The Effect of Local Labor Market Downturns on Postsecondary Enrollment and Program Choice

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Abstract

We examine how workers invest in human capital following unanticipated local labor market downturns. We find that, on average, two-year college enrollment increases by three students within three years for every 100 workers laid off. This rise in enrollment accounts for half the observed increase in labor force non-participation following mass layoffs. Completions in career-technical programs also increase, especially in short-term certificates, but vary by field of study. We find that the effect on completions is strongest in fields of study with larger earnings returns.

(Keywords: human capital, postsecondary education, job loss, local labor markets)

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1 Introduction

The dynamics of worker adjustment following job loss have gained renewed interest in light of the recent Great Recession and declines in labor force participation (Council of Economic Advisers, 2016). Some workers regain employment quickly, but many exit the labor force. Recent work has documented some of the types of labor force exits of displaced and unemployed workers, including early retirement, enrollment in disability insurance, migration, use of opioid painkillers, and even playing video games (Aguiar et al., 2017; Krueger, 2017; Rege, Telle and Votruba, 2009; Coile and Levine, 2007; Blanchard and Katz, 1992; Foote, Grosz and Stevens, 2018).

One particularly important channel of response to labor market downturns is enrollment in postsecondary education. Workers who exit the labor force may experience significant depreciation in human capital over time, with permanent productivity and wage consequences (Albrecht et al., 1999; Görlich and De Grip, 2009). However, if these workers invest in retraining, their career prospects may improve. The federal government has invested many billions of dollars in worker retraining efforts over the past decades (Barnow and Smith, 2015; Eyster, Durham and Anderson, 2016), largely with this model of human capital investment in mind. Thus, it is important to understand to what extent workers enter postsecondary institutions in bad economic times and, crucially, what fields they study. To date, most of the research documenting the relationship between job loss and postsecondary enrollment has measured the aggregate effects of large macroeconomic shocks, or has focused on particular industries or workers. Much less is known about how acute local labor demand shocks affect the extent of human capital investment, as well as what fields new students study.

In this paper, we measure the extent to which enrollment in postsecondary education, especially at community colleges, acts as a channel for worker adjustment following job displacement. We focus on community colleges because they are a primary engine of worker retraining, especially for older and non-traditional students, who are the ones most likely affected by local economic downturns. We consider enrollment effects as well as the receipt of associate degrees and certificates. We group awards by field of study and duration, with a particular focus on how response magnitudes vary across various career-technical fields.

To measure the size of the local labor demand shock, we use counts of the number of workers in a labor market directly affected in mass layoffs. Mass layoffs, defined for our purposes as an event where at least 50 workers filed unemployment claims against a single establishment within a five-week period, are a large, acute shock to employment for workers. Using mass layoffs as a measure of local downturns is not subject to many of the methodological limitations common to studies of this kind.

This paper makes several contributions to the literature. We focus on effects at the two-year college level, in the spirit of influential analysis by Betts and McFarland (1995), but also go a step further and explore other key outcomes. Most importantly, we can separately estimate effects for completion in different fields of degree and certificate programs, such as health, information technology, and construction. Another contribution is our focus on the effect of local mass layoffs, which resolves many of the issues in the usual approach in this literature, which is to examine the effect of the unemployment rate on labor market outcomes. In previous work (Foote, Grosz and Stevens, 2018), we examined how job displacement caused labor force exit. A third contribution is that we conduct our analyses at the labor market level, and examine local shocks. Much of the literature on postsecondary enrollment examines the effect of macroeconomic shocks, but local shocks may have more direct effects on workers.

We find that, following mass layoff events, there is a marked increase in community college enrollment. Our main results suggest that for every 100 workers laid off, enrollment increases by three students within the next three years. Additionally, we find that for 100 workers involved in a mass layoff, there is an increase in degree completion of two students. When we examine different types of awards separately, we find that the bulk of this effect is concentrated among short-term certificates, as opposed to associate's degree programs. The implications of this work are more optimistic than those of recent studies showing the effects of recent economic declines on drug abuse, worker discouragement, and adverse health outcomes. We find that the increase in enrollment following a local labor market downturn accounts for at most half of the increase in labor force non-participation from these events. This suggests that, while many workers may well exit the labor force because they feel despair, a large portion do seek re-training in order to re-enter the labor force.

We also find that there is heterogeneity in the extent to which workers complete different programs following layoff events. There are much larger responses in career-technical fields than in academic fields focused on transfer to four-year colleges. Within career-technical fields, we find particularly large effects for degrees in construction and manufacturing, as well as certificate programs in allied health.[1] Overall, we find a positive correlation between a particular program's completion response to layoff events and its estimated earnings return, which we take as suggestive evidence that workers tend to re-train in high-return fields. Thus, our results suggest that when workers do enroll in college they aim to gain credentials in fast-growing fields that may lead to increased earnings.

Our findings suggest that there are a number of ways that policymakers may be able to encourage re-training that is beneficial after job displacement. First, more information needs to be available to inform potential students about earnings by field of study. Some progress has been made on providing this information at the state level, and the U.S. Census Bureau has recently started publishing earnings outcomes for a select group of institutions, but the information is not comprehensive.[2] Additionally, Xia (2016) shows that for-profit schools exhibit greater responsiveness to changes in demand than community colleges, while Grosz (2018) shows that community colleges do not expand nursing programs even though the social return is large. In recent years the federal government has invested more in training programs at the community college, with a specific focus on displaced workers. The Trade Adjustment Assistance Community College and Career Training Grant Program (TAACCCT), for example, shows early promising results (Durham et al., 2017). These and other programs are small, though, relative to the large number of individuals needing training either due to displacement or changes in the demand for specific occupations.

The rest of this paper proceeds as follows. Section 2 reviews the previous literature on the topic, and Section 3 discusses our data. To motivate our analysis, Section 4 presents aggregate trends in postsecondary enrollment and degree receipt, as well as the geographic variation in postsecondary enrollment. Section 5 outlines our research design, while Section 6 presents our results. Section 7 concludes and discusses potential directions for future work.

[1] Examples of allied health programs include medical and nursing assistants, dental hygienists and assistants, emergency medical technicians, and radiologic technologists.

[2] The Post-Secondary Employment Outcomes data are available at `https://lehd.ces.census.gov/data/pseo_beta.html`.

2 Literature

A large literature has shown the adverse effects of job loss on workers. Jacobson, LaLonde and Sullivan (1993) show that workers involved in a mass layoff lose about 25 percent of their earnings over the next six years. Additionally, Stevens (1997) shows that much of this effect can be explained by individuals losing subsequent jobs, effectively compounding the adverse effects. However, recent literature has shown that while the mean effect of job loss is quite negative, the dispersion of outcomes for displaced workers is large and can even be positive. Fallick, Haltiwanger and McEntarfer (2012) find that for workers that separate from distressed firms and experience 4 or more quarters of non-employment, more than 25% of workers experience positive earnings growth. One potential channel for this growth is that workers increase their human capital accumulation following a separation and non-employment spell, ultimately leading to higher earnings.

There is also a growing literature documenting labor force exit following adverse labor demand shocks. Autor, Dorn and Hanson (2013) show that workers in areas experiencing lower labor demand because of increased trade competition drop out of the labor force at higher rates than workers in areas not exposed to this competition. Foote, Grosz and Stevens (2018) find that following a mass layoff, about half of the adjustment in labor force size is due to non-participation. Yagan (2017) also shows that non-participation was particularly important in the Great Recession.

There is also strong evidence that postsecondary enrollment is counter-cyclical. Betts and McFarland (1995) find that unemployment rate increases of one percentage point lead to enrollment increases of four percentage points, and recent work uses similar designs (Hillman and Orians, 2013; Nutting, 2008; Clark, 2011).[3] Additionally, recent evidence shows that enrollment in the two-year and four-year sectors increased considerably due to the Great Recession (Barrow and Davis, 2012), and that enrollment in community colleges is particularly sensitive to labor demand changes due to globalization and offshoring (Hickman and Olney, 2011). However, there is much less evidence on whether the content of what people study is affected by downturns. Nutting (2008) finds that career technical enrollment is more responsive to labor market conditions than academic enrollment at one large public university, while Blom, Cadena and Keys (2015) find that students

[3] It should be noted that Betts and McFarland (1995) only use regional unemployment rates, which do not capture the local labor demand conditions.

are more likely to enroll in STEM fields during a recession, especially for female students.[4]

Recent work also examines the skill upgrading of displaced workers. Barr and Turner (2015) find that longer unemployment insurance duration and more generous unemployment insurance policies increase the likelihood of individuals to enroll in postsecondary education. Jacobson, LaLonde and Sullivan (2005*a*,*b*) use administrative data from Washington and find that workers who enroll in schooling following a job loss have increased earnings, even for older workers, but that these earnings gains are concentrated in specific fields.

There is also growing interest in how postsecondary institutions themselves act as economic agents, and whether they respond to local changes in labor demand. This interest is partially related to the rise of two-year for-profit colleges, leading to concern about competition between the public and the private sector (Deming, Goldin and Katz, 2012; Cellini, 2009, 2010).

3 Data

This section outlines the main data sources that we use for the analysis. While all the data we collect is reported at the county or sub-county level, we aggregate the data to the commuting zone level (Tolbert and Sizer, 1996). Commuting zones approximate the boundaries of a local economy according to commuting patterns, thus reducing the likelihood of confounding spillovers due to local migration and commuting. Moreover, because commuting zones are aggregations of counties, they are straightforward to use with publicly provided data.

