, 0.063]	[-0.132, 0.061]
Panel B: Post-Program Employment (Quarter 5–8)					
Any employment	0.603	-0.012	0.660	0.061	0.078
		[-0.133, 0.109]		[-0.061, 0.183]	[-0.093, 0.251]
Share of quarters worked	0.448	0.023	0.535	0.064	0.040
		[-0.087, 0.133]		[-0.048, 0.176]	[-0.118, 0.196]
Worked every quarter	0.274	0.091	0.393	0.083	-0.011
		[-0.031, 0.212]		[-0.041, 0.207]	[-0.184, 0.162]
Average quarterly earnings	$2,038	$228	$2,004	$146	$-71
		[-413, 872]		[-498, 795]	[-992, 836]
Share of quarters above 130% FPL	0.245	0.045	0.243	0.001	-0.041
		[-0.049, 0.136]		[-0.091, 0.093]	[-0.173, 0.090]
Agency-Rate Block FEs		X		X	X

Notes: Data source is administrative UI earnings data from CDLE. Panels A and B report estimates on in-program and post-program employment outcomes, respectively, for the sample of ReHire applicants who applied between 7/2015 and 12/2017. Quarter 0 represents the quarter in which a participant completed an application, and is thus a different calendar quarter from person to person. Formal employment is defined as having UI-covered earnings in Colorado greater than $0 in a given quarter. Earnings from a ReHire-sponsored transitional job are covered by the UI system and are thus counted as formal sector employment. The sample is stratified by predicted likelihood of receiving a transitional job. Half of the sample is used to predict the outcome in the treated and untreated state. The remaining half of the sample is divided into quartiles based on the difference in the predicted treated and untreated outcomes. Treatment effects are estimated within each quartile, controlling for vendor-randomization rate block fixed effects. Reported coefficients come from estimates averaged over 1,000 sample splits. 90 percent confidence intervals are reported in brackets, and p-values used to denote significance levels are doubled to account for splitting uncertainty (see Chernozhukov et al., 2020).
**0.01, *0.05, +0.10 significance levels

Finally, Table A-26 provides information on the type of characteristics that are correlated with larger predicted effects on any in-program employment. The table reports differences in average baseline characteristics among individuals who are predicted to be least affected (column 1) and most affected (column 2) when using the elastic net. Estimates of the difference across groups is reported in column (3) and 90 percent confidence intervals are reported in brackets in column (4). The p-values for the hypothesis that the parameter is equal to zero are reported in column (5). All estimates come from the median value across 1,000 random splits of the data.

Individuals who are predicted to experience the largest increases in any in-program employment are more disadvantaged on a number of margins. Pre-application earnings and employment rates are substantially lower in the most affected group. Ninety-four percent of the least affected group worked in four quarters before application and earned on average \$2,760, relative to 24.9 percent and \$275 in the most affected group. The most affected group was also substantially older (13.2 years and 50.4 percentage points more likely to fall in the older worker target population), and relatedly were more likely to experience a work-limiting health program. Conversely, they were less likely to experience some common employment barriers such as child care issues or substance abuse problems.

Table A-26: Average Characteristics of Most and Least Affected Groups, Any Employment During Quarters 0 through 4, Elastic Net

