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Abstract

This paper examines how and why returning to education fosters recovery from negative employment shocks among high school dropouts. High school dropout remains a problem, particularly as employment is increasingly skilled over time. Exploiting a policy expanding a Norwegian vocational certification scheme in a triple difference framework, workers displaced post-expansion certify their skills at significantly higher rates relative to those displaced pre-expansion. Increases in certification post-expansion significantly reduce income losses after job loss. Certifying skills fosters recovery among early career displaced workers through the retention of relevant industry-specific human capital, which increases job stability over 20 years later.

JEL-Codes: J630, J650, I260.

Keywords: job displacement, vocational education, unemployment.

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1 Introduction

Employment has become increasingly skilled over time—total hours worked by the non-college educated in the US fell from over 70% in the 1960s to just 40% by 2017 (Autor, 2019)— and high school dropouts increasingly lack relevant skills in the labor market. Such strong declines in demand have long-lasting labor market implications: job loss and other negative labor market shocks cause persistent earnings losses, particularly among the lower educated (Jacobson et al., 1993; Kahn, 2010; Huttunen et al., 2011; Schwandt and von Wachter, 2019). Recent work focuses on isolating the factors which determine the persistence of earnings losses, distinguishing between lost hours worked, declining wages, and worker-firm factors.[1] However, far less is known about how to effectively combat such declines: how can low-educated workers recover from negative employment shocks and what are the underlying mechanisms which foster such recovery?

This paper reveals how returning to formal education to finish high school fosters recovery from adverse employment shocks. I assess how early career workers certify their practical vocational skills following job separations of an involuntary nature—job displacement due to a mass-layoff or closing event—and how returning to education minimizes earnings losses among low educated displaced workers. To isolate the causal role of education in the recovery of labor market outcomes in the aftermath of job loss, I combine a policy expanding access to a second chance certification scheme with the methodology of the displaced worker literature. This triple difference approach, comparing displaced workers both before and after the scheme's expansion, informs the mechanisms behind why second chances in the education system eliminate the long-lasting earnings penalties of job displacement (Jacobson et al., 1993).

Isolating the causal role that returning to education to certify practical skills plays in the recovery from negative labor market shocks presents an empirical challenge. Indeed, both the choice to return to education to certify skills and the timing of when in the life cycle to do so are determined by endogenous factors. To overcome the endogeneity of

[1] See, for instance, Schmieder et al. (2018); Raposo et al. (2019); Lachowska et al. (2020)

returning to education in the aftermath of displacement, I compare the certification rates of high-tenured early career workers who are laid off to similar non-displaced high-tenured early career workers. In a triple difference framework, I exploit a sudden expansion of the vocations covered by a second chance certification scheme to compare displaced workers' education and labor market outcomes before and after the expansion in the short- and long-run. Such an approach assesses how an exogenous increase in high school completion, as determined by the expanded access to opportunities to transition back into the education system, combats earnings losses in the aftermath of job loss.

The paper makes four key contributions. First, the paper documents that being laid off causes young high school dropouts to certify their skills with a vocational high school degree when second chances are available in the education system. Exploiting an expansion of the Practical Candidate Scheme (PCS) to incorporate fields which employ a large fraction of women such as health care, social work, and retail sales reveals that women displaced after the expansion of the PCS certify at significantly higher rates compared to women displaced pre-expansion. Importantly, there is no evidence that those displaced before and after the expansion have differential trends in certification prior to job loss, suggesting that those displaced pre-expansion are a suitable counterfactual for those displaced post-expansion in the triple difference approach. While there is no additional impact of displacement on the completion of higher education after the PCS' expansion—that is, increases in higher education among women displaced post- and pre-expansion are similar—displacement leads workers to complete higher education at significantly higher rates than their non-displaced counterparts. While recent work concludes that a large fraction of dropouts return to graduate later in life (Albæk et al., 2019; Bennett et al., 2020), this paper emphasizes that job loss causes early career workers—who only recently dropped out of high school—to document their vocational qualifications when the education system enables them to do so.

Second, the paper documents how returning to education mitigates the earnings penalties due to job loss. Certification significantly reduces the long-run income penalty of job loss: women displaced after the expansion of the PCS—those who certify at signifi-

cantly higher rates—exhibit significantly stronger income recovery compared to women displaced pre-expansion. The rapid recovery of income, despite substantial short-run income penalties, stands in contrast to an extensive literature documenting that job loss during mass-layoff events causes persistent earnings losses (Jacobson et al., 1993; Couch and Placzek, 2010). The probability of working full-time is similar among women displaced pre- and post-expansion, suggesting that certification mitigates income losses after job loss by combating reductions in the wage level. Indeed, Lachowska et al. (2020) show that both reductions in wages and hours worked are important sources behind the long-run earnings losses of displaced workers.

Third, the paper isolates the underlying mechanisms behind why the certification of skills through a high school diploma effectively combats earnings losses. Focusing on the long-run effects of certification far later in adulthood, over 20 years after workers are displaced early in their career, reveals that the retention of industry-specific human capital is an important reason behind why certification combats income losses. By retaining their relevant experience and skills within a given industry, those displaced early in their career benefit from increased job stability later in life. Relative to women displaced pre-expansion, those displaced post-expansion are significantly more likely to be employed in the same industry they were displaced from early in their career, have a significantly less volatile income, and are significantly less dependent upon unemployment insurance benefits. In addition, those displaced after the PCS' expansion are considerably less likely to have no occupation and are considerably more likely to be employed in service based occupations incorporated in the expansion of the scheme such as health care. Such changes in occupations translate into significant changes in the tasks workers perform on the job: post-expansion displaced women perform significantly less routine based tasks, whose demand in the labor market has declined over time (Autor et al., 2003), and perform significantly more serviced based tasks, which are less susceptible to future displacement events. Certification increases job stability far later in life by enabling workers to be compensated for their extensive industry-specific human capital, to perform tasks which are in demand, and to be more resilient to future shocks.

Finally, the paper reveals important differences in who is on the margin of certifying, shedding light on why early career workers, who only recently dropped out of school, decided to return to finish high school after being laid off. In addition to reducing the opportunity cost of certifying—foregone wage income as in Becker's (1975) schooling decision theory—displacement may lead workers to update their expectations about the labor market returns to being a high school dropout. Differences across who is at the margin of returning to education suggest that dropouts may have previously had wrong expectations about the future returns to education over the life cycle. Indeed, the impact of displacement on certification is significantly larger among those with higher levels of IQ and is particularly strong among high school dropouts who experienced favorable employment opportunities at young ages such as those who have a parent co-worker. Importantly, while cognitive ability matters for returning to education, differences in IQ cannot explain all of the decision to return to education following job loss. Such differences in certification across workers of different ability levels and favorable employment opportunities imply that dropouts leave education too soon (Oreopoulos, 2007) and job loss causes them to reevaluate the importance of a high school degree.

The finding that returning to education after a policy-induced expansion of a vocational certification scheme reduces the earnings penalty due to displacement is robust to a number of robustness checks and alternative approaches. First, using men, the vast majority of whom work in fields eligible for the PCS both pre- and post-expansion, as a placebo group reveals that certification after the expansion of the PCS remains largely unchanged compared to their pre-expansion counterparts. The lack of an increase in certification among men displaced post-expansion confirms that the availability of second chance opportunities within the education system matters considerably for the skill upgrading of early career displaced workers. Second, dynamic selection into displacement is not of concern: future displaced and non-displaced workers have similar trends in education prior to displacement and estimated pre-displacement coefficients are not significantly different from zero. Third, selection into displacement on factors such as worker ability, which may be particularly problematic among a sample of early career workers,

is also not of concern. Finally, results are robust to alternative choices of counterfactual groups as well as sample selection.

The paper contributes to a number of strands of literature. First, it informs an extensive literature on the persistent impacts of job displacement, isolating the mechanisms behind why returning to certify skills with a formal education diploma combat earnings declines in the aftermath of job loss.[2] By enabling displaced workers to retain industry-specific human capital, certification resulting from job loss at young ages increases future job stability and reduces the volatility of earnings far later in life, consistent with Delaney and Devereux (2019) who show increases in on-time education decrease earnings volatility. Second, the paper highlights the importance of the "work-to-school" transition after drop out, contributing to the education literature emphasizing the distinction between academic and vocational education in the "school-to-work" transition (Ryan, 2001).[3] Third, the paper reveals that second chance schemes to graduate high school can have persistent labor market benefits later in life, in contrast to the lack of labor market return found for the General Educational Development (GED) in the US (Tyler et al., 2000; Heckman et al., 2011; Jepsen et al., 2016). Compared to the GED program, the vocational certification scheme examined is straightforward, attains the exact same high school diploma formally documenting occupation-specific vocational skills, and is relatively inexpensive as the examination costs are paid by the candidate. Finally, the paper establishes the labor market benefits of increases in certification among previously low-educated workers, contributing to the literature on licensing and certification within occupations. Though there exists limited causal evidence on the effectiveness of licensing and certification requirements (Anderson et al., 2020), understanding the labor market implications of certification is increasingly important as mandates for certified and licensed workers have drastically increased over time (Kleiner and Krueger, 2013).

[2]An extensive literature also documents the non-economic impacts of job displacement with adverse impacts on health and mortality (Sullivan and von Wachter, 2009; Black et al., 2015), family structure and fertility (Charles and Stephens Jr., 2004; Del Bono et al., 2012; Huttunen and Kellokumpu, 2016), child outcomes (Oreopoulos et al., 2008; Rege et al., 2011), and geographic mobility (Huttunen et al., 2018; Gathmann et al., 2018).

[3]For evidence on the impacts of academic education relative to vocational education, see Oosterbeek and Webbink (2007); Malamud and Pop-Eleches (2010); Hall (2012); Hanushek et al. (2017); Bertrand et al. (2019).

2 Norwegian Register Data and Education in Norway

2.1 Norwegian Register Data

To analyze the importance of job loss for returning to the education system, this paper makes use of detailed Norwegian Register data provided by Statistics Norway. Interlinked by an anonymized personal identification number, the panel data tracks individuals over time and irrespective of employment status. The population register provides data on demographic characteristics such as age, gender, birth year, and municipality of residence. The data also contains the identity of a child's parents, permitting the construction of the number of children. Data is recorded for the entire population, that is, any individual who is legally residing in Norway.

Earnings are measured as pre-tax income, which includes annual labor income as well as any taxable benefits earned such as parental leave, unemployment, or sickness benefits. To the extent that displaced workers receive public transfers after job loss, the magnitude of the estimated earnings losses post-displacement will be smaller than if earnings were measured as only labor income.[4] Norway has a generous safety net of unemployment benefits, and the sample of workers defined in section 3.1 are all eligible for unemployment benefits. Throughout the paper, earnings are measured in year 2015 Norwegian kroner (NOK).

Data on education comes from the education register and schools are legally required to report any information on student enrollment and graduation to Statistics Norway. The data includes information on the years of education an individual has completed as well as the exact qualification attained including information on field of study. Additionally, any ongoing education is also recorded for each student, including information on field of study. The completion of educational qualifications and ongoing student status are measured at the start of October. Throughout the paper, education is defined as the completion of high school, separately for academic and vocational high school, and the completion of higher education, any tertiary education. Further details of the Norwegian

[4]Appendix B provides a comparison of post-displacement income losses between income measured with and without benefits for the cohorts of workers for whom data on labor income is available.

education system are discussed below.

Crucially, the data provides a linkage between workers and their employers, where both plant and firm identifiers are observed. Such data is available from 1986–2015 and enables the construction of the number of employees in the plant/firm as well as tenure with the same employer. Throughout the paper, the focus is on plants, and the terms employer and plant are used interchangeably. Additional information such as employment status—employed, unemployed, or outside the labor force—, full- or part-time status, and the industry of employment is also recorded. Prior to 1994, data on employment is measured as matches between workers and plants at the end of May while from 1995 onwards, such information is recorded at the end of November.

Finally, data on cognitive ability is extracted from compulsory military testing data performed at the age of 18. Military testing was compulsory for all men of the birth cohorts considered throughout the paper. Cognitive ability is measured as an IQ test, an aggregate score of tests in arithmetic, word similarities, and figures.[5] IQ is measured on a 9 point scale, with an average value of 5 and a standard deviation of 2.

2.2 Education in Norway

For all birth cohorts considered in this paper, compulsory schooling is 9 years of education.[6] This is comprised of 6 years of primary schooling and 3 years of lower secondary education. As such, all individuals are able to join the labor force from 16–17 after the completion of compulsory schooling.

After the completion of compulsory schooling, a student decides whether to enroll in high school, which is non-compulsory. High school education lasts for 3–4 years and is structured into vocational programs as well as academic programs. Vocational high school emphasizes a theoretical and practical component in the classroom and is, primarily, geared towards professional employment in a particular vocation rather than post-secondary education. Typical vocational high school programs last 3–4 years, beginning

[5]The first two exams are similar to the Wechsler Adult Intelligence Scale (WAIS) test while the figures test is similar to a Raven Progressive Matrix test.

[6]See Black et al. (2005, 2008) for further details of the change in compulsory schooling.

with the theoretical classroom component and finishing with practical training. Practical training may be done either at the school itself or as an apprenticeship. To complete the vocational high school program, students must pass exams in both the theoretical and practical components.

The completion of academic high school typically takes 3 years and enables students to continue into university education. Prior to a reform in 1994 examined in Bertrand et al. (2019), the system was very divided between academic and vocational education with little progression to university education from the vocational track. All birth cohorts considered in this paper are enrolled in education under the divided pre-reform system, as the reform defined eligibility according to birth year.

Tertiary education is comprised of university colleges (høgskole), which specialize in shorter programs in subjects such as nursing and teaching, and universities. The direct cost of higher education is close to zero in Norway, as there is no tuition and most students will qualify for student loans and direct subsidies from the government. In addition, technical colleges (teknisk fagskole) offer non-tertiary, post-secondary education in vocational subjects. Such programs are short, spanning a minimum of 6 months to 2 years. The completion of a post-secondary education at a technical college conveys the status of a vocational technician, and is tailored as further education among those who already have a considerable background in a particular vocation. Admission to technical colleges requires a vocational high school degree and at least two years of experience in the vocation, though students at technical colleges may be admitted on the basis of other factors such as extensive work experience (Farstad, 1999). Throughout the paper, higher education is defined as the completion of tertiary education, following the International Standard Classification of Education (ISCED) definition.

2.3 The Practical Candidate Scheme

The PCS enables those who previously dropped out of high school to certify their on-the-job knowledge with a formal vocational high school education diploma. Unlike the GED program in the United States, students are awarded the exact same degree as if

they had completed vocational high school. The content of the examination in the PCS is equivalent to the final year examination as students in vocational education, and practical candidates do not need to have completed any other subjects such as Norwegian, English, math, science, or history to be issued the vocational education certificate.

Eligibility to register under the PCS mirrors the vocational high school system and includes both a theoretical component and a practical component. If a candidate had previously completed the theoretical portion of vocational high school while enrolled in formal education in the past, this qualifies the student under the first eligibility criteria. Any candidate who lacks the theoretical qualifications under the PCS is required pass an examination in vocational theory, and counties offer free preparation courses for the theoretical examination under the PCS.[7] However, applicants to the PCS are not classified as formal students enrolled in an educational institution unless they return to formally enroll in high school.

To fulfill the second eligibility criteria, an applicant must describe, in detail, the nature of their professional employment which provides them with a sufficient level of knowledge in the practical components of their vocation. Typically, the candidate must detail their tasks and responsibilities as well as how long they have been working in an industry corresponding to their vocation. The candidate must submit an application with their detailed on-the-job competencies to the county, who is responsible for assessing the eligibility of the candidate. If the county deems the candidate's description to be inadequate, they may seek further documentation and clarification from the individual. Practical candidates must apply to the PCS in the county they reside in.

Should the county deem a PCS applicant to satisfy both eligibility criteria, the individual is responsible for registering with the county to take an examination demonstrating their on-the-job competence. Throughout the process, the individual is responsible for taking the initiative in qualifying under the PCS and the individual must pay a fee to sit the examination set by the national government annually.[8] The length of the examina-

[7] Counties have a large amount of responsibility for their educational programs. There were 19 counties during the time period considered in this paper.

[8] In 2019, the fee for the PCS examination was 951NOK.

tion under the PCS is subject dependent, but lasts roughly one day where the candidate demonstrates, to an evaluation committee, their competence in the skills of that specific trade. Importantly, an individual may apply for the PCS irrespective of employment status provided they fulfill both eligibility criteria. As such, both workers in employment and workers out of employment may be examined under the PCS. If an individual fails to pass the PCS, the candidate must wait a minimum of another 6 months should they wish to try again. Pass rates are also subject dependent, but tend to be high, roughly 80–90% at the time (Kirke-, utdannings- og forskningsdepartementet, 1999).

2.3.1 The Expansion of the PCS

Prior to 1997, many vocational fields which traditionally employ a high fraction of women were not eligible for certification under the PCS, as the scheme historically covered vocational subjects traditionally dominated by men. The expansion of newly recognized vocations such as health care, social work, and retail allowed workers in these jobs to certify their skills under the PCS (Michelsen et al., 2014; Tangen, 2000; Farstad, 1999). Farstad (1999) points to the lack of possibility of formal certification in these vocations as an explanation for a lack of females completing vocational high school, which had historically been dominated by men in Norway. Consistent with this, following the inclusion of these additional fields, there was a dramatic increase in certification under the PCS at the end of the 1990s (Michelsen et al., 2014).[9] Section 4 examines how the expansion of the PCS impacted certification among displaced workers, comparing not only those displaced before and after the expansion but also contrasting women, who are disproportionately impacted by the expansion, to men, who are largely unimpacted. Since men are largely unimpacted by the expansion of the PCS, they offer an opportunity to understand how the balance between academic and vocational education evolves over time irrespective of the expansion. For instance, comparing the outcomes of women and men post-expansion informs whether there is a general shift away from academic to vocational education over

[9] A point emphasized in the GED literature is that it induces students to drop out of high school (Heckman et al., 2012). The expansion of the PCS does not seem to have had any such effects: as women are impacted more by the expansion, their dropout would increase relative to men following the expansion if this had any impacts. If anything, female dropout relative to male dropout decrease over the period.

time.

3 Defining Involuntary Job Loss

3.1 Isolating a High-Tenured Sample

By combining a definition of job loss which is plausibly involuntary with a sample of high-tenured workers for whom job loss is unanticipated, the job displacement literature estimates the impacts of job loss among displaced workers. This paper follows a similar approach to isolate a smaple of high-tenured young workers. Sample restrictions are defined relative to the year $b = 1990, \ldots, 1999$, where a worker is employed in b but might transition into non-employment one year after in $b+1$. Several sample restrictions ensure that the sample of early career workers, who are aged 21–27 in year b, are high-tenured workers who dropped out of high school.

First, young workers must have at least one year of tenure in their employing plant in b.[10] Second, they must be attached to the labor force in all years from $b-3$ to b, defined as having minimum level of income in a given year (one grunnbeløpet).[11] Third, they must have dropped out of education from the ages of 16–18 having not completed high school. Age of dropout is defined as the age a student was when they were first not enrolled in education in the current as well as the subsequent year. Non-enrollment in two subsequent years eliminates students who take a gap in their studies and return to education the following year.

Fourth, young workers must be employed in a plant with at least 10 employees in b.[12] Such a restriction eliminates the possibility of very small changes in employment classifying as a mass-layoff event, as defined in section 3.2. Finally, workers must not be enrolled in education prior to the sample period in $b-4$. Note that future displaced and

[10] See Appendix Table L in Bennett and Ouazad (2019) for an overview of tenure restrictions in the displacement literature.

[11] A grunnbeløpet is an amount of income which corresponds to a basic amount in the National Insurance scheme. The amount of income which constitutes one basic amount (1G) changes from year to year with inflation. At the start of the sample period in 1990, 1G corresponded to 34,100kr (in 1990 NOK) and in 1999, 1G corresponded to 46,950kr (in 1999 NOK).

[12] See Appendix Table J in Bennett and Ouazad (2019) for an overview of employer size in the displacement literature.

non-displaced workers are subject to the exact same sample criteria, and that all workers are followed unconditionally after year b.

Table A.1 describes the final estimation sample in year b separately by gender. The sample pools all years $b = 1990, \ldots, 1999$, resulting in a sample of 76,791 men and 56,666 women. While workers span the ages 21–27, they are, on average, aged 25 in year b. The sample of high school dropouts is of lower cognitive ability, as only 40% of men have an IQ score at or above the median.

