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The effect of job displacement on public college enrollment: Evidence from Ohio

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ABSTRACT

Displaced workers suffer large and persistent earnings losses. These losses can be mitigated by returning to school, yet the extent to which such workers enroll in post-secondary education in response to displacement is poorly understood. Using employer-employee-student matched administrative data from Ohio, we provide the first direct evidence of workers' enrollment responses following mass layoffs in the United States. We estimate that for every 100 displaced workers, only 1 is ever induced to enroll in a public college. This effect is concentrated almost entirely among displaced manufacturing workers, who enroll at a rate of 2.5 per 100. Workers with relatively low earnings at their layoff firms are the most likely to enroll in public institutions.

1. Introduction

Highly-tenured workers who lose their jobs in mass layoffs suffer large and persistent earnings losses many years after their initial separations. This "scarring effect" curtails earnings by 15 to 20% even two decades after displacement (Davis & Von Wachter, 2011). Community college credentials and retraining programs that specifically target displaced workers can ameliorate these losses, even for older workers and those in particularly distressed industries and regions (Hyman, 2018; Jacobson et al., 2005a,2005b). In the absence of other constraints, job displacement decreases the opportunity cost of postsecondary enrollment and such workers might seek to reduce the risk of future displacement by upskilling when faced with grim economic prospects.

College enrollments and major choices have been shown to be responsive to labor market conditions in general, in line with predictions from economic theory that students will invest more in education when the expected returns are greater and when opportunity costs are lower (Blom et al., 2021; Charles et al., 2019; Ersoy, 2020; Liu et al., 2019).[1] Prior work has also established that community college enrollment specifically rises when the labor market is weak (Barrow & Davis, 2012; Betts & McFarland, 1995; Foote & Grosz, 2019; Hillman & Orians, 2013). But surprisingly few studies have attempted to directly estimate the causal effect of job displacement on postsecondary enrollment among those workers who are actually displaced, as broader enrollment patterns are not necessarily informative regarding the effects on displaced workers themselves. In prior work, the enrollment induced by poor labor markets may come primarily from individuals besides those who lost their job: workers who voluntarily leave their jobs to return to

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[1] Specifically, positive shocks that improve labor market opportunities lower community college enrollment (Charles et al., 2019) and increase high school dropout rates of young and less-educated males (Cascio and Narayan, 2022). Economic downturns influence college major decisions of bachelor's degree recipients (Liu et al., 2019; Ersoy, 2020; Blom et al., 2021), particularly at universities in areas most exposed to the negative shocks (Weinstein, 2020).

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school, recent high school graduates who opt to pursue college instead of entering a weak labor market, and those whose college choices are indirectly affected via the financial situations of their parents.

One paper which directly examines job displacement and subsequent postsecondary enrollment is Frenette et al., and Wright (2011). The authors use the Canadian Longitudinal Worker File to compare enrollment for workers displaced in 2003 versus similar workers who were not displaced. They find that job displacement for Canadian workers age 25-44 increases postsecondary enrollment by 0.6 to 1.3 percentage points over the subsequent four years, from a baseline enrollment rate of about 10% among a non-displaced comparison group.

It is not clear whether the findings of Frenette et al. (2011) would translate to an American setting, given the differences in UI policies, educational options, and safety net programs (Card & Oreopoulos, 2019; Card & Riddell, 1993; Jones & Riddell, 2019). For example, Barr and Turner (2015, 2018) find that specific UI policy factors influence the enrollment response of unemployed workers in the United States[2] – among them, UI benefit duration, the ease with which UI recipients can claim benefits while enrolled, and whether agencies are proactive about informing unemployed workers of available financial aid. Further, the relative "push" of weaker labor markets and "pull" of more generous disability insurance (DI) in the U.S. compared to Canada may induce some American workers who would have otherwise sought retraining to instead take up DI (Milligan & Schirle, 2019). To illustrate this point, in U.S. regions that were highly exposed to Chinese import competition in the 1990s and 2000s, the per capita increase in Social Security DI payments was more than thirty times that of Trade Adjustment Assistance (TAA), the federal program which incentivizes retraining for workers displaced by foreign trade (Autor et al., 2013). For these and other reasons, it is not obvious whether Frenette et al. (2011) findings would generalize to an American setting. Our paper provides the first direct evidence using micro-level data of the effect of job displacement on college enrollment in the United States.

Using employer-employee-student matched administrative data from Ohio, we identify workers who lose their job in a mass layoff between 2002 and 2009 and find 9% enroll in public two- or four-year colleges after displacement. The typical enrollment spell persists for five semesters, and 29% of these displaced workers attain a degree after being laid off. However, much of this enrollment may have occurred regardless of an individual's career disruption. Using a dynamic two-way fixed effects approach similar to Jacobson et al. (1993), we estimate the causal effect of job displacement on postsecondary enrollment. Our preferred model includes linear worker-specific time trends in addition to worker fixed effects, and all specifications include a comparison group of non-displaced workers. We find that the enrollment response to job displacement of roughly 1%: for every 100 displaced workers, only 1 is ever induced to enroll in a public college within four years of layoff. Nearly all of this "enrollment effect" occurs within the first year of displacement.[3]

On one hand, this estimated effect is small relative to the number of displaced workers who are non-employed following layoff. Using the same administrative records, Moore and Scott-Clayton (2019) document that 10% of workers are consequentially non-employed in the years following a mass layoff, implying that the vast majority of even those workers without jobs after displacement are not induced to enroll in college. On the other hand, baseline enrollment rates among stably-employed workers is quite low (upper bound of 17%, see Table 1), and therefore among those with a low likelihood of enrolling, our effects translate to a larger relative enrollment boost that should not be understated.

Table 1
Descriptive Statistics for Displaced and Comparison Group

	Displaced	Comparison
Industry of Layoff Firm		
Manufacturing	0.291	0.240
Retail Trade	0.118	0.090
Construction	0.102	0.021
Finance and Insurance	0.097	0.074
Administrative, Support, Waste Management	0.056	0.028
Health Care and Social Assistance	0.054	0.142
Accommodation and Food Services	0.046	0.027
Professional, Scientific, and Technical	0.040	0.042
Wholesale Trade	0.030	0.057
Arts, Entertainment, Recreation	0.028	0.006
Transportation and Warehousing	0.026	0.031
Educational Services	0.025	0.111
Information	0.022	0.027
Other Services	0.019	0.015
Public Administration	0.013	0.053
Real Estate and Rental Leasing	0.008	0.011
Agriculture, Fishing, Hunting	0.008	0.001
Mining, Quarrying, Oil and Gas Extract	0.007	0.003
Management of Companies and Enterprises	0.005	0.008
Utilities	0.002	0.010
Yearly Pre-Layoff Earnings		
1-4 Quarters Before ($)	49,888	54,153
	(38,976)	(37,491)
Higher Education		
Ever Enrolled in 2-Year Institution	0.111	0.094
Ever Enrolled in 4-Year Institution	0.063	0.086
N	57,076	898,040

Note: Standard errors for earnings are expressed in parentheses. Earnings are in inflation-adjusted to USD$2012 using the CPI-U. Table lists the share of workers displaced between 2002q1 and 2008q4 by industry, such that the columns sum to 1. Industries are listed at 2-digit NAICS level. Because the comparison group is never displaced, industries represent their industry of employment in 2005q1. "Pre-layoff earnings" for the comparison group is four times their 2005q1 earnings.

Our identifying assumption is that displacement, as proxied by separation during the quarter of a mass layoff, is orthogonal to unobserved, non-linear trends in employment or human capital. If a worker receives a positive or negative shock that affects both postsecondary enrollment decisions and displacement, our approach will incorrectly attribute any change in enrollment trajectories to the effect of displacement. While it is not possible to rule out every possible alternative explanation, we find that our results are robust to a range of sensitivity checks, including models that exclude the individual-specific trends, models that utilize alternative measures of enrollment, and models examining effects for shutdowns versus mass layoffs separately.

After presenting our main results, we then explore how these enrollment effects differ by industry of displacement. We show this effect is almost entirely concentrated in the manufacturing sector, which comprises just 29% of our displaced sample. Within a year of displacement, more than 2 workers per every 100 laid off from manufacturing firms enrolled in college. After three years, this effect grew to 2.5 workers. Our sample (laid off between 2002 and 2008) spans the period when U.S. manufacturing employment's decades-long decline fell at its fastest rate (Pierce & Schott, 2016). Thus, the relative value of switching industries may be particularly high for these workers, potentially driving these results.