	Stratify by Predicted Effect on Any Employment (Q0–Q4)				
	Least Affected	Most Affected	Difference	Confidence Interval	*p*-value
	(1)	(2)	(3)	(4)	(5)
Employment and Benefit Receipt					
Average quarterly earnings last year	$2,760	$275	$-2,495**	[-2,843, -2,156]	0.000
Share of quarters worked last year	0.938	0.249	-0.687**	[-0.749, -0.624]	0.000
TANF recipient	0.112	0.033	-0.077**	[-0.122, -0.030]	0.002
SNAP recipient	0.589	0.568	-0.017	[-0.106, 0.070]	1.000
Demographics					
Age	41.054	54.722	13.253**	[11.383, 15.047]	0.000
Male	0.552	0.477	-0.071	[-0.161, 0.019]	0.230
Racial minority	0.402	0.353	-0.051	[-0.140, 0.037]	0.515
Less than high school credential	0.149	0.162	0.012	[-0.053, 0.077]	1.000
High school graduate	0.170	0.166	-0.004	[-0.072, 0.062]	1.000
Some college	0.299	0.261	-0.041	[-0.120, 0.039]	0.618
Associate's degree	0.108	0.116	0.007	[-0.050, 0.063]	1.000
Bachelor's degree	0.131	0.170	0.041	[-0.025, 0.104]	0.434
ReHire Target Populations					
Veteran	0.257	0.191	-0.066	[-0.141, 0.008]	0.160
Non-custodial parent	0.249	0.100	-0.154**	[-0.220, -0.086]	0.000
Older worker	0.290	0.793	0.504**	[0.428, 0.581]	0.000
Barriers to Employment					
Stable housing	0.633	0.585	-0.044	[-0.131, 0.045]	0.697
Not allowed to drive	0.220	0.170	-0.046	[-0.116, 0.024]	0.399
Issue with childcare	0.133	0.054	-0.079**	[-0.130, -0.028]	0.005
Limiting health problem	0.220	0.328	0.108*	[0.030, 0.189]	0.014
Experience with homelessness	0.415	0.373	-0.037	[-0.125, 0.051]	0.806
Felony	0.199	0.212	0.017	[-0.057, 0.088]	1.000
Alcoholic	0.095	0.129	0.034	[-0.020, 0.092]	0.412
Drinking has affected life	0.199	0.116	-0.083*	[-0.149, -0.018]	0.025
Addicted to marijuana	0.033	0.021	-0.012	[-0.041, 0.014]	0.624
Smoking marijuana has affected life	0.050	0.021	-0.025	[-0.060, 0.006]	0.203
Addicted to drugs	0.100	0.087	-0.012	[-0.063, 0.042]	1.000
Drug use has affected life	0.075	0.033	-0.041+	[-0.080, 0.001]	0.076
Any substance abuse problem	0.253	0.149	-0.104**	[-0.174, -0.032]	0.008
Cognitive skills					
Math Score (out of 100)	62.011	59.695	-2.303	[-5.115, 0.506]	0.214
Number of math questions attempted (out of 160)	101.898	98.582	-3.192	[-7.642, 1.310]	0.332
Raven's score (out of 36)	31.674	30.510	-1.131**	[-1.916, -0.351]	0.009
Non-cognitive characteristics					
Locus of control (1–5)	4.103	4.018	-0.082	[-0.179, 0.015]	0.197
Grit (1–5)	3.859	3.933	0.079	[-0.004, 0.162]	0.125
Extraversion (1–5)	3.171	3.053	-0.105	[-0.245, 0.037]	0.291
Agreeableness (1–5)	3.946	3.942	-0.002	[-0.104, 0.100]	1.000
Conscientious (1–5)	3.968	4.017	0.047	[-0.059, 0.154]	0.770
Neoroticism (1–5)	2.473	2.423	-0.052	[-0.173, 0.068]	0.792
Imagination (1–5)	3.060	3.091	0.032	[-0.048, 0.111]	0.863
Life satisfaction ladder (0–10)	5.510	5.786	0.286	[-0.065, 0.631]	0.217
Depression scale (0–10)	1.584	1.306	-0.293*	[-0.521, -0.059]	0.028
Caseworker Assessment					
Motivated to get back to work (1–10)	8.452	8.261	-0.177	[-0.505, 0.149]	0.567
Likely to overcome barriers (1–10)	8.083	7.896	-0.183	[-0.538, 0.163]	0.600

Notes: Data source is a baseline survey and administrative data from CDLE and CBMS. The sample includes ReHire applicants who applied between 7/2015 and 12/2017 The sample is stratified by an individual's predicted conditional average treatment effect on having any employment in the in-program period. The table reports differences in average baseline characteristics among individuals who are predicted to be least affected (column 1) and most affected (column 2). Estimates of the difference across groups is reported in column (3) and 90 percent confidence intervals are reported in brackets in column (4). The *p*-values for the hypothesis that the parameter is equal to zero are reported in column (5). All estimates come from the median value across 1,000 random splits of the data. See Section A.14.3 for details on the estimation procedure.

A.16 Long-Term Effects and MVPF of ReHire

This section provides details about the surrogate index approach we use to construct estimates of the long-term effects of ReHire on earnings. We then use these estimates to inform a cost-benefit analysis using the marginal value of public funds (MVPF) framework (Hendren and Sprung-Keyser, 2020).