In our context, the use of commuting zones is useful for two other reasons. First, while community colleges likely draw students from the local area, students also likely often cross county lines to attend college. This is especially probable in labor markets where counties are small. Second, many counties do not have any postsecondary institutions. Limiting the analysis to these counties would lead to biased results, since workers in counties with colleges are likely systematically different than those in counties without colleges. On the other hand, states are too large a definition of a local labor market, especially since two- and four-year colleges tend to draw

[4]A growing number of papers using natural experiments focus on educational impacts of natural resource booms (Basso, 2016; Black, McKinnish and Sanders, 2005; Morissette, Chan and Lu, 2015; Cascio and Narayan, 2015),[5] though most consider the high school dropout margin as opposed to the college enrollment decision.

students locally.[6,7]

3.1 Mass Layoffs

We use mass layoff events as our key measure of local labor market downturns. Between 1996 and 2013, the Bureau of Labor Statistics (BLS) compiled monthly reports on layoffs by observing the initial claims for unemployment insurance filed by workers. The BLS identified a mass layoff event when more than 50 workers filed claims against a single establishment within a five-week period. For these events, the BLS contacted the establishment to determine whether these workers experienced a layoff of at least 31 days.[8] We use these data to quantify the size of a local labor demand shock at the county level. The data are reported by county of residence and so, for each county, we measure the number of workers residing in that county who were involved in a mass layoff in a given year. These county-level data are reported at an annual frequency, and therefore our analysis is at an annual frequency as well. We aggregate these county-level counts to the commuting zone level.

3.2 Education Data

Our data on enrollment and degree receipt come from the Integrated Postsecondary Education Data System (IPEDS), from the U.S. Department of Education National Center for Education Statistics. IPEDS data includes extensive information for all institutions of higher education that participate in federal financial aid programs, as well as some that may volunteer their own data. We focus on two measures of enrollment, overall and first-time fall enrollment counts.[9]

The data in IPEDS also include information on awards, both degrees and certificates. We focus on associate's degrees and two types of certificates: one-to-four year certificates and certificates requiring less than a year.[10] We examine degrees and certificates in the aggregate and by broad

[6]Bettinger and Long (2009) find that, in Ohio, the median distance between home and four-year college was 26 miles, and over half of students lived within 50 miles; we expect that this is an upper bound for community colleges.

[7]There are a few commuting zones that span multiple states, but it represents less than 20% of the commuting zones.

[8]The data we use for this paper is technically tabulates "extended mass layoffs"; throughout the paper, when we use mass layoffs, this is the measure to which we are referring.

[9]First-time enrollment is defined as the first time a student enrolls at any university or college.

[10]There is also information on bachelor's degrees and graduate degrees, but these are not relevant to the margin we are studying. Bachelor's degrees at community colleges are a small and relatively new phenomenon. There are also data on enrollment and degree by age, but it is only required to be reported in some years, and so the data are not reliable.

field of study.[11] To further simplify, we categorize certain fields of study as "career-technical," based on U.S. Department of Education classifications. IPEDS data also provide address data for every year for all institutions. We match each institution with its commuting zone and, thus, the number of layoffs in the local area.

Other work has discussed the drawbacks of using the IPEDS to measure the activity of for-profit sub-baccalaureate institutions (Cellini, 2005, 2010). In particular, IPEDS tends to undercount these institutions, and is not always accurate in determining their location, which is crucial for our analysis.[12] This data limitation may affect results over time, as distance and online-only education has been secularly increasing as a share of enrollment, especially for sub-baccalaureate degrees. We present results separately for for-profit colleges, with the caveat that they may be subject to measurement error.

3.3 Other Data

We supplement these main sources of data with additional information on county demographics. We use age, gender, and racial composition information from the Surveillance, Epidemiology, and End Results (SEER) program of the National Cancer Institute. We also use the SEER data to calculate the size of the working age population (ages 16-65). Additionally, we use the Local Area Unemployment Statistics (LAUS) from the BLS in order to measure the size of the labor force and the unemployment rate in the county.

4 Descriptive Evidence

4.1 Trends in Post-Secondary Enrollment and Degree Receipt

To better understand how college enrollment responds to macroeconomic conditions, and how college-going rates vary geographically, in this section we present enrollment trends over our study period, with a particular emphasis on the dynamics of the community college sector.

[11] All awards are categorized by their Classification of Instructional Program (CIP) codes maintained by the U.S. Department of Education National Center for Education Statistics (NCES) and updated periodically. There are over 1,300 CIP codes. To simplify matters, we group them into broader categories. Appendix Table A1 shows the grouping of CIP codes we use.

[12] Cellini and Goldin (2014) estimates that IPEDS undercounts for-profit schools a factor of two.

Figure 1 shows first-time enrollment from 1996 to 2011, disaggregated by type of institution (4-year, 2-year public and 2-year private). Two-year public enrollment increased markedly in the two most recent recessions, shown as shaded bars. In contrast, four-year enrollment has been secularly increasing since the beginning of our period, with no visible changes in the trend in response to business cycles. Also, while 2-year for-profit schools have received increasing scrutiny, they make up a small portion of enrollment in IPEDS.[13]

There are also regional differences in postsecondary and community college enrollment, as shown in the maps in Figure 2, which display postsecondary enrollment by commuting zone.[14] Panel (a) of Figure 2 shows enrollment as a share of population in the CZ, and panel (b) shows community college enrollment as a share of total enrollment. There is some geographic variation in enrollment in postsecondary institutions across the country, though no particular pattern stands out. The variation in the community college share of postsecondary enrollment, though, is particularly striking. The West Coast and Southeast have large community college shares, as do parts of the Midwest. In fact, the strong correlation between community college enrollment and distance to the nearest institution is an often-used instrument for enrollment patterns in this literature (Rouse, 1995; Xu and Jaggars, 2013; Long and Kurlaender, 2009).

There are also significant geographic differences in field of study. Figure 3 displays the share of overall community college awards in a few large fields of study. While career-technical education is concentrated in the Rust Belt, there is regional variation in the particular types of programs. For example, childcare and cosmetology are concentrated in the South and in Southern California. On the other hand, health programs are much more broadly represented.

Overall, it is clear that community college enrollment is correlated with macroeconomic labor market conditions, and that career-technical education is an important piece of this response. In addition, there are considerable regional differences in educational access, enrollment, and attainment in the cross-section as well. We harness both of these levels of variation to estimate the causal effect of local economic shocks on two-year college enrollment and receipt of degrees and certificates.

[13] IPEDS does not cover the for-profit sector nearly as well, as noted in Section 3.

[14] As with our empirical estimates, we choose to display statistics at the commuting zone level, because many counties have no postsecondary institutions, and individuals could easily attend a school in an adjacent county. For presentation purposes, Hawaii and Alaska are not included in the maps, but they are included in the analyses.

4.2 Sample Summary Statistics

Table 1 displays summary statistics for the main variables we use for the analysis, for the years 1996-2013, at the commuting zone level. On average, almost 1,500 workers per year were laid off in mass layoff events in each commuting zone. This represented around 0.6 percent of the labor force each year. Additionally, mass layoff intensity varies a lot within a commuting zone year-to-year; the within-CZ standard deviation of mass layoff rate is 0.3 percent, which is half of the size of the mean.

In each year approximately a fifth of commuting zones had layoffs of over one percent of the labor force, while two percent of commuting zones had particularly large shocks of over five percent of the labor force laid off.

Commuting zones have an average of between two and three community colleges, and around twice as many for-profit, two-year schools. Although there were more for-profit than public two year colleges, community colleges represented the lion's share of two-year college enrollment.

A number of commuting zones had no community colleges or for-profit two-year colleges; these commuting zones are almost exclusively in rural areas, while in a large share of commuting zones—37 percent—two-year colleges represented the only type of postsecondary institution. Given that laid-off workers likely seek to retrain closer to home, this fact provides further motivation for focusing on the community college sector, which primarily draws students from nearby (Rouse, 1995).

The last rows of Table 1 show the distribution of the content of degrees and certificates across broad programmatic areas. Forty percent of awards were in career-technical fields. Of these, a quarter were in construction and manufacturing fields. An even larger share of awards were in health fields such as nursing, medical assisting, and various medical technologies such as radiology or respiratory care therapy. Only three percent of awards were in information technology, and even fewer in cosmetology and childcare.

5 Methodology

In this section we describe our empirical strategy for estimating the effect of local labor market downturns on postsecondary enrollment and completions. We first discuss the use of local mass layoffs as a measure of labor market downturns, and how it improves upon using the unemployment rate, which is common in this literature. We then describe the main estimation equation.

5.1 Mass Layoffs and the Unemployment Rate

Much of the previous literature on local labor demand and post-secondary enrollment uses unemployment rates as the measure of labor market conditions (Betts and McFarland, 1995; Hillman and Orians, 2013; Clark, 2011). Using unemployment rates introduces a number of possible biases into the estimation. First, this type of analysis is normally done at the state level, which may be too broad a definition of a local labor market. On the other hand, unemployment rates are measured with significant error at lower levels of geography, such as counties (Hoynes, 2000; Bartik, 1996; Lindo, 2015). Second, the unemployment rate captures both labor supply and labor demand changes (Bartik, 1996). Third, changes in the labor force, such as postsecondary enrollment, are mechanically related to the unemployment rate: an increase in full-time enrollment means a decline in the size of the labor force, the denominator of the unemployment rate.

Using mass layoffs as a measure of labor market shocks addresses many of the issues with the unemployment rate, for a number of reasons. First, while a change in educational enrollment will mechanically reduce the unemployment rate over time, enrollment does not similarly affect mass layoffs. Second, because the BLS data on mass layoffs are based on administrative records of individual firms, they do not suffer from the same small area estimation problems as county level unemployment rates. Therefore, because the sources of data are distinct, any measurement error present in the mass layoffs data - which arises primarily from coverage issues - is likely unrelated to measurement error in the local unemployment rate - which arises from small area estimation problems. Third, any measurement error present in the mass layoffs data is most likely uncorrelated with the measurement error in the local unemployment rate. Lastly, as we discuss in more detail a later section, mass layoffs represent an acute, permanent, and plausibly exogenous shock that comes from a decrease in local labor demand (Foote, Grosz and Stevens, 2018).