High-tenured workers have, on average, 4 years of tenure. As such, some of the high-tenured workers are still employed in their first job after entering the labor market and dropping out of high school. While all almost men are employed full-time, only 75% of women are working full-time in year b. High-tenured men earn considerably more than women (313,986kr vs 231,420kr), though high school dropouts of both genders are high earners for their age: in 1994, median income among all workers aged 18–54 was 308,067kr for men and 201,826kr for women. There exist considerable differences in the industry men and women work in: 43% of high-tenured men are employed in manufacturing, while 32% of women are employed in the public, education, health, and social work industries and 29% employed in retail and service jobs.

The vast majority of the sample dropped out of education having completed only compulsory education, though roughly 20% dropped out having completed some high school. As the sample definition does not restrict the education of high-tenured workers from $b - 3$ to b, a considerable portion of men (12%) have already completed vocational high school by year b. Women return to complete high school in the same period to a lesser degree, and only 3% of women have completed vocational high school by b, reflecting the reduced opportunities available to women pre-expansion. Less than 1% of both men and women have completed academic high school by b.

3.2 Defining Mass-Layoff Events and Job Displacement

The paper combines idiosyncratic mass-layoff events at the plant level with employee job transitions (either job-to-job or employment to non-employment) to define displaced

workers. At the worker level, a job transition is defined as an employee who transitions to a new plant or to non-employment between b and $b+1$. At the plant level, a mass-layoff event is defined as a plant in year b which satisfies one of two criteria: (i) closed between b and $b+1$ or (ii) plant reduced employment by 30% or more between b and $b+1$. Plant closures address potential administrative closings or mergers, and exclude false closings where over 80% of workers employed in the same plant in year b are employed together in the same plant in $b+1$.

Combining these two definitions, a displaced worker is one who loses their job and is employed in a plant in year b which has a mass-layoff event or closes in the next year. Such a definition is similar to existing measures of displacement used throughout the displacement literature as well as those used in the context of Norway (Huttunen et al., 2018). Flaaen et al. (2019) validate the methodology of the displacement literature: combining survey and administrative data reveals that conventional definitions of job displacement produce similar displacement rates and estimates to alternative methodological approaches. However, as there may be particular concerns with displacement defined among a sample of young workers (Von Wachter and Bender, 2006), section 4.3 examines in detail the potential issue of selection into displacement.

Throughout, displaced workers are compared to similar high-tenured workers who are non-displaced; that is, those who did not experience a job transition during a mass-layoff event. As such, non-displaced workers may continue to be employed in the same plant, transition between jobs, leave their job for voluntary reasons, or even be displaced in a future year (but not between b and $b+1$). Indeed, Krolikowski (2018) emphasizes the importance of defining a non-displaced group which is both similar prior to displacement and followed unconditionally for the post-displacement period for the estimated impacts of job displacement on earnings.

4 The Impact of Job Displacement on Certification and Higher Education

4.1 Empirical Specification

To understand the causal role that job loss has on certification, and how the availability of opportunities in the education system impact certification after job loss, the paper combines job displacement with an expansion of the PCS in the late 1990s. Such an expansion permits the comparison of the education of displaced workers pre-expansion to displaced workers post-expansion (both relative to their respective non-displaced counterparts). Prior to 1997, many vocational fields which traditionally employ a large fraction of women were not eligible for certification under the PCS. After the expansion of the PCS, fields such as health care, social work, and retail sales were incorporated (Michelsen et al., 2014; Tangen, 2000).

Pooling all base years $b = 1990, \ldots, 1999$, equation (1) estimates the impact of job displacement on education, differentially for those displaced post- and pre-expansion:

$$\begin{aligned} Y_{it} = \; & \alpha + \sum_{k=-3}^{+10} \gamma_k \cdot (D_i \times \tau_t)^k + \sum_{k=-3}^{+10} \delta_k \cdot (D_i \times \tau_t)^k \times expansion_b \\ & + \theta \cdot D_i + \eta \cdot expansion_b + \zeta \cdot D_i \times expansion_b + \phi \cdot expansion \times \tau_{b,t} \\ & + municipality^{t=0} \times \tau_{m(i),t} + \pi_b + \varepsilon_{it}, \end{aligned} \tag{1}$$

where the cross-sectional dimension i corresponds to a worker in a specific base year b. As such, all variables are base year specific and the outcome of a worker in time t depends on what base year they are in. Time is measured relative to displacement by $t = y - b$, the calendar year y relative to b. Workers are followed from -3 to $+10$, where displacement, as defined above, occurs at some point between $+0$ and $+1$. Y_{it} corresponds to two education outcomes, measured as the completion of vocational high school or the completion of higher education.

Cohorts displaced after the expansion of the PCS are defined as:

$$expansion_b = \begin{cases} 1, \text{ if } b = 1996, ..., 1999 \\ 0, \text{ if } b < 1996. \end{cases}$$

As the 1996 cohort is displaced between 1996 and 1997, they are the first cohort to be displaced into the post-expansion years. While those displaced prior are also eventually treated by the expansion of the scheme, they are not eligible to certify under the PCS in the expanded vocational fields immediately following displacement.

$(D_i \times \tau_t)^k$ is equal to one k years after a worker is displaced. The triple difference coefficients of interest, δ_k, correspond to the difference in the impact of displacement on education after the expansion of the PCS. As such, they estimate the difference in outcomes between those displaced after the expansion and those displaced before the expansion, both relative to their respective non-displaced counterparts. For $k = +1, \ldots, +10$, δ_k corresponds to the post-displacement difference in the impact of displacement after the expansion of the PCS.

The impact of displacement pre-/post-expansion estimated in equation (1) corresponds to a triple difference regression. Compared to the standard double difference regression in the displacement literature, the triple difference framework requires that the displaced/non-displaced difference in education between pre-/post-expansion cohorts would be stable in the absence of the expansion of the PCS. If this assumption holds, then those displaced pre-expansion represent a valid counterfactual for those displaced post-expansion.

While such an assumption is inherently untestable, the coefficients $\delta_{-3}, \ldots, \delta_{+0}$ provide a direct test of the similarity of trends in education between future displaced and non-displaced workers before and after the expansion of the PCS *prior* to the displacement event. Indeed, Table A.1 reveals that a considerable fraction of the high-tenured high school dropout sample has already certified prior to displacement. The placebo coefficients test if future displaced and non-displaced workers post-expansion certified in the time leading up to displacement at similar rates as the same workers pre-expansion. In addition, Section 4.2.1 uses men as a placebo group, as men are employed in jobs

eligible for the PCS both before and after its expansion and are largely unimpacted by the expansion.

Throughout the paper, equation (1) is estimated separately by gender. The inclusion of municipality-time fixed effects ($municipality^{t=0} \times \tau_{m(i),t}$) control for municipality-specific confounders which may vary over time such as school quality. Municipality is measured prior to displacement in the base year and, as such, are (on their own) time-invariant. The inclusion of base year fixed effects (π_b) compares displaced and non-displaced workers within the same base year. By pooling all base years, the relevant panel dimension i is base year-person, and standard errors are clustered at the person level. Both γ_{-1} and δ_{-1} are set to zero by convention, and the estimated γ_k and δ_k coefficients are interpreted relative to the omitted difference in time -1.

4.2 The Impact of Displacement on Education After the PCS' Expansion

As a starting point, Figure 1 plots the unconditional certification rates across four different groups of women: non-displaced workers pre-expansion, displaced pre-expansion, non-displaced post-expansion, and displaced post-expansion. Prior to displacement, all four groups have similar trends in certification. Over time, all groups see increases in certification. However, comparing post- to pre-expansion cohorts reveals that this increase in certification is far greater after the expansion of the PCS. This is true among both displaced as well as non-displaced workers.

The triple difference exploits the difference in certification rates between displaced and non-displaced workers post-expansion, compared to the same difference pre-expansion. Indeed, there is a considerable difference between the certification rates of displaced and non-displaced workers post-expansion, where those displaced certify at even higher rates relative to those non-displaced. At the same time, those displaced pre-expansion eventually go on to certify at marginally lower rates. These considerable differences suggest that the expansion of the PCS had a substantial impact on certification and that displacement post-expansion has an additional impact on certification over and above this.

Figure 1: Average Pre- and Post-displacement Certification Rates Before and After the PCS' Expansion, Female Workers

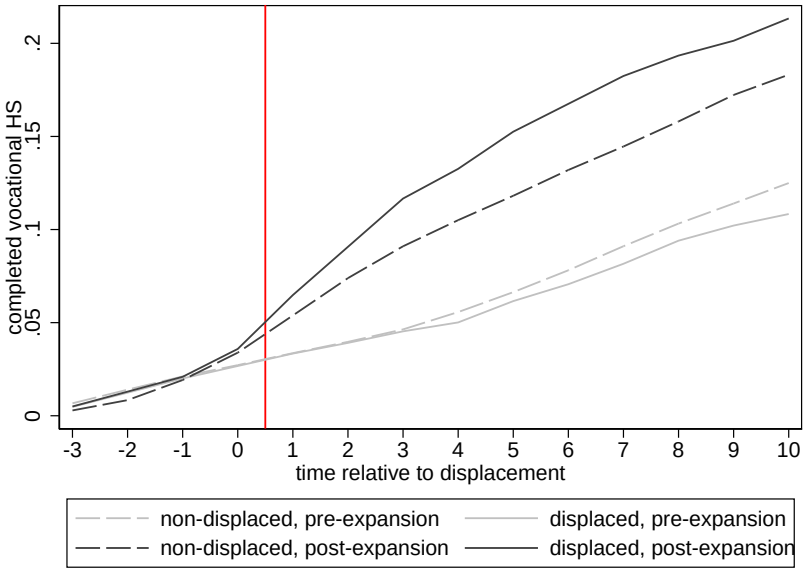


Figure plots the unconditional average completion of vocational high school across four groups relative to the displacement event: non-displaced workers before the PCS expansion, displaced workers before the PCS expansion, non-displaced workers after the expansion, and displaced workers after the expansion. Expansion cohorts are those in base years 1996 onward. Sample of high-tenured workers defined as in Section 3.1.

Figure 2 plots the estimated difference in certification rates between post- and pre-expansion displaced women relative to their respective non-displaced counterparts (δ_k from equation 1). The estimated interaction coefficients confirm the descriptive patterns above: the impact of displacement on certification is greater for women displaced post-expansion relative to women displaced pre-expansion. From three years after displacement, those displaced post-expansion certify at significantly higher rates relative to the fixed difference in certification in time -1. Such differences are large in magnitude, and correspond to a 3–4 percentage point increase in certification. Relative to the average probability of certification among all non-displaced workers in $+10$ of 0.136, the post-expansion increase in certification among displaced women corresponds to roughly a 30% increase in certification. Crucially, those displaced post- and pre-expansion have similar trends in certification prior to displacement, and these differences in certification are stable pre-displacement, small in magnitude, and not statistically significant. The lack of differential trends pre-displacement suggests that those displaced pre-expansion

Figure 2: The Estimated Difference in the Impact of Displacement on Certification Post-Expansion Relative to Pre-Expansion Cohorts, Female Workers

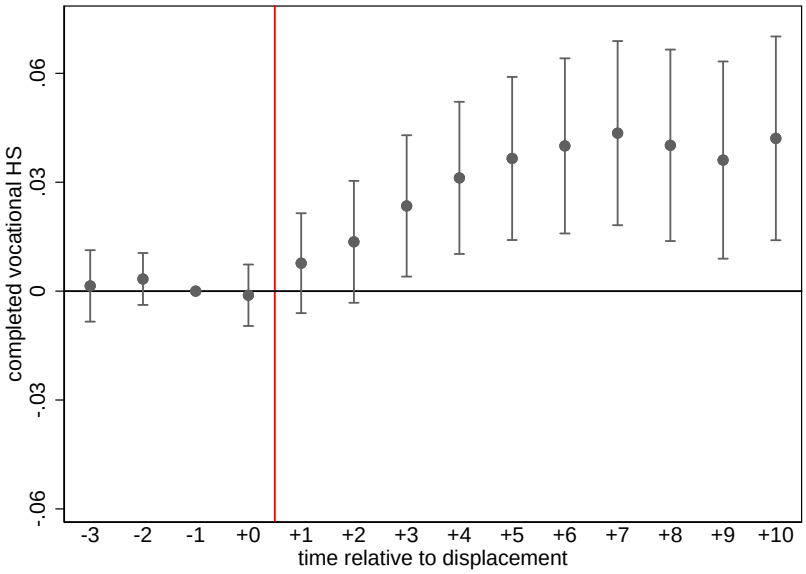


Figure plots the interaction between $Expansion_b$ and $D_{it}^{k \text{ years after displacement}}$ from equation 1 for women, with the outcome variable equal to 1 if an individual has completed vocational high school. Post-expansion cohorts are those from 1996 onward. Coefficients interpreted at the difference between displaced workers post-expansion and displaced workers pre-expansion (both relative to their respective non-displaced counterparts). Average completion of vocational high school among non-displaced workers in +10 (both pre- and post- expansion cohorts): 13.6%. δ_{-1} set to zero by convention. Full results reported in Appendix C. Displacement event occurs between +0 and +1. 95% confidence interval reported. Sample of high-tenured workers defined as in Section 3.1.

represent a suitable counterfactual for those displaced post-expansion.

Increases in certification among women after displacement and after the expansion of the PCS indicate that the opportunities available for graduating high school matter considerably. Indeed, the negative shock of displacement leads displaced workers to reevaluate the importance of a high school degree. However, displaced women only certify their skills when they have the opportunity to do so, as the estimated γ_k coefficients from equation (1) reported in Table C.1 are generally small in magnitude and not significantly different from zero.

The increase in certification among displaced women post-expansion may also translate into increases in higher education. Indeed, the completion of vocational high school leads to additional opportunities in the education system, as described in Section 2.2, to further invest and refine specialist skills. In contrast to Figure 2, there is no differential impact of displacement on the completion of higher education between post- and pre-expansion cohorts (Figure 3).

Table C.2 reveal that while there is no differential impact on the completion of higher education before and after the PCS' expansion, displacement does translate into increases in higher education among displaced workers. Indeed, the estimated γ_k coefficients are positive and statistically significant after displacement. Thus, while the availability of opportunities matters for those at the margin of certifying, increases in certification do not translate into gains in higher education among displaced women at the margin post-expansion.

4.2.1 Men as a Placebo Group

To further test whether the expansion of the PCS is responsible for the increase in certification among women displaced post-expansion in Figure 2, Appendix C estimates the same regressions for men. As displaced men are eligible for the PCS throughout the sample period, both prior to and after the PCS' expansion, certification among men displaced post-expansion should be largely unimpacted by the inclusion of new fields. While men and women are employed in different jobs, Appendix C.1 reveals that they follow very similar trends in employment rates over time. Thus, there may be level differences in the

Figure 3: The Estimated Difference in the Impact of Displacement on the Completion of Higher Education Post-Expansion Relative to Pre-Expansion Cohorts, Female Workers

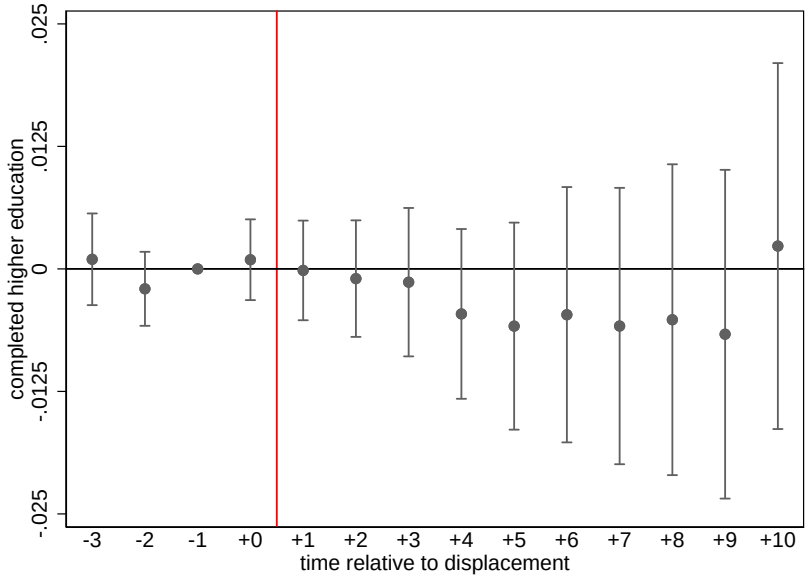


Figure plots the interaction between $Expansion_b$ and $D_{it}^{k \text{ years after displacement}}$ from equation 1 for women, with the outcome variable equal to 1 if an individual has completed higher education. Post-expansion cohorts are those from 1996 onward. Coefficients interpreted at the difference between displaced workers post-expansion and displaced workers pre-expansion (both relative to their respective non-displaced counterparts). Average completion of higher education among non-displaced workers in +10 (both pre- and post-expansion cohorts): 5.2%. δ_{-1} set to zero by convention. Full results reported in Appendix C. Displacement event occurs between +0 and +1. 95% confidence interval reported. Sample of high-tenured workers defined as in Section 3.1.

employment rates of men and women, but the similar employment trends suggests that they are similarly impacted by downturns and booms.

Using men as a placebo group, Table C.4 reveals that there is no increase in certification among men displaced post-expansion compared to those displaced pre-expansion and, if anything, they are slightly less likely to certify. The lack of an increase in certification among men suggests that the expansion of second chance opportunities for women, rather than a general shift away from academic towards vocational education, causes the increase in post-expansion certification among women.[13]

While there is no additional impact of displacement on certification after the expansion of the PCS among men (the δ_k coefficients from equation 1), displacement does lead to significant increases in certification among men (the γ_k coefficients from equation 1). Such increases in certification correspond to a 1.5–3 percentage point increase in the probability of completing vocational high school. Similar patterns are seen for the impact of displacement on the completion of higher education for men in Table C.5: while there is no additional impact of displacement on higher education post-expansion, displacement leads to significant increases in higher education.

4.3 Establishing the Validity of the Displaced Worker Methodology

4.3.1 Assessing the Potential for Selection into Job Displacement

The validity of the displaced methodology hinges on the fact that non-displaced workers represent a valid counterfactual for displaced workers. An important remaining question is whether *all* future displaced workers, combining pre- and post-expansion displacement cohorts, have similar trends in education as non-displaced workers prior to displacement. In particular, it might be that returning to education leads to voluntary job transitions among workers. While the triple difference relies on the similarity in trends of displaced/non-displaced workers between pre- and post-expansion cohorts, it remains

[13]If anything, there is a slight tendency towards academic education over time, as post-expansion displaced men have slightly higher completion of academic high school relative to pre-expansion displaced men (such differences are insignificant). At the same time, the academic high school of women displaced pre- and post-expansion are virtually identical, and increases in vocational high school post-expansion do not come at the expense of academic high school.

informative to understand how education evolves before job loss among all displaced workers.

Estimating the impact of displacement among all workers, both those displaced pre- and post-expansion, reveals that while displacement leads to significant increases in both certification (Figures D.1a and D.1b) and higher education (Figures D.2a and D.2b) among women and men. Prior to displacement, the estimated coefficients when $k \leq 0$ are small in magnitude and not significantly different from zero. The lack of significant differences prior to displacement reveals that while future displaced and non-displaced workers do certify prior to displacement, they do so at similar rates over time. Such similar trends in education prior to displacement suggest little scope for selection into who is displaced.

Figure D.3 shows that there is no impact on enrollment in high school education. Indeed, displaced workers complete vocational high school without returning to the classroom, pointing to the importance of certification rather than returning to the classroom. In addition, there is no impact of displacement on the completion of academic high school (Figure D.4), suggesting young displaced workers certify rather than return to full-time high school education.

Appendix D.3 further confirms that selection into who is laid off is not of concern for the results. While there might be selection into which workers plants layoff and which workers plants retain, this is not the case. Figure D.5a compares the cognitive ability of displaced workers by whether they are displaced in a mass-layoff or plant closing event. If, for instance, plants lay off their least capable workers while retaining their more productive workers, then there would be large differences in cognitive ability in Figure D.5a as while there may be choice in who to retain during a mass-layoff event, this is not the case during a plant closing as all workers are laid off. Reassuringly, those displaced during a mass-layoff event have similar levels of IQ compared to those displaced during a plant closing, and such differences are not statistically significant.

In addition, Appendix D.4 reveals that there is not selection of young workers into different plants, an issue emphasized in Von Wachter and Bender (2006). If, for in-

stance, lower ability workers self-select into plants (or industries) with higher levels of turnover, and plants with higher turnover are more prone to mass-layoff events, then displaced workers will be negatively selected on ability relative to non-displaced workers. Appendix D.4 confirms that, if anything, displaced workers have slightly *higher* levels of cognitive ability relative to their non-displaced counterparts (Figure D.6a) and results are robust to accounting for these small differences in the levels of cognitive ability between displaced and non-displaced workers (Figure D.7).