We then restrict our sample to manufacturing employees to explore whether heterogeneity in these effects follows the patterns we would predict based upon economic theory. First, we present evidence that a worker's likelihood of enrollment depends strongly on her income prior to layoff, specifically relative to coworkers. Because lower earners (within a firm) are typically younger and have less educational attainment, one would predict these workers may be differentially more likely

[2] The authors do not restrict their samples to highly-tenured displaced workers.

[3] While we don't explicitly analyze the higher education financing decision, it should be noted the average cost of enrolling in a public 2-year institution in Ohio is about 50% higher than the national average (National Center for Education Statistics and IPEDS, 2009).

to pursue schooling after displacement.[4] Although we document that even the highest-paid displaced manufacturing employees are drawn to college after layoff, middle- and low-earners are more likely to seek retraining. For instance, three years after layoff, the displaced from the bottom-tercile of firm earnings distribution are more than three times as likely to enroll in college than those laid off from the top tercile.

Next, we examine whether a displaced workers' geographic proximity to Ohio institutions of higher education relates positively with likelihood of enrollment, consistent with economic theory (lower economic cost of enrollment for workers nearby) and past empirical evidence (Card, 1993). We find that proximity to a higher concentration of public colleges doesn't predict increased public enrollment. In the appendix, we document that enrollment in public institutions are depressed in local labor markets with a higher concentration of for-profit schools. Our study complements previous evidence that public and for-profit schools are substitutes (Cellini, 2009; Cellini et al., 2020; Laband & Lentz, 2004).

We find that other dimensions of heterogeneity do not predict a displaced worker's likelihood of college enrollment. For example, despite the fact that those laid off in the third calendar quarter (July to September) may be better-positioned to swiftly transition to college in the autumn semester compared to those displaced in the fourth quarter, we conclude that the season of one's layoff does not explain variation in subsequent enrollment. Similarly, while firm size or whether the firm closes permanently (as opposed to simply shedding workers) could theoretically influence workers' post-layoff educational decisions, we detect no empirical relationship. Our heterogeneity analysis lends credibility to our causal interpretation of the effects of job loss on enrollment. To the extent that our baseline estimates were driven by selection bias rather than a causal mechanism, we would not necessarily expect our estimation to yield these patterns of heterogeneity. Further work is needed to determine how many displaced workers retrain at private, for-profit, or non-college institutions and whether the postsecondary training programs effectively match displaced workers with new jobs. We proceed by summarizing related literature in section 2 and describing the data in section 3. Section 4 outlines the empirical strategy. Section 5 reviews our findings, and section 6 discusses and concludes.

2. Previous literature

For workers displaced in mass layoffs and plant closings, the consequences of job loss are large and extend beyond when they are unemployed (Brand et al., 2008; Charles & Stephens, 2004; Jacobson et al., 1993). On average, these workers experience a 20% reduction in their earnings up to two decades after the displacement occurred (Von Wachter et al., 2009). The long-run earnings losses of displaced workers are associated with a declining demand for a certain set of job- or industry-specific skills (Jacobson et al., 2005). Employees with specific skills in waning industries experience lower earnings even after they are reemployed full-time because their old skills are less valuable to other employers and more difficult to transfer to emerging and growing sectors (LaLonde & Sullivan, 2010).

The job displacement literature is linked to a well-developed scholarship on the impact of retraining on earnings. This literature estimates substantial returns to college and shows that it takes time for the benefits of training to be realized. Using administrative earnings records linked with community college transcripts, Jacobson et al., 2005a,2005b) estimate returns to one year of college of about 9% for displaced men and about 13% for displaced women. More recently, Hyman (2018) estimates that TAA participation boosts earnings by $50,000 over a decade for displaced workers through its extended unemployment benefits, job search assistance, and retraining subsidies. Finally, using a similar dataset and time period as we examine here, Leung and Pei (2020) study the returns to schooling by applying a matching strategy that compares UI claimants from Ohio who enrolled in further education to similar claimants who did not. They find that enrollees earned about 7% more than non-enrollees three to four years after enrollment.

Although this research demonstrates that retraining through community colleges can reduce the skills gaps of some of these displaced workers and mitigate their earnings losses, the extent to which such workers enroll in postsecondary education in response to displacement is poorly understood. Theoretically, in the absence of other constraints, labor market downturns decrease the opportunity cost of postsecondary enrollment by reducing current labor market opportunities.

The literature studying the impact of losing one's job on educational investment has largely focused on settings with high unemployment or in a recession (Berger & Kostal, 2002; Betts & McFarland, 1995; Card & Lemieux, 2001). In a more recent study, Barr and Turner (2015) document that more generous UI benefits increases postsecondary enrollment and younger workers' enrollment is more responsive to cyclical variation in economic conditions.

Far less attention has been devoted to the causal effect of job displacement on postsecondary enrollment among those who were actually displaced and often face especially difficult readjustments. Foote and Grosz (2019) estimate the effect of local labor market downturns measured by local mass layoff events on two-year college enrollment using aggregate data at the commuting-zone level and applying a generalized difference-in-difference approach with year and commuting-zone fixed effects. Three years after a mass layoff, they find that for every 100 workers involved, 3 enrolled in a two-year college and 2 completed a credential. While their analysis spans the entire country and includes for-profit institutions, it is conducted at the aggregate level and therefore cannot pinpoint whether individuals enrolling are the same ones who were laid off. Ost et al. (2018) find that working college students are no less likely to drop out upon layoff, and instead increase their enrolled credits. While the authors use the same administrative data that we use in this study, their sample and research question are focused on those already enrolled prior to a layoff. Our sample covers the more expansive universe of all displaced workers, which may behave differently than the subset of workers who are already enrolled at the time of layoff.

Our study is most similar to Frenette et al. (2011), who exploit micro-level variation in individual job displacement and consider the impact of mass-layoff on the postsecondary enrollment of workers in the Canadian context. They find that workers affected by mass layoff events are slightly more likely to subsequently enroll in college compared to workers not affected by mass layoff events. Using a strategy of individual fixed effects with a control group comparing enrollment before and after 2003 for workers displaced in 2003 versus similar workers who were not displaced, they find that job displacement for Canadian workers age 25-44 increases postsecondary enrollment by 0.6 to 1.3 percentage points over the subsequent four years, from a baseline enrollment rate of about 10% among a non-displaced comparison group.

Our study is the first to use micro-level data to measure the direct effect of job displacement on college enrollment in the United States. Aided by the richness of our worker-student matched administrative data, our work is also the first to examine heterogeneity in these effects, including by industry, geography, and earnings rank within the firm.

3. Data

We utilize three administrative data sources from the state of Ohio to study the links between displacement and education decisions. These data are made available through the Ohio Educational Research Center (OERC), which assembles data from multiple state agencies, including the Ohio Department of Higher Education (ODHE) and the Ohio Department of Job and Family Services (ODJFS), into a repository

[4] Because our data lack information on age for all workers, income serves as a proxy.

known as the Ohio Longitudinal Data Archive (OLDA).[5]

The first dataset provides information for all students attending Ohio public institutions of higher education between 2000 and 2011.[6] The data, which aggregate student performance to the student-by-semester level, includes credits earned, institution attended, degree information, and demographic variables such as race, age, and gender. All schools have four semesters corresponding to winter, spring, summer and fall, with the vast majority of schools experiencing peak enrollment in the fall and spring. We follow the approach of Jepsen et al. (2014) by assigning the spring semester a start date of the first quarter and end date of the second quarter. From this dataset, we construct a binary measure of enrollment and a discrete measure of the number of classes taken.

The second dataset includes information on both firms and private sector, state, and local public employees subject to Unemployment Insurance (UI) contributions in Ohio between 1999Q3 and 2013Q1. Thus, an observation exists for every quarter an individual has positive earnings in the state of Ohio during this time period. Importantly, the earnings records include individual identifiers that link to the education data. Thus, for our purposes, we can identify the quarter of a displaced worker's separation as well as the quarter of entry at an Ohio public college or university.