Not surprisingly, however, the unemployment rate and mass layoffs are highly correlated. A regression of the unemployment rate on the mass layoff rate over the period we study has an F statistic of 15. [15] For the main analysis, however, we focus on the reduced form effect of mass

[15] With such high first stage power, one potential approach to take is to use the rate of mass layoffs as an instrument for

layoffs on educational outcomes, which allows us to estimate how the number of jobs lost translates into individuals enrolling in community college.[16] As noted earlier, the BLS Mass Layoff Statistics represent separations that resulted in 50 or more unemployment insurance claimants. Thus, they are a good measure in our setting precisely because they account for workers who lose their job, do not find work, and apply for unemployment benefits.[17] In other words, the number of workers involved in mass layoffs represent a group for whom job re-training is potentially the most advantageous.

5.2 Main Methodological Approach

Our goal is to measure the effect of local economic shocks on the educational behavior of individuals. We estimate the effect of mass layoffs on enrollment in postsecondary education. We estimate an elasticity, and allow mass layoffs to impact enrollment in more than one period, since it takes workers time to adjust. To do so, we estimate the following equation:

$$y_{ct} = \sum_{i=1}^{3} \beta_i m_{c,t-i} + \Theta X_{ct} + \gamma_c + \eta_t + \xi_c * t + \epsilon_{ct} \tag{1}$$

Where y_{ct} is the logged value of one of our outcomes of interest, either enrollment or awards, while m_{ct} is the logged number of workers directly affected by mass layoff events in commuting zone c in year t. In our preferred specifications, we include three lags of the mass layoffs, because even if enrollment effects are immediate, degree receipt takes time.

In the matrix X_{ct} we include a set of time-varying measures of local characteristics: age, gender, and race/ethnicity. We include commuting zone fixed effects, γ_c, to account for systematic, time-invariant differences between commuting zones, and year fixed effects, η_t, to control for national trends. We also include commuting zone specific linear time trends, $\xi_c * t$, and discuss their

the unemployment rate. We show these results, along with the OLS version, in Appendix B.

[16] A commonly used instrument for the unemployment rate to isolate labor demand shocks is the shift-share or "Bartik" instrument (Saks and Wozniak, 2011; Bound and Holzer, 2000), which leverage pre-existing area-specific industry structure and changes in industry outcomes at the national level. There are a number of reasons why such a method is likely inadequate in the context we study. First, these instruments do not usually give intuition on the size of a shock relative to the local labor force. More importantly, the shift-share instruments are better suited to identifying long-run structural shocks, as opposed to the transitory, acute impact of layoffs that we study in this paper. Moreover, Bartik demand measures combine local industry structure with trends in national product and labor demand. Education may respond to both local and national business cycle conditions, but here we focus on local measures, so it is not desirable to combine local and national conditions in a single measure.

[17] Most states allow displaced workers to collect unemployment benefits while enrolled in school, since it falls under re-training. For more on these policies, see Barr and Turner (2015).

importance below. All regressions are weighted by the local labor market's lagged total population. To address the fact that mass layoffs may be correlated within a commuting zone over time, we cluster our standard errors at the commuting zone level.

A key element of our main estimating equation is that the coefficient β_i is identified off deviations from labor market-specific linear time trends $\xi_c * t$. Including these trends is important: their inclusion controls for long-run changes in economic conditions in commuting zones that are not unanticipated shocks to labor demand. If a labor market's economy is consistently declining, for example, an increasing number of layoffs is likely and expected, which would lead workers to obtain training before the layoffs occur. Inclusion of trends allows us to identify the effect of unanticipated layoff events. A second reason to include trends trends is to control for long-term patterns in enrollment and degree receipt. In particular, the demographic composition of certain areas are likely changing over our time period, making the area's population increasingly more or less likely to attend postsecondary institutions. Not controlling for these differential demographic changes would confound the effect of mass layoffs with demographic changes. The identifying assumption of equation 1 is that the number of workers laid off in a mass layoff event is exogenous conditional on labor market and time fixed effects, as well as the labor market trends.

One feature of our approach is that we estimate equation 1 at an aggregate level, as opposed to using individual-level data on job loss. Thus we are unable to assert that the workers losing their jobs are exactly the individuals enrolling in postsecondary institutions: it may be the case that other workers are responding to slack labor market conditions and choosing to enroll in school. Additionally, there is a possibility that some students are affected because their parents lost their jobs, and choose to enroll in community college as a less expensive alternative to a four-year college (Hilger, 2014). For this to be a large portion of the effect, we would expect a commensurate decline in four-year school enrollment. We do not find such an effect when estimating equation 1, which limits our concern about this issue.

As shown in much of the prior literature, there is a dramatic migration response to local economic downturns (Blanchard and Katz, 1992). While we do not explicitly estimate it here, in related work using a similar empirical design we find a migration response to mass layoffs as well (Foote, Grosz and Stevens, 2018). If some students are being induced to move across labor markets following economic shocks, this will reduce our estimates of β_i. In that sense, our estimates are a lower bound for the the effect of mass layoffs on the educational enrollment of students who remain in the labor market.

6 Results

6.1 Event Study Evidence of Exogeneity

Before showing the main results, in this subsection we present evidence to further motivate our use of mass layoffs as a labor demand shock. Our main estimation strategy is based off deviations from commuting zone trends, and thus we cannot visually show evidence of parallel trends as is common in a difference-in-difference approach. Instead, here we focus on commuting zones that experienced particularly large layoff events throughout the time period. The event study analysis mimics the overall estimation strategy, showing suggestive evidence that these acute shocks to the labor market were not preceded by long-term declines in our outcomes of interest.

We focus the analysis on the subset of commuting zones where at least one percent of the labor force was laid off in mass layoff events throughout the time period. We limit the sample in this way to facilitate the event study approach. We then estimate the following event study model:

$$y_{ct} = \alpha + \sum_{\substack{\text{i=-4} \\ \text{i}\neq 0}}^{3} [\beta_i \mathbb{1}(t - T_c = i)] + \delta_t + \gamma_c + u_{ct} \tag{2}$$

We define T_c as the year the labor market experienced layoffs of at least one percent of the labor force, and thus the indicator $\mathbb{1}(t - T_c = 1)$ takes a value of one when the observation is i years from $T - c$. We omit the dummy for $i = 0$, so all coefficients are relative to the year of the event. We include controls for year and commuting zone.

Figure 4 shows the resulting coefficients and 95 percent confidence intervals for total fall enrollment, first-time fall enrollment, and total awards. The main objective of the analysis is to show evidence of a flat trend prior to the event, which is clear from all three panels of the figure. There do appear to be positive effects after the event, which we describe in more detail in the next subsections. However, this figure shows visual support for our use of mass layoffs as an indicator of local labor market shocks.

6.2 Enrollment and Completions

Table 2 shows results for first-time enrollment. We include three lags of the log layoffs variable, and also compute the total effect as the sum of the three lagged coefficients. Table 2 shows how our main result changes when adding controls. Column 1 just includes the lags of logged mass layoffs. Adding CZ and year fixed effects lowers the effect significantly in Column 2. Inclusion of demographic controls in Column 3 has little effect on the coefficients. Columns 4 and 5, however, include commuting zone specific trends, which we argued previously are crucial for the identification strategy. Controlling for these trends does not dramatically change the first and second lag, but does make the third lag no longer statistically significant. We calculate F-statistics to test the joint significance of the trends in the regressions; these tests are always highly significant, with p-values well under 0.001, which suggest that it is important to control for trends in our specifications. We also show in the final column that our results are unaffected when we omit controls for demographics. These main results show that there is a positive immediate response in first-time community college enrollment following a layoff event: a one percent increase in the number of workers laid off leads to a 0.025 percent increase in first time students the following year and an additional 0.018 percent increase after two years. For the rest of the analyses we use the specification in column 4 as our preferred specification.[18]

Table 3 shows results for the main outcomes using our preferred specification with demographic controls and commuting zone specific trends. The top panel shows results for community colleges and the lower panel shows the same specifications for for-profit colleges. The first column shows that a one percent increase in the number of workers laid off leads to an insignificant 0.01 percent increase in community college enrollment, with a smaller effect in subsequent years. The second column displays fall enrollment just among first-time students, which we showed earlier. We expect this response to be more pronounced than for overall enrollment, because overall enrollment includes continuing students. Indeed, the estimates in the second column of the table are almost twice as large, and the second lag is also larger and statistically significant. Additionally, this estimate likely understates the total response because it only counts students who have never attended any post-secondary institution.

[18]We present results with all the specifications for the other main outcomes in Appendix Table A4.

The second panel of the table shows estimates for for-profit institutions. The point estimates are similar in magnitude, but the confidence intervals do not allow us to rule out large negative effects. While the for-profit sector is a fraction of the size of the public sector, and is likely underrepresented in the IPEDS data, this is nevertheless suggestive evidence of a response. Given our lack of precision in these estimates, as well as restraint in the general literature on relying too much on for-profit college statistics in the IPEDS data, we focus on community colleges for the remainder of the paper.

The next four columns of Table 3 explore the effect of layoff shocks on degree receipt. We expect the measured effects to be more muted than for enrollment, because of high attrition rates in the two-year sector, as well as the lag between enrollment and degree completion (Calcagno et al., 2008). Still, the third column shows that degree and certificate receipt does respond to layoffs. A one percent increase in layoffs results in a 0.017 percent increase in community college awards within three years. There is a smaller effect at the for-profit level. We find no evidence of an increase in total associate's degrees following layoffs but, perhaps not surprisingly, there are larger effect are for smaller certificate programs that take less time to complete. These programs also have fewer general education requirements than associate degree programs.[19]

The timing of the award response is consistent with the length of time required to finish these programs. For example, the effect on the completion of associate's degrees, which take approximately two years of full-time study, is concentrated in the two-year lag, although not statistically significant. Completion of certificates is evenly distributed across all years.