4.3.2 Robustness to Choice of Counterfactual and Sample Selection

Two key challenges to the triple difference methodology can be addressed at this stage, and results are presented in Appendix E. First, results are robust to altering the counterfactual group of non-displaced workers. While non-displaced workers are, by definition, not displaced between b and $b+1$, they may be displaced in future years from $b+1$ and onward. Indeed, young workers are particularly prone to displacement relative to older workers (Farber, 2015). The sample of high-tenured young workers is no exception: 46% of the non-displaced sample is employed in a plant which, in a future year $b+1,\ldots,b+10$ experiences a mass-layoff or closing event. Though non-displaced workers are not necessarily displaced during such an event, that is, they do not necessarily transition to non-employment or another employer, such a counterfactual represents a group of workers whose plants will eventually downsize and are, arguably, more similar to displaced workers. Results in Appendix E.1.1 reveal similar estimates of the impact of displacement when excluding non-displaced workers whose employing plant is expanding.

In addition, Appendix E.1.2 assesses the importance of the presence of future displaced workers in the non-displaced counterfactual group. In particular, the pre-expansion non-displaced sample may contain workers who are displaced in the future, and are potentially treated by the expansion later in life. Appendix E.1.2 reveals that future displaced workers in the pre-expansion period do not drive the increase in education observed in Figure 2, and excluding those who become unemployed at any point from +1–+10 from the non-displaced group produces similar results.

Second, results in Appendix E.2 are robust to increasing the number of workers in year

b to 50 workers as is standard among the displacement literature in the United States (Jacobson et al., 1993; Lachowska et al., 2020). While restricting the sample to 10+ employees limits the scope for small changes in employment being classified as a layoff event, this is even more true among a sample of 50+ employee plants. As the average plant in Norway is smaller compared to the US, imposing the restriction of 50+ employees reduces the total sample by over 40%. Despite this, certification and the completion of higher education remains significantly higher among displaced workers compared to non-displaced workers, reinforcing the validity of the displacement methodology.

4.3.3 Comparing the Certification of Younger and Older Workers

Finally, Figure E.4 compares the post-expansion certification rates of young workers, those aged 21–27 as in the baseline results, to a sample which includes even older workers, those aged 28–30. Interestingly, including these older workers reduces the magnitude of the estimated triple difference coefficients. While the younger sample sees increases in certification post-expansion of 3–4 percentage points, the slightly older sample of workers sees increases of around 2 percentage points. This decrease in the impact of displacement on education post-expansion reveals that age is a key factor in the ability to return to education in the aftermath of displacement. Indeed, the work-to-school transition is a more important avenue among those who recently dropped out and older workers are less likely to certify vocational skills.

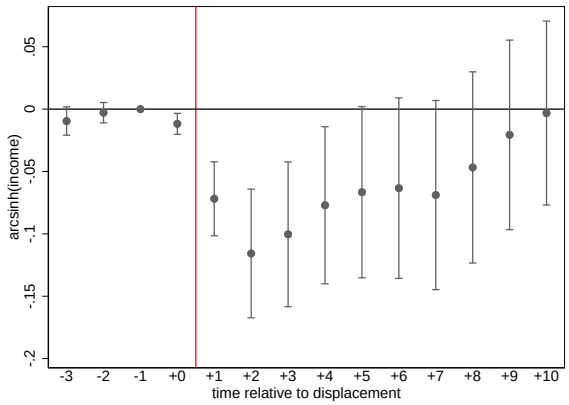
5 The Causal Impacts of Certification on Labor Market Outcomes

As a starting point, Figure 4 presents the impact of job displacement on income (Figure 4a) and full-time employment (Figure 4b) among all female workers, both those displaced before and after the expansion of the PCS, estimating a double difference regression corresponding to the average impact of displacement among pre- and post-expansion cohorts. Rather than using the log of income, which by construction excludes those with zero income post-displacement, income is transformed using the inverse hyperbolic sine

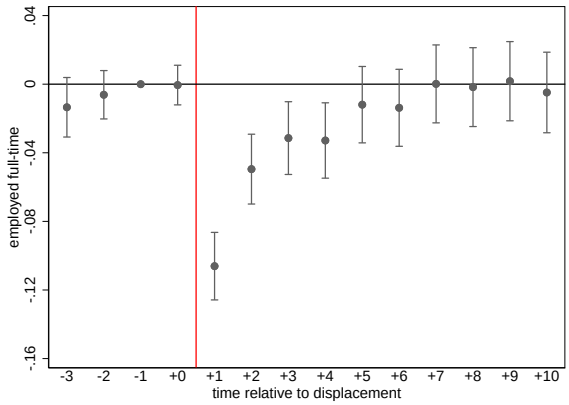
(Ravallion, 2017; Bellemare and Wichman, 2020). Such a transformation has a similar interpretation as a log transformation, but is defined at zero. The probability of having zero income post-displacement increases considerably (Figure F.5) and it is important to include those who have zero income as a direct result of displacement.

Figure 4: The Estimated Impact of Displacement on Labor Market Outcomes

(a) Female—Income



(b) Female–Full-time Employment



Outcome variable inverse hyperbolic sine (arcsinh) of income in panel (a), equal to 1 if an individual is employed full-time (30+ hours/week) in panel (c). Displacement event occurs between +0 and +1. 95% confidence interval reported. Average full-time employment among sample in base year (both displaced and non-displaced): 74.5%. Sample of high-tenured workers defined as in Section 3.1. γ_{-1} set to zero by convention. Estimating equation: $Y_{it} = \alpha + \sum_{k=-3}^{+10} \gamma_k \cdot (D_i \times time_t)^k + \theta \cdot D_i + municipality^{t=0} \times time_{m(i),t} + \pi_b + \varepsilon_{it}$.

While all workers are employed prior to displacement in +0, they may differ in their working hours. Figure 4b reveals that future displaced workers have similar working hours to non-displaced workers, as differences in the probability of working full-time are not statistically significant pre-displacement. However, future displaced workers begin to experience a slowdown in income just prior to displacement in +0. As is frequently observed in the job displacement literature (see e.g. Jacobson et al., 1993), this "Ashenfelter dip" (Ashenfelter, 1978) suggests that the income of future displaced workers begins to decline just prior to displacement. While statistically significant, the decline in earnings is small in magnitude and is, at least in part, due to the fact that workers may be displaced in the later months of +0 after employment status is recorded.

Consistent with other papers in the job displacement literature, displacement is a pronounced adverse shock leading to significantly lower earnings in the short-run. Income

declines for displaced women by around 6–12% following job loss. However, income losses are much shorter lasting than previously found. Indeed, the income of young displaced workers quickly recovers such that 10 years after displacement, there are no significant differences in earnings between displaced and non-displaced workers. Similar patterns are observed for full-time employment, which substantially declines immediately after displacement but then rapidly recovers.

5.1 Does Certification Causally Impact Income?

Such rapid recovery of income and employment after job loss stands in contrast to not only the job displacement literature, but also the literature on the scarring effects of unemployment at young ages (Gregg and Tominey, 2005). Combined with the significant impacts on certification among post-expansion displaced workers, the recovery of income suggests that certification among displaced workers fosters recovery after job loss. However, young workers may simply be more resilient than older workers post-displacement: Kletzer and Fairlie (2003) and Von Wachter and Bender (2006) suggest that the earnings losses of young displaced workers are lower relative to older displaced workers.

Figure 5 directly tests the causal role of certification in the recovery of post-displacement income, combining the displaced worker methodology with the expansion of the PCS. Estimating the triple difference regression of equation (1), the Figure asks whether the income recovery of women displaced after the expansion of the PCS—who certify at significantly higher rates compared to their non-displaced counterparts—is greater relative to women displaced pre-expansion. If certification causally impacts labor market outcomes, then the recovery of income post-displacement should be greater among women displaced post-expansion.

Figure 5 confirms that certification fosters income recovery post-displacement: while the short-run income losses of women displaced post-expansion are similar to those displaced pre-displacement, income in the long-run is significantly higher among post-expansion women. Income begins to increase precisely when post-expansion displaced women certify at significantly higher rates in Figure 3. Ten years after displacement,

Figure 5: The Estimated Difference in the Impact of Displacement on Income Post-Expansion Relative to Pre-Expansion Cohorts, Female Workers

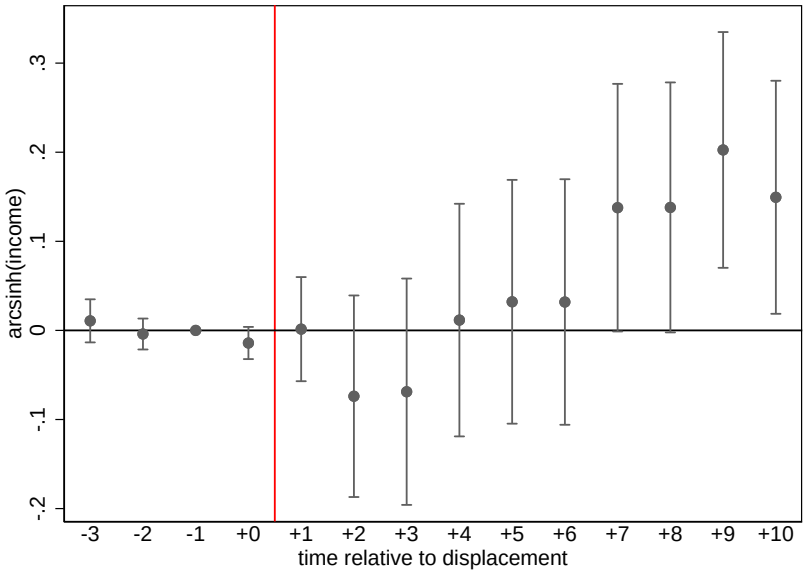


Figure plots the interaction between $Expansion_b$ and $D_{it}^{k \text{ years after displacement}}$ from equation 1 for women, with the outcome variable the inverse hyperbolic sine (arcsinh) of income. Post-expansion cohorts are those from 1996 onward. Coefficients interpreted at the difference between displaced workers post-expansion and displaced workers pre-expansion (both relative to their respective non-displaced counterparts). δ_{-1} set to zero by convention. Full results reported in Appendix C. Displacement event occurs between +0 and +1. 95% confidence interval reported. Sample of high-tenured workers defined as in Section 3.1.

women displaced after the expansion of the PCS have income 15% higher despite similar income losses immediately following displacement. In addition, Table C.3 reveals that those displaced pre-expansion experience persistent and significant declines in income as a result of displacement.

The stronger income recovery among women displaced post-expansion may be due to an increase in wages relative to those displaced pre-expansion, an increase in hours worked, or some combination of the two forces. Lachowska et al. (2020) emphasize that both reductions in wages and hours worked are responsible for long-run earnings declines, with declines in hours worked explaining slightly more than lost earnings. Figure G.1 tests the competing explanations of wages and hours worked in the stronger income recovery post-expansion, showing that the probability of being employed full-time is not significantly different among women displaced post- and pre-expansion. As hours worked are similar, this suggests that certification combats declining wage levels among women displaced post-expansion.[14]

The significant differences in post-displacement income trajectories after the expansion of the PCS confirm that certification plays an important causal role in recovery from adverse shocks. The importance of certification for the recovery of income losses is further established by examining the difference in income between men displaced post- and pre-expansion in Table C.6. Using men as a placebo group, the income losses of men displaced post-expansion are not significantly different from those of men displaced pre-expansion in the long-run. As men are eligible for certification under the PCS over the entire period, the lack of significant differences in long-run income recovery supports the fact that certification is behind the strong recovery of income of women displaced post-expansion.

[14]More detailed data on hours worked is unavailable throughout the period.

6 The Mechanisms Behind why Second Chance Education Fosters Recovery

Early career displaced workers experience short-run income losses which recover rapidly after job loss. Certification plays an important role in such recovery and 10 years after displacement, there are no differences in the employment and income between displaced and non-displaced workers. A remaining question is why returning to education to finish high school via this second chance certification scheme is so effective in mitigating earnings losses post-displacement. To address this question, results below examine the long-run effects of certification on labor market outcomes far later in life. Doing so not only establishes the persistent effects of education over time but, crucially, informs the underlying mechanisms behind why certification combats lost earnings over a long time horizon. Indeed, the impact of early career certification in the aftermath of job loss persists into adulthood.

The retention of industry-specific human capital is an important mechanism behind why second chance education among women displaced post-expansion improves labor market prospects. While all displaced workers, both pre- and post-expansion, lose any firm-specific human capital, certification enables workers to remain qualified within specific vocation. Such a finding is consistent with prior work highlighting the importance of industry-specific human capital in earnings losses among displaced workers (Neal, 1995; Huttunen et al., 2011).

The retention of extensive experience within an industry is fundamentally important in combating earnings losses, supported by a number of facts. First, women displaced post-expansion, who certify at significantly higher rates post-displacement, have significantly less volatile income and are significantly less likely to receive unemployment insurance benefits later in life over 20 years after early career displacement (Section 6.1). Thus, for the same level of earnings, those who certify their skills with a formal qualification are employed in significantly more stable jobs. In addition, women displaced post-expansion are significantly more likely to be employed in the same industry that they were employed

in prior to displacement. By formally documenting experience and skills within their specific vocation, certification enables workers to retain their extensive industry-specific human capital in the aftermath of displacement.

Third, those who certify post-expansion are considerably more likely to be employed in service occupations and much less likely to have no occupation relative to women displaced pre-expansion (Section 6.2.1). Importantly, service occupations are those which are incorporated into the PCS after its expansion, further supporting the importance of the retention of industry-specific human capital through certification. Finally, certification enables displaced workers to perform tasks which are in demand later in life: those displaced post-expansion perform less routine tasks and more service based tasks (Section 6.2.2). The retention of industry-specific human capital impacts on-the-job tasks, enabling certified women to shift away from routine tasks which faces a declining labor market premium over time (Autor et al., 2003; Goos et al., 2014).

6.1 Income and Income Stability Later in Life

Table 1 tests how persistent the impacts of certification on labor market outcomes are over the life cycle. Labor market outcomes are measured over 20 years after early career displacement, from 2014–2018. These cross-sectional long run regressions mirror the specification of equation 1, interacting a displacement indicator with a post-expansion indicator for displaced women (panel A) and displaced men (panel B). As women are those treated by the PCS' expansion, men offer a placebo group whose labor market outcomes should be largely unchanged as their education is unaffected by the schemes' expansion.

Table 1 reveals that for the same level of income, young women displaced post-expansion have a significantly more stable income relative to those displaced pre-expansion. Certification at young ages does not impact the level of income later in life from 2014–2018, measured by the percentile in the income distribution, as while the interaction between post-expansion and displaced is positive, it is statistically insignificant and small in magnitude (columns 1–3, panel A). However, certification significantly reduces the

volatility of income later in life (column 4, panel A). Such changes are large in magnitude, the income of women displaced post-expansion is 10% less volatile relative to the average among non-displaced workers, and are consistent with prior work emphasizing that education both increases the level of earnings and reduces the volatility of earnings (Delaney and Devereux, 2019).

While certification leads to less volatile income over 20 years after displacement, women displaced post-expansion are also significantly less likely to receive unemployment insurance benefits (column 5, panel A). Significant decreases in the receipt of unemployment benefits suggest that certification increases income stability via increased job stability later in life as a result of certification. Indeed, Stevens (1997) emphasizes the importance of multiple job losses among displaced workers, and workers displaced early in their career may face future displacement events later in their career. This increased job stability is also reflected in the industry of employment later in life, where certification increases the probability of working in the same broad industry that workers are displaced from early in their career by over 40% (column 6, panel A).

Taken together, these significant impacts later in life reveal the underlying mechanisms through which certification combats earnings losses: certification enables displaced workers to retain their industry-specific human capital. Prior work in the job displacement literature points to the importance of industry-specific human capital in post-displacement earnings profiles (Neal, 1995; Huttunen et al., 2011). While all displaced workers, both those displaced pre- and post-expansion, lose any employer-specific human capital after being laid off, they continue to retain their extensive expertise and work experience within their industry. By certifying their skills, women displaced post-expansion are able to continue to be employed in the same industry over time, and are compensated for their extensive industry-specific human capital in the form of more stable employment. Switching industries is costly for pre-expansion displaced women who do not certify, as they have a significantly more volatile income and are significantly more likely to receive unemployment insurance later in life.

In contrast to women, men, see no significant differences after the expansion of the

PCS, confirming that differences in certification among women are the cause behind the increased stability of income. Job stability is an important factor which increases among women who certify, and retention of industry-specific human capital is an important reason behind why certification of vocational knowledge and skills combats earnings losses post-displacement.

Table 1: The Long Run Impacts of Certification on Labor Market Outcomes Among Early Career Workers Displaced Pre- and Post-Expansion

	Income				Benefits	Industry
	(1)	(2)	(3)	(4)	(5)	(6)
	Percentile in Income Distribution	Income in Top 50%	Income in Top 25%	S.D. Income (1000s)	Ever receive U.I.	Employed in Same Pre-Disp. Industry
			Panel A - Female			
Disp.	-0.076	0.005	0.004	4.511***	0.006	-0.051***
	(0.515)	(0.012)	(0.008)	(1.260)	(0.007)	(0.008)
Disp. × Expansion	0.295	0.006	0.009	-5.156***	-0.027**	0.108***
	(0.857)	(0.020)	(0.014)	(1.879)	(0.011)	(0.018)
Individuals	56256	56256	56256	56189	56256	56256
Avg. Non-Disp.	48.326	0.447	0.141	52.489	0.089	0.248
			Panel B - Male			
Disp.	1.716***	0.036***	0.031***	7.582***	0.002	-0.049***
	(0.421)	(0.010)	(0.009)	(1.955)	(0.006)	(0.007)
Disp. × Expansion	-0.831	-0.005	-0.009	1.808	-0.005	-0.022
	(0.751)	(0.019)	(0.016)	(4.539)	(0.012)	(0.015)
Individuals	75796	75796	75796	75649	75796	75796
Avg. Non-Disp.	55.663	0.583	0.209	72.427	0.102	0.198

Standard errors clustered at the individual level. ***, **, and * correspond to significance at the 1%, 5%, and 10% levels respectively. Table reports results from cross-sectional regression of one of six outcome variable (percentile in earnings distribution, 2 variables indicating if an individual is in the top 50% or top 25% of the income distribution, the standard deviation of income, a variable indicating if an individual ever received unemployment insurance, and a variable indicating if an individual is employed in the same industry they were displaced from) on displacement dummy interacted with $expansion_b$. National income distribution calculated using data on income from 2014–2018, separately by gender and for each birth cohort. Estimating equation: $Y_i = constant + \beta_1 \cdot D_i + \beta_2 \cdot D_i \times Expansion_b + \pi_b + \varepsilon_i$, where $D_i = 1$ if a worker was displaced from 21–27.

6.2 Occupational Choices and Task Composition of Work

6.2.1 Occupational Shifts among Post-Expansion Displaced Women

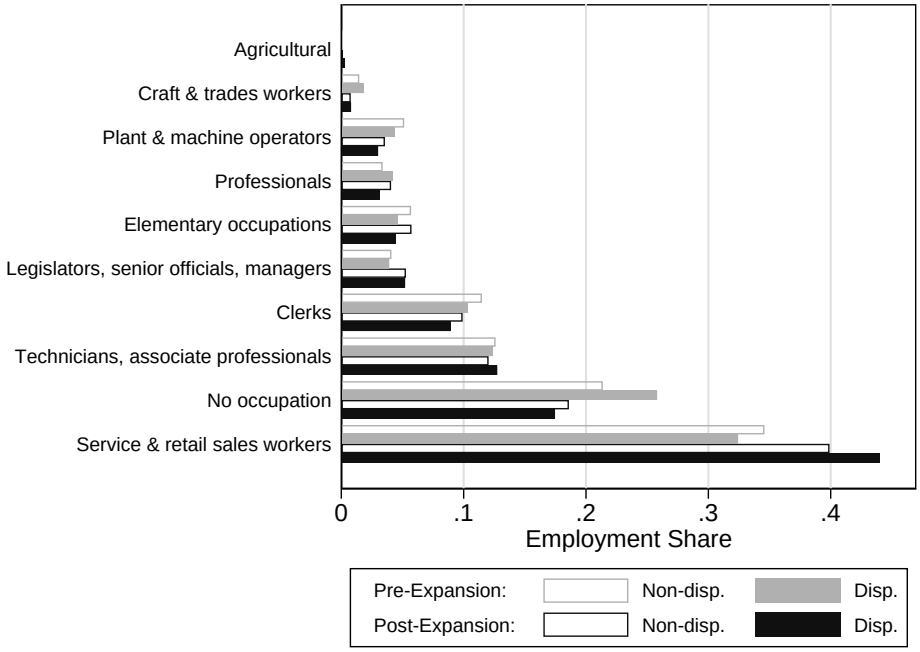
In the long run, women displaced post-expansion retain industry-specific human capital through certification and avoid switching to another sector. To further understand the benefits to remaining in the same type of work, the paper makes use of detailed occupation data available far later in life to understand how the composition of work changes. If workers who certify shift away from tasks whose importance has declined over time, such as routine tasks, and shift to non-routine tasks whose importance has increased over time, then certification enables workers to perform jobs which are in demand in the labor market. Previous work reveals that education is an important factor in occupational choices and the tasks performed within an occupation: higher skilled college educated workers have an advantage in performing non-routine tasks compared to non-college educated workers who traditionally specialize in more routine tasks (Autor et al., 2003).