The third dataset includes firm-level variables such as employer identifier, threedigit North American Industry Classification Systems (NAICS) codes, and county of the employer. The identifiers, all derived from the Quarterly Census of Employment and Wages (QCEW), allow for construction of a firm-size variable by summing across the records associated with a given employer in each quarter. Note that the employer county data reflects the location of the enterprise. A necessary caveat to our findings by employers' industry and location is that the enterprise data may be imprecise to identify firm industry and location for multi-establishment firms.[7]

The Ohio administrative data is particularly advantageous for the purposes of studying displaced workers' earnings patterns and education decisions. Ohio is the seventh largest U.S. state by population and lies at the heart of America's manufacturing region that has experienced several decades of deindustrialization. Between 2005 and 2016, three of the top ten "trade-displaced" ZIP codes as calculated from Department of Labor estimates were located in Ohio (Hyman, 2018). The longitudinal nature of the data enables the tracking of worker tenure and enrollment patterns, facilitating the study of questions which could not be feasibly addressed in previous displaced worker studies which relied on information at a highly aggregated geographic level, such as Census division (Betts & McFarland, 1995) or commuting zone (Foote & Grosz, 2019).

The Ohio data nevertheless have some limitations, typical of state administrative UI and education databases. First, we are unable to distinguish between individuals who leave Ohio, exit the labor force, or begin working for non UI-covered employers in the state. Second, we lack demographic information for workers who did not attend Ohio public institutions during the selected timeframe. Third, the education data does not include enrollment records at any private institutions or at public institutions outside of the state of Ohio. Nevertheless, we use information on location of for-profit colleges to shed light on the role such institutions play for displaced workers.

We use the Ohio administrative records to construct a sample of displaced workers and a comparison group for our analysis of post-secondary enrollment patterns. We describe the construction of such samples below.

3.1. Displaced sample

Displaced workers are typically defined as individuals with stable work histories who involuntarily separate from a firm because of a mass layoff and are unlikely to be recalled to their prior job – features which distinguish them from routine job changers or other unemployed individuals (Kletzer, 1998). Because we use administrative data, we cannot explicitly identify the reason for a worker's separation (quit, discharge for cause, etc.). Consistent with the displaced worker literature, we use separations during a mass layoff to identify workers who separate because of economic distress at their firm. Despite concerns that this approach misclassifies voluntary movers as displaced workers, Flaaen et al. (2019) shows that mass layoffs identified in administrative data serve as a reliable proxy for involuntary displacement.

We define a mass layoff as a 30% or more quarter-to-quarter reduction in a firm's level of employment, a convention aligned with Davis and Von Wachter (2011). A firm shutdown is counted as a mass layoff. Because some firms exhibit many mass layoffs, we rank a firm's four largest mass layoffs by percentage change during the observed period (2002-2008) and assess only these four events to avoid over-counting. Furthermore, because small employers are mathematically more likely to meet this 30% benchmark without a substantial change in absolute employment, we adhere to Jacobson et al.'s (1993) practice of excluding firms with fewer than 50 employees from the sample of mass layoff firms.

Upon identifying dates of mass layoffs, we define a displaced worker as someone satisfying the following conditions: the individual (1) worked at a firm experiencing a firm shutdown or mass layoff in 2002q1 through 2008q4 within one year prior to the layoff date; (2) is not employed at the firm the quarter after the mass layoff; (3) worked at the firm continuously for at least three years prior to displacement; (4) holds only one job at the time of job separation; (5) earns the equivalent of at least minimum wage corresponding to 30 hours per week.[8] This definition aligns with Davis and Von Wachter (2011). Choosing a less-stringent tenure requirement (three years rather than six) allows us to study a greater number of displaced cohorts.[9] Our panel of displaced workers is balanced, including all observations for workers starting from 8 quarters prior to layoff through 12 quarters after.[10]

[5] The Ohio Longitudinal Data Archive is a project of the Ohio Education Research Center (http://www.oerc.osu.edu/oerc.osu.edu) and provides researchers with centralized access to administrative data. The OLDA is managed by The Ohio State University's CHRR (https://chrr.osu.edu/chrr.osu.edu) in collaboration with Ohio's state workforce and education agencies (http://www.ohioanalytics.gov/ohioanalytics.gov), with those agencies providing oversight and funding. For information on OLDA sponsors, see http://chrr.osu.edu/projects/ohio-longitudinal-data-archive.

[6] We have data on Ohio Technical Centers (OTCs) as well, a network of noncredit career development programs operated by local educational institutions, but do not use it in our analysis because only 1% of displaced workers in our sample (769 individuals) matched to the OTC dataset.

[7] It is unclear, however, how imprecise the employers' industry information is for multi-establishment firms. A recent study by Guo (2021) suggests that large multi-establishment firms that own multiple locations within a state often have a different Employer Identification Number (EIN) for each industry they operate in. Moreover, according to the Census Bureau, enterprises with multiple establishments are classified into single industries with the largest share of payroll, after excluding non-operating establishments. Details about the Census methodology can be found in on its technical documentation webpage.

[8] Quarterly earnings corresponding to the minimum wage (in 2014 inflation adjusted dollars) is $2,163 in the quarter before displacement. This corresponds to earning $5.15/hour, Ohio's minimum wage from 2002-2006, for 30 hours per week for one full quarter.

[9] Lachowska et al. (2020) show that job displacement depresses long-run hours worked for employees with higher tenure (6 years) compared to lower tenure (3-4 years). To the extent that this suggests our sample is less attached to the labor force and more likely to return to school after layoff, our study's baseline estimates could be even lower if we restricted to six years of pre-displacement tenure.

[10] We exclude the very small number of twice-displaced workers from our sample, as their inclusion would contaminate our estimates.

We choose not to impose certain sample restrictions common in studies which examine the effect of job loss on future earnings if the conditioning behavior is correlated with or influenced by the decision to re-enroll. For example, we do not condition that workers in our sample remain attached to the labor force in the post-layoff period. While such a condition may be sensible for studying the wage scarring effects of unemployment, we are interested in the educational rather than employment outcomes of displaced workers. Some workers, particularly those who are not burdened by credit constraints, may opt to devote several years to schooling without balancing a full-time work schedule. This sample selection criterion renders our paper's conclusions about educational choices relevant for all displaced workers, not just those attached to the labor force.

Likewise, we also do not impose that displaced workers claim unemployment insurance benefits upon job loss because, once again, such a condition influences one's decision to enroll in postsecondary education (Barr & Turner, 2018). Further, such a restriction would omit a substantial share of the population of interest from the sample. Auray et al. (2019) document that from 1989–2012, 23% of Americans eligible for UI benefits did not claim them. Moreover, the insured unemployment rate – defined as the number of unemployed individuals receiving UI benefits as a percentage of the labor force – during the Great Recession never eclipsed 5.0% even as the overall unemployment rate peaked at 10.0%.

3.2. Comparison sample

We then create a sample of individuals who are not displaced throughout the whole panel. On these comparison and displaced samples, we estimate our multi-period individual fixed effects model, described in section 4, to compare enrollment outcomes before and after displacement. Traditionally, the displaced worker literature uses a control group of workers who remain continuously employed at the same firm in order to isolate the share of future potential earnings that is destroyed when an individual involuntarily separates from a particular job (Krolikowski, 2018). However, in our case, the outcome of interest is the likelihood of post-secondary enrollment instead of earnings. Thus, there is no need to compare a displaced worker to one who remained continuously at the same job.

We define a non-displaced worker as someone satisfying the following conditions: the individual (1) is continuously employed (but not necessarily at the same employer) throughout the whole panel (1999-2012); (2) had at least 3 years of tenure at any firm; (3) earns at least minimum wage corresponding to 30 hours per week. These latter two restrictions ensure our comparison group is similar to our treatment group, which has these same requirements. By limiting our comparison group to those who are continuously employed, we would if anything overstate the effects on education college enrollments. This comparison group has a higher opportunity cost of college enrollment, and would presumably be less sensitive to other factors driving education enrollments.

In Appendix A.2, we construct alternative comparison group samples that are either "stricter" (containing fewer workers) or more "lenient" and (containing more workers) based on a variety of criteria.[11] We show that our main results are robust to alternative sample selections.