The main result from Table 3 is that there is a positive and statistically significant effect of mass layoffs on enrollment and completion in community colleges. To scale these effects, consider a commuting zone at the mean of the mass layoffs distribution. For 100 workers involved in a mass layoff in this commuting zone, our estimates suggest that first-time enrollment increases by approximately 2.8 students within three years. Moreover, eventual degree receipt increases by 1.9 students over the same period.

In related work using a similar methodology, sample, and time period, we find that a one percentage point increase in the share of the labor force laid off leads to a 0.2 percentage point decrease in the size of the labor force, of which only half can be explained through observable

[19] While it may seem counterintuitive that the shortest certificates show effects after two years, Ma and Baum (2016) look at graduation and certificate completion, and find that only 20% of certificate-seekers complete in 150% of the time to degree.

channels such as migration, retirement, and enrollment in disability insurance (Foote, Grosz and Stevens, 2018). Our results on enrollment suggest that about half the workers exiting the labor force not through these channels are accounted for by increases in community college enrollment.

In these results, as well as in the ones in the next subsection, our sample changes slightly based on the outcome, because some commuting zones do not have institutions that offer certain programs or certain types of degrees or certificates. When we run our results on a consistent set of commuting zones, our results are very similar.[20]

In Appendix Table A2 we repeat the same analysis for four-year college enrollment and bachelor's degrees. These colleges, especially ones that offer online degrees or are non-selective, may be an alternative to two-year colleges for laid off workers, and thus by just focusing on two-year colleges we may be underestimating the effects. However, we find small estimates that are not statistically significant.

6.3 Field of Study

Next we estimate the differential responses for degree and certificate production by field of study. For this analysis we focus exclusively on awards at community colleges, and exclude for-profit colleges. Ideally, we would be able to observe enrollment in different types of degree and certificate programs. Identifying which student is enrolled in a particular program, though, is particularly difficult (Belfield, Scott and Zeidenberg, 2015). We can only observe completion by program of study, which incorporates a certain measure of endogenous differences in completion rates. Nevertheless, in all cases we expect our estimates of the effect of mass layoffs on program-level completions to be an underestimate, both in terms of the absolute magnitude as well as in the speed of response. Thus, we believe measuring completion can shed light on how workers are responding to displacement.

Figure 6 shows the coefficient and confidence interval for the total effect summed over three lags. The first bar of Panel (a) in Figure 6 shows the aggregate award response. These awards encompass career-technical programs as well as academic programs for students aiming to transfer. In the second and third bars we split out the academic and career-technical programs. Not surprisingly,

[20] Additionally, for our main results we only include institutions that are consistently in the sample; some institutions only report in certain years, which causes spurious changes in enrollment and degree counts.

the results are higher and also statistically significant for CTE awards overall, given that displaced workers are likely to enroll in these programs in order to upgrade their skills.

The next five bars of panel (a) further disaggregate the career-technical awards by the specific content of the programs. We find a large though marginally significant increase in the production of awards in construction and manufacturing fields following layoffs. This is perhaps surprising given the contemporaneous decline of manufacturing. However, there are a few potential explanations. First, workers laid off in mass layoff events are more likely to be in manufacturing and production fields, making them also more likely to retrain in manufacturing fields. Second, aggregating all programs of this type ignores the fact that much of the response may be in certain high-growth areas. In fact, in recent years funding from large federal programs such as Trade Adjustment Assistance (TAA) and the Workforce Investment and Opportunity Act (WIOA) has gone specifically to high-tech manufacturing programs (US Department of Labor, 2014; Eyster et al., 2017). We return to this issue in the next subsection.

Panels (b), (c), and (d) of Figure 6 disaggregate the various awards by their type, which reveals heterogeneity in response beyond the lack of positive effects overall. We find strong effects for short-term certificates in health, as opposed to associate's degrees or even long-term certificates. Short-term certificates grow almost 0.06 percent in the first year following a one percent increase in layoffs, and a similar size in the following year. These short-term certificates are generally for medical assisting, nursing assisting, and related fields. Prior research has found that employment in these occupations is highly countercyclical (Stevens et al., 2015; Baughman and Smith, 2012),[21] and our results suggest that training for these occupations is also counteryclical. On the other hand, it is not surprising that we find little effect for associate's degree and long-term certificates programs. These programs tend to be oversubscribed and face large capacity constraints, so it is unlikely that additional student demand following layoff events would lead to increases in enrollment and completion in these programs (Kuehn, 2007).

We find a similar pattern for awards in construction and manufacturing. There is no effect on associate's degrees, but we do find positive responses for long certificates. There is no effect, however, on short-term certificates in construction and manufacturing.

[21] There are many reasons for why employment in these occupations is countercyclical: they tend to be low-income, provide low-benefits, with high turnover, low job stability, and high levels of stress (Banaszak-Holl and Hines, 1996; Yamada, 2002).

For information technology programs the main effect seems to be concentrated in increases in associate's degree completions, although the magnitudes are similar for 1-4 year certificates. In contrast, the only result that is significant for public and protective services is for 1-4 year certificates, which is large and statistically significant. However, these awards represented a particularly small fraction of overall awards, so while the effect is large, its importance is less clear. For other award types in public and protective services the coefficients are small and not statistically significant.

Finally, we examine the personal and family fields.[22] Overall, we find negative and statistically insignificant results. However, we do find an increase in certificates that is statistically significant. This, as with public/protective services, is somewhat of a red herring: this group of awards represents a small share of total certificates in this category. Most of these awards require less than a year of study, for which we find small and statistically insignificant results.

Appendix Table A3 shows coefficients for each of the three lags that we sum up to construct these figures. Most importantly, the individual lag coefficients provide evidence on the timing of the responses by field of study and length of program. In particular, completion in short-term certificates occurs within one or two years of the layoff event. The only exception is for long health certificates. This makes sense, since these are often highly sought-after programs, which might have a waitlist or additional prerequisites.

6.4 Degree Receipt Response by Expected Earnings Returns

So far, we have documented heterogeneity in the educational production response to mass layoffs that depends on field of study. An important question is whether the fields that see the largest responses are the ones with the greatest earnings potential. A number of recent papers have measured the labor market returns to different community college programs and found a great deal of heterogeneity across field of study (Stevens, Kurlaender and Grosz, 2018; Jepsen, Troske and Coomes, 2014; Liu, Belfield and Trimble, 2015). However, how students select into different programs of study is still an open question: there is limited evidence that four-year college and community college students incorporate expected earnings returns into their choice of field (Baker

[22]We examine these two types of programs together because they are both lower-skill service occupations with low economic returns.

et al., 2017; Arcidiacono, Hotz and Kang, 2012; Wiswall and Zafar, 2015). Thus, it is important to understand whether, when faced with weak employment prospects, workers sort into fields with high earnings potential.

For this exercise we estimate our main results for programs at the four-digit CIP code level, which is a much more detailed description of programs than the two-digit codes we display in Figure 6. We then match these four-digit CIP code results to program-level earnings returns in Stevens, Kurlaender and Grosz (2018), who use comparable four-digit program codes.[23] Most of the CIP codes match to the coefficients reported in Stevens, Kurlaender and Grosz (2018), but in cases where there is no observed coefficient we do not estimate a layoff response. Stevens, Kurlaender and Grosz (2018) disaggregate degrees based on units required, while we only have years required for certificates (one to four years or less than one year). To harmonize these definitions, we average the 30-59 and 18-29 unit effects from their paper and treat that as the estimate for the one to four year certificate.

Figure 7 shows a scatter plot of the layoff response magnitudes (vertical axis) with the estimated return for that field and degree (horizontal axis). In panels (a) and (b) of Figure 7 the size of the dots correspond to the product of the average annual completions in that field and award type nationwide and the inverse of the standard error from our estimate.[24] Panel (a) shows that there is a weak yet positive correlation between the measures: a regression line through these data has a coefficient of 0.019 (0.016). In panel (b) we omit all statistically insignificant estimates of earnings returns. This leads to a relationship that slightly larger in magnitude and more precisely estimated, with a coefficient of 0.032 (0.015). Panels (c) and (d) show the same data, with the dots in different colors corresponding to the type of degree or certificate. The positive association between earnings returns and completion effects following layoffs is not necessarily limited to a particular type of award: degrees and certificates all had positive associations even though degrees tended to have larger earnings returns than certificates.

These analyses show that there are considerable differences in the field of study workers enter following local downturns, and suggestive evidence that there are larger responses for fields with higher labor market returns. This is an optimistic finding for those concerned about the role

[23] The estimates in Stevens, Kurlaender and Grosz (2018) come from California community colleges, though the results are broadly similar to estimates in other states (Belfield and Bailey, 2017).

[24] Thanks to an anonymous referee for this suggestion; this approach gives more weight to more precise estimates.

community colleges play in helping labor markets adjust in the long term. However, one broader concern is that students may not be able to enroll in high-demand, high-return programs if these programs are capacity constrained, which means the true demand for these programs is actually higher. We also do not measure the job security of these fields, which may be another important outcome over which students maximize. We leave these questions for future research.

6.5 Other Findings

Given previous work that finds larger non-participation responses during the Great Recession, we may expect larger enrollment effects in this period. To estimate the size of the difference, we allow the effect of a mass layoff to differ for the years before and after the start of the Great Recession in 2007. Our results, in Table 4, show minimal differences between the two periods, which suggests that the increased non-participation did not result in larger enrollment responses.[25] However, one reason for this effect may have been decreases in availability of community college, as funding levels fell during the Great Recession. Another explanation for this result is that the IPEDS data does not capture online degrees or enrollment. To the extent that enrollment in these types of programs has been secularly increasing, the estimates for the later period may be a lower bound on the true effect.