As a starting point, Figure 6 compares the occupational choices among displaced women pre-expansion and displaced women post-expansion, both relative to their non-displaced counterparts. As in the previous section, occupations are measured much later in life, when early career displaced workers are between ages 39–45. Two clear differences between pre- and post-expansion displaced women emerge. First, those displaced post-expansion are substantially more likely to be employed in service and sales occupations. While women displaced post-expansion are over 3 ppt more likely to be employed in such occupations, those displaced pre-expansion are slightly less likely to be employed in such occupations (panel B). The most common occupations among services are nursing assistants and care workers, the exact type of vocations which were included into the PCS after its expansion.

Second, those displaced post-expansion are nearly 2 ppt *less* likely to have no occupation later in life, while those displaced pre-expansion are over 2 ppt *more* likely to have no occupation later in life. Thus, while there are shifts in the types of occupations performed among post-expansion displaced women, certification also impacts the extensive margin, the probability of being employed in any occupation. Such dramatic differences reinforce

Figure 6: Long-run Differences in Occupational Choices Between Early Career Displaced and Non-Displaced Workers, Pre- and Post-Expansion

(a) Occupational Shares, Levels



(b) Occupational Shares, Difference between Displaced and Non-Displaced

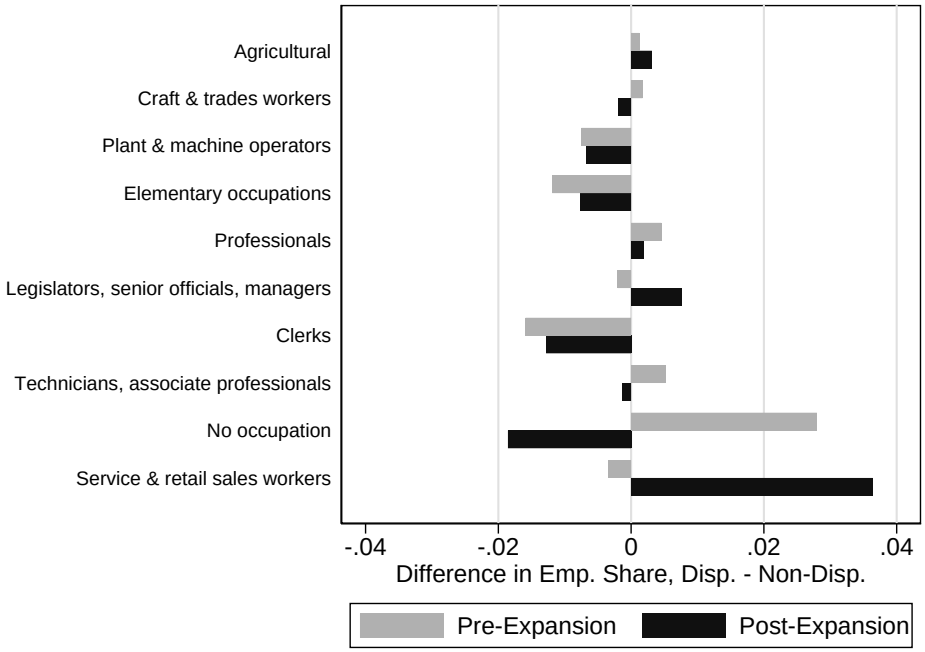


Figure plots the occupational shares of displaced and non-displaced women pre- and post-expansion (panel a) and the difference between displaced and non-displaced women pre- and post-expansion (panel b). Occupations are measured annually from 2008 (for 1990 cohort) until 2017 (for 1999 cohort), when sample of early career workers are aged 39–45. Occupations are classified according to the Norwegian standard classification of occupations as discussed in Appendix I. Sample of high-tenured workers defined as in Section 3.1.

the finding of the importance of job stability as a result of certification, as those women displaced prior to the expansion of the PCS struggle to find employment later in life as they remain significantly less educated after being laid off. In addition, such changes are not observed among men whose access to certification remains unchanged post-expansion (see Section H).

6.2.2 Does Certification Impact On-the-job Tasks?

Table 2 asks whether the observed differences in occupational choices translate into meaningful shifts in the nature of work performed among young displaced workers, matching occupations to measures of math, routine, social, and service tasks using O*NET data as in Deming (2017).[15] An extensive literature documents the role of computerization in the decline of clerical work and routine tasks as a whole (Autor et al., 2003; Goos et al., 2014), and the rise of work specializing in services (Autor and Dorn, 2013).

Conditional on being employed, displaced workers pre- and post-expansion perform starkly different tasks. Women displaced post-expansion perform significantly lower levels of routine tasks, suggesting that certification enables displaced workers to shift away from occupations which experience declining labor demand. These shifts lead to increased job stability: Table J.1 confirms that plants whose workers perform more routine tasks are significantly more likely to have a mass-layoff or closing event in the next year. As such, the retention of industry-specific human capital through certification enables displaced workers to specialize in occupations which are less susceptible to future displacement events.

At the same time, women displaced post-expansion see stark increases in service tasks. These increases come at the expense of specialization in math tasks, which also significantly decline among women displaced post-expansion. Specialization in service based tasks is increasingly common in the labor market over time (Autor and Dorn, 2013), something which is reflected in the significant increase in service tasks among

[15]Appendix I details the linkage of occupations in the Norwegian register data to tasks in the U.S. O*NET data. Importantly, Appendix I.4 reveals that the observed differences in tasks are not driven by the matching process between occupations in the Norwegian classification system to occupations in the US classification system, as focusing on direct one to one matches reveals similar results.

men displaced post-expansion. Despite this, the increase in service tasks among post-expansion women is considerably stronger. Given the types of vocations which were incorporated into the PCS after its expansion—health care, social work, and retail sales—it is unsurprising that certification leads to such strong increases in service based tasks.

Importantly, those who have no occupation perform no tasks by construction in Table 2. As such, the considerable differences in the probability of having an occupation between pre- and post-expansion displaced women in Figure 6 are not taken into account. Table I.2 incorporates those with no occupation, defining the same four measures of tasks as equal to one if an occupation performs that task at a high intensity, having a task intensity above the median occupation. While the significant declines in both routine and math tasks among women displaced post-expansion become less apparent when incorporating those with no occupations, the strong increase in service tasks remains.

7 Who is on the Margin of Returning to High School?

While displaced workers reevaluate the importance of completing high school after job displacement, it is less clear what underlying factors change between dropout and eventual certification. Appendix K presents a standard school decision for those deciding whether to restart education as in Becker (1975). In addition to directly impacting the opportunity cost of returning to education, displaced workers may update their expectations about the labor market returns to being a high school dropout as a direct result of job loss. Indeed, previous literature points to the importance of expectations about the benefits of education in major education decisions and that students may have wrong expectations (Jensen, 2010; Wiswall and Zafar, 2014). At the same time, displacement might directly impact how much an individual discounts the future. In addition, preferences may change with age such that, later in the life cycle, the same individual may be more mature or patient than their younger self (Lavecchia et al., 2016).

Further understanding precisely *who* decides to certify is crucial to shed light on the potential importance of such factors. Previous work emphasizes the importance of cognitive ability (Heckman and Vytlacil, 2001)—where more cognitively able students go

Table 2: Task Usage Among Early Career Displaced Workers, Pre- and Post-expansion

	(1) Routine Tasks	(2) Social Tasks	(3) Service Tasks	(4) Math Tasks
		Panel A - Female		
Displaced	-0.034	0.133**	0.081	0.144***
	(0.062)	(0.054)	(0.073)	(0.052)
Displaced × post-expansion	-0.242**	-0.085	0.383***	-0.319***
	(0.101)	(0.087)	(0.122)	(0.084)
Individuals	37021	37021	37021	37021
Avg. Non-Displaced	3.48	4.18	5.09	3.14
		Panel B - Male		
Displaced	-0.250***	0.103*	0.080*	0.060
	(0.048)	(0.056)	(0.047)	(0.042)
Displaced × post-expansion	-0.036	0.087	0.190**	-0.013
	(0.085)	(0.104)	(0.088)	(0.078)
Individuals	53581	53581	53581	53581
Avg. Non-Displaced	5.05	3.35	2.72	3.66

Standard errors clustered at the individual level. ***, **, and * correspond to significance at the 1%, 5%, and 10% levels respectively. Table reports results from cross-sectional regression of one of four task measures (math, routine, social, and service). Tasks defined as in Deming (2017). Occupations are measured annually from 2008 (for 1990 cohort) until 2017 (for 1999 cohort), when sample of early career workers are aged 39–45. Sample of workers whose occupation is mapped to task intensity measures, see Appendix I for a discussion of the linkage between occupations and tasks. Estimating equation: $task_{o(i)} = constant + \beta_1 \cdot D_i + \beta_2 \cdot D_i \times Expansion_b + \pi_b + \varepsilon_i$, where $D_i = 1$ if a worker was displaced from 21–27.

further in education—and economic conditions during adolescence (Cascio and Narayan, 2019; Carrillo, 2020)—where students complete less education during positive economic shocks—for education decisions. Section 7.1 reveals that while more cognitively able men return to education at significantly higher rates after job loss, those with an average IQ are also able to take advantage of second chance education. Section 7.2 suggests that economic conditions prior to displacement also matter for returning to education, and that those who dropout to take advantage of such employment opportunities drop out too soon (Oreopoulos, 2007).

7.1 Does cognitive ability matter for returning to education?

How important is cognitive ability in the decision to return to graduate high school by certifying vocational skills under the PCS? Fundamental to the literature estimating the labor market returns to education is the need to abstract from potential biases due to ability differences of workers with different levels of education. Indeed as Heckman and Vytlacil (2001) emphasize, if the correlation between ability and education is reasonably strong, then it is impossible to distinguish between the effect of education on earnings and the effect of ability on earnings.[16] Recent work concludes that while everyone benefits from graduating high school irrespective of ability level, the returns to high school education are larger among those with lower ability (Heckman et al., 2018).

Making use of data available for men measuring cognitive ability at the age of 18, Table L.1 reveals that while cognitive ability does matter for the probability of certifying and completing higher education post-displacement, workers with the sample average IQ also return to education post-displacement. Thus, while those with higher levels of cognitive ability do return to the education system at significantly higher rates, the possibility to certify is an important second chance option which also benefits the typical worker with the sample average, lower level of IQ.

[16]Unsurprisingly, there is a strong relationship between cognitive ability and dropout. However, while on average, dropouts are negatively selected from the IQ distribution, there is substantial variation in IQ (see Figure D.6a).

7.2 Who returns to education?

Results in Appendix L provide a detailed understanding of who decides to certify after job loss. Section L.2 finds that the presence of a parent working in the same employer prior to displacement matters considerably for the probability of certifying skills. Networking through parental connections matters when entering the labor market (Corak and Piraino, 2011; Kramarz and Skans, 2014), and men who are employed in the same plant as their father prior to job loss certify at much higher rates than those without a paternal coworker. Section L.3 exploits area-cohort variation in local employment rates, showing that certification is higher among those whose local area had stronger employment opportunities available at age 15, though such differences are not significant. Finally, Section L.4 suggests that the presence of children in the household prior to displacement does not matter for certification, but that parents are considerably less likely to continue into higher education after certification.

Such differences suggest that economic conditions prior to displacement matter: displaced workers who certify are those who had favorable employment opportunities available at young ages. The importance of employment opportunities prior to displacement in certification suggests that young individuals are willing to sacrifice higher future earnings for immediate benefits and that favorable labor market opportunities may lead dropouts to leave education too soon (Oreopoulos, 2007). While such differences are consistent with students having wrong expectations about the future returns to education over the life cycle and that shifts in expectations matter for the decision to certify after dropping out, the importance of changing preferences cannot be excluded.

8 Conclusion

How can high school dropouts recover from negative employment shocks and remain competitive in the labor market? This paper reveals that returning to education fosters recovery from negative shocks among high school dropouts. Comparing early career workers who are displaced both before and after an expansion of a second chance certi-

fication scheme reveals that attaining a vocational high school diploma in the aftermath of job loss significantly reduces the earnings penalties of job loss.

By leading young workers to certify their practical skills, job displacement has long-lasting consequences for young high school dropouts. In contrast to the displacement literature, which identifies persistent earnings losses following job loss, early career displacement may actually be beneficial to workers through increases in education. Crucially, the availability of opportunities to formally certify skills matters: an unanticipated expansion of the certification scheme to include additional fields causes women displaced after the expansion to certify at significantly higher rates. This increase in certification among women displaced post-expansion leads to strong income recovery relative to women displaced pre-expansion, whose recovery is significantly weaker.

Making use of data on labor market outcomes far later in life sheds light on the mechanisms behind why certification fosters recovery from negative labor market shocks: by returning to the education system to attain a high school diploma, displaced workers are able to retain their extensive industry-specific human capital after job loss. Indeed, certification significantly increases the probability of remaining in the same industry which workers were displaced from early in their career. Displaced workers benefit from their retention of industry-specific human capital in terms of increased job stability over 20 years later in life: those displaced post-expansion are significantly less reliant on unemployment insurance benefits, have a significantly less volatile income later in life, increase their specialization in service occupations, and shift away from routine tasks whose importance has declined over time. Given the declining demand for routine tasks established in the literature (Autor et al., 2003), such changes reduce the probability that workers displaced at young ages are afflicted by additional mass-layoff events.

This paper reveals that the work-to-school transition in vocational education is an important option for young workers who joined the labor market after dropping out of high school and that expanding second chance opportunities enables displaced workers to return to the education system. The paper's findings provide novel insights into the debate within the education literature on the importance of the relative merits of

academic education—with its more general focus and transferable skills—compared vocational education—with its more narrow focus on specific occupational skills at the expense of broader skills—in the school-to-work transition (Ryan, 2001). Though vocational education can play an important role in developing relevant labor market skills, it is traditionally marginalized in policy debates in favor of academic education (OECD, 2010).

Results are relevant to policymakers wishing to improve the prospects of high school dropouts, as they reveal that flexibility in the provision of second chance opportunities for formally documenting relevant skills within the education system fosters recovery from negative shocks. Among the 20–30% of a cohort who drop out of high school, a route for skill upgrading through certification of practical vocational skills offers a labor market return. In addition, the impacts of skill upgrading at young ages persist well into adulthood, consistent with the literature on active labor market programs which emphasizes the importance of human capital accumulation in the labor market benefits of ALMPs (Card et al., 2017). Indeed, skill upgrading in vocational education at young ages is an important opportunity for subsequent labor market outcomes among the low educated. As certification and licensing mandates have drastically increase over time (Kleiner and Krueger, 2013), the provision of second chances in the education system enables workers to not only bounce back from negative shocks but remain competitive in the labor market into adulthood.

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Online Appendix

A Describing the High-Tenured Estimation Sample

Table A.1: Descriptive Statistics of Estimation Sample in year b

	(1) Men	(2) Women
Demographics		
Age in base year	24.9	24.7
	(1.7)	(1.8)
Has children (%)	32.8	47.4
	(46.9)	(49.9)
Median or above IQ (%)	39.1	
	(48.8)	
Employment		
Income, year 2015 NOK	313985.7	231419.6
	(80182.3)	(68878.0)
Years of Tenure	4.1	3.9
	(2.3)	(2.2)
Employed (%)	100.0	100.0
	(0.0)	(0.0)
Employed full-time (%)	95.6	74.5
	(20.5)	(43.6)
Manufacturing (%)	42.9	19.5
	(49.5)	(39.6)
Wholesale & Retail Trade, Restaurants, Hotels (%)	19.3	28.9
	(39.4)	(45.3)
Public, Education, Health, & Social Work (%)	6.1	31.5
	(24.0)	(46.5)
Same employer as father (%)	10.9	3.7
	(31.1)	(18.9)
Same employer as mother (%)	3.8	7.8
	(19.2)	(26.8)
Education		
Age dropped out	17.2	17.3
	(0.8)	(0.8)
Dropped out with compulsory education (%)	80.0	82.1
	(40.0)	(38.3)
Dropped out with some HS (%)	20.0	17.9
	(40.0)	(38.3)
Completed vocational HS (%)	11.5	2.9
	(31.9)	(16.7)
Completed academic HS (%)	0.2	0.5
	(4.5)	(7.0)
Completed higher education (%)	0.6	0.6
	(8.0)	(7.7)
Number Individuals	76791	56666
Fraction Displaced	0.047	0.055

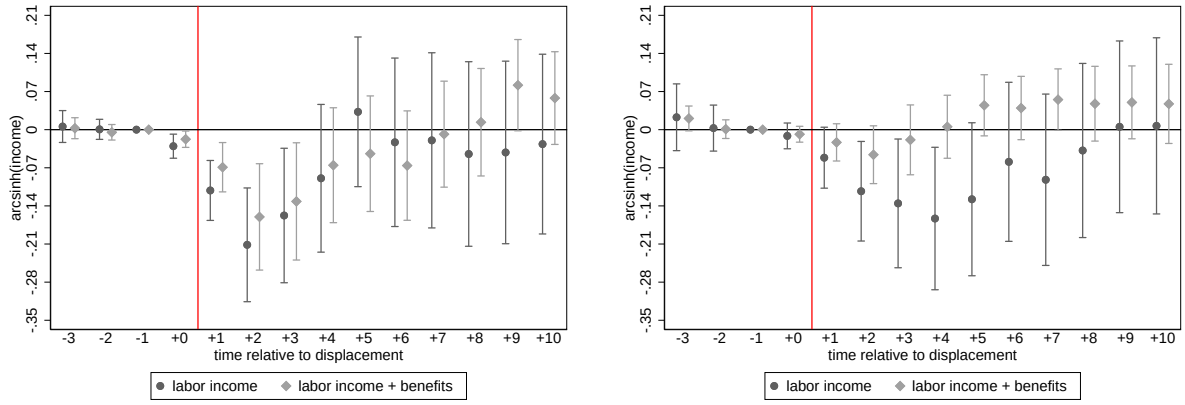
Sample of high-tenured workers defined as in Section 3.1. All variables measured in base year $b = 1990, \ldots, 1999$. Earnings measured in constant year 2015 Norwegian kroner.

B Estimated Impact of Job Displacement on Income Varying Income Measurement

For displacement cohorts 1996 and onward, a measure of labor income excluding benefits is available for the entire period from -3 to $+10$. Figure presents how the impact of job displacement on income varies across a measure of income including and excluding benefits. As expected, benefits reduce the earnings losses post-displacement.

Figure B.1: The Estimated Impact of Displacement on Labor Market Outcomes

(a) Female (b) Male



Outcome variable inverse hyperbolic sine (arcsinh) of income in panels (a) and (b). Income defined as labor income and labor income including benefits, the measure of income used throughout this paper. Displacement event occurs between +0 and +1. 95% confidence interval reported. Sample of high-tenured workers defined as in Section 3.1. γ_{-1} set to zero by convention. Estimating equation: $Y_{it} = \alpha + \sum_{k=-3}^{+10} \gamma_k \cdot (D_i \times time_t)^k + \theta \cdot D_i + municipality^{t=0} \times time_{m(i),t} + \pi_b + \varepsilon_{it}$.

C Full Results Interacting Post-Expansion Indicator with Displacement Indicators

C.1 Raw Trends in Employment by Gender, 1990–2010

Figure C.1: Trends in Employment by Gender

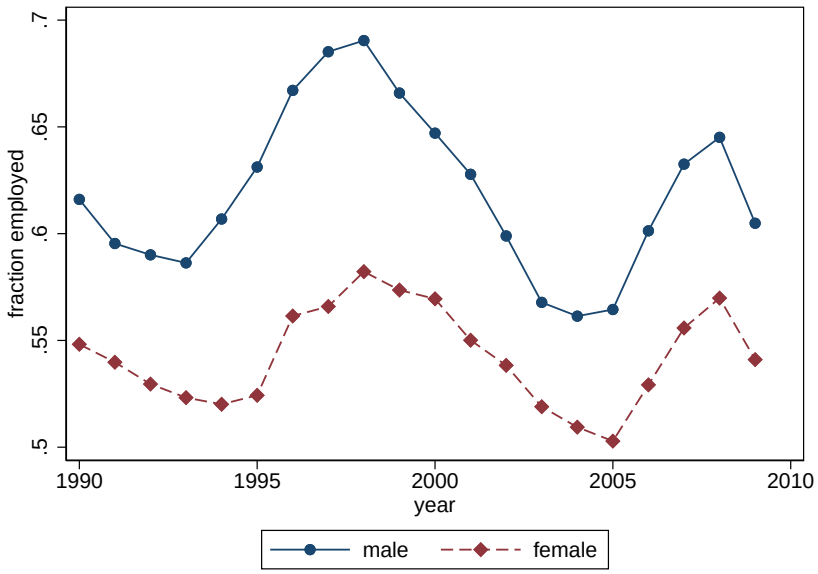


Figure plots the fraction of men/women who are employed in a given year. Sample of individuals aged 21–27 who dropped out of high school.