4. Empirical approach

To infer the causal effect of displacement on various educational outcomes, we apply the standard multi-period individual fixed effect with comparison group model that has frequently been used to measure the effect of job loss on earnings (Davis & Von Wachter, 2011; Jacobson et al., 1993; Lachowska et al., 2020; Moore & Scott-Clayton, 2019). Our preferred measure of enrollment is $cumul\_enroll_{it}$ an indicator which assumes zero for each worker i until the first time she enrolls in a public college or university. This measure, $cumul\_enroll_{it}$, equals one during the period of first enrollment, and remains one for the rest of the panel regardless of worker i's enrollment status. We focus on enrollment as our primary outcome of interest because conceptually it is the educational outcome most proximal to displacement and thus most likely to be immediately affected; longer term educational outcomes like degree completion will be spread over time and thus harder to tie directly to the displacement event.[12]

On the sample of displaced workers and non-displaced comparisons, we estimate

$$cumul\_enroll_{it} = \alpha_i + \gamma_t + \lambda_i \cdot t + W_{it}'\beta + \sum_{k=-2}^{12} \delta_k \cdot D_{itk} + \varepsilon_{it} \quad (1)$$

where the variable of interestD_{itk} is an indicator that equals one if worker i is observed in quarter k relative to displacement in time period t, and equals zero otherwise. The final quarter of a displaced worker's observed tenure with the layoff firm is reflected when k assumes the value zero. We allow the index k to assume negative values as low as -2, because a worker may enroll in college in anticipation of a layoff that has not yet occurred. k assumes a maximum value of 12, thus restricting measurement of the effect of displacement to three full post-layoff years. The "omitted category" for the treated sample includes enrollment in quarters $-8 \leq k \leq -3$.[13] Because the within-worker residuals cannot be assumed to be independent across time, we cluster at the worker level.

In Eq. (1), α_i are worker fixed effects which absorb an individual's constant propensity to enroll in public college over the length of the panel. Year-quarter time fixed effects, γ_t, capture any non-linear time effects of enrollment common across all workers (such as during the beginning of the Great Recession). We include worker-specific linear time trends, denoted by λ_i, which absorb any linear differential trend across workers. These worker-specific time trends account for the fact that the change in one's likelihood of enrolling in college over time is much greater for some workers than others. For example, workers in different industries or occupations may have systematically different enrollment trends over time, even in the absence of displacement. These worker-specific trends will thus also control for differential trends by industry or occupation. Similarly, older workers are typically less likely to enroll in postsecondary school because they have fewer years left in the labor market to reap the returns of such education. Because we suspect the probability of enrollment is correlated with worker age[14], we consider one of the main values of worker-specific linear time trends in this case is to account for potentially differential time trends by age. Lastly, recognizing that workers with lower earnings are more likely to be displaced and, holding other factors constant, should be differentially more likely to enroll in college to increase future earnings, we further control for pre-layoff earnings interacted with time dummies. Specifically, W_{it} is a vector of year-quarter indicators interacted with the log of pre-displacement earnings (average of the 5-8 quarters before separation for the treatment group, average of 2003 earnings for comparison

[11] The stricter comparison group (smaller than the baseline sample) requires workers being employed with only one firm for the entire duration of the panel. The more lenient comparison group (larger than the baseline sample) conditions that workers have some minimal labor force attachment.

[12] Descriptive findings presented earlier show that 29% of displaced workers who enroll in public colleges after displacement completed a degree – a completion rate higher than the average community college entrant in Ohio.

[13] Observations of displaced workers before the 8th pre-layoff quarter are dropped, as are those after the 12th post-layoff quarter.

[14] Like many state administrative employment datasets, our sample lacks information on employees' ages.

group), capturing any non-linear differential time-trends by pre-displacement earnings.[15]

In order to identify $\widehat{\delta}_k$ coefficients from Eq. (1) as a causal effect of displacement, we need to assume that displacement was orthogonal to unobserved, non-linear trends in employment or human capital. For example, if a worker receives a positive or negative shock that affects both post-secondary enrollment decisions and displacement, our approach will attribute any change in enrollment patterns to displacement rather than to this other shock. Another concern would be if employers specifically target workers for displacement that they know are planning to return to school. While it is not possible to fully rule out all alternative explanations, we do test the sensitivity of our results to alternative specification choices. We include several robustness checks in Appendix A, including models without individual-specific trends and examining effects for shutdowns versus mass layoffs separately.[16] In addition, we also run our main specification separately for subgroups by industry, geography, and earnings percentile.

We use several measures of enrollment throughout our analysis. Our preferred dependent variable is the cumulative indicator of any enrollment, $cumul\_enroll_{it}$, as defined above. We also examine an alternative point-in-time measure of enrollment, $enroll_{it}$, which indicates enrollment in an institution of higher education for worker i in year-quarter t.[17] Additionally, we use transcript information to construct a cumulative measure of college credits attained, $cumul\_credit_{it}$, as a dependent variable in robustness checks.

5. Results

5.1. Descriptive statistics on displaced workers and college enrollment

Table 1 describes basic characteristics of the displaced and non-displaced samples. Displaced workers are slightly more likely to have ever enrolled in a 2-year institution but less likely to have ever enrolled in a 4-year institution compared to non-displaced workers.[18] Predisplacement earnings are slightly lower for displaced workers than comparison workers in 2005Q1. There are also notable differences in their industry composition: displaced workers are substantially more likely than comparison workers to have been employed in construction, manufacturing, and administrative, support, and waste management. Over half of all displaced workers were laid off from three 2-digit NAICS industries: manufacturing, construction, and retail trade.

Table 2 provides further details about displaced workers who enrolled in postsecondary education at some point between 2000 and 2011. The first column describes those who ever enrolled, the second describes those who enrolled after displacement, and the third describes displaced workers who enrolled for the first time as undergraduates after displacement. By comparing the sample size in the second column of Table 2 to the total sample of displaced workers from Table 1, we note that just under 10% of displaced workers exhibit a spell of post-layoff enrollment. The three samples are broadly similar in terms of their demographics and academic characteristics, although those who enroll for the first time (in our sample window) after displacement are older at the time of layoff and first enrollment than their peers. Interestingly, while the majority of enrollment for all three groups occurs at two-year institutions, 39% of displaced workers enrolled in a four-year institution after displacement, and 8% enrolled in a graduate program.

Displaced workers enroll in a wide range of fields, but health, engineering, and business are the most popular. Among those who enroll after layoff, 29% of them earn a degree within two years of

Table 2
Summary Statistics: Displaced Workers with Enrollment Records.

	Displaced Workers		
	Ever enrolled, 2000-2011	Enrolled Post-Displacement	First Time UG Enroll Post Displacement
Basic Demographics			
Female	0.48	0.49	0.50
Non-white	0.15	0.15	0.16
Age at Displacement (median)	32	32	35
Age at First Enrollment (median)	34	34	37
Enrollment			
Any Enrollment in 2-yr Institution	0.71	0.75	0.76
Any Enrollment in 4-yr Institution	0.40	0.39	0.34
Any Undergraduate Enrollment	0.95	0.96	0.94
Any Graduate Enrollment	0.07	0.08	0.08
CIP Area at First Enrollment			
Arts & Humanities	0.14	0.11	0.12
Business	0.16	0.15	0.16
Education	0.05	0.05	0.05
Engineering	0.16	0.16	0.15
Health	0.16	0.20	0.20
Law	0.01	0.01	0.01
Natural Science & Mathematics	0.08	0.09	0.08
Services	0.04	0.04	0.04
Social & Behavioral Sciences	0.09	0.09	0.08
Trades & Repair Technicians	0.03	0.03	0.04
Degree Attainment			
Earned Degree w/i 2yrs of Displacement	N/A	0.30	0.26
Employment			
Unemployed quarter after layoff	0.36	0.37	0.40
More than Part-Time Employment	0.54	0.51	0.50
N	8,902	5,432	3,641

Note: The first column includes workers displaced between 2002q1 and 2008q4 with any record of enrollment at an Ohio public college or university (community college, 4-year undergraduate, or graduate program) between 2000 and 2011. This group includes workers who pursued higher education before and/or after displacement. The second column isolates displaced workers who enroll in a public college or university after displacement, regardless of enrollment status before job loss. The third column includes only workers who enroll in an undergraduate institution for the first time after they are displaced (or more specifically, they were never enrolled in the pre-displacement periods that we observe). The variable "Earned Degree w/i 2yrs of Displacement" refers to the share of workers who, conditional on their status as prescribed by the column, earned a degree less than two years after job displacement.