As discussed earlier, there is considerable variation across the country in the availability of community colleges. This presents an important source of heterogeneity: individuals in areas with fewer colleges may be less likely to enroll in college when laid off. Figure 5 shows estimates of the effect of mass layoffs on enrollment and community college awards, separated by the number of community colleges in the commuting zone.[26] For both enrollment and awards, there is an upward trend in the coefficient: workers in areas with more colleges are more likely to enroll in college following layoffs, and also more likely to complete a degree or certificate.

Areas with fewer colleges might also have a smaller range of courses of study, potentially limiting the ability of workers to choose a program that will have a straightforward outlet into the labor market. To investigate this issue, we repeated the analysis in the previous subsection, estimating effects of mass layoffs on completions in each individual program; this time, however,

[25]Table A5 shows results by field of study, with similar results as in Table 3.
[26]Commuting zones with more than five colleges are coded as having five.

we estimated separate effects for commuting zones with one college, commuting zones with two to four colleges, and commuting zones with at least five colleges. We then regressed the completion effect in each subset of commuting zones on the estimated return in that program from Stevens, Kurlaender and Grosz (2018). There is a clear positive gradient. In commuting zones with one college, the effect was actually negative: -0.014 (0.004). In areas with two to four community colleges, the effect was positive and small, though statistically significant: 0.031 (0.008). In areas with many community colleges, the effect was 0.105 (0.06), which is much larger but not statistically significant. This analysis is not causally identified, yet it is at least suggestive evidence that workers in "education deserts" are constrained not only in their ability to enroll in college altogether, but also their ability to receive training in high-paying occupations.

6.6 Robustness Checks

We perform a number of robustness checks for the main results. First, we test using counties rather than commuting zones as our area of study. In Appendix Table A6 we show results using counties as the definition of local labor markets. The results are similar to the main results using commuting zones, which confirms that our results are not driven by the level of geography chosen. The effects are more muted, however, because many counties do not have a postsecondary institution even though they experience layoffs: the analysis at the county level drops these counties.

Our main results, in Table 3, have different observation counts for each outcome. This is because not every commuting zone has an institution that offers each type of degree or certificate. Table A7 shows the results when we limit the sample to commuting zones in which all degree and certificate types are represented. The results are almost identical to the main results, which suggests that commuting zones with limited community college offerings are not driving the results.

We also test if there are heterogeneous effects by race and gender, and do not find any differences. These results are in Table A8, and suggest that the effects are quite similar across demographic groups. We also disaggregate the layoff measures by age, race, and gender in Table A9, and again find similar results across demographic groups.

As a final check, we test whether our main results are sensitive to alternative definitions of commuting zones. Commuting zones are often used as proxies for local labor markets, collections of counties meant to capture distinct areas of economic activity. However, there are concerns about underlying survey error in the commuting flows data Tolbert and Sizer (1996) originally used to construct them.[27] Foote, Kutzbach and Vilhuber (2017) propose a test to address the uncertainty inherent in commuting zone definitions, by creating 1000 different commuting zone definitions based on resampling the underlying county-to-county migration flows using the Tolbert and Sizer (1996) methodology. The test consists of using all these realizations to re-estimate regression coefficients and standard errors, and using the resulting distribution of t-statistics to assess if a coefficient is robust to this uncertainty. Specifically, to assess if a coefficient is significant at the 5 percent level, the interval between the 2.5th and 97.5th percentiles of the t-statistic distribution should not intersect with the interval (-1.96,1.96).

Table 5 shows the results of such a test, for our main outcomes. For each lag of the layoff variable, we show the interval between the 2.5th and 97.5th percentile of the distribution of t-statistics created by running our results on the 1000 commuting zone definitions. The results on first-time enrollment in the second and third lags are robust to this test, as are the results on total degrees and certificates.

7 Conclusion

Our results show that for the average labor market, an additional 100 workers laid off leads to three more first-time community college students within three years. When we compare this effect to earlier work using a similar methodological approach, we find that educational enrollment accounts for about half of the increase in labor force non-participation following a mass layoff event. This is an optimistic finding, especially relative to recent work that shows increases in non-participation due to opioid and other drug use during hard economic times (Hollingsworth, Ruhm and Simon, 2017).

We find suggestive evidence that workers seek degrees and certificates in fields with higher labor market returns. However, the correlation between degree receipt and labor market returns is somewhat weak. This may be because some students do not know about differences in earnings potential across different majors, as has been shown often in the literature (Wiswall and Zafar,

[27] The commuting zone definitions by Tolbert and Sizer (1996) are based on 1990 Journey to Work Data from the Decennial Census, which has underlying survey error. Foote, Kutzbach and Vilhuber (2017) show that if one resamples from the implied distribution for each county-to-county flow and re-run the procedure, the commuting zone definitions differ substantially, re-assigning an average of 5% of the population.

2015; Baker et al., 2017). Some progress in producing these statistics has been made at the state and federal levels (for example, the Post-Secondary Employment Statistics data from the U.S. Census Bureau), but the information is for a select number of institutions. Alternatively, some students may not be able to enroll in high-return programs that often have capacity constraints. Programs in high-return health fields often have separate admissions requirements, and bottleneck courses often have waitlists. If community colleges were more responsive to local demand for certain courses, it may improve both completion and subsequent earnings outcomes for students. Furthermore, we only measure completion. This excludes workers who enrolled in courses and started a program, but did not complete a degree in a certain field. This latter mechanism may be important if mass layoffs push marginal students into school, or workers who have not been in school for a long time.

There are a number of potential directions for future research. Individual-level administrative data would allow us to follow the educational and labor market trajectories of laid off workers, as well as neighborhood-level effects. It is also important to investigate responses at for-profit colleges, which are not well-represented in our data. Recent evidence suggests that earnings outcomes at for-profits are not high (Darolia et al., 2015; Deming et al., 2016; Cellini and Turner, 2016; Cascio and Narayan, 2015), but students may still enroll in these institutions when faced with poor labor market conditions.

In sum, we find evidence that workers respond to mass layoffs by seeking short-duration degrees and certificates that are generally in fields with higher labor market returns. This is consistent with the idea that displaced workers seek to make new investments in specific human capital, and that there are high opportunity costs for their time.

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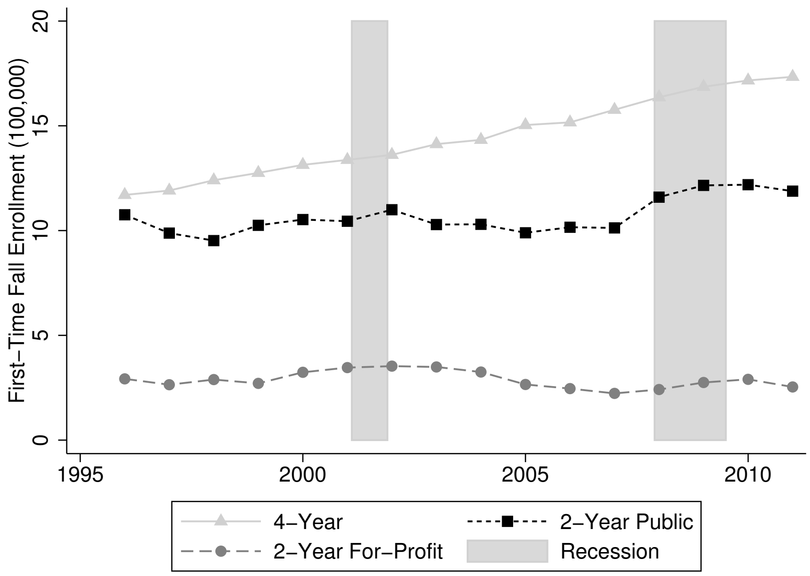
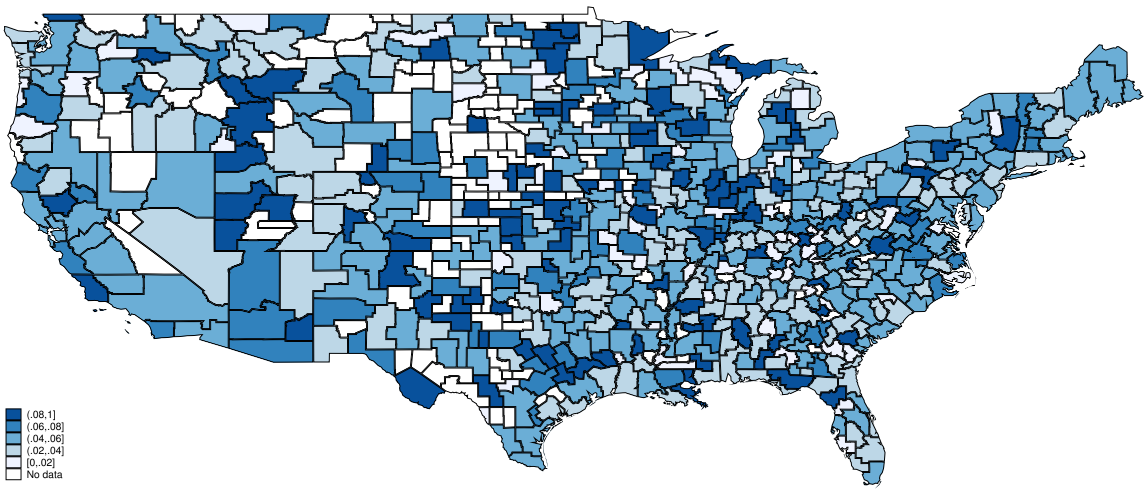
Tables and Figures