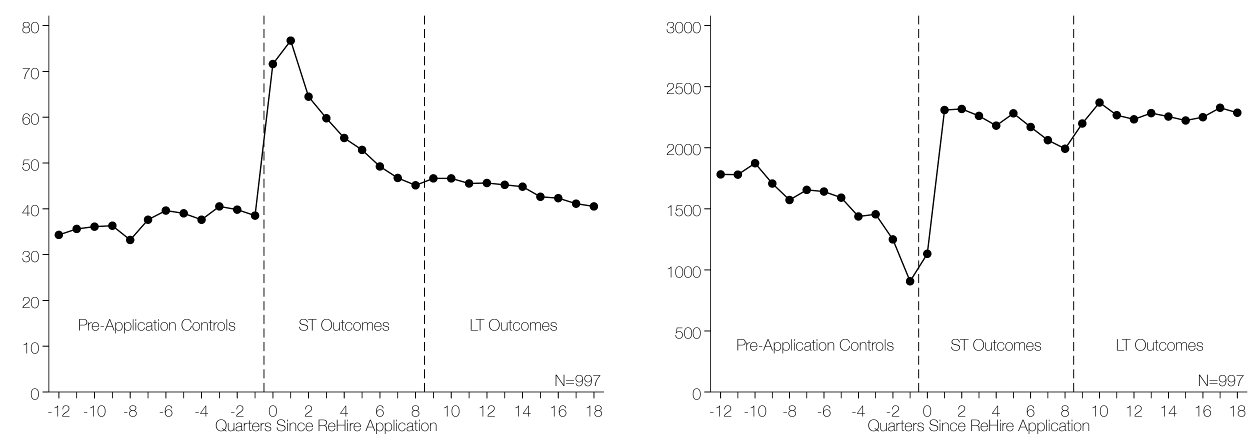
A.16.1 Surrogate Index

We combine observational data from an earlier (pre-RCT) wave of ReHire applicants with experimental variation in access to ReHire from the RCT to estimate the long-term effect of ReHire on employment and earnings. Our approach follows the surrogate index approach of Athey et al. (2019) who estimate the long-term effects of the Riverside GAIN intervention using proxies constructed with short-term outcomes.

The analysis requires two separate samples: (i) an experimental sample for whom access to ReHire is randomly assigned and includes measures of short-term outcomes; and (ii) a sample drawn from a similar population that includes measures of both short-term outcomes and long-term outcomes. We supplement data from the RCT ($N = 1,931$) with long-term observational data of ReHire participants who applied and entered the program prior to the implementation of the RCT ($N = 997$). These participants applied to ReHire between January 2014 and June 2015. During this timeframe, ReHire was largely being operated by the same service agencies in the same geographic areas as the RCT sample. For this pre-RCT sample, we are able to observe employment and earnings outcomes in the 12 quarters prior to application and up to 18 quarters following application. Figure A-10 presents the trends in quarterly employment rates and average earnings for the observational sample.

Figure A-10: Formal-Sector Employment Rates in Colorado, Pre-RCT ReHire Participants

(a) Quarterly Employment (b) Quarterly Earnings



Notes: Data source is administrative UI earnings data from CDLE. The sample includes pre-RCT ReHire applicants who applied for ReHire between 1/2014 and 6/2015. Quarter 0 represents the quarter in which a study participant completed their ReHire application, and is thus a different calendar quarter from person to person. Formal-sector employment is defined as having UI-covered earnings in Colorado greater than $0 in a given quarter. Earnings from a ReHire-sponsored transitional job are covered by the UI system and are thus counted as formal-sector employment. Treatment and control groups are based on an individual's randomly assigned treatment status. The figure plots the percent of treatment and control applicants with formal-sector employment.

The intuition of the surrogate index approach is as follows. We are able to observe the relationship between short-term outcomes (Q0–Q8) and long-term outcomes (Q9–Q18) using the pre-RCT observational data. The RCT provides experimental variation in access to treatment, which allows us to estimate causal effects on short-term outcomes. Combining these causal effects with the correlations between short- and long-term effects in the observational sample allows us to infer long-term causal effects.

Specifically, we implement a three-step process to predict long-term (Q9–Q18) outcomes in the RCT sample.