C.2 Female Workers

Tables present the full results of equation (1) shown in Section 4.2, both the estimated δ_k coefficients as well as the γ_k coefficients.

Table C.1: Estimated Impact of Displacement on Certification Interacting with Post-Expansion Indicator, Women

	completed vocational HS	
	(1)	(2)
	Displacement Base Term	× post-expansion
−3	-0.0009	0.0014
	(0.0028)	(0.0050)
−2	-0.0005	0.0033
	(0.0020)	(0.0036)
−1	0.0000	0.0000
	(.)	(.)
+0	0.0003	-0.0011
	(0.0018)	(0.0043)
+1	0.0005	0.0077
	(0.0025)	(0.0070)
+2	0.0001	0.0136
	(0.0029)	(0.0086)
+3	-0.0004	0.0235**
	(0.0034)	(0.0099)
+4	-0.0053	0.0312***
	(0.0037)	(0.0107)
+5	-0.0041	0.0366***
	(0.0043)	(0.0115)
+6	-0.0063	0.0400***
	(0.0047)	(0.0123)
+7	-0.0077	0.0435***
	(0.0053)	(0.0129)
+8	-0.0073	0.0402***
	(0.0057)	(0.0135)
+9	-0.0101*	0.0361***
	(0.0061)	(0.0139)
+10	-0.0144**	0.0421***
	(0.0063)	(0.0143)
N	793301	793301
avg. outcome, −1	0.029	0.029
avg. outcome, non-displaced +10		0.136

Standard errors clustered at the individual level. ***, **, and * correspond to significance at the 1%, 5%, and 10% levels respectively. Table reports the interaction between $Expansion_b$ and $(D_{ib} \times time_t)$ from equation 1 (δ_k coefficients) as well as base coefficients from $(D_{ib} \times time_t)$ (γ_k coefficients) for women. Outcome variable equal to 1 if an individual has completed vocational high school. Post-expansion cohorts are those from 1996 onward. Column (1) corresponds to impact of displacement on certification among pre-expansion cohorts while column (2) corresponds to the additional impact of displacement on certification among post-expansion cohorts relative to pre-expansion cohorts (both relative to their respective non-displaced counterparts). Displacement event occurs between +0 and +1. Sample of high-tenured workers defined as in Section 3.1.

Table C.2: Estimated Impact of Displacement on Higher Education Interacting with Post-Expansion Indicator, Women

	completed higher education	
	(1)	(2)
	Displacement Base Term	× post-expansion
−3	-0.0013	0.0014
	(0.0016)	(0.0024)
−2	-0.0001	-0.0016
	(0.0009)	(0.0020)
−1	0.0000	0.0000
	(.)	(.)
+0	0.0007	0.0010
	(0.0011)	(0.0021)
+1	0.0015	-0.0012
	(0.0016)	(0.0027)
+2	0.0009	-0.0010
	(0.0019)	(0.0032)
+3	0.0013	-0.0013
	(0.0024)	(0.0040)
+4	0.0022	-0.0043
	(0.0030)	(0.0046)
+5	0.0043	-0.0054
	(0.0034)	(0.0055)
+6	0.0083**	-0.0046
	(0.0040)	(0.0068)
+7	0.0081*	-0.0062
	(0.0043)	(0.0074)
+8	0.0095**	-0.0046
	(0.0046)	(0.0083)
+9	0.0098**	-0.0060
	(0.0048)	(0.0087)
+10	0.0093*	0.0031
	(0.0050)	(0.0097)
N	793301	793301
avg. outcome, −1	0.004	0.004
avg. outcome, non-displaced +10		0.045

Standard errors clustered at the individual level. ***, **, and * correspond to significance at the 1%, 5%, and 10% levels respectively. Table reports the interaction between $Expansion_b$ and $(D_{ib} \times time_t)$ from equation 1 (δ_k coefficients) as well as base coefficients from $(D_{ib} \times time_t)$ (γ_k coefficients) for men. Outcome variable equal to 1 if an individual has completed higher education. Post-expansion cohorts are those from 1996 onward. Column (1) corresponds to impact of displacement on certification among pre-expansion cohorts while column (2) corresponds to the additional impact of displacement on certification among post-expansion cohorts relative to pre-expansion cohorts (both relative to their respective non-displaced counterparts). Displacement event occurs between +0 and +1. Sample of high-tenured workers defined as in Section 3.1.

Table C.3: Estimated Impact of Displacement on Income Interacting with Post-Expansion Indicator, Women

	arcsinh(income)	
	(1) Displacement Base Term	(2) × post-expansion
−3	-0.0116	0.0107
	(0.0073)	(0.0123)
−2	-0.0030	-0.0040
	(0.0052)	(0.0089)
−1	0.0000	0.0000
	(.)	(.)
+0	-0.0047	-0.0141
	(0.0052)	(0.0092)
+1	-0.0731***	0.0014
	(0.0197)	(0.0298)
+2	-0.0895***	-0.0739
	(0.0314)	(0.0577)
+3	-0.0757**	-0.0688
	(0.0355)	(0.0648)
+4	-0.0826**	0.0116
	(0.0406)	(0.0666)
+5	-0.0912**	0.0321
	(0.0453)	(0.0698)
+6	-0.1089**	0.0319
	(0.0486)	(0.0703)
+7	-0.1563***	0.1378*
	(0.0519)	(0.0709)
+8	-0.1376***	0.1380*
	(0.0527)	(0.0716)
+9	-0.1350**	0.2026***
	(0.0534)	(0.0675)
+10	-0.1003*	0.1494**
	(0.0514)	(0.0667)
N	793291	793291
avg. outcome, −1	8.392	8.392
avg. outcome, non-displaced +10		8.000

Standard errors clustered at the individual level. ***, **, and * correspond to significance at the 1%, 5%, and 10% levels respectively. Table reports the interaction between $Expansion_b$ and $(D_{ib} \times time_t)$ from equation 1 (δ_k coefficients) as well as base coefficients from $(D_{ib} \times time_t)$ (γ_k coefficients) for women. Outcome variable log of income. Post-expansion cohorts are those from 1996 onward. Column (1) corresponds to impact of displacement on certification among pre-expansion cohorts while column (2) corresponds to the additional impact of displacement on certification among post-expansion cohorts relative to pre-expansion cohorts (both relative to their respective non-displaced counterparts). Displacement event occurs between +0 and +1. Sample of high-tenured workers defined as in Section 3.1.

C.3 Male Workers

Table C.4: Estimated Impact of Displacement on Certification Interacting with Post-Expansion Indicator, Men

	completed vocational HS	
	(1)	(2)
	Displacement Base Term	× post-expansion
−3	-0.0003	-0.0094
	(0.0047)	(0.0086)
−2	0.0020	-0.0067
	(0.0031)	(0.0063)
−1	0.0000	0.0000
	(.)	(.)
+0	0.0026	-0.0057
	(0.0032)	(0.0066)
+1	0.0269***	-0.0274***
	(0.0051)	(0.0099)
+2	0.0308***	-0.0388***
	(0.0057)	(0.0116)
+3	0.0259***	-0.0361***
	(0.0061)	(0.0125)
+4	0.0219***	-0.0286**
	(0.0065)	(0.0134)
+5	0.0212***	-0.0245*
	(0.0070)	(0.0140)
+6	0.0192***	-0.0216
	(0.0074)	(0.0144)
+7	0.0162**	-0.0243
	(0.0077)	(0.0148)
+8	0.0148*	-0.0247
	(0.0080)	(0.0152)
+9	0.0169**	-0.0279*
	(0.0081)	(0.0154)
+10	0.0149*	-0.0252
	(0.0082)	(0.0156)
N	1075041	1075041
avg. outcome, −1	0.115	0.115
avg. outcome, non-displaced +10		0.312

Standard errors clustered at the individual level. ***, **, and * correspond to significance at the 1%, 5%, and 10% levels respectively. Table reports the interaction between $Expansion_b$ and $(D_{ib} \times time_t)$ from equation 1 (δ_k coefficients) as well as base coefficients from $(D_{ib} \times time_t)$ (γ_k coefficients) for men. Outcome variable equal to 1 if an individual has completed vocational high school. Post-expansion cohorts are those from 1996 onward. Column (1) corresponds to impact of displacement on certification among pre-expansion cohorts while column (2) corresponds to the additional impact of displacement on certification among post-expansion cohorts relative to pre-expansion cohorts (both relative to their respective non-displaced counterparts). Displacement event occurs between +0 and +1. Sample of high-tenured workers defined as in Section 3.1.

Table C.5: Estimated Impact of Displacement on Higher Education Interacting with Post-Expansion Indicator, Men

	completed higher education	
	(1) Displacement Base Term	(2) × post-expansion
−3	0.0001	-0.0007
	(0.0012)	(0.0022)
−2	-0.0002	0.0000
	(0.0010)	(0.0018)
−1	0.0000	0.0000
	(.)	(.)
+0	0.0001	0.0006
	(0.0009)	(0.0017)
+1	0.0020	-0.0028
	(0.0016)	(0.0021)
+2	0.0075***	-0.0071**
	(0.0025)	(0.0033)
+3	0.0107***	-0.0121***
	(0.0030)	(0.0039)
+4	0.0128***	-0.0083
	(0.0034)	(0.0052)
+5	0.0125***	-0.0073
	(0.0035)	(0.0058)
+6	0.0126***	-0.0061
	(0.0037)	(0.0062)
+7	0.0128***	-0.0080
	(0.0038)	(0.0064)
+8	0.0130***	-0.0060
	(0.0041)	(0.0069)
+9	0.0148***	-0.0053
	(0.0043)	(0.0073)
+10	0.0147***	-0.0043
	(0.0044)	(0.0075)
N	1075041	1075041
avg. outcome, −1	0.005	0.005
avg. outcome, non-displaced +10		0.039

Standard errors clustered at the individual level. ***, **, and * correspond to significance at the 1%, 5%, and 10% levels respectively. Table reports the interaction between $Expansion_b$ and $(D_{ib} \times time_t)$ from equation 1 (δ_k coefficients) as well as base coefficients from $(D_{ib} \times time_t)$ (γ_k coefficients) for women. Outcome variable equal to 1 if an individual has completed higher education. Post-expansion cohorts are those from 1996 onward. Column (1) corresponds to impact of displacement on certification among pre-expansion cohorts while column (2) corresponds to the additional impact of displacement on certification among post-expansion cohorts relative to pre-expansion cohorts (both relative to their respective non-displaced counterparts). Displacement event occurs between +0 and +1. Sample of high-tenured workers defined as in Section 3.1.

Table C.6: Estimated Impact of Displacement on Income Interacting with Post-Expansion Indicator, Men

	arcsinh(income)	
	(1)	(2)
	Displacement Base Term	× post-expansion
−3	-0.0082	0.0140
	(0.0085)	(0.0145)
−2	0.0058	-0.0124
	(0.0071)	(0.0113)
−1	0.0000	0.0000
	(.)	(.)
+0	-0.0100	0.0068
	(0.0063)	(0.0098)
+1	-0.0697***	0.0553**
	(0.0124)	(0.0218)
+2	-0.1019***	0.0662**
	(0.0202)	(0.0338)
+3	-0.0772***	0.0613
	(0.0221)	(0.0401)
+4	-0.0576***	0.0620
	(0.0222)	(0.0380)
+5	-0.0347	0.0862**
	(0.0233)	(0.0377)
+6	-0.0170	0.0655*
	(0.0245)	(0.0387)
+7	-0.0145	0.0801**
	(0.0267)	(0.0397)
+8	0.0227	0.0357
	(0.0261)	(0.0436)
+9	0.0185	0.0386
	(0.0266)	(0.0436)
+10	0.0284	0.0229
	(0.0263)	(0.0461)
N	1075015	1075015
avg. outcome, −1	8.711	8.711
avg. outcome, non-displaced +10		8.797

Standard errors clustered at the individual level. ***, **, and * correspond to significance at the 1%, 5%, and 10% levels respectively. Table reports the interaction between $Expansion_b$ and $(D_{ib} \times time_t)$ from equation 1 (δ_k coefficients) as well as base coefficients from $(D_{ib} \times time_t)$ (γ_k coefficients) for men. Outcome variable log of income. Post-expansion cohorts are those from 1996 onward. Column (1) corresponds to impact of displacement on certification among pre-expansion cohorts while column (2) corresponds to the additional impact of displacement on certification among post-expansion cohorts relative to pre-expansion cohorts (both relative to their respective non-displaced counterparts). Displacement event occurs between +0 and +1. Sample of high-tenured workers defined as in Section 3.1.

D Robustness of Baseline Results—Assessing the Potential for Selection into Displacement

D.1 The Impact of Displacement on Certification, Pooling Pre-/Post-Expansion Cohorts

Figures D.1a and D.1b present estimates of the pre- and post-displacement γ_k coefficients from equation (1) for women and men respectively, excluding the interaction with the expansion of the PCS. While both displaced and non-displaced workers certify in the time prior to displacement, the estimated coefficients for γ_k when $k \leq 0$ are small in magnitude and not significantly different from zero. The lack of significant differences prior to displacement reveals that while future displaced and non-displaced workers do certify prior to displacement, they have similar trends in certification prior to displacement.

Immediately following displacement in +1, displaced workers certify their skills with a vocational degree at significantly higher rates. This is particularly true among men, who are slightly more than 2 percentage points more likely to certify soon after job loss (19% from base year average in Table A.1). Certification among women continues to increase over time, such that 5 years after displacement, displaced women are 1.5 percentage points more likely to certify (51%).

For both women and men, the estimated impact of displacement on certification fades out over time. Ten years after displacement, the impact of certification among displaced workers is smaller, and not significantly different from zero. Such decline over time is driven by increases in certification among non-displaced workers in the longer run. Irrespective of displacement status, young workers on the whole return to certify at high rates. Thus, displacement leads young workers to certify at younger ages, as though those displaced ultimately certify at similar rates compared to their non-displaced counterparts, they do so earlier in life.

Figure D.3 shows that there is no impact on enrollment in high school education. Indeed, displaced workers complete vocational high school without returning to the classroom, pointing to the importance of certification rather than returning to the classroom.

In addition, there is no impact of displacement on the completion of academic high school (Figure D.4), suggesting young displaced workers certify rather than return to full-time education.

Figures D.2a and D.2b plot the estimated impact of displacement on the completion of higher education. Certification may lead to the completion of additional higher education and the opportunity to invest in even further skills. Higher education increases among both women and men and certification matters not only for immediate employment opportunities but also for further opportunities in the education system. In contrast to the estimated impact of displacement on certification, the impact of displacement on higher education does not fade out over time. As such, the age of certification matters considerably for the probability of continuing into higher education: while non-displaced workers eventually do certify over time, they do not continue into higher education. Similar patterns are seen in Bennett et al. (2020), where women who return to high school at younger ages also complete higher education at significantly higher rates than those who return at older ages.

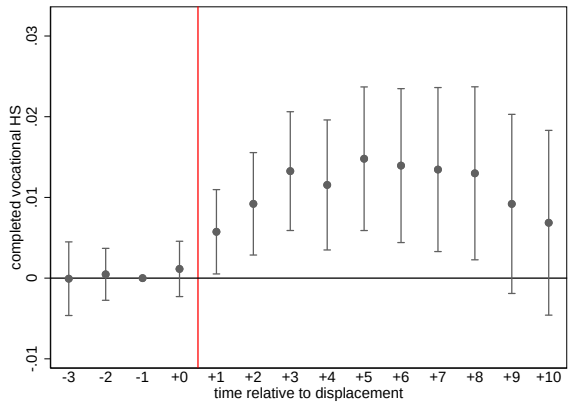
As longer time is needed to invest in the completion of higher education, the impact of displacement on higher education increases a few years after job loss. This is particularly true for women. In the long-run, women and men are roughly 1.5 percentage points more likely to have finished higher education. The impact of displacement on higher education is sizable in magnitude, as less than 1% of the sample completes higher education prior to displacement. While they complete higher education at similar rates, displaced women and men complete higher education in very different fields. While women complete degrees in science subjects (a half-year course), nursing, and teacher training, men complete higher education in mechanical engineering, social education, and electrical engineering.

D.2 The Impact of Displacement on Other Measures of Education

D.2.1 Enrollment in Vocational High School

Figure D.1: The Estimated Impact of Job Displacement on Certification

(a) Female



(b) Male

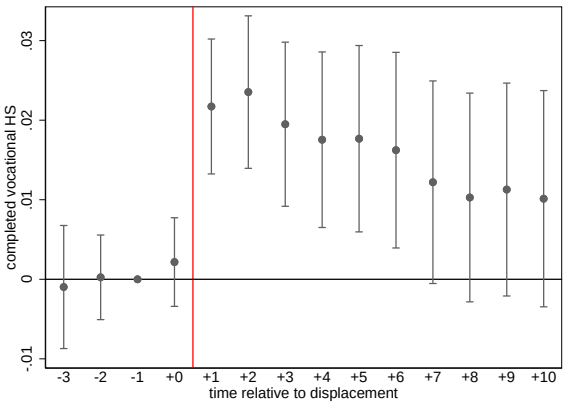
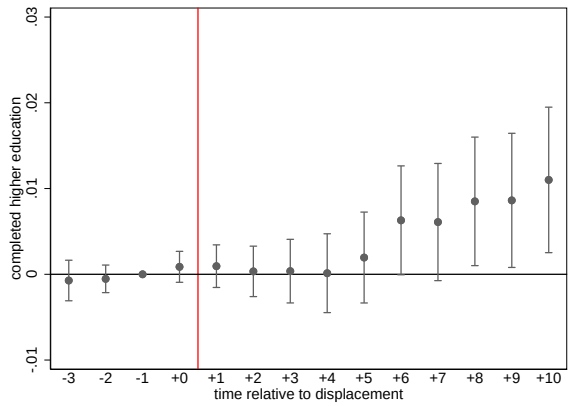


Figure plots the estimated impact of displacement separately for women (panel a) and men (panel b), with the outcome variable equal to 1 if an individual has completed vocational high school. Displacement event occurs between +0 and +1. 95% confidence interval reported. Average completion of vocational high school among sample in base year (both displaced and non-displaced): 2.9% for women and 11.5% for men. Long-run average completion of vocational high school among non-displaced workers in +10: 13.6% for women and 31.2% for men. Sample of high-tenured workers defined as in Section 3.1. γ_{-1} set to zero by convention. Estimating equation: $HS_{it} = \alpha + \sum_{k=-3}^{+10} \gamma_k \cdot (D_i \times time_t)^k + \theta \cdot D_i + municipality^{t=0} \times time_{m(i),t} + \pi_b + \varepsilon_{it}$.

Figure D.2: The Estimated Impact of Displacement on Higher Education

(a) Female



(b) Male

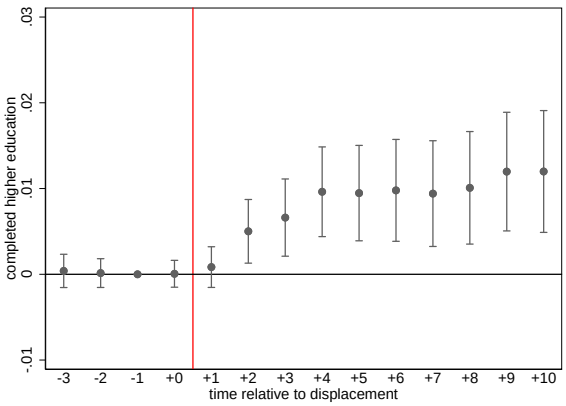


Figure plots the estimated impact of displacement separately for women (panel a) and men (panel b), with the outcome variable equal to 1 if an individual has completed higher education. Displacement event occurs between +0 and +1. 95% confidence interval reported. Average completion of higher education among sample in base year (both displaced and non-displaced): 0.6% for women and 0.6% for men. Long-run average completion of vocational high school among non-displaced workers in +10: 5.2% for women and 4.3% for men. Sample of high-tenured workers defined as in Section 3.1. γ_{-1} set to zero by convention. Estimating equation: $Higher_{it} = \alpha + \sum_{k=-3}^{+10} \gamma_k \cdot (D_i \times time_t)^k + \theta \cdot D_i + municipality^{t=0} \times time_{m(i),t} + \pi_b + \varepsilon_{it}$.