[15] Appendix Fig. A.16 provides a robustness check for earnings covariates by instead controlling for all workers' 2001 earnings. The results are consistent with our baseline.

[16] We believe a true "reverse causality" story is unlikely; i.e., that unrelated worker decisions to enroll in school would cause the firm to be classified as having a mass layoff event. Still, we show our results are robust to limiting our treatment group to cases where firms shutdown completely (Appendix Fig. A.10), helping address concerns about reverse causality.

[17] We consider a quarter-by-quarter enrollment measure a less illuminating measure than a cumulative one with respect to the question of how many individual workers enroll in college as a result of displacement because resulting $\widehat{\delta}_k$ coefficients only reveal how many displaced workers are induced to enroll at a given point in time. When a quarter-by-quarter enrollment measure is the dependent variable, one cannot distinguish between the case where the same set of displaced workers are enrolling in consecutive quarters and the case where an entirely new group of displaced workers enrolls each quarter.

[18] In Appendix Table A.1, we report these figures according to a worker's origin industry.

displacement. Note that only 37% of workers who enrolled after job loss were unemployed in the quarter after displacement, and 51% were working more than part-time. Thus, the decision to return to school or continue seeking work is not a mutually exclusive one for displaced workers.

Data limitations prevent us from comparing the demographic information of workers who enroll in college to those who do not enroll. Nevertheless, we find roughly half of the displaced workers who enroll in an institution of higher education are female and 15% are non-white (Table 2). Among such workers, the median age at displacement and enrollment were 32 and 34, respectively.

Table 3 further describes patterns of educational enrollment and attainment for displaced workers who pursued school after layoff. On average, most displaced workers enroll as part-time students within two years after displacement and remain enrolled for over a year. Among those who earn a degree within four years after displacement (about 30% of displaced workers), about 40% earn an associate's degree, and 30% earn a bachelor's and 12% attain a master's degree.

We explore enrollment patterns of displaced workers according to the industry of their layoff employers in Table 4. Among our sample who enrolls in college after job loss, workers displaced from industries with lower-earnings—retail trade, transportation and warehousing, arts and entertainment, and food and accommodation services—skew much younger than the rest of the sample (median age 24 at layoff), while displaced manufacturing employees are substantially older (age 38). Nearly two-thirds of workers displaced from education and health services who seek postsecondary training do so at 4-year institutions, while this number is only 26% for manufacturing (the vast majority attend 2-year schools). Those displaced from education and health are the only group which pursue graduate enrollment at any appreciable rate (24%), while upwards of 95% of displaced workers from all other sectors attend undergraduate programs.

Table 3
Displaced Workers: Educational Attainment

	Years From Displacement to Enrollment	
	0-2 years	2-4 years
Enrollment		
Any Enrollment in a 2-yr Institution	0.732	0.725
Any Enrollment in a 4-yr Institution	0.331	0.344
Any Undergraduate Enrollment	0.943	0.943
Any Graduate Enrollment	0.066	0.070
Any Full-Time (FT) Enrollment	0.429	0.392
Any Part-Time (PT) Enrollment	0.869	0.874
Attainment		
# Courses Enrolled within 2 or 4 years	11.99	11.96
# Quarters Enrolled within 2 or 4 years	4.656	4.934
# Quarters Enrolled FT w/i 2 or 4 years	1.327	1.251
# Quarters Enrolled PT w/i 2 or 4 years	3.062	3.295
Earned Degree w/i 2 or 4yrs of Displacement	0.302	0.325
Among Those Completing Degree After Layoff		
Less than one-year award	0.060	0.053
Associate's degree	0.432	0.415
Bachelor's degree	0.289	0.305
Master's degree	0.120	0.135
First-professional degree	0.009	0.011
Doctoral degree	0.022	0.011
N	6,031	4,297

Note: First column provides enrollment and attainment variable means for displaced workers who enroll in an institution of higher education any time within the first two years after their displacement (including workers who were enrolled prior to displacement). The second column provides means for the same variables for displaced workers who enroll in an institution of higher education anytime between 2 and 4 years after their displacement. Because some workers enroll in the year after displacement and continue schooling for many years, the two groups are not disjoint. However, the 2-4 group is also not a proper subset of the 0-2 group. Attainment variables for courses and quarters enrolled correspond to either "within 2 years" for the first column or "within 4 years" for the second column.

Table 4
Summary Statistics: Displaced Workers with Enrollment Records by Industry of Layoff

	Displaced Workers, Enrolled Post-Layoff			
	Manufacturing	Educ/ Health	RWTAEFA	Other
Basic Demographics				
Age at Displacement (median)	38	33	24	34
Enrollment				
Any Enrollment in 2-yr Institution	0.81	0.63	0.66	0.80
Any Enrollment in 4-yr Institution	0.26	0.62	0.54	0.31
Any Undergraduate Enrollment	0.98	0.86	0.97	0.95
Any Graduate Enrollment	0.02	0.24	0.08	0.07
CIP Area at First Enrollment				
Arts & Humanities	0.07	0.07	0.12	0.13
Business	0.17	0.06	0.18	0.15
Education	0.02	0.09	0.08	0.05
Engineering	0.22	*	0.08	0.23
Health	0.22	0.40	0.20	0.13
Law	0.02	*	*	*
Natural Science & Mathematics	0.10	0.11	0.10	0.07
Services	0.03	0.03	0.05	0.05
Social & Behavioral Sciences	0.06	0.14	0.14	0.07
Trades & Repair Technicians	0.03	*	*	0.05
Employment				
Unemployed quarter after layoff	0.52	0.46	0.32	0.30
More than Part-Time Employment	0.41	0.39	0.46	0.63
N	1,194	557	1,407	2,082

Note: This table splits the sample of workers who enroll in a public college after displacement (column 2 of Table 2) by broad industrial category of their layoff employer. The sample includes workers displaced between 2002q1 and 2008q4 with any record of enrollment at an Ohio public college or university after layoff and until 2011. Enrollment rates within a column may sum to more than 1 because workers enroll at multiple types of institutions. RWTAEFA includes workers displaced from Retail Trade, Wholesale, Transportation & Warehousing, Arts & Entertainment, and Food & Accommodation Services. Other includes remaining displaced workers laid off from firms outside manufacturing, education and health services, and RWTAEFA. * indicates that the cell value suppressed, as it represents less than 10 individuals.

We also examine fields of study pursued by displaced workers from different industries. Although we lack occupational data, previous research has documented that students exiting from specific occupations such as health and law enforcement enroll in community college programs that require similar skills (Acton, 2021). In our Ohio sample, many former manufacturing employees study engineering upon college enrollment (22% compared to 16% of overall displaced workers who enroll after layoff). Unsurprisingly, 40% of those laid off from education and health services pursue postsecondary training in health-related fields (and another 9% in education). This group is also disproportionately likely to pursue social and behavioral sciences (14% compared to 9% average). Those originating from the aforementioned low-wage industries pursue many different areas of study after job loss, including health (20%), business (18%), social and behavioral science (14%), arts and humanities (12%), and natural science and mathematics (10%).

5.2. Main results

Before turning to effects on enrollment, it is useful to establish that the workers in our sample experience the same employment and earnings outcomes of displacement as has been documented by prior

research. Fig. 1 illustrates the well-documented effects of job displacement on employment and earnings for workers in our Ohio sample.[19] Four years after job loss, 15% of workers are not employed. They earn roughly 25% less than they would if they had not been displaced, a number consistent with the literature since Jacobson et al. (1993). Using the same administrative data and a very similar displaced sample, Moore and Scott-Clayton (2019) estimate about a 10-12 percentage point negative effect of displacement in a mass layoff on the likelihood of employment several years later. It is possible some of these unemployed individuals are enrolled in an institution of higher education, many are likely searching for a job, retired, or accepting public benefits such as disability insurance which keep them out of the labor force. Moreover, a number of the displaced workers who do enroll in school may be working full- or part-time contemporaneously.