1. Use the observational data to estimate the following regression:

$$y_{it} = \sum_{k=-12}^{8} \beta_t^{Emp,k} Emp_{ik} + \sum_{k=-12}^{8} \beta_t^{Earn,k} Earn_{ik} + \epsilon_{it} \tag{5}$$

   where y_{it} is an outcome—an indicator for formal-sector employment or formal-sector earnings—measured for person i in the observational sample for quarters $t \in [9, 18]$. Emp_{ik} are indicators for quarterly employment and $Earn_{ik}$ are formal-sector earnings, measured in quarters $k \in [-12, 8]$.

2. Use estimates of $\beta_t^{Emp,k}$ and $\beta_t^{Earn,k}$ to predict $\hat{y}_{it}$ in the RCT sample.

3. Estimate the predicted long-term effect of ReHire on employment and earnings using the same estimation equation as when we estimate the main effects of ReHire (Equation 1) where $\hat{y}_{it}$ is the outcome of interest.

Three assumptions are needed in order for the surrogate index approach to identify the average treatment effect on long-term employment and earnings—unconfoundedness, surrogacy, and comparability—all of which are likely satisfied in this context. Under unconfondoudedness, we assume that access to treatment is uncorrelated with any unobservable characteristics that affect short-term outcomes, which follows from the random assignment of ReHire among individuals in the experimental sample. The surrogacy assumption requires that the effect of ReHire on long-term outcomes is fully mediated through the effect of ReHire on short-term employment and earnings. This assumption is reasonable for two reasons. First, all ReHire services were received during the period over which short-term outcomes are measured. Second, it is reasonable to think that any long-term employment gains would come through the direct effect of ReHire on employment and earnings while in the program (Q0–Q4). Finally, the comparability assumption requires that the distribution of long-term outcomes conditional on short-term employment and earnings is the same for both the experimental sample and the observational sample. Both samples are individuals who sought out ReHire services in the same geographic locations in Colorado. Both sets of individuals, therefore, would have likely had similar expected outcomes had they faced similar labor markets. However, the experimental sample would have been exposed to labor market disruptions posed by the COVID-19 pandemic during the quarters over which we estimate surrogate indices. For this reason, any actual experimental effects for Q9–Q18 that materialize over time may differ from those estimated with the surrogate index approach. In this sense, the surrogate index approach provides estimates of what the long-term effects of ReHire would have been had the pandemic not occurred.

Table A-27 provides estimates of the long-term effects of ReHire using the surrogate index approach. In columns (1) and (2), the outcome is the predicted probability of employment. In columns (3) and (4), the outcome is predicted formal-sector earnings. Columns (1) and (3) report control group means, and columns (3) and (4) report effects from a regression of the outcome on treatment, controlling for stratification fixed effects. Each row reports the outcomes measured at a different time period, and the outcome in the final row is the average effect of all 10 quarters. Standard errors that come from 10,000 bootstrap samples of the data are reported in parentheses.

During quarters 9 through 18, ReHire is predicted to increase employment by 4 percentage points and earnings by roughly \$200 per quarter. As noted by Athey et al. (2019), the surrogacy approach produces gains in efficiency such that nearly all estimates in Table A-27 are statistically significant at the 10 percent level or lower. We use these effect estimates from the surrogate index approach to inform cost-benefit analysis of ReHire, which we describe in the next section.

Table A-27: ITT Effect of ReHire on Long-Term Formal-Sector Employment and Earnings in Colorado, By Quarter

	Any Employment		Earnings	
	Control Mean	ITT Effect Controls	Control Mean	ITT Effect Controls
	(1)	(2)	(3)	(4)
Quarter 9	0.45	0.05**	\$1,989	\$224*
		(0.02)		(107)
Quarter 10	0.46	0.04*	\$2,050	\$194+
		(0.02)		(102)
Quarter 11	0.45	0.05**	\$2,126	\$246*
		(0.02)		(100)
Quarter 12	0.45	0.05**	\$1,993	\$247**
		(0.02)		(96)
Quarter 13	0.45	0.04*	\$1,974	\$260**
		(0.02)		(91)
Quarter 14	0.45	0.03*	\$1,992	\$217*
		(0.02)		(91)
Quarter 15	0.43	0.02	\$2,006	\$180+
		(0.01)		(94)
Quarter 16	0.43	0.03*	\$2,041	\$151+
		(0.01)		(90)
Quarter 17	0.41	0.04*	\$2,103	\$159+
		(0.01)		(91)
Quarter 18	0.40	0.04**	\$1,947	\$146+
		(0.01)		(86)
Average Q9–Q18	0.43	0.04**	\$2,015	\$197*
		(0.01)		(85)