Figure 1: First-Time Enrollment, by Sector, 1996-2011

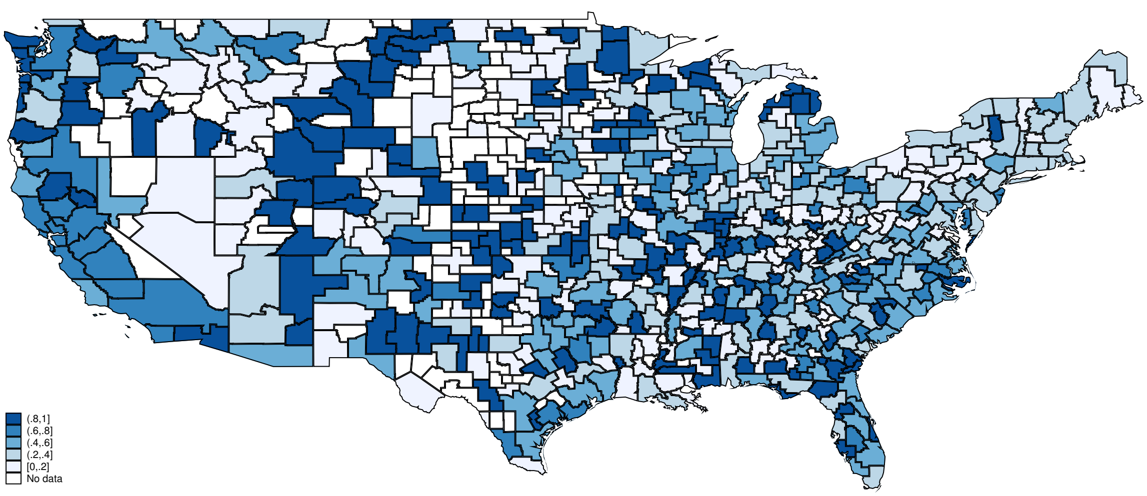


Notes: Degree and certificate data is from IPEDS, years 1996-2011. Shaded areas indicate recessions as defined by the NBER.

Figure 2: Enrollment, 2005, Commuting Zones



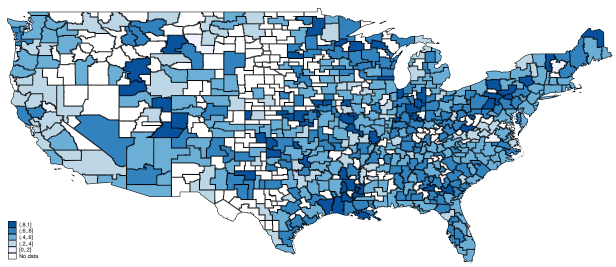
(a) Share of Population in Postsecondary Institutions



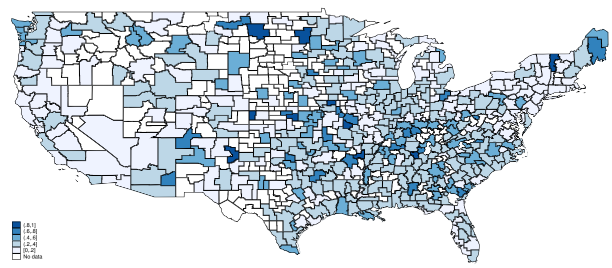
(b) Community College Share of Enrollment

Notes: Enrollment data is IPEDS from years 1996-2011, population data is from SEER. Panel (a) displays the share of the population in postsecondary education, while panel (b) displays the share of enrollment accounted for in community colleges.

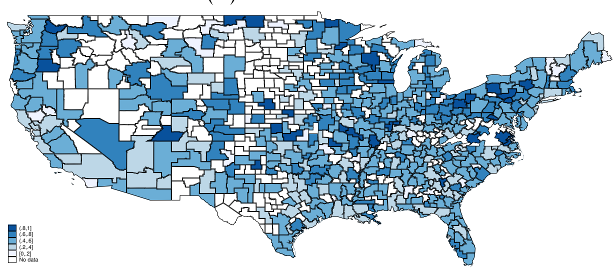
Figure 3: Content of Community College Awards, 2005, Commuting Zones



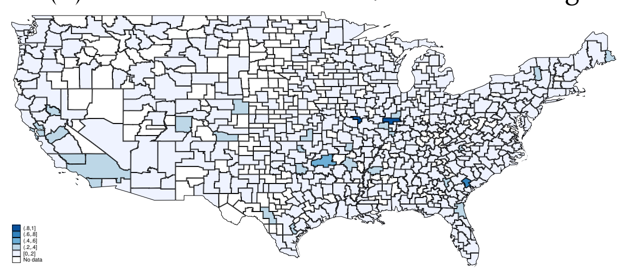
(a) Share in CTE



(b) Share in Construction/Manufacturing



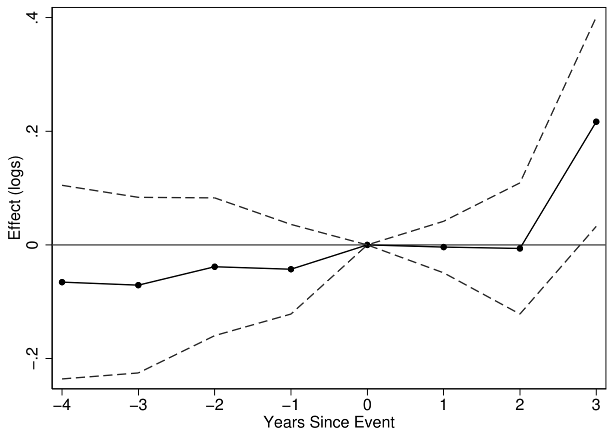
(c) Share in Health



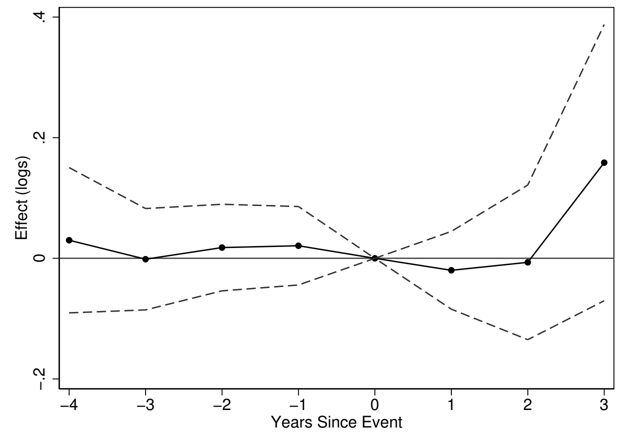
(d) Share in Childcare/Cosmetology

Notes. Figure (a) shows CTE awards as a share of total awards. Figures (b)-(d) show awards in the particular field as a share of all CTE awards.

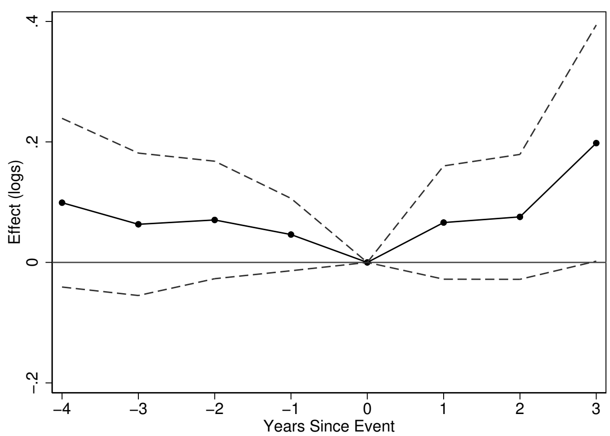
Figure 4: Event Study Estimates of Effect of Mass Layoffs, Commuting Zones with One Event of At Least 1% of the Labor Force



(a) Total Fall Enrollment



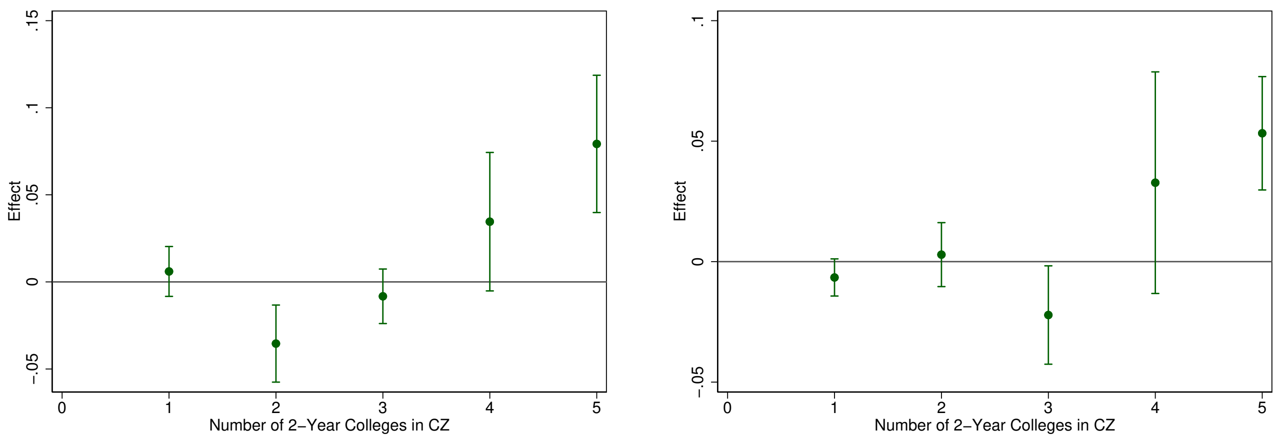
b) First-Time Fall Enrollment



(c) All Awards

Notes. Figures display coefficients from equation 2 in text and a 95% point-wise confidence interval is shown. Sample consists of 103 commuting zones that had exactly one year with mass layoffs exceeding one percent of the total labor force between 1995 and 2011. Outcome variables are listed below each sub-figure. Specifications include commuting zone and year fixed effects. Standard errors are clustered at the state level.