Fig. 2 plots two different measures of the enrollment rate for the comparison sample and cohort displaced in 2006Q1 and provides plausible evidence that our displaced and comparison samples follow similar enrollment trends prior to displacement. The point-intime enrollment rate from Fig. 2a exhibits a declining trend over time, likely representing age effects (enrollment declines as individuals get older). Fig. 2b plots a cumulative enrollment rate, which increases over time but at a decreasing rate. The figure suggests that job displacement may have a positive effect on college enrollment. Further, enrollment appears to increase modestly at the time of or just before layoff. We quantify this effect by estimating the impact of displacement in the two pre-layoff quarters in Eq. (1).

Fig. 3 plots the estimated coefficients from our main specification (listed in Table A.4), which can be interpreted as the cumulative effect of job displacement on public college enrollment.[20] We find that the enrollment response to job displacement is statistically significant: for every 100 displaced workers, only 1 is ever induced to enroll in a public college within three years of layoff. Nearly the entire effect of displacement on enrollment occurs in the first year after layoff. The stability of the $\widehat{\delta}_k$ coefficients for $k > 4$ suggest that virtually no new workers are induced to enroll after the first year.

We subject our main finding, that displacement has a positive but limited effect on public college enrollment, to several robustness checks in Appendix A. First, we apply our preferred specification *without* worker-specific linear time trends to the displaced and comparison sample. Fig. A.17 estimates a noticeably larger but still limited effect of 2.5 workers per 100 who enroll as a result of layoff. Additionally, two alternative measures of enrollment – a quarter-varying enrollment indicator (as from Fig. 2a) and a cumulative measure of college credits attained, constructed from student transcript information – both suggest a small but positive effect of displacement on enrollment (Figs. A.18 and A.19).

These results are consistent with Frenette et al. (2011) who find that for every 100 displaced workers in Canada, one worker is induced to return to school. Most of the "enrollment effect" occurs within the first year after displacement. Even though effects of job loss on enrollment seem small, Moore and Scott-Clayton (2019) document a longer-run causal effect of displacement on employment of about 10 percentage points.

5.3. Heterogeneity in enrollment effects

Next, we explore how this estimated 1 percentage point average enrollment effect may vary by key characteristics of one's layoff job, such as industry, relative earnings level, and geographic region.[21] With respect to industry, theory might suggest that workers in industries such as manufacturing facing permanent disruptions (Baily & Bosworth, 2014; Pierce & Schott, 2016) might be more likely to return to school to retrain rather than try to find another similar job. On the other hand, older displaced workers have a shorter time horizon to recoup the payoff from additional educational investment and may be overrepresented in industries facing permanent disruptions like manufacturing.[22] To maintain statistical power, we divide workers into four broad industrial groups: manufacturing (NAICS 31-33), educational services, health care and social assistance (NAICS 61-62), wholesale trade, retail trade, transportation and warehousing, arts, entertainment, recreation, accommodation and food services (NAICS 42, 44-45, 48-49, 71, 72), and a remaining miscellaneous group.[23] We apply Eq. (1) separately to each group. Results are presented in Fig. 4 and Appendix Table A.5.

Former manufacturing employees clearly drive the bulk of the college enrollment response to displacement. These workers exhibit a strong enrollment response soon after displacement, leading 2 in every 100 manufacturing workers to enroll in college just four quarters after layoff. After four years, more than 2.5 displaced Ohio manufacturers pursued public college as a result. These workers contrast sharply with those laid off from other sectors, who do not appear to be induced to public college enrollment after job loss. While those laid off from retail, wholesale, transportation and warehousing, arts, entertainment, food and accommodation exhibit a modest significant positive effect in the first post-layoff year, after three years their likelihood of enrollment relative to the comparison group is not distinguishable from zero. Displaced workers in education, health, and the "other" category never enroll in college at a significantly higher rate relative to the comparison group of non-displaced workers.

The reasons for differentially large estimates in manufacturing will be a fruitful area for further research, but we can speculate for reasons why this sector drives most of the effect.[24] First, it is likely that manufacturing workers may be differentially eligible for and/or targeted by Trade Adjustment Assistance, which prior research indicates may increase enrollment (Hyman, 2018). Second, our sample covers a time period when the U.S. manufacturing sector contracted considerably, so workers displaced from this sector may be more likely to switch careers than workers displaced in other industries. If the cost of switching occupations or sectors is mitigated by retraining at public colleges, displaced manufacturing workers may differentially opt into enrolling, especially if leaving the manufacturing sector is particularly

[19] Coefficients plotted in Fig. 1 result from specifications similar to Eq. (1), with employment status or log earnings as a dependent variable. These specifications do not use worker-specific linear time trends.

[20] There is a slight discrepancy in the construction of the displacement sample that does not meaningfully affect our estimates. The results reported in this manuscript include displaced workers from 2002Q1 and 2002Q2, for whom we can only guarantee 2.75 and 2.5 years of tenure, respectively, rather than the standard 3 years. Many of these workers would have likely met our eligibility threshold if our data included their earnings records. When we exclude these cohorts (who constitute less than 10% of the displaced sample), our baseline point estimates remain the same to the 3rd decimal place. These results will be made available upon request.

[21] While our geographic results cannot account for online learning, we argue that any noise added to our geographic measure of access makes it more notable that we are able to detect significant differences by location. Nevertheless, fully remote enrollment accounts for a very small proportion of enrollment overall (4-6% of undergraduate enrollment, or 8-13% among students age 30+, according to NCES Digest of Education Statistics).

[22] Because of the Ohio sample...s limitations on demographic information, we examine demographics by industry of layoff for those in the Displaced Workers Supplement (DWS) of the Current Population Survey in Appendix Table C.1. We document that those laid off from manufacturing are, on average, among the oldest displaced workers (Table C.2).

[23] For displaced workers, this classification corresponds to the layoff employer. For the non-displaced comparison sample, it corresponds to the employer in 2005Q1.

[24] While baseline enrollment rates are higher in other sectors relative to manufacturing, they are not so high in any sector that ceiling effects would be a plausible explanation for this difference (see Appendix Table A.1).

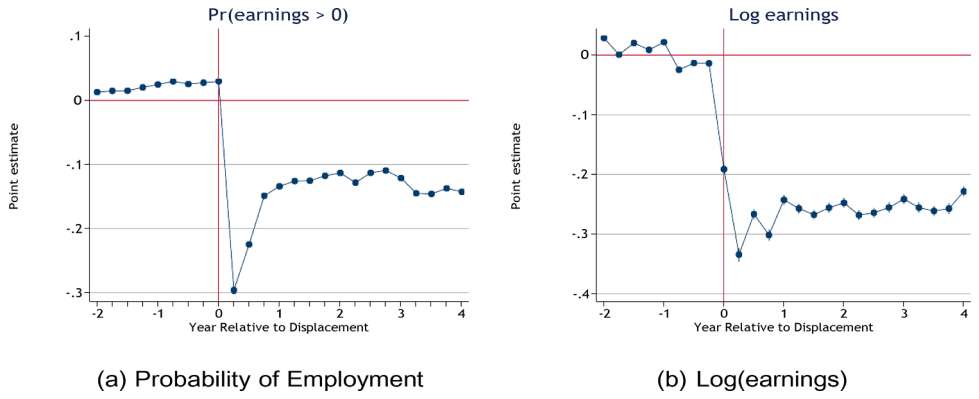

Fig. 1. Effect of Displacement on Employment and Earnings. *Note*: Figure plots the estimated effect of displacement on a worker's probability of being employed (panel a) and log of earnings (panel b) in a given quarter compared to a stably employed comparison group (always employed at same employer). Whiskers (very small) denote 95-percent confidence intervals based on standard errors clustered by worker. Displaced sample is laid off between 2002q1 and 2008q4.