Notes: Data source is administrative UI earnings data from CDLE. Each row represents outcomes measured in a different quarter relative to ReHire application. Quarter 0 represents the quarter in which a participant completed an application, and is thus a different calendar quarter from person to person. Formal employment is defined as having UI-covered earnings in Colorado greater than \$0 in a given quarter. Earnings from a ReHire-sponsored transitional job are covered by the UI system and are thus counted as formal sector employment. The dependent variable in column (1) and (2) is an indicator for formal-sector employment. The dependent variable in columns (3) and (4) is an individual's UI-covered earnings. Columns (1) and (3) report the mean for the control group, respectively. Columns (2) and (4) report the coefficients on treatment indicators, selecting controls from a high-dimensional set of baseline characteristics that are fully interacted with the subgroup indicator using the post-double selection LASSO procedure from Belloni, Chernozhukov and Hansen (2014). Bootstrap standard errors that take into account the uncertainty from predicting long-term outcomes are reported in parentheses.
**0.01, *0.05, +0.10 significance levels

A.16.2 MVPF

In order to better understand the relative costs and benefits of ReHire, we construct an estimate of the Marginal Value of Public Funds (MVPF) following Hendren and Sprung-Keyser (2020). The MVPF compares the aggregate willingness to pay for a particular policy to the cost to provide that policy net of any fiscal externalities. A MVPF of 0 suggests small benefits relative to the overall program cost. An MVPF greater than 1 suggests that aggregate benefits exceed costs. Finally, if the fiscal externality (i.e., savings from additional taxes or reduced transfers) exceeds program costs such that the net cost is negative, then the MVPF is defined to be ∞, which means the program more than pays for itself.

We measure the willingness to pay (WTP) of ReHire as the change in the present value of future earnings net of taxes and transfers. The WTP depends on the time horizon over which earnings gains are assumed to persist. We report different scenarios including assuming that earnings gains fail to persist beyond the two years measured in Section 5.1, estimated effects projected over 4.5 years using the surrogate index approach described in Appendix Section A.16.1, and earnings gains that persist throughout the remainder of a worker's life (18 years). Our baseline estimates use an annual discount factor of 3 percent and assume the typical ReHire applicant is 47 years old at baseline. We follow Hendren and Sprung-Keyser (2020) in imputing tax and transfer rates based on CBO estimates tied to various incomes relative to the federal poverty level.[50]

Information on program costs are provided by CDHS. Our baseline estimate of the per person cost of ReHire is \$5,594, which is based on 2015–2017 program expenditures spread across the 1,055 individuals placed into the treatment group. This estimate assumes that treatment group members do not forgo any non-ReHire services that they would have received in the absence of the program. Many service agencies provide additional re-employment services outside of the scope of ReHire (e.g., two agencies in the study are the local America Jobs Centers). We model additional assumptions about relative costs to provide ReHire by assuming the control group received services that were proportional to the indirect costs of providing ReHire.

Table A-28 reports MVPF estimates across different scenarios that vary the time horizon of earnings impacts, discount rates, assumptions about program costs, and potential improvements in program targeting. Columns (1), (3), and (5) report estimates of the MVPF, WTP, and cost net of fiscal externalities, respectively. 95 percent confidence intervals in columns (2), (4), and (6) are based on 10,000 bootstrap samples.