Figure D.3: The estimated impact of job displacement on enrollment in vocational high school

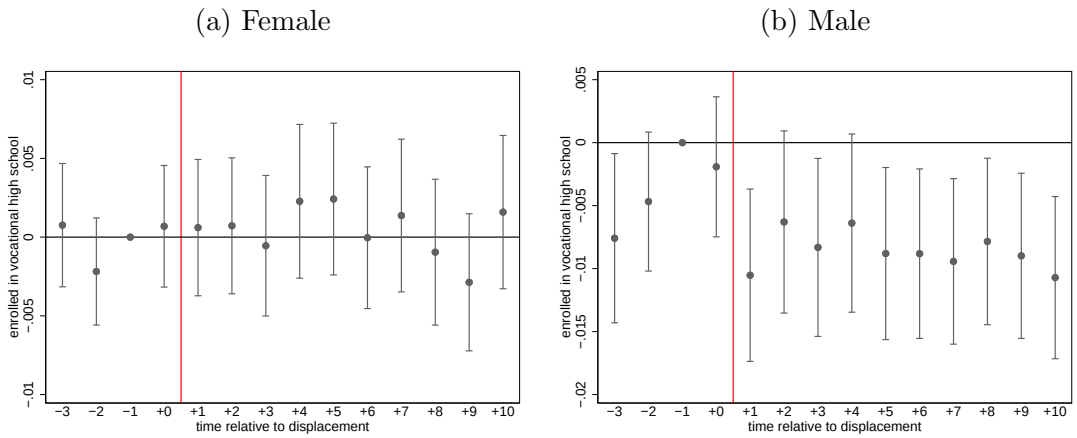


Figure plots the estimated impact of displacement separately for women (panel a) and men (panel b), with the outcome variable equal to 1 if an individual is enrolled in vocational high school. Displacement event occurs between +0 and +1. 95% confidence interval reported. Sample of high-tenured workers defined as in Section 3.1. γ_{-1} set to zero by convention. Estimating equation: $enrolled_{it} = \alpha + \sum_{k=-3}^{+10} \gamma_k \cdot (D_i \times time_t)^k + \theta \cdot D_i + municipality^{t=0} \times time_{m(i),t} + \pi_b + \varepsilon_{it}$.

D.2.2 Completion of Academic High School

Figure D.4: The estimated impact of job displacement on completion of academic high school

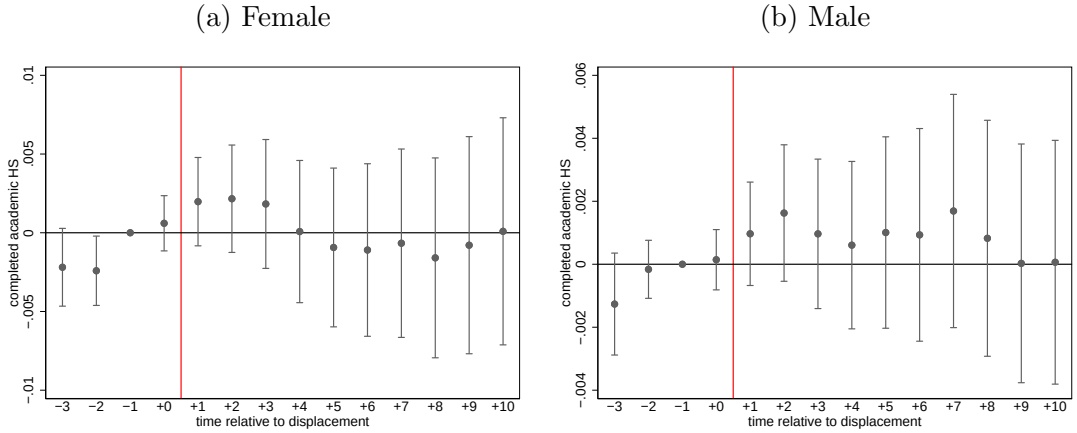


Figure plots the estimated impact of displacement separately for women (panel a) and men (panel b), with the outcome variable equal to 1 if an individual has ever completed academic high school. Displacement event occurs between +0 and +1. 95% confidence interval reported. Sample of high-tenured workers defined as in Section 3.1. γ_{-1} set to zero by convention. Estimating equation: $AcademicHS_{it} = \alpha + \sum_{k=-3}^{+10} \gamma_k \cdot (D_i \times time_t)^k + \theta \cdot D_i + municipality^{t=0} \times time_{m(i),t} + \pi_b + \varepsilon_{it}$.

D.3 Selection into worker retention

First, there may be selection into whom plants layoff. In particular, plants may layoff their least capable workers while retaining their more productive workers. To address whether selection into layoff is of concern among the young displaced worker sample, Figure D.5a compares the ability of workers who are displaced during a mass-layoff event to those displaced during a plant closing event. While there may be considerable choice in who to retain during a mass-layoff event, this is clearly not the case during plant closings as all workers are impacted. As such, if selection into whom to layoff were very problematic for the results, those displaced during mass-layoff events should be negatively selected on ability relative to those displaced during a plant closing. Note that selection of this nature would likely *overstate* earnings losses attributed to displacement.

Figure D.5a plots the distribution of cognitive ability for displaced men separately for whether they were displaced during a plant closing or mass-layoff event. Workers displaced during a plant closing are slightly more likely to have a median IQ of 5, and slightly less likely to have an IQ of 4, just below the median. While those displaced in

a plant closing do have a slightly higher IQ, such differences are small: 36.5% of those displaced in a plant closing have a median IQ or higher, 35.7% of the mass-layoff displaced have a median IQ or above. As such differences are not statistically significant ($p = 0.64$), the relative similarity of cognitive ability between displaced men across different types of displacement suggests that selection into who is laid off is not of concern.

Figure D.5: Distribution of IQ by Displaced in Mass-layoff/Plant Closing

(a)

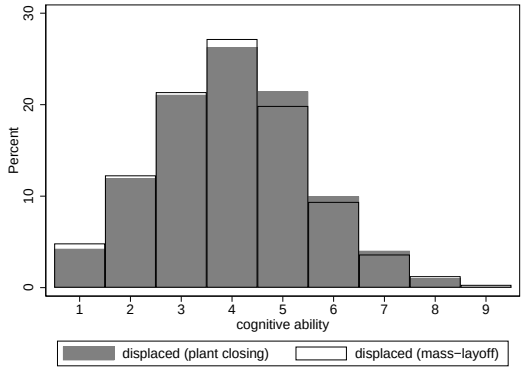


Figure compares the cognitive ability of men, measured by IQ scores at age 18, of displaced workers comparing those displaced in a plant closing event to those displaced in a mass-layoff event. Plant closings are defined as plants whose employment declines by 95% or more from b to $b+1$, excluding false closings where 80% of the workers move to the same plant in $b+1$.

D.4 Selection of young workers into plants

Second, as discussed in Von Wachter and Bender (2006), there may be selection of young workers into different plants. Indeed, some of the workers employed in the sample will still be employed in their first job after entering the labor market. If lower ability workers self-select into plants (or industries) with higher levels of turnover, and plants with higher turnover are more prone to mass-layoff events, then displaced workers will be negatively selected on ability relative to non-displaced workers. To examine the potential importance of selection into the composition of displaced workers relative to non-displaced workers, Figure D.6a plots the distribution of cognitive ability comparing displaced men (of any reason) to non-displaced men.

While lower ability men may select into plants with higher turnover, Figure D.6a

reveals that, if anything, displaced workers have slightly *higher* levels of cognitive ability relative to their non-displaced counterparts. Differences are more pronounced in the bottom of the IQ distribution, where a lower fraction of displaced workers have IQ scores of 3 or below. Indeed, while 36% of displaced workers have a median or higher IQ, only 33.1% of non-displaced workers do, and differences are significant at the 1% level ($p = 0.0005$). Relative to their non-displaced counterparts, displaced workers have slightly higher levels of IQ and are not negatively selected in terms of ability. Results in Figure D.7 confirm that the main results are robust to accounting for the small differences in the composition of cognitive ability between displaced and non-displaced workers. As such, the displacement methodology isolates displaced and non-displaced workers with similar observable characteristics and ability levels.

Figure D.6: Distribution of IQ by Displaced/Non-Displaced

(a)

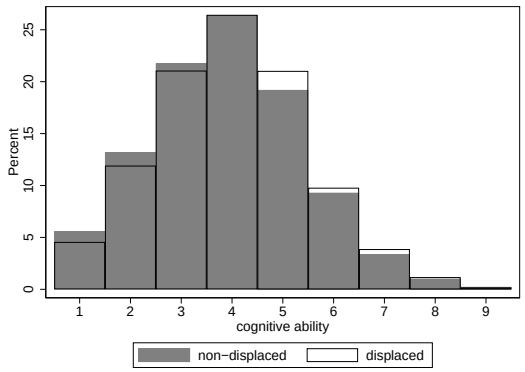


Figure compares the cognitive ability of men, measured by IQ scores at age 18, of displaced and non-displaced workers as defined in Section 3.2.

D.4.1 Weighting Baseline Results by IQ

However, given the slightly higher levels of cognitive ability among displaced workers, increase in education and rapid recovery of earnings may be due to slightly higher cognitive ability among displaced workers. Figure D.7 designs a robustness check to examine how the results are impacted by such IQ differences. Results replicate the main results accounting for differences in cognitive ability between displaced and non-displaced workers. Using data on IQ to estimate the probability of being displaced in the future, the results weight the regression by the inverse propensity score measured prior to displacement. Such a procedure accounts for pre-treatment differences in observable factors (Abadie, 2005; Blundell and Dias, 2009). The average cognitive ability of non-displaced workers is lower than that of displaced workers. Intuitively, weighting by the inverse propensity score weights up non-displaced workers with higher IQ, those with more similar IQ levels to future displaced workers, and weights down non-displaced workers with lower levels of IQ, those with less similarity to future displaced workers. Results display the same patterns and the estimated post-displacement coefficients have similar magnitude, suggesting that pre-displacement differences in cognitive ability do not impact the post-displacement dynamics of outcome variables.

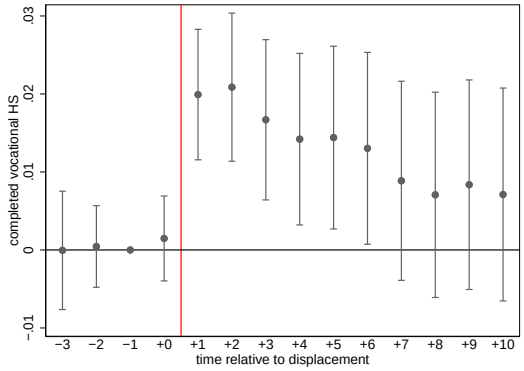
Figure D.7 estimated the regression equation (1), weighting by the inverse propensity score as in Mastrobuoni and Pinotti (2015):

$$displaced\frac{p}{P\left(X_i\right)}+\left(1-displaced\right)\frac{1-p}{1-P\left(X_i\right)}. \tag{2}$$

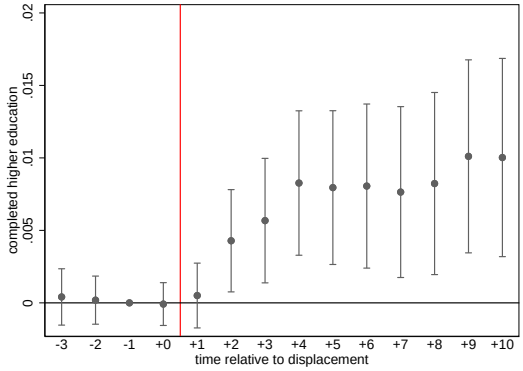
p corresponds to the unconditional probability of displacement and $P\left(X_i\right)$ corresponds to the estimated propensity score (probability of displacement conditioning on IQ scores).

Figure D.7: The Estimated Impacts of Job Displacement, re-weighting on IQ

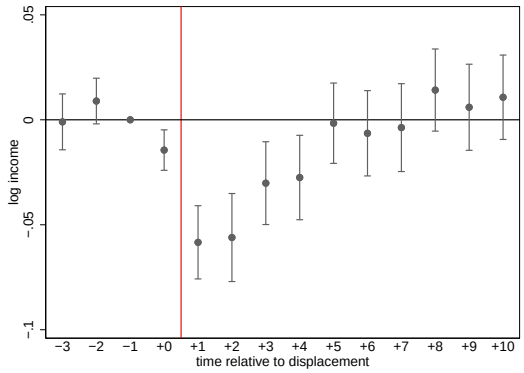
(a) Male—Certification



(b) Male—Higher Education



(c) Male—Income



(d) Male—Full-time Employment

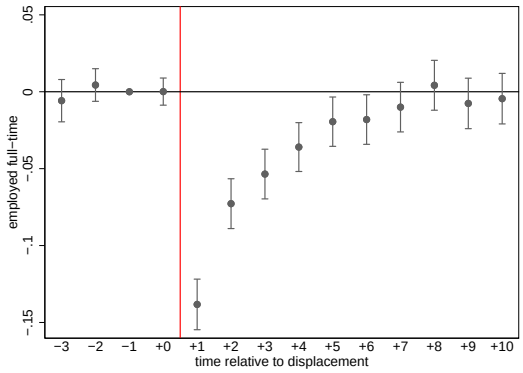


Figure plots the estimated impact of displacement, weighting by the inverse propensity score of equation (2), for one of four outcome variables for men. Outcome variable is certification in panel (a), the completion of higher education in panel (b), log income in panel (c), and full-time employment (30+ hours/week) in panel (d). Displacement event occurs between +0 and +1. 95% confidence interval reported. Sample of high-tenured workers defined as in Section 3.1. γ_{-1} set to zero by convention. Estimating equation: $Y_{it} = \alpha + \sum_{k=-3}^{+10} \gamma_k \cdot (D_i \times time_t)^k + \theta \cdot D_i + municipality^{t=0} \times time_{m(i),t} + \pi_b + \varepsilon_{it}$.

E Robustness of Baseline Results—Choice of Counterfactual, Definition of Displacement, and Sample Selection

E.1 Different Counterfactual Groups of Non-Displaced Workers

E.1.1 The Estimated Impacts of Job Displacement, declining plants between b and $b+1$ counterfactual

Counterfactual group is those workers who are non-displaced, but in plants which decline in employment between b and $b+1$. Those whose plants are increasing in employment size are thus excluded.

Figure E.1: The Estimated Impact of Job Displacement on Certification, Counterfactual in Declining Plants

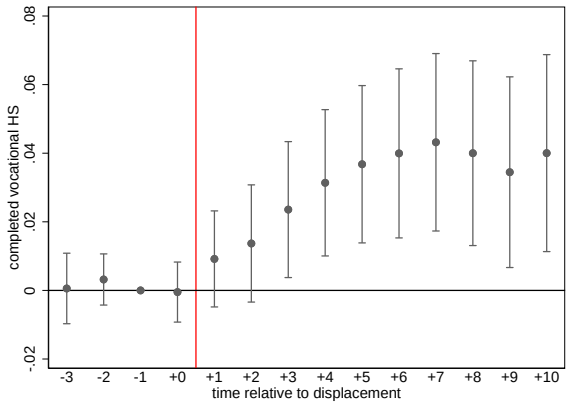


Figure plots the interaction between $Expansion_b$ and $D_{it}^{k \text{ years after displacement}}$ from equation 1 for women, with the outcome variable equal to 1 if an individual has completed vocational high school. Sample restricts the counterfactual to those non-displaced workers employed in plants whose employment declines between b and $b+1$. Post-expansion cohorts are those from 1996 onward. Coefficients interpreted at the difference between displaced workers post-expansion and displaced workers pre-expansion (both relative to their respective non-displaced counterparts). δ_{-1} set to zero by convention. Displacement event occurs between +0 and +1. 95% confidence interval reported. Sample of high-tenured workers defined as in Section 3.1.

E.1.2 The Estimated Impacts of Job Displacement, Excluding Those in Counterfactual who are Unemployed

Figure E.2: Triple Difference Results, Sample of Women Excluding Those Unemployed in Counterfactual Group

(a) Estimated Difference in Certification Post-Expansion

(b) Estimated Difference in Income Post-Expansion

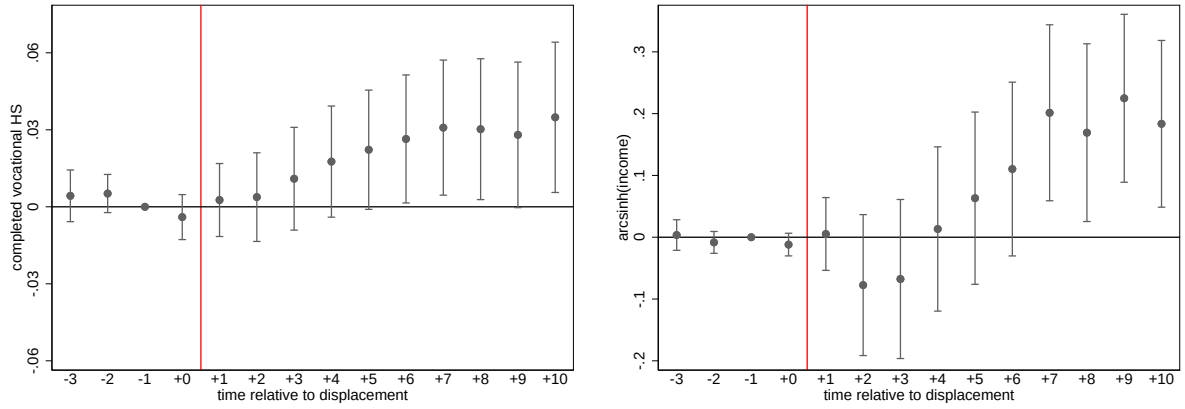


Figure plots the interaction between $Expansion_b$ and $D_{it}^{k \text{ years after displacement}}$ from equation 1 for women, with the outcome variable equal to 1 if an individual has completed vocational high school (panel a) and inverse hyperbolic sine transformed income (panel b). Sample excludes those non-displaced workers who are unemployed at any point from +1 to +10. Post-expansion cohorts are those from 1996 onward. Coefficients interpreted at the difference between displaced workers post-expansion and displaced workers pre-expansion (both relative to their respective non-displaced counterparts). δ_{-1} set to zero by convention. Displacement event occurs between +0 and +1. 95% confidence interval reported. Sample of high-tenured workers defined as in Section 3.1.

E.2 The Estimated Impacts of Job Displacement, 50+ employees in year b

Restricts sample to 50+ employees. While a restriction of 10+ employees in year b corresponds to the 70$^{\text{th}}$ percentile of plant size distribution in 1990 (excluding those self-employed), a restriction of 50+ employees corresponds to 94$^{\text{th}}$ percentile of employer size distribution, as plants in Norway are, on average, smaller than in the US. 133,457 high-tenured workers are in sample of 10+ employees (both men and women), while only 77,791 high-tenured workers are in the sample of 50+ employees.

Figure E.3: The Estimated Impact of Job Displacement on Certification

(a) Female

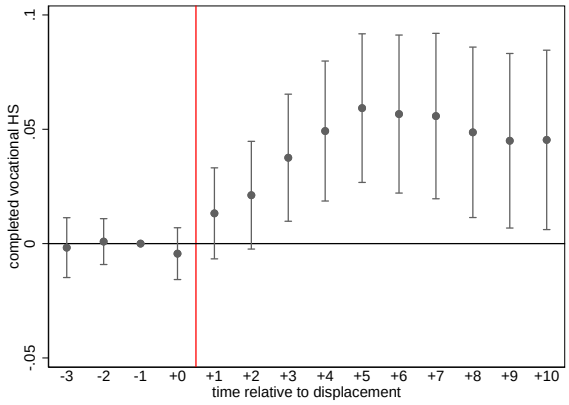


Figure plots the interaction between $Expansion_b$ and $D_{it}^{k \text{ years after displacement}}$ from equation 1 for women, with the outcome variable equal to 1 if an individual has completed vocational high school. Sample restricted to those workers employed in plants with at least 50 employees in b. Post-expansion cohorts are those from 1996 onward. Coefficients interpreted at the difference between displaced workers post-expansion and displaced workers pre-expansion (both relative to their respective non-displaced counterparts). δ_{-1} set to zero by convention. Displacement event occurs between +0 and +1. 95% confidence interval reported. Sample of high-tenured workers defined as in Section 3.1.