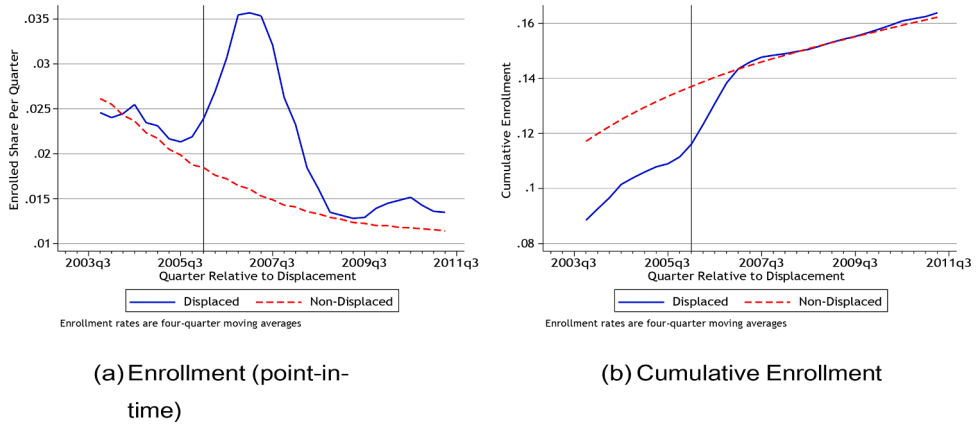

Fig. 2. Enrollment Rates of Displaced and Non-Displaced Workers
Note: Panels (a) and (b) plot the four-quarter moving averages of point-in-time and cumulative enrollment rates, respectively, for the cohort of workers displaced in 2006q1 and a comparison group attached to the labor force.

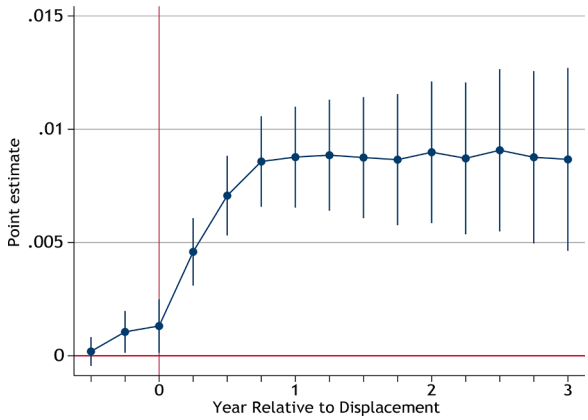

Fig. 3. Cumulative Effect of Displacement on Enrollment, Displaced 2002-2008. Note: Figure plots the estimated $\widehat{\delta}_k$'s from Eq. (1). Whiskers denote 95-percent confidence intervals based on standard errors clustered by worker. Displaced sample is laid off between 2002q1 and 2008q4. Coefficients with standard errors are listed in Table A.4.

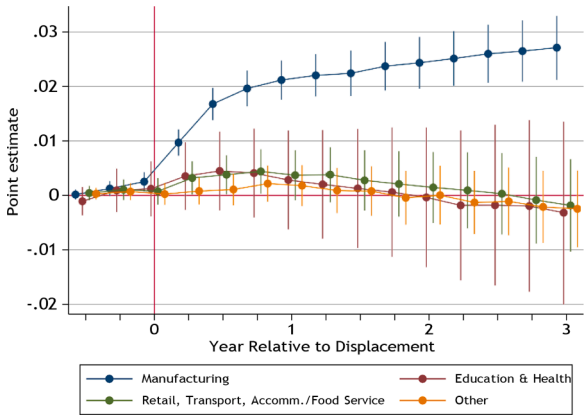

Fig. 4. Cumulative Effect of Displacement on Enrollment by Industry of Layoff. *Note*: Figure plots the $\widehat{\delta}_k$'s from Eq. (1) estimated separately for workers displaced from employers (or stably employed at) in manufacturing (23% of displaced and comparison workers), education and health services (24%), retail, transport & warehousing, arts and entertainment, accommodations and food services (20%), or other industries (33%). Point estimates and standard errors are listed in Appendix Table A.5.

difficult (Artuç et al., 2010).

Because employees displaced from manufacturing account for the vast majority of those who consequently enroll relative to the comparison group, we focus our subsequent heterogeneity analysis on these workers. Restricting to a more homogeneous set of workers in the same industry will allow us to better assess how enrollment responses to displacement vary along other dimensions. As Table 4 describes, these laid off individuals are much more likely to enroll in two-year

institutions than other displaced workers. Their most common fields of study are health, engineering, and business. At a national level, displaced manufacturing workers are older (average age at layoff is 44 years) and more likely to be male (62%). Over half have only a high school diploma or less (Table C.2).

It is well-documented that earnings increase with firm-tenure (and therefore age) (Brown, 1989; Topel, 1991). While we cannot observe age for all workers directly, displaced workers with lower within-firm earnings may be younger and have more years remaining in their careers. These lower-paid, often younger workers may find schooling a more attractive pursuit after losing their job than their higher-paid counterparts. Even holding age and other factors constant, one might expect workers with lower incomes to be differentially likely to pursue postsecondary education to increase their human capital and future earnings. This may be especially true in manufacturing, as the highest-paid workers are often engineers or production managers, whose positions require a bachelor's degree and whose skills may be in higher demand at other firms. Those who worked as former assemblers and machinists, positions that are less well-remunerated and don't require a college degree, may have fewer attractive destinations in the labor market. Therefore, we investigate whether the enrollment effect varies by a worker's position within the earnings distribution at her layoff firm.

We divide displaced and comparison manufacturing workers by tercile of earnings within the firm and apply Eq. (1).[25] Despite splitting the sample by within-firm earnings, we still control for a worker's pre-layoff earnings interacted with time. As Fig. 5 illustrates, the percentile of a worker's within-firm earnings strongly predicts college enrollment after layoff. Four quarters after displacement from a manufacturing firm, 4 workers per every 100 from the bottom tercile enrolled in college as a result of layoff, compared to just 2 and 1 from the middle and top terciles, respectively. Three years after layoff, the lowest-paid workers are still more than three-times as likely to have enrolled in college than those laid off from the top of the earnings distribution. The finding that lower-earning workers are more likely to enroll in college after displacement is robust to whether workers are divided into two or four groups (Appendix Fig. A.7).

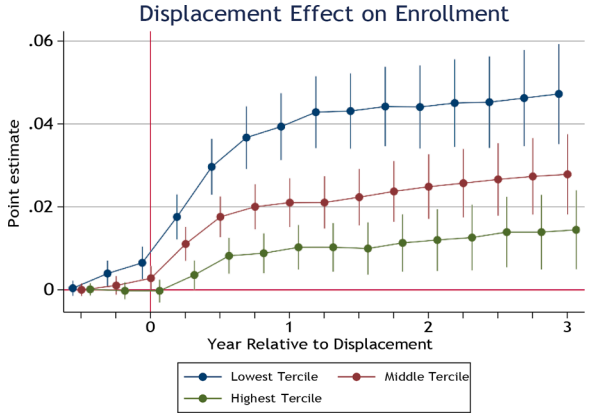

Fig. 5. Cumulative Effect of Displacement from Manufacturing on Enrollment by Earnings Tercile. *Note*: Figure plots the $\widehat{\delta}_k$'s from Eq. (1) estimated separately for displaced manufacturing workers with earning in the lowest, middle, and highest tercile of their firm at the time of layoff. The comparison workers are similarly split by wage tercile and include those who were employed at a manufacturing firm for at least three consecutive years. Displaced and comparison workers in the lowest, middle, and highest tercile comprise 20%, 35%, and 45% of the manufacturing sample, respectively. Point estimates and standard errors are listed in Appendix Table A.6.

We next investigate how job loss may have differential effects on enrollment patterns of manufacturing workers with varying proximity to public and for-profit colleges. We assign each displaced and non-displaced comparison worker a local labor market based on the county of her employer according to the Commuting Zone (CZ) scheme developed by Tolbert and Sizer (1996). CZs are clusters of counties that are characterized by commuting ties which are strong within-region and weak across regions. We then classify each of Ohio's seventeen multi-county CZs[26] as either high- or low-access in terms of higher education based on the number of institutions in the local labor market. We first designate high- and low-access CZs for public colleges, and then within this stratification we classify CZs by relative availability of for-profit institutions using data on location of for-profits from the Urban Institute's Education Data Portal in order to examine whether for-profit access may depress public enrollment.[27]

Because our data is limited to enrollment records at public universities, we cannot directly observe those who retrain at private institutions, including for-profit colleges. In 2009, for-profits accounted for 9% of nationwide enrollment in degree-granting schools. Deming et al. (2012) find that relative to other institutions, for-profits educate a larger fraction of minority, disadvantaged, and older students and more often grant degrees for short programs at the certificate and AA levels, suggesting they may be more prominent school avenues for displaced workers. Thus, displaced workers may seek retraining at easily accessible for-profits rather than public colleges. When Foote and Grosz (2019) estimate the enrollment response to mass layoff events, they do not find any statistically significant enrollment response at for-profit institutions (in contrast to their findings on public enrollment). However, their point estimate is still more than 50% as big as their estimate for public enrollment (1.5 for-profit enrollees per 100 displaced workers, versus 2.8 at public colleges), suggesting that for-profits may attract displaced workers at higher rates than they attract other types of students.