The estimated MVPF of ReHire varies depending on the time horizon over which earnings gains persist (Panel A). In our most conservative estimate, which relies only on estimated experimental effects and assumes that program effects fall to zero after quarter 8, we estimate the MVPF of ReHire to be 0.319 [0.100, 0.564]. Under this scenario, the present value of the ReHire earnings impacts net of taxes and transfers totals \$1,680. The key inputs to these calculations are the estimated program effects on quarterly earnings reported in Appendix Table A-4, column 6. As individuals experienced increases in their earnings, they also paid more in taxes. These additional taxes paid over the two years following ReHire decrease the net cost of the program to \$5,266, or by roughly \$328. The remainder of Panel A provides MVPF estimates under alternative assumptions about how long earnings gains persist beyond the two years after application. We first include the additional earnings gains predicted by the surrogate index approach, which are presented in Appendix Table A-27. Including these additional estimates, which extend the earnings gains through the 18$^{\text{th}}$ quarter following application, increases the MVPF estimate to 0.643 [0.171, 1.242]. Some of this gain in cost efficiency comes through a higher WTP (\$3,149) and some through a lower net cost of the program (\$4,899). Finally, we assume that the relative earnings gain in quarters 15 through 18 persists through retirement (i.e 18 years after application). Projecting this gain into the future, taking into

[50] We use the 2016 threshold for one person under age 65, \$12,486. Roughly 70 percent of our sample have no kids in the household and about half live alone.

account the evolution of earnings across different ages, gives an MVPF estimate of 1.941 [0.177, 6.239].[51]

The remainder of Table A-28 presents estimates based on changes in other assumptions. Each panel takes as its starting point the scenario that combines experimental impacts (Q0–Q8) with surrogate impacts (Q9–Q18). Panel B shows that varying the discount rate from 0 percent to 10 percent leads to MVPF estimates ranging from 0.554 to 0.689. Panel C presents results under different assumptions about cost. Our baseline cost measure—$5,594—assumes that the cost of services received by the control group is $0. While the control group was not eligible for ReHire-funded services, they were eligible for other services that the local service agency provided, as well as other programs in the area (e.g., WIOA-funded programs or programs aimed at veterans) potentially provided by other service providers. Estimates range from 0.694 to 2.331 depending on whether we make adjustments to account for contamination in the control group (0.694), assume that the control group receives services equivalent to 50 percent of the indirect costs of ReHire (1.008), or assume the control group receives services equivalent to the entire indirect costs of ReHire (2.331).[52,53]

Finally, we ask what the MVPF could be if the program were able to improve the share of participants who were hired into unsubsidized employment at their host site. Section 6 documented that post-program impacts are concentrated among the 15 percent of the treatment group who work a transitional job and then transition from subsidized to unsubsidized employment with the same employer. We construct a set of weights that holds constant the relative size of the treatment group but increases the share of treatment individuals hired by their TJ job site by 50 percent to 22 percent. We re-estimate experimental impacts and long-term surrogate effects using this weighted sample and find that this change would increase the MVPF to 0.928.

This analysis has the limitation that it does not explicitly account for some likely costs and benefits that could affect the MVPF. First, our measure of WTP does not include any utility implications from a labor-leisure tradeoff. We do find that earnings gains occur alongside an increased employment rate, which might suggest that changes in earnings overestimate a participant's WTP. However, stable employment may provide a worker with improvements in mental and physical well-being such that earnings gains represent a lower bound in WTP. Evidence from the follow-up survey shows the treatment group experienced improvements in well-being as measured by subjective well-being and self-report physical and mental health (Section 5.2). Second, there could be other public finance implications that we have not measured in this study. In Section 5.1, we ruled out reductions in participation in government benefit programs like SNAP and TANF. However, one fifth of our sample reported some prior involvement with the criminal justice system, two fifths of the sample reported ever being homeless, and one third of employed follow-up survey respondents reported having employer-provided health insurance. The MVPF would be larger in the event that ReHire reduces involvement with the criminal justice system, reduces usage of shelter or other housing services, and increases private insurance coverage. Finally, our MVPF analysis does not explicitly account for the benefits accrued by the employer over the period during which they have a fully subsidized worker. The worker's marginal value of production is likely somewhere between zero and the worker's subsidized wage.

How do these estimates compare to other similar job training or re-employment programs? Hendren and Sprung-Keyser (2020) construct MVPF estimates using reported impact estimates from a number

[51]When making these projections, we follow Hendren and Sprung-Keyser (2020) in measuring the age-earning profile in the 2014–16 American Community Survey (ACS) downloaded from IPUMS Ruggles et al. (2020). Specifically, we calculate the average earnings at each age for adults with 2 or fewer years of post-secondary education. We assume that the relative magnitude of the earnings gain, roughly 9 percent, stays constant until age 65, and project the evolution of earnings in the control group using the age-earnings profile estimated in the ACS.