Figure 5: Heterogeneity by Number of 2-Year Colleges in Commuting Zone

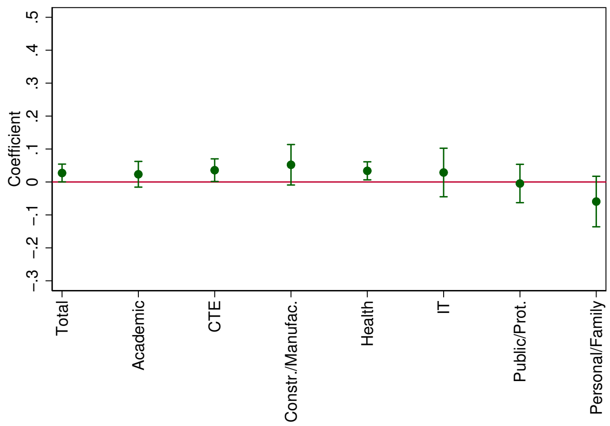


a) First-time Fall Enrollment

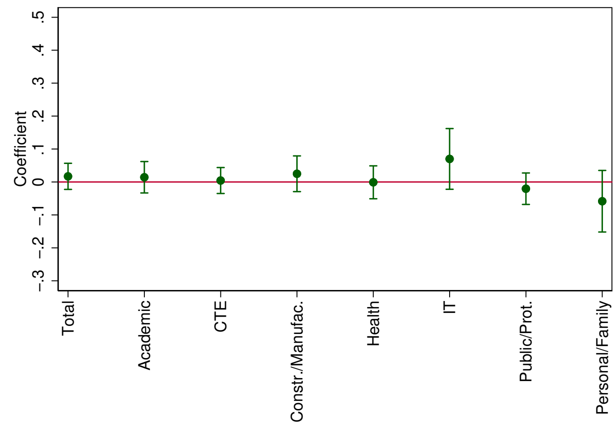
b) Awards

Notes. Figures display coefficients and standard errors, estimated separately for commuting zones with the specified number of 2-year colleges. The category for commuting zones with 5 colleges includes commuting zones with more than 5 colleges as well. Outcome variables are listed below each sub-figure, and expressed in logs. Specifications include commuting zone and year fixed effects, as well as commuting zone specific linear time trends. Standard errors are clustered at the state level.

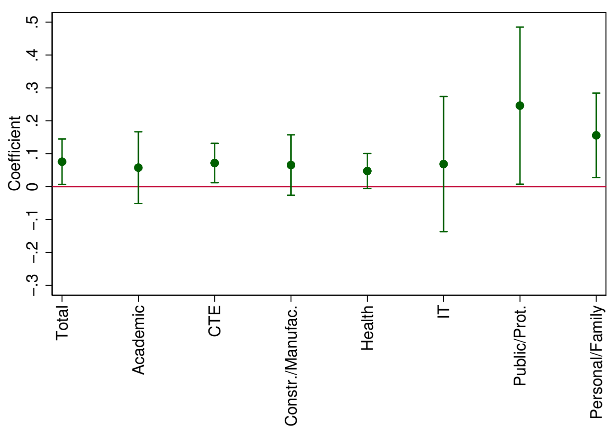
Figure 6: Effects of Mass Layoffs on Completions, by Field of Study and Award Type



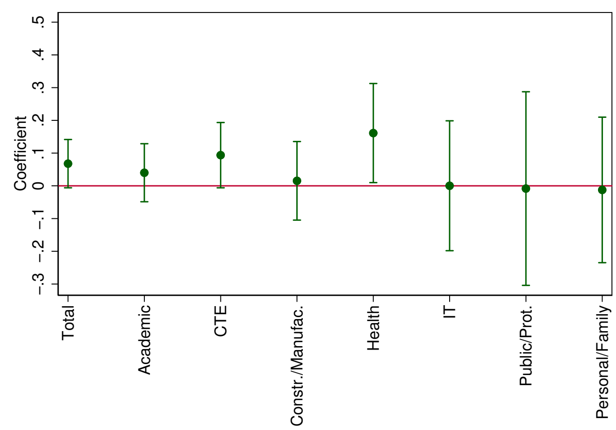
(a) All Awards



b) AA/AS



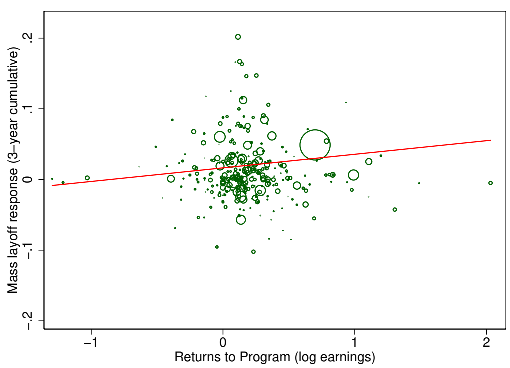
(c) 1-4 Year Certificates



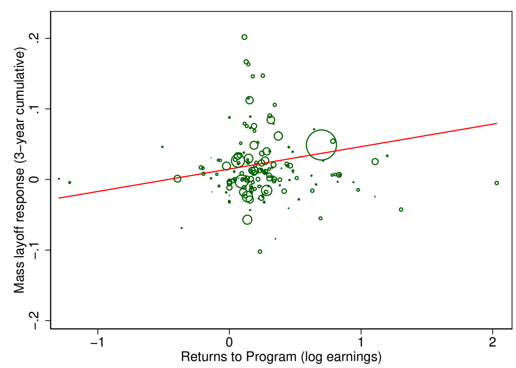
(d) < 1 Year Certificates

Notes: Figures show total effects of three lagged coefficients. Each box and whisker shows the result of one regression, with the point estimate and 95 percent confidence interval.

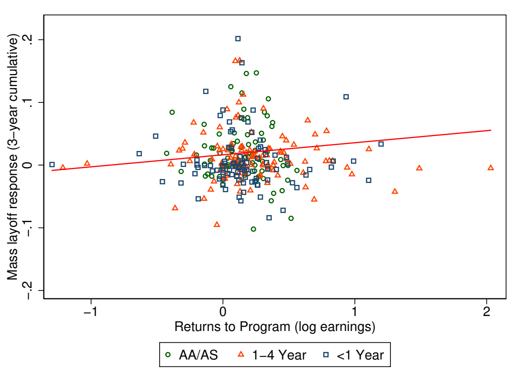
Figure 7: Completion Effects and Estimated Earnings Returns



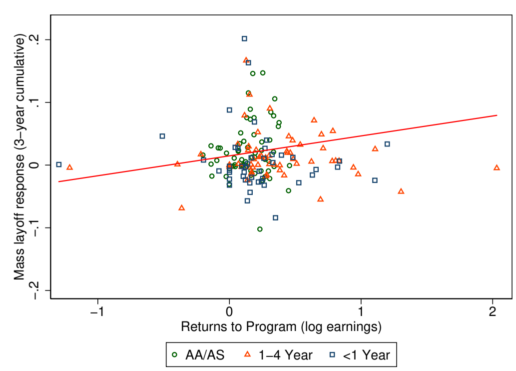
(a) All Estimates



(b) Statistically Significant Returns Only



(c) All Estimates



(d) Statistically Significant Returns Only

Notes: Estimated returns from Stevens, Kurlaender and Grosz (2018) at the 4-digit Taxonomy of Programs level. Regression line, weighted by the average number of graduates of each program each year, is 0.019 (0.016) in panels a) and c) and 0.032 (0.015) in panels b) and d).

Table 1: Summary Statistics, 1996-2013

Workers in Mass Layoffs	1445.8
	(6434.5)
Workers in Mass Layoffs as Share of Labor Force	0.00568
	(0.00775)
Layoffs > 1% of Labor Force	0.203
	(0.402)
Layoffs > 5% of Labor Force	0.0235
	(0.152)
Unemployment Rate	0.0588
	(0.0324)
Population (1000s)	365.7
	(1047.0)
Population Age 18-60 (1000s)	206.4
	(602.1)
Community Colleges	2.496
	(3.853)
For-Profit 2-year Colleges	5.296
	(16.61)
Community College Fall Enrollment	9407.9
	(30888.6)
For-Profit Fall Enrollment	788.4
	(2934.8)
No 2-Year Institutions in CZ	0.0672
	(0.250)
Only 2-Year Institutions in CZ	0.374
	(0.484)
Associate's Degrees	1117.1
	(2822.4)
1-4 Year Certificates	562.2
	(1571.7)
< 1 Year Certificates	597.2
	(2045.5)
Share of Awards in CTE	0.405
	(0.174)
Share of Awards in Construction/Manufacturing	0.0967
	(0.110)
Share of Awards in Health	0.179
	(0.118)
Share of Awards in Information Technology	0.0284
	(0.0314)
Share of Awards in Public/Protective Services	0.0381
	(0.0404)
Share of Awards in Cosmetology/Childcare	0.0132
	(0.0189)

Notes: Unit of Observation is Commuting Zone by year. Means and standard deviations displayed.