First, focusing on proximity to public institutions, we classify six CZs – Cincinnati, Cleveland, Columbus, Dayton, Portsmouth, and Toledo – as 'high-access' given they host at least 7 public colleges or universities. These CZs are home to employers which displace roughly 70% of the overall sample. Fig. 6 presents estimates from specification (1) when splitting the manufacturing sample by high- and low-public college access CZ. In the first post-layoff year, displacement induces roughly two workers out of every 100 to enroll in college regardless of their geographic proximity to public colleges. After three years, these estimates diverge slightly, as roughly 2.5 (3.5) workers of every 100 displaced in a CZ with high (low) proximity to public schools are induced to enroll. The fact that workers displaced in low-access CZs have slightly higher enrollment propensities after four years than their high-access counterparts may suggest a relatively stronger labor market for those displaced in the high-access CZs, which render retraining at a public college less critical. Nevertheless, the medium-run cumulative effect of displacement on enrollment follows a similar trajectory for both sets of workers: a strong push into enrollment in the first few quarters followed by two years of a gradually increasing effect. Further robustness checks at the county-level (rather than CZ-level) bolster the finding that

[25] A displaced worker is assigned an earnings tercile based on her earnings in the last full quarter before layoff. Terciles for a comparison worker are assigned based on earnings in 2005Q1.

[26] Two CZs – Huntington, WV and Parkersburg, WV – include only one Ohio county as they are mostly part of West Virginia, so we drop the small number of workers employed in these counties for geographic analysis.

[27] The Urban Institute's data combines information from Integrated Postsecondary Education Data System (IPEDS), the Department of Education's College Scorecard, and the National Historical Geographic Information System (NHGIS).

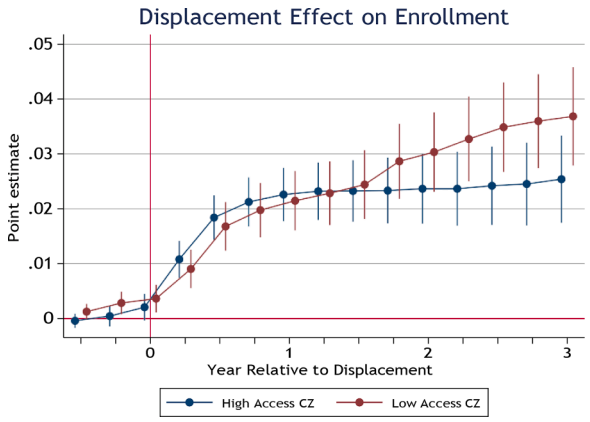

Fig. 6. Cumulative Effect of Manufacturing Displacement on Enrollment by Public College Proximity. *Note*: Figure plots the $\widehat{\delta}_k$'s from Eq. (1) estimated separately for workers displaced from employers located in high vs. low college access CZs. "High-access CZs" host 7+ public institutions (4-year universities, branch campuses, community colleges, technical colleges). Appendix Table B.1 lists each CZ's status as high- or low-access. Workers displaced in the Parkersburg and Huntington, WV commuting zones are excluded because they include only one Ohio county. Point estimates and standard errors are listed in Appendix Table A.9.

geographic proximity to public institutions does not strongly predict enrollment propensity (Appendix Fig. A.11).[28]

6. Discussion and conclusion

Although displaced workers who pursue postsecondary education realize appreciable earnings benefits (Jacobson et al., 2005a,2005b), we find that only a small share (1 in 100) of the displaced are induced to enroll in public college within four years of layoff. Workers are most likely to pursue higher education in the first post-layoff year, with the median enrollment spell lasting five semesters. Very few workers are induced into enrollment beyond the first few quarters post-layoff.

Our causal estimates are comparable to those from the limited empirical work on postsecondary enrollment patterns of displaced workers in other settings. Our baseline estimate that 1 out of every 100 displaced workers enrolls in college as a result of displacement is similar to Frenette et al. (2011), who estimate an effect of between 0.6 to 1.3 workers for every 100 displaced workers in Canada.[29] Our estimates are also in line with those from Foote and Grosz (2019), who estimate that for every 100 workers involved in mass layoff, 3 enrolled in a two-year college after three years.[30]

Our quantitatively-small estimate of displacement's effect on college enrollment, if anything, may overstate the true response we seek to measure. To obtain a causal estimate, we followed the displacement-earnings literature's long-standing approach by comparing the outcomes of our displaced sample's to those of a stably-employed control (Davis & Von Wachter, 2011; Jacobson et al., 1993; Lachowska et al., 2020). Our dynamic difference-in-difference model, which controls for individual-specific trends over time, assumes that displaced and comparison workers do not differentially deviate from these trends over time except for the effects of displacement. However, to the extent this assumption is violated (for example if some third factor contributes to both higher displacement and higher enrollment, or if employers displace workers they expect to enroll), this violation is likely to overestimate the enrollment response because workers in the continuously-attached comparison group exhibit such a high degree of employment stability that there could be less of motive for this group to seek postsecondary schooling at any point during their tenure. In addition, Ohio is more permissive than some states in allowing UI recipients to claim benefits while enrolled in college (Barr & Turner, 2015). While our sample is not limited to UI claimants, this is another factor that might lead our estimates to be larger than they would be in states with more strict policies for UI recipients.

A possible explanation for the magnitude of effects could be that those who do experience persistent employment and earnings declines following a layoff may also face greater financial constraints (Ganong & Noel, 2019), depressing college enrollment. Student aid policies and labor market policies – including UI – can play a role in determining how and whether displaced workers engage in postsecondary education (Barr & Turner, 2015). Information failures could also play a role if displaced workers are not aware of the aid available to them. During the Great Recession, the State of Ohio sent out letters to UI recipients proactively informing them of their eligibility for federal Pell Grants. Barr and Turner (2018) studied this policy, exploiting the idiosyncratic timing of when the letters were sent in different areas, and concluded that the letters significantly increased the likelihood of college enrollment.[31]

Finally, it is worth placing the magnitude of this finding in context of post-displacement employment patterns, which indicate that most displaced workers quickly return to other jobs. For example, Moore and Scott-Clayton (2019) estimate a 10–12 percentage point negative effect of layoff on likelihood of employment several years later using the same administrative data and displaced sample. It would be surprising for the share seeking retraining to be larger than the share remaining jobless in the years following separation. Because the upper bound of the baseline enrollment rates among stably-employed workers is no more than 17%, our effects translate to a larger relative enrollment boost among those with a low likelihood of enrolling. Still, interpreted along with other evidence, our results suggest that more work may be needed to ensure that college enrollment is an accessible option for displaced workers seeking to retrain.

Data Availability

The data that has been used is confidential.

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[28] In Appendix A.3, we also provide analysis of geographic heterogeneity with respect to for-profit and public colleges jointly. Further, we test other dimensions of heterogeneity which could have predictive power for workers' enrollment patterns, such as calendar-quarter of layoff, firm size, and firm shutdown status. In each case, roughly two per every 100 displaced manufacturing workers from various subgroups were induced to enroll in college.

[29] Frenette et al.'s (2011) estimates vary based on definition of displacement. Their definition most similar to ours (using mass layoffs to proxy for job displacement) yields estimates of 0.6% for males and 1.3% for females.

[30] Although Jacobson et al. (2005a) do not estimate a reduced-form effect of job loss on enrollment, the authors document that roughly 15% of displaced workers in 1990s Washington state later enroll in a 2-year community college. Although this is larger than our sample's post-layoff enrollment rate of 9%, the magnitudes of these descriptive patterns are reasonably aligned.

[31] Note, however, Ohio did not send letters to UI recipients until December 2009, after the displacement period of this analysis.

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