[52]Appendix Figure A-5 shows the share of the control group in any given quarter employed at a ReHire service agency, which proxies for transitional job placement. We assume these individuals receive services equal to the typical ReHire participant.

[53]Direct costs are measured as transitional job wages and other services or supports that were directly billable to specific participants (e.g., gas cards, work uniforms, training tuition). Appendix Table A-2 reports average direct costs in the sample. Indirect costs are then assumed to be the per person program cost less average direct cost services.

of experimentally-evaluated programs. The typical job training program has an MVPF of 0.44 (Table II, Hendren and Sprung-Keyser, 2020) with a confidence interval that often does not rule out 0. For job training programs, their primary specification assumes that earnings gains do not persist beyond estimated effects given the presence of fadeout in the literature, which most closely aligns with our estimates of 0.32 and 0.64. The MVPF of ReHire exceeds that of Job Corps (0.15) and JobStart (0.20), and is within the confidence interval of the adult JTPA program [-0.21, 2.13]. More broadly, our estimates are largely in line with other programs targeting similar adult participants: unemployment insurance policies (0.43–1.03); disability insurance expansions (0.74–0.96); and the EITC (1.12–1.20).

Table A-28: Marginal Value of Public Funds

	MVPF		WTP		Net Cost	
	Estimate	CI	Estimate	CI	Estimate	CI
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Time Horizon of Impacts						
Experimental Impacts (Q0–Q8)	0.319	[0.100, 0.564]	$1,680	[554, 2,825]	$5,266	[5,005, 5,538]
Add Surrogate Impacts (Q0–Q18)	0.643	[0.171, 1.242]	$3,149	[929, 5,412]	$4,899	[4,356, 5,446]
Project Lifecycle Effect (18 Years)	1.941	[0.177, 6.239]	$7,515	[964, 14,174]	$3,872	[2,265, 5,440]
Panel B: Discount Rates						
0%	0.689	[0.173, 1.352]	$3,342	[945, 5,763]	$4,852	[4,269, 5,438]
3%	0.643	[0.171, 1.242]	$3,149	[929, 5,412]	$4,899	[4,356, 5,446]
5%	0.615	[0.167, 1.176]	$3,031	[908, 5,194]	$4,929	[4,412, 5,452]
10%	0.554	[0.158, 1.038]	$2,765	[861, 4,711]	$4,994	[4,532, 5,460]
Panel C: Cost Assumptions						
Per person cost : $5,594	0.643	[0.171, 1.242]	$3,149	[929, 5,412]	$4,899	[4,356, 5,446]
Net Control Contamination : $5,233	0.694	[0.183, 1.354]	$3,149	[929, 5,412]	$4,539	[3,995, 5,085]
Direct + 0.5 x Indirect Costs : $3,820	1.008	[0.252, 2.093]	$3,149	[929, 5,412]	$3,125	[2,582, 3,672]
Direct Costs Only : $2,046	2.331	[0.484, 6.683]	$3,149	[929, 5,412]	$1,351	[808, 1,898]
Panel D: Program Improvement						
50% Increase in Hired by TJ Rate	0.928	[0.395, 1.589]	$4,416	[2,105, 6,682]	$4,758	[4,208, 5,326]

Notes: Data source is administrative UI earnings data from CDLE and program data from CDHS. The sample includes all ReHire applicants who applied between 7/2015 and 12/2017. Columns (1), (3), and (5) report estimates of the marginal value of public funds (MVPF), willingness to pay of the program, and per person program cost net of fiscal externalities, respectively. Columns (2), (4), and (6) report 95% confidence intervals that come from 10,000 bootstrap trials of the individual-level data. Our baseline scenario uses a 3% annual discount rate and a per treatment group member cost of $5,595. Panel A reports estimates that vary the time horizon of earnings impacts: only the experimental impacts reported in Table A-4; adding quarterly surrogate estimates from Table A-27; and assuming a constant relative earnings impact through age 65. The remaining panels vary assumptions using experimental and surrogate impact estimates (Q0–Q18) as time horizon of impacts. Panel B varies the annual discount rate. Panel C assumes different assumptions about program costs. The estimate in Panel D comes from a re-weighted sample that increases the share of the treatment group who worked at a transitional job and transitioned to unsubsidized work with the same employer by 50%. See Appendix Section A.16.2 for additional details.