E.3 The Impact of Job Displacement on Certification, Comparing Older and Younger Workers

Figure E.4: The Estimated Impact of Job Displacement on Certification

(a) Female, baseline ages 21–27

(b) Female, ages 21–30

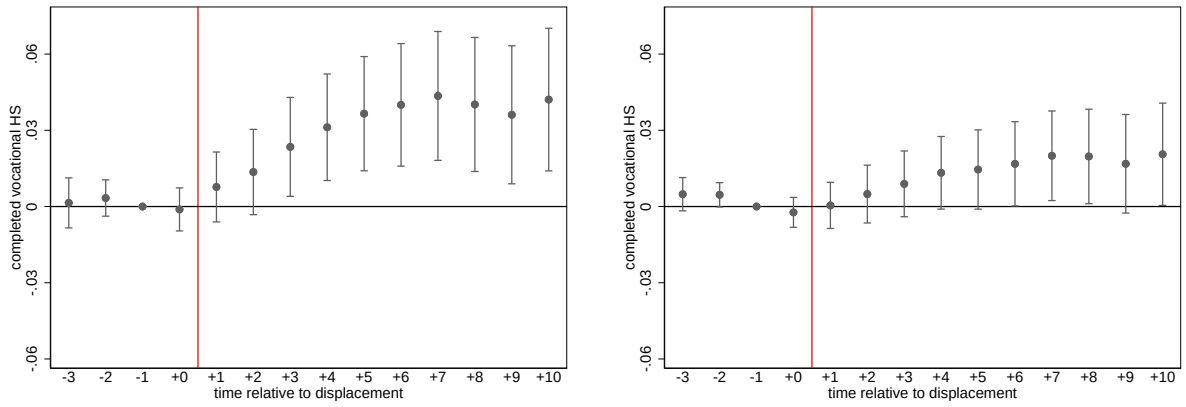
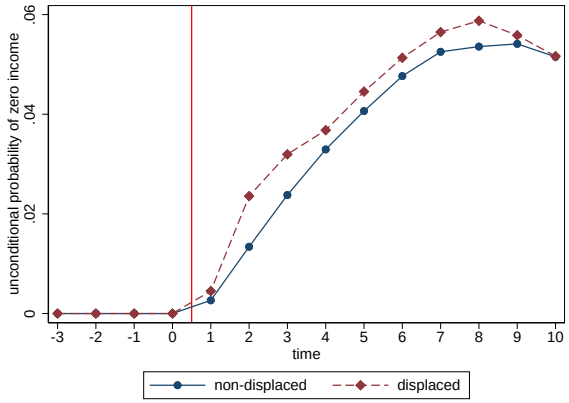


Figure plots the interaction between $Expansion_b$ and $D_{it}^{k \text{ years after displacement}}$ from equation 1 for women, with the outcome variable equal to 1 if an individual has completed vocational high school. Sample of panel (a): those aged 21–27 in b. Sample of panel (b): those aged 21–30 in b. Post-expansion cohorts are those from 1996 onward. Coefficients interpreted at the difference between displaced workers post-expansion and displaced workers pre-expansion (both relative to their respective non-displaced counterparts). δ_{-1} set to zero by convention. Displacement event occurs between +0 and +1. 95% confidence interval reported. Sample of high-tenured workers defined as in Section 3.1.

F Probability of Zero Income Post-Displacement

Figure F.5: The probability of zero income post-displacement

(a) Female



(b) Male

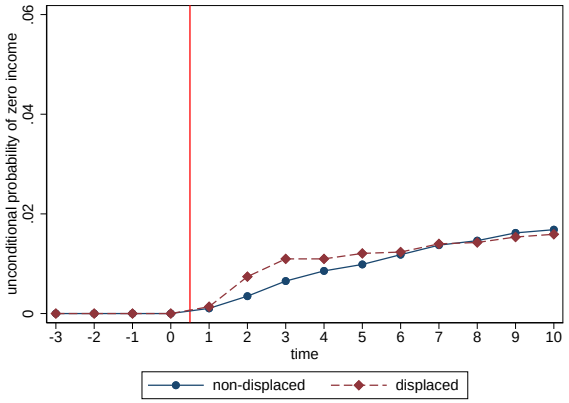


Figure plots the unconditional probability of having zero income for displaced and non-displaced workers separately for women (panel a) and men (panel b).

G Does Employment Differ Between Displaced Pre-/Post-Expansion?

Figure G.1: Post-displacement Employment Pre- and Post-Expansion of the PCS

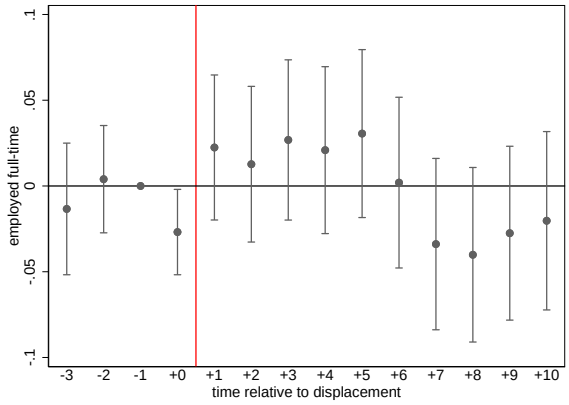


Figure plots the interaction between $Expansion_b$ and $D_{it}^{k \text{ years after displacement}}$ from equation 1 for women, with the outcome variable full-time employment. Post-expansion cohorts are those from 1996 onward. Coefficients interpreted at the difference between displaced workers post-expansion and displaced workers pre-expansion (both relative to their respective non-displaced counterparts). δ_{-1} set to zero by convention. Displacement event occurs between +0 and +1. 95% confidence interval reported. Sample of high-tenured workers defined as in Section 3.1.

H Long-Run Differences in Occupational Choices for Men

Figure H.1: Long-run Differences in Occupational Choices Between Early Career Displaced and Non-Displaced Workers, Pre- and Post-Expansion

(a) Occupational Shares, Levels

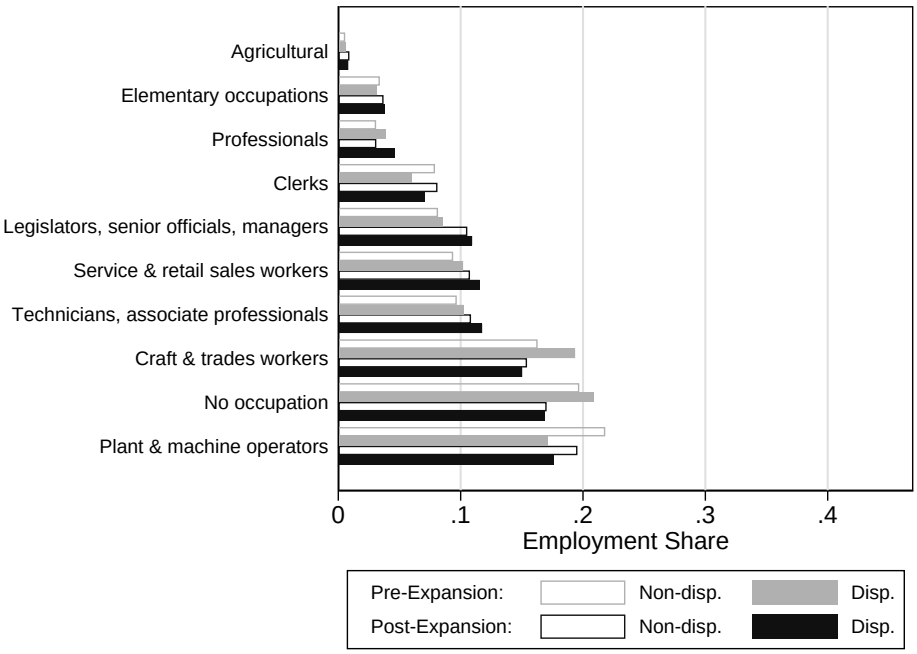


Figure plots the occupational shares of displaced and non-displaced men pre- and post-expansion (panel a) and the difference between displaced and non-displaced men pre- and post-expansion (panel b). Occupations are measured annually from 2008 (for 1990 cohort) until 2017 (for 1999 cohort), when sample of early career workers are aged 39–45. Occupations are classified according to the Norwegian standard classification of occupations as discussed in Appendix I. Sample of high-tenured workers defined as in Section 3.1.

I Linking Occupations to Tasks

I.1 Norwegian Occupation Data

Occupations are classified in the Norwegian Register data according to the Norwegian Standard Classification of Occupations, developed in 1998 (STYRK-1998). The basis of the classification system is the European International Standard Classification of Occupations 1988 (ISCO-88) system. At the 3 digit level, the Norwegian standard is virtually identical to the ISCO-88, and only differs in minor aspects at the most detailed (4 digit) level to accommodate differences in the Norwegian structure of work. An occupation is defined as a group of jobs which are bound by very similar tasks and responsibilities. There exist 356 unique occupations at the 4 digit level. In 2017, 100% of workers who are employed at least 1 hour have an occupation reported in the data.

I.2 Linking Norwegian Occupation Data to US Standard Occupational Classification

To match Norwegian occupations to tasks using O*NET data on the task intensity of occupations in the US, I develop a linkage between the Norwegian occupation standard and the US Standard Occupational Classification (SOC), 2000 version. The mapping proceeds as follows. First, 4 digit occupations in the Norwegian standard are matched manually to the closest 6 digit occupation in the SOC.[17] Direct matches where 1 Norwegian occupation matches to 1 US occupation represent 60.3%. This is due to the fact that the US system is much more detailed than the Norwegian system: while there are 356 unique occupations in the Norwegian standard, there exist 821 unique occupations in the US standard.

Second, all occupations which do not have one-to-one matches are matched to multiple occupations in the US standard. For instance, while "Historians, archaeologists and philosophers" are grouped into one occupation in the Norwegian standard, "Historians" and "Anthropologists and Archeologists" are two separate occupations in the US stan-

[17] Matches are created based on the description of tasks in both standards, as well as relevant occupation titles.

dard. One-to-two matches represent 24.7% of occupations in the Norwegian standard. One-to-three matches represent another 6.6%. For instance, while "Butchers, fishmongers and related food preparers" is one Norwegian occupation, "Butchers and Meat Cutters", "Meat, Poultry, and Fish Cutters and Trimmers", and "Slaughterers and Meat Packers" are 3 separate occupations. One-to-four matches represent another 3.7% and occupations which match to more than 4 occupations in the US standard are the remaining 4.6% of occupations.

In practice, when one Norwegian occupation maps to multiple occupations in the US SOC, these occupations often fall within the same group in the SOC standard. 37.2% of one-to-two matches are within the same 5 digit level (broad occupation) and 60.4% are within the same 3 digit level (minor group). 52.2% of one-to-three are within same broad occupation and 65.2% fall within the same occupation minor group.

I.3 Linking Norwegian Occupation Data to O*NET Task Measures

O*NET data used is version 3.0 from year 2000. Tasks are extracted at the 6 digit US SOC level following Deming (2017), whose four main task measures are math, routine, social, and service tasks.[18] Deming (2017) shows these measures closely resemble other measures used in the literature. For occupations in the Norwegian standard which map to multiple occupations in the US standard, the average of the US occupations is taken and assigned to the unique Norwegian occupation.

Tasks are standardized to run from 0–10, where 10 is the occupation with the highest task intensity and 0 is the occupation with the lowest task intensity. The three occupations in the Norwegian system with the highest routine intensity are Sewing-machine operators, Stenographers and typists, and Shoemaking- and related machine operators. For math intensity, the three highest ranked occupations are Mathematicians and related professionals, Physicists and astronomers, and Chemical engineers. For service intensity, the three highest ranked occupations are Religious professionals, Registered Nurses for the Mentally Subnormal, and Nursing and midwifery professionals. For social inten-

[18]See Online Appendix in Deming (2017) for details of the survey measures in the O*NET data which represent the data used to create the tasks

sity, the highest ranked occupations are Senior government officials, Directors and chief executives, and Lawyers.

I.4 Task Usage Results Focusing Exclusively on 1 to 1 Matches

Table I.1: Task Usage in 2017 Among Young Displaced Workers Post-expansion and Pre-expansion, 1 to 1 Matches Between Norwegian and US

	Female			
	(1) Routine	(2) Social	(3) Service	(4) Math
Displaced	-0.0889	0.2200***	0.1032	0.1921**
	(0.0851)	(0.0719)	(0.1021)	(0.0776)
Displaced × post-expansion	-0.2209*	-0.1421	0.3477**	-0.3469***
	(0.1330)	(0.1092)	(0.1548)	(0.1164)
Individuals	22039	22039	22039	22039
Avg. Non-Displaced	3.12	4.17	5.97	2.93
	Male			
Displaced	-0.4149***	0.1344	0.2127**	0.0955
	(0.0711)	(0.0994)	(0.0862)	(0.0744)
Displaced × post-expansion	-0.0394	0.1465	0.2371	-0.0991
	(0.1276)	(0.1797)	(0.1589)	(0.1327)
Individuals	21978	21978	21978	21978
Avg. Non-Displaced	4.80	3.71	2.97	3.97

Standard errors clustered at the individual level. ***, **, and * correspond to significance at the 1%, 5%, and 10% levels respectively. Table reports results from cross-sectional regression of one of four task measures (math, routine, social, and service) on displacement dummy. Tasks defined as in Deming (2017). Occupations are measured in 2017, when sample of young workers are aged 39–54. Sample of workers who are employed in 2017 and whose occupation is mapped to task intensity measures, see Appendix I for a discussion of the linkage between occupations and tasks. Sample restricted to 1 to 1 matches between the Norwegian and US occupation classification systems. Estimating equation: $task_{o(i)} = constant + \beta_1 \cdot D_i + \beta_2 \cdot D_i \times Expansion_b + \pi_b + \varepsilon_i$, where $D_i = 1$ if a worker was displaced from 21–27.

I.5 Incorporating Those with No Occupations: A Binary Measure of Task Specialization

Table I.2: Task Usage in 2017 Among Young Displaced Workers Post-expansion and Pre-expansion

	Female			
	(1) High Routine	(2) High Social	(3) High Service	(4) High Math
Displaced	-0.0085	0.0086	0.0018	0.0116
	(0.0082)	(0.0083)	(0.0099)	(0.0074)
Displaced × post-expansion	-0.0083	-0.0048	0.0700***	-0.0228*
	(0.0135)	(0.0150)	(0.0191)	(0.0124)
Individuals	56666	56666	56666	56666
Avg. Non-Displaced	0.15	0.15	0.27	0.11
	Male			
Displaced	-0.0331***	0.0165**	0.0085	0.0096
	(0.0092)	(0.0075)	(0.0056)	(0.0073)
Displaced × post-expansion	0.0055	-0.0077	0.0233*	-0.0102
	(0.0178)	(0.0147)	(0.0123)	(0.0142)
Individuals	76791	76791	76791	76791
Avg. Non-Displaced	0.33	0.16	0.08	0.15

Standard errors clustered at the individual level. ***, **, and * correspond to significance at the 1%, 5%, and 10% levels respectively. Table reports results from cross-sectional regression of one of four task measures (math, routine, social, and service) on displacement dummy. Tasks defined as in Deming (2017). Tasks measured as "high", which is equal to 1 if a worker is employed in an occupation whose task is above the occupation with the median task specialization. Those not employed in an occupation are assigned 0 for task measures. Occupations are measured annually from 2008 (for 1990 cohort) until 2017 (for 1999 cohort), when sample of early career workers are aged 39–45. Sample of workers who are employed in 2017 and whose occupation is mapped to task intensity measures, see Appendix I for a discussion of the linkage between occupations and tasks. Estimating equation: $task_{o(i)} = constant + \beta_1 \cdot D_i + \beta_2 \cdot D_i \times Expansion_b + \pi_b + \varepsilon_i$, where $D_i = 1$ if a worker was displaced from 21–27.

J Does task composition predict future mass-layoff/ closing event?

Table J.1: Do Tasks Measured in 2016 Predict Future Mass-Layoff or Closing Event in 2017?

	(1) Mass-layoff or plant closure
Average routine tasks	0.0040***
	(0.0006)
Average social tasks	-0.0016**
	(0.0007)
Average service tasks	-0.0038***
	(0.0005)
Average math tasks	-0.0127***
	(0.0008)
Number of plants	181170
average outcome, -1	0.121

Standard errors clustered at the individual level. ***, **, and * correspond to significance at the 1%, 5%, and 10% levels respectively. Table reports results from cross-sectional regression, at the plant-level, of a variable equal to 1 if a plant has a mass-layoff or plant closing event in 2017 on average task composition of workforce in 2016. Data on all workers are linked to tasks and collapsed to the plant-level. Mass-layoff and plant closing event defined as in Section 3.2. Estimating equation: $layoff_{p,2017} = constant + \beta_1 \cdot routine_{p,2016} + \beta_2 \cdot social_{p,2016} + \beta_3 \cdot service_{p,2016} + \beta_4 \cdot math_{p,2016} + \varepsilon_p$.

K Why Might Displaced Workers Return to Education?

A student deciding between stopping education at a lower level and entering the labor market or completing additional education at a higher level will weigh the present value of earnings with the lower level of education and the present value of earnings with the higher level of education. However, this decision is complicated by many factors. The school stopping decision is an inherently complex decision, and individuals who found it optimal to stop education in favor of joining the labor force might find it optimal to re-enroll in education later in life for many reasons.

First, a student enrolled in high school might lack information about the true returns to education when deciding to continue with further education. That is, the true returns to education may differ from the perceived returns to education. Over time, individuals may update their expectations about the labor market returns to a given level of education. Manski (1993) emphasizes the joint importance of preferences, expectations, and opportunities for students making the optimal schooling decision. Given the high degree of uncertainty surrounding such a decision, the potential for mis-specified decisions is high. Consistent with this, Bridgeland et al. (2006) report that among young disadvantaged high school drop outs in the United States, 74% of students who dropped out of high school reported they would have stayed in school if they could make the decision again.

Existing evidence suggests that student beliefs are important in explaining decisions. Stinebrickner and Stinebrickner (2014) document that beliefs explain a substantial amount of education decisions in university. Wiswall and Zafar (2014) find that such beliefs about the returns to specific fields of study in university education are biased. In particular, students both over- and under-state the true labor market returns to specific fields of study. Boneva and Rauh (2017) conclude that socio-economic status is an important factor in the gap between perceived and actual benefits to university education. Jensen (2010) show that middle school students in the Dominican Republic substantially understate the returns from additional schooling and that randomly providing informa-

tion on the returns to education not only increase perceived returns months later but also lead to an increase in schooling.

Second, students place less weight on the future due to less-developed cognitive brain functions during adolescence. As such, individual preferences may change over time. Lavecchia et al. (2016) emphasize that preferences change with age due to the development of brain functions and that lifetime investments such as education occur in a time period when the brain of students overemphasize the present. As such, what is optimal for young individuals in their teenage years might not be optimal if the same person were to make the same decision later in life. In line with this, Oreopoulos (2007) suggests that the presence of substantial drop out rates from high school despite the large lifetime benefits is consistent with overweighing the immediate costs of schooling. Carrillo (2020) find evidence consistent with students' overemphasizing the present and that temporary booms in coffee prices in Colombia lead students to leave school at the expense of future earnings gains had they remained in education.

Lastly, students may return to education due to a change in opportunities or personal situations. For instance, students may drop out of high school due to becoming a parent, caring for a family member, or needing to provide for their family. Incomplete access to resources to fund further education might also lead to students dropping out of education even if they would have liked to continue in the education system.

Following Becker (1975), equation (3) formulates the a standard school restarting decision in a formal way as someone at age a_0 maximizing lifetime earnings:

$$\underbrace{\sum_{a=a^0+1}^{A} \frac{Y(a)_{s \text{ years}} - Y(a)_{s-1 \text{ years}}}{(1+r)^a}}_{\text{return to high school}} = \underbrace{Y(a^0)_{s-1 \text{ years}}}_{\text{opportunity cost}} + \underbrace{C(a^0)}_{\text{psychic cost}}, \tag{3}$$

where A represents retirement age, s years of schooling, Y earnings, and C the psychic cost of schooling. For simplicity, focus on the decision to re-enroll in high school for someone who dropped out of high school one year away from completing high school. At each age a_0 after dropping out of high school, an individual faces a choice of whether to restart their education. Their restarting decision weighs the return to completing

high school—the earnings potential of graduating from high school compared to their earnings remaining a high school dropout over their remaining working years—with the costs of returning to high school—foregone earnings through a reduction in time spent in employment and any psychic cost of returning to schooling.

Immediately following job displacement, displaced workers have a substantially lower opportunity cost of returning to school, as they find themselves laid off and searching for a new job. Thus, job displacement would lead those at the margin of returning to education to do so, even if the return to high school and psychic costs of returning to schooling were unchanged. However, the shock of job displacement may also lead workers to change their expectations of the lifetime return to being a high school dropout. Such a negative shock is likely to lead some workers to believe the difference in lifetime income between being a dropout and graduating high school is larger than they previously thought. Such a change will also lead those at the margin to return to education. At the same time, displacement might directly impact individual preferences, for instance how much an individual discounts the future. There exists little evidence on how displacement directly impacts worker preferences.

L The Importance of Other Factors for Certification

L.1 The Importance of cognitive ability

Table L.1 presents the combined impact of displacement on certification and higher education (columns 1 and 3 respectively) and the estimated interaction between the displacement indicators and IQ (columns 2 and 4 respectively) among both pre- and post-expansion cohorts. IQ scores are demeaned, such that the estimated impact of displacement on certification and higher education in columns 1 and 3 corresponds to the impact of displacement on education for a worker with the average level of IQ in the sample.

Immediately after displacement, displaced workers with average levels of IQ certify their vocational skills at significantly higher rates than non-displaced workers. Those displaced with higher levels of IQ are even more likely to certify after job loss, as the interaction between displacement and IQ is positive and statistically significant. In the first few years after job loss, a displaced worker with a one point higher IQ (a 0.5 standard deviation change in IQ) is 0.8–1 percentage points more likely to certify. As the impact of displacement on certification fades out due to non-displaced workers also eventually certifying, so too does the additional impact on certification among those with higher levels of IQ.

Similar patterns are seen for the completion of higher education after displacement. However, IQ matters less for the completion of higher education in the longer run as while the completion of higher education remains significant 10 years after displacement, the estimated interaction term becomes insignificant.

Table L.1: Does IQ Matter for Certification and Returning to Higher Education?

	Vocational HS		Higher Education	
	(1) Base Disp. Term	(2) × IQ	(3) Base Disp. Term	(4) × IQ
-3	-0.0012	0.0007	0.0007	-0.0005
	(0.0041)	(0.0027)	(0.0010)	(0.0012)
-2	0.0005	0.0008	0.0004	-0.0005
	(0.0028)	(0.0019)	(0.0008)	(0.0010)
−1	ref.	ref.	ref.	ref.
+0	0.0018	0.0028	0.0001	0.0002
	(0.0030)	(0.0020)	(0.0008)	(0.0007)
+1	0.0223***	0.0078***	0.0007	0.0008
	(0.0046)	(0.0030)	(0.0012)	(0.0010)
+2	0.0229***	0.0097***	0.0034*	0.0032**
	(0.0051)	(0.0034)	(0.0018)	(0.0016)
+3	0.0190***	0.0085**	0.0039*	0.0031
	(0.0056)	(0.0036)	(0.0022)	(0.0020)
+4	0.0157***	0.0081**	0.0057**	0.0045**
	(0.0059)	(0.0038)	(0.0025)	(0.0022)
+5	0.0157**	0.0068*	0.0058**	0.0046**
	(0.0063)	(0.0041)	(0.0027)	(0.0024)
+6	0.0144**	0.0066	0.0056*	0.0059**
	(0.0066)	(0.0043)	(0.0029)	(0.0026)
+7	0.0094	0.0082*	0.0056*	0.0046*
	(0.0068)	(0.0044)	(0.0030)	(0.0026)
+8	0.0070	0.0088*	0.0063*	0.0046*
	(0.0071)	(0.0046)	(0.0032)	(0.0028)
+9	0.0081	0.0071	0.0084**	0.0040
	(0.0072)	(0.0047)	(0.0034)	(0.0029)
+10	0.0074	0.0068	0.0086**	0.0040
	(0.0073)	(0.0047)	(0.0035)	(0.0029)
N	981344	981344	981344	981344
avg. outcome, −1	0.117	0.117	0.006	0.006
avg. outcome, non-disp. +10	0.317	0.317	0.040	0.040

Standard errors clustered at the individual level. ***, **, and * correspond to significance at the 1%, 5%, and 10% levels respectively. Table reports the interaction between demeaned IQ scores and $D_{it}^{k \text{ years after displacement}}$ from equation 1 as well as base coefficients from $D_{it}^{k \text{ years after displacement}}$ for men. Regression equation includes complete set of interaction terms between IQ, displacement, and time. Outcome variable equal to 1 if an individual has completed vocational high school (columns 1 and 2) and equal to 1 if an individual has completed higher education (columns 3 and 4). Odd columns report to the estimated impact of job displacement on education while even columns report the interaction between displacement and demeaned IQ score. Average IQ score among sample is 3.89, while an IQ of 5 corresponds to the national median. Displacement event occurs between +0 and +1. Sample of high-tenured workers defined as in Section 3.1, restricted to those who have a non-missing IQ score. Regression equation: $Y_{it} = \alpha + \sum_{k=-3}^{+10} \gamma_k \cdot (D_i \times time_t)^k + \sum_{k=-3}^{+10} \psi_k \cdot (D_i \times time_t)^k \times IQ_i + \theta \cdot D_i + \zeta \cdot IQ \times time_{i,t} + municipality^{t=0} \times time_{m(i),t} + \pi_b + \varepsilon_{it}$.

L.2 The importance of having a parent co-worker

Networking is an important channel for finding a job, and is particularly important after the completion of education when entering the labor market for the first time (Kramarz and Skans, 2014). Parental connections matter: Corak and Piraino (2011) show that 40% of men are employed at an employer which their father has worked for at some point in their working lives. Kramarz and Skans (2014) conclude that parental ties matter if the parent is employed within the same plant as a child and such parental connections matter more among the lowest educated. Indeed, 14% of compulsory school graduates are employed in their first job at a plant which employs their parent. Similar patterns exists among sample of high-tenured high school dropouts, where 11% (8%) of men (women) are employed in the same employer as their father (mother) prior to displacement. Such workers are negatively selected on cognitive ability: 26% of men who are employed in the same employer as their father have a median or above IQ compared to 31% of non-same employers.

Having a parental connection may matter for the dropout decision of a child, either by the direct influence of a parent to follow in their footsteps or by reducing the search costs of finding employment. The availability of networking via parental connections makes employment marginally more attractive than investing in an additional year of education, pushing students at the margin of dropping out to enter the labor market. Figure L.1a assesses the importance of having a mother employed in the same plant in the base year for women and Figure L.1b assesses the importance of having a father co-worker for men. While certification remains significantly higher among displaced workers who do not have a parent co-worker, the estimated impacts of displacement on certification are remarkably higher among displaced workers with a parent co-worker. While the standard errors among a relatively small sub-sample of the total estimation sample are large, displacement increases certification among women with a co-working mother by 5 p.p. and among men with a co-working father by 7.5 p.p., an impact which remains statistically significant by +10.

The presence of a co-working parent clearly matters for certification. Such work-

Figure L.1: The Importance of Parental Co-workers for Certification Post-displacement

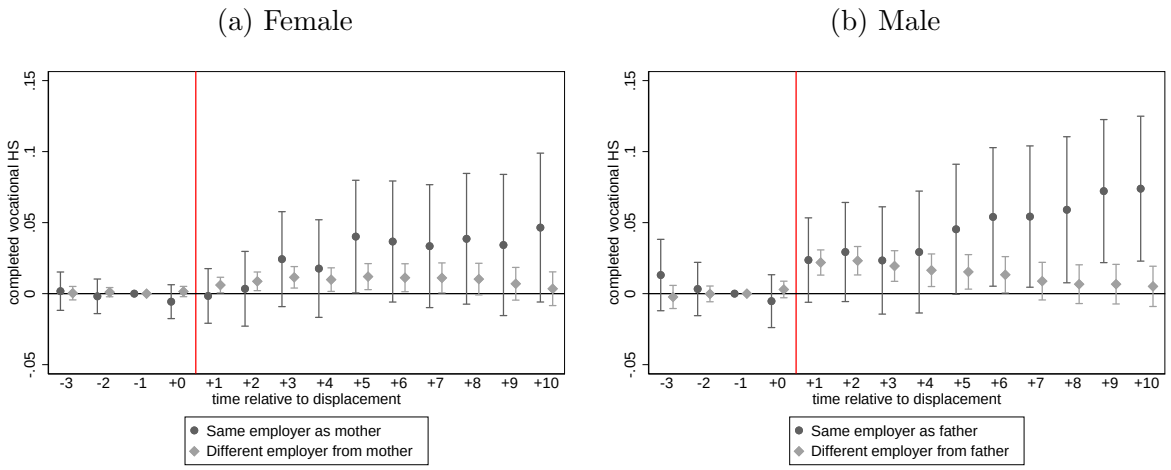


Figure plots the estimated impact of displacement separately for women (panel a) and men (panel b), with the outcome variable equal to 1 if an individual has completed vocational high school. Separate regressions estimated by whether or not a worker is employed in the same plant as their mother (panel a) or father (panel b) in time +0. Displacement event occurs between +0 and +1. 95% confidence interval reported. Sample of high-tenured workers defined as in Section 3.1. γ_{-1} set to zero by convention. Estimating equation: $Y_{it} = \alpha + \sum_{k=-3}^{+10} \gamma_k \cdot (D_i \times time_t)^k + \theta \cdot D_i + municipality^{t=0} \times time_{m(i),t} + \pi_b + \varepsilon_{it}$.

ers experience a more salient shock—indeed their parent may also be displaced in the same mass-layoff event—and their network is severely impacted, limiting the potential to quickly transition to a new job. Bearing these points in mind, the importance of parental connections for certification reveals that such connections among local employers lead students to drop out of education too early, and the shock of job displacement unequivocally leads them to re-evaluate the importance of certified skills. As the long-run impacts on certification among the parental connection sample do not fade out in the same fashion as seen previously, non-displaced workers in well connected jobs have no need for certification of skills. These stark differences by parental connections suggest that revised expectations on future employment prospects as a high school dropout play an important role in returning to certify skills.

L.3 The importance of local economic conditions at the time of dropout

A diverse literature exploits area-cohort variation in economic conditions to examine the importance of graduating into a recession (Kahn, 2010; Oreopoulos et al., 2012; Liu et al., 2016; Bell et al., 2018; Schwandt and von Wachter, 2019). By isolating variation

in economic conditions within an area across graduating cohorts, the literature assumes that the remaining variation at the local level is attributed to shifts in aggregate demand which are uncorrelated with characteristics which vary across graduation cohorts. In a similar fashion, results below exploit variation in the local employment rate across different cohorts, measured at the age of 15 just prior to when a student is deciding whether to enroll in high school.

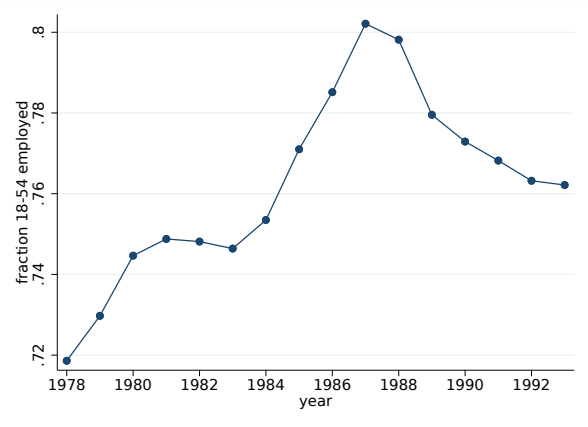
Figure L.2a plots the variation in the national employment rate ($\frac{\sum_{m=1}^{M} employed_m}{\sum_{m=1}^{M} population_m}$) from 1978 (when those aged 27 in base year 1990 are 15) to 1993 (when those aged 21 in base year 1999 are 15). At the national level, there is considerable variation in the employment. Employment ranges from 72% in 1978, to over 80% at its peak in 1987, and then declining to 76% by 1993. Such fluctuations impact the opportunities available in different areas at different points in time, such that two students aged 15 living in the same municipality face very different available employment opportunities.

Figures L.2b and L.2c assess the importance of employment conditions at age 15 for post-displacement certification for women and men respectively. Results plot regressions of equation (1) from separate samples of workers who faced more favorable economic conditions at age 15, those with local employment above the median, and those who faced less favorable conditions at age 15, those below the median. While the estimated coefficients are not statistically different across the two sub-samples, displaced workers who faced favorable conditions at age 15 certify at much higher rates and those displaced who faced less favorable conditions tend to see no significant increases in certification.

Such differences suggest that booming local economic conditions at the time of deciding to continue in high school may have pushed some students who were at the margin of continuing in high school to enter the labor market instead. Following the labor market shock of displacement, such workers re-evaluate the returns to dropping out of high school and certify their vocational skills. Updated expectations relative to what the same person had at the time of drop out appears to be a key determinant of future certification: indeed preferences would need to be very different across high school dropouts of areas with different employment prospects at age 15 to reconcile the differences of Figures L.2b

Figure L.2: The Importance of Variation in Local Economic Opportunities at age 15 for Certification Post-displacement

(a) National Employment Rate, 1978–1993



(b) Female

(c) Male

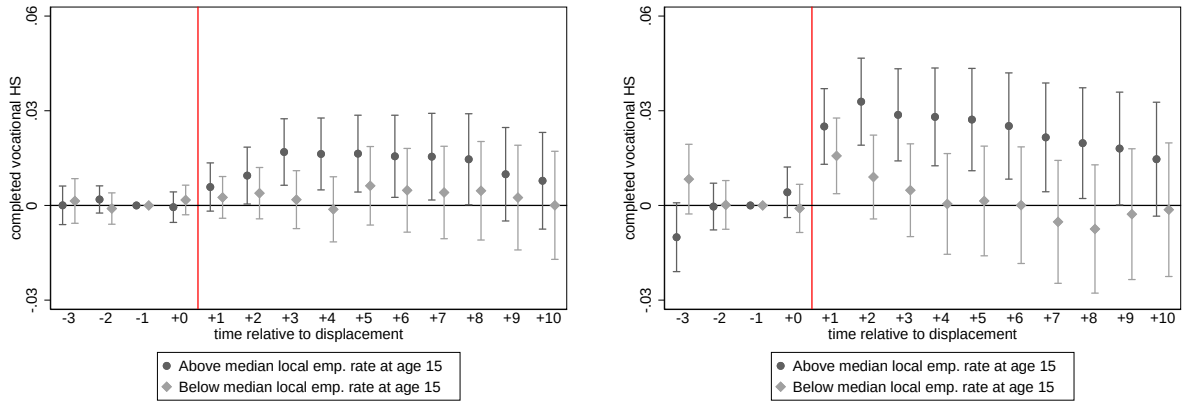


Figure plots the national employment rate from 1978–1993 (panel a) and the estimated impact of displacement separately for women (panel b) and men (panel c), with the outcome variable equal to 1 if an individual has completed vocational high school. National employment rate defined as total employment over the national population for all individuals aged 18–54. Panels (b) and (c) estimate separate regressions by whether or not a worker lived in an area at age 15 with equal to or higher employment. Displacement event occurs between +0 and +1. 95% confidence interval reported. Sample of high-tenured workers defined as in Section 3.1. γ_{-1} set to zero by convention. Estimating equation: $Y_{it} = \alpha + \sum_{k=-3}^{+10} \gamma_k \cdot (D_i \times time_t)^k + \theta \cdot D_i + municipality^{t=0} \times time_{m(i),t} + \pi_b + \varepsilon_{it}$.

and L.2c.

L.4 The importance of children

The availability of workers' time may also impact the decision to certify post-displacement. Figures L.3a and L.3b examine whether the impacts of displacement on certification differ by the presence of children. Those with children prior to displacement, 33% of men and 47% of women, may find it more difficult to take time away from their children to invest in certification and additional higher education. While certification rates are similar between women displaced with and without children, men without children tend to certify at higher rates post-displacement. In addition, results in Figure L.4 reveal that those without children continue in the education system to complete higher education at much higher rates for both women and men, suggesting that available time impacts the ability to invest in higher education which requires a longer time invested compared to certification.

Figure L.3: The Importance of Children for Post-displacement Certification

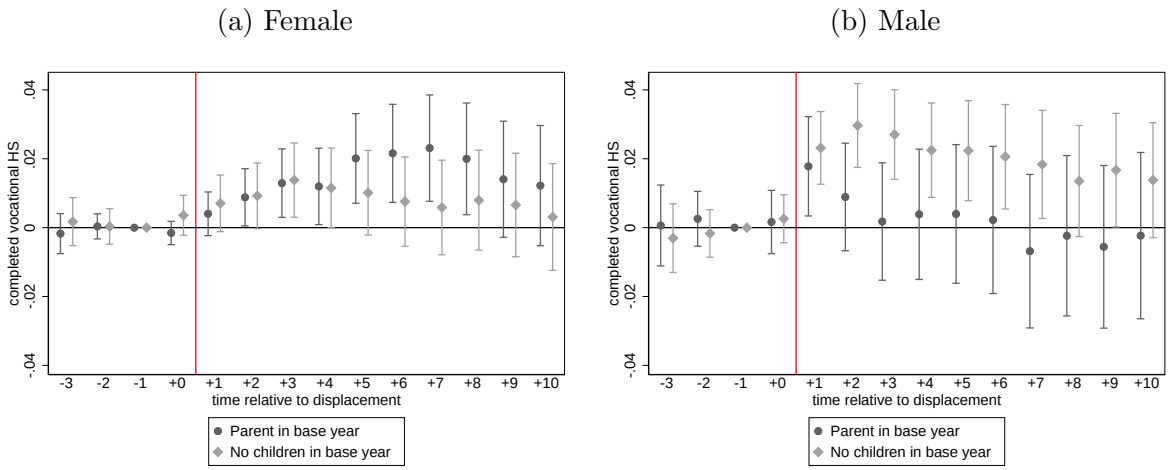


Figure plots the estimated impact of displacement separately for women (panel a) and men (panel b), with the outcome variable equal to 1 if an individual has completed vocational high school. Panels (a) and (b) estimate separate regressions by whether or not a worker had a child in +0. Displacement event occurs between +0 and +1. 95% confidence interval reported. Sample of high-tenured workers defined as in Section 3.1. γ_{-1} set to zero by convention. Estimating equation: $Y_{it} = \alpha + \sum_{k=-3}^{+10} \gamma_k \cdot (D_i \times time_t)^k + \theta \cdot D_i + municipality^{t=0} \times time_{m(i),t} + \pi_b + \varepsilon_{it}$.

Figure L.4: The Importance of Children for Post-displacement Higher Education

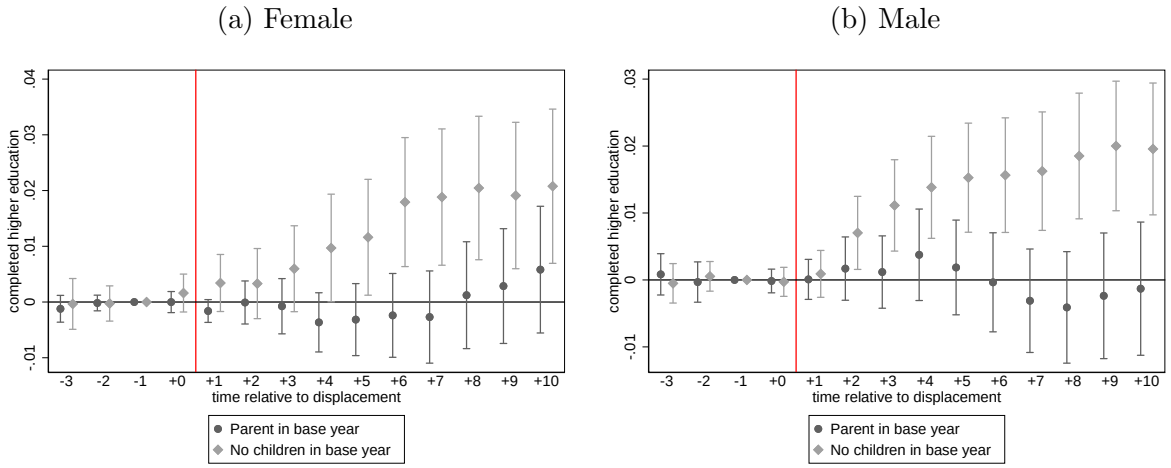


Figure plots the estimated impact of displacement separately for women (panel a) and men (panel b), with the outcome variable equal to 1 if an individual has completed higher education. Panels (a) and (b) estimate separate regressions by whether or not a worker had a child in +0. Displacement event occurs between +0 and +1. 95% confidence interval reported. Sample of high-tenured workers defined as in Section 3.1. γ_{-1} set to zero by convention. Estimating equation: $Y_{it} = \alpha + \sum_{k=-3}^{+10} \gamma_k \cdot (D_i \times time_t)^k + \theta \cdot D_i + municipality^{t=0} \times time_{m(i),t} + \pi_b + \varepsilon_{it}$.