Table 2: Mass Layoffs and Two-Year First-Time College Enrollment

	(1)	(2)	(3)	(4)	(5)
Layoffs, t-1	0.288***	0.0210**	0.0195**	0.0244**	0.0249**
	(0.0292)	(0.00928)	(0.00970)	(0.00949)	(0.0104)
Layoffs, t-2	0.128***	0.00855	0.00555	0.0160**	0.0179**
	(0.0118)	(0.00704)	(0.00676)	(0.00712)	(0.00799)
Layoffs, t-3	0.174***	-0.0262***	-0.0261***	-0.0118	-0.0106
	(0.0168)	(0.00891)	(0.00930)	(0.00826)	(0.00779)
Total Effect	0.5907***	0.0034	-0.001	0.0286	0.0323*
	(0.0489)	(0.018)	(0.018)	(0.0176)	(0.0194)
Y-Mean	2138.1	2138.1	2138.1	2138.1	2138.1
Observations	6882	6882	6882	6882	6882
R-sq	0.612	0.957	0.958	0.979	0.978
CZ Fixed Effects		X	X	X	X
Year Fixed Effects		X	X	X	X
Demographics			X	X	
CZ Trends				X	X

Notes: Outcome variable is log first-year full time enrollment. The first column just includes lags of log mass layoffs, while the second column adds CZ and year fixed effects. Column 3 adds controls for the age distribution, racial makeup, and share male of the CZ, while column 4 adds CZ-specific trends. The sum of the effects is at the bottom of the table. Standard errors are clustered at the commuting zone level. *p<0.10, ** p<0.05, *** p<0.01

Table 3: Mass Layoffs and Two-Year College Enrollment, Degrees and Certificates

	(1)	(2)	(3)	(4)	(5)	(6)
	Fall Enrollment		Associate's Degrees and Certificates			
	Total	First-Time	Total	AA/AS	1-4 Year Cert	<1 Year Cert
Community Colleges						
Layoffs, t-1	0.011	0.024***	0.0029	-0.0056	0.031*	0.0079
	(0.0076)	(0.0092)	(0.0072)	(0.0093)	(0.017)	(0.020)
Layoffs, t-2	0.0021	0.016**	0.014**	0.0013	0.022**	0.038**
	(0.0059)	(0.0071)	(0.0057)	(0.0076)	(0.011)	(0.015)
Layoffs, t-3	-0.0017	-0.012	0.00031	-0.018	0.022*	0.012
	(0.0072)	(0.0082)	(0.0054)	(0.012)	(0.011)	(0.015)
Total Effect	0.0111	0.0287	0.017	-0.0227	0.0741	0.0584
	(0.0159)	(0.0173)	(0.0139)	(0.0259)	(0.0332)	(0.0374)
Y-Mean	12184.2	2138.1	1664.7	1051.7	320.8	493.3
Observations	6882	6882	6872	6318	6714	5354
R-sq	0.99	0.98	0.98	0.98	0.95	0.94
For-Profits						
Layoffs, t-1	0.010	0.016	0.0066	-0.0096	0.0045	0.0045
	(0.0095)	(0.010)	(0.0085)	(0.033)	(0.013)	(0.021)
Layoffs, t-2	0.011	0.014	0.0071	-0.046	0.011	0.027
	(0.0088)	(0.0095)	(0.0081)	(0.029)	(0.012)	(0.021)
Layoffs, t-3	0.012	0.011	0.025**	-0.0074	0.018	0.018
	(0.011)	(0.011)	(0.011)	(0.033)	(0.013)	(0.021)
Total Effect	0.0334	0.041	0.0386	-0.0633	0.034	0.0499
	(0.0188)	(0.0187)	(0.0164)	(0.0688)	(0.0265)	(0.0439)
Y-Mean	1442.9	729.6	945.5	355.9	423.9	486.7
Observations	4783	4783	4785	2005	4656	3773
R-sq	0.98	0.98	0.98	0.91	0.97	0.95
Year FEs	X	X	X	X	X	X
CZ FEs	X	X	X	X	X	X
CZ Trends	X	X	X	X	X	X

Notes: Outcome variables are listed at the top of each column, and are the log counts of the corresponding outcome. Estimates are from equation 1. Panel (a) shows estimates for public community colleges, while panel (b) shows estimates for for-profit schools. All regressions include year and commuting zone fixed effects, commuting zone specific trends, and demographic controls. Regressions are weighted by commuting zone population. Standard errors are clustered on commuting zone. *p<0.10, ** p<0.05, *** p<0.01

Table 4: Mass Layoffs and Two-Year College Enrollment, Degrees and Certificates, Before and After 2007

	(1)	(2)	(3)	(4)	(5)	(6)
	Fall Enrollment		Degrees and Certificates			
	Total	First-Time	Total	AA/AS	1-4 Year Cert	<1 Year Cert
Community Colleges						
Layoffs, t-1	0.011	0.017*	0.00025	-0.0089	0.023	-0.0095
	(0.0098)	(0.0092)	(0.0085)	(0.011)	(0.017)	(0.024)
Layoffs, t-2	0.0043	0.017**	0.019***	0.0048	0.024**	0.063***
	(0.0062)	(0.0068)	(0.0063)	(0.0092)	(0.0099)	(0.022)
Layoffs, t-3	-0.0048	-0.016	-0.0068	-0.024*	0.015	0.0045
	(0.0092)	(0.0099)	(0.0066)	(0.014)	(0.011)	(0.020)
Layoffs, t-1xPost-2007	-0.00069	0.019	0.0081	0.0089	0.024	0.055**
	(0.0086)	(0.014)	(0.0079)	(0.0079)	(0.020)	(0.028)
Layoffs, t-2xPost-2007	-0.0066	-0.00046	-0.016**	-0.0092	-0.0039	-0.078**
	(0.0061)	(0.010)	(0.0063)	(0.0083)	(0.018)	(0.031)
Layoffs, t-3xPost-2007	0.0090	0.010	0.020**	0.014	0.017	0.018
	(0.0091)	(0.012)	(0.0080)	(0.0089)	(0.027)	(0.029)
Y-Mean	12184.2	2138.1	1664.7	1051.7	320.8	493.3
Observations	6882	6882	6872	6318	6714	5354
R-sq	0.99	0.98	0.98	0.98	0.95	0.94
Year FEs	X	X	X	X	X	X
CZ FEs	X	X	X	X	X	X
CZ Trends	X	X	X	X	X	X

Notes: Outcome variables are listed at the top of each column, and are the log counts of the corresponding outcome. Estimates are from equation 1, and allows the effect of mass layoffs to differ before and after 2007. All regressions include year and commuting zone fixed effects, commuting zone specific trends and demographic controls. Regressions are weighted by commuting zone population. Standard errors are clustered on commuting zone. *p<0.10, ** p<0.05, *** p<0.01

Table 5: Distribution of T-Statistics from Alternate Commuting Zone Definitions

	(1)	(2)	(3)	(4)	(5)	(6)
	Fall Enrollment		Associate's Degrees and Certificates			
	Total	First-Time	Total	AA/AS	1-4 Year Cert	<1 Year Cert
Layoffs, t-1	[1.21, 2.20]	[2.11, 3.06]	[-0.35, 1.11]	[-2.23, -0.45]	[0.967, 1.95]	[0.08, 1.43]
Layoffs, t-2	[1.14, 2.39]	[2.91, 4.06]	[1.96, 3.39]	[-0.004, 1.48]	[1.01, 2.57]	[0.94, 2.64]
Layoffs, t-3	[-1.04, -0.22]	[-1.82, -0.72]	[-0.29, 1.07]	[-1.53, 0.22]	[1.30, 2.42]	[-0.49, 1.46]

Notes: Results shown from the test outlined in Foote, Kutzbach and Vilhuber (2017), and discussed in Section 6.6. The row for each coefficient shows the 2.5th and 97.5th percentile of the distribution of t-statistics on the noted coefficient, when running the analysis with each of 1000 different commuting zone realizations.

A Appendix Tables and Figures

Table A1: Broad Educational Categories

Name	CIP Code		# of Codes
Information Tech.	10	Communications Technologies/Technicians And Support Services.	15
	11	Computer And Information Sciences And Support Services.	26
Construction/ Manufacturing	15	Engineering Technologies/Technicians.	54
	46	Construction Trades.	22
	47	Mechanic And Repair Technologies/Technicians.	34
	48	Precision Production.	16
	49	Transportation And Materials Moving.	16
Public Services	43	Security And Protective Services.	16
	44	Public Administration And Social Service Professions.	7
Health	51	Health Professions And Related Clinical Sciences.	196
Business	52	Business, Management, Marketing, And Related Support Services.	84
Family/Personal	19	Family And Consumer Sciences/Human Sciences.	32
	12	Personal And Culinary Services.	25
Education	13	Edcuation	89

Table A2: Effect of Mass Layoffs on Enrollment and Degrees at Four-Year Colleges

	(1)	(2)	(3)
	Fall Enrollment		
	Total	First-Time	BA Degrees
Layoffs, t-1	-0.00370	-0.000730	-0.00179
	(0.00369)	(0.00458)	(0.00287)
Layoffs, t-2	-0.000401	0.000800	0.00207
	(0.00367)	(0.00429)	(0.00252)
Layoffs, t-3	-0.00279	0.00123	-0.00321
	(0.00238)	(0.00315)	(0.00200)
Y-Mean	17948.4	3298.7	5386.3
Observations	6177	6132	6166
R-Sq	0.996	0.993	0.997
Year FEs	X	X	X
CZ FEs	X	X	X
CZ Trends	X	X	X

Notes: Outcome variables are listed at the top of each column, and are the log counts of the corresponding outcome. Estimates are from equation 1. Outcomes are total and first-time enrollment at four-year colleges, as well as bachelor's degrees at four-year colleges. All regressions include year and commuting zone fixed effects, commuting zone specific trends, and demographic controls. Regressions are weighted by commuting zone population. Standard errors are clustered on commuting zone. *p<0.10, ** p<0.05, *** p<0.01

Table A3: Effect ofMass Layoffs and Two-Year College Degrees and Certificates, by Program Type

	(1) Total	(2) Academic	(3) Career-Technical	(4) Constr./Manufac.	(5) Health	(6) IT	(7) Public/Protect.	(8) Family/Personal.
All Awards								
Layoffs, t-1	0.0034	0.00012	0.010	0.0089	0.012*	0.021	0.0025	-0.025
	(0.0072)	(0.0094)	(0.0089)	(0.015)	(0.0066)	(0.023)	(0.016)	(0.019)
Layoffs, t-2	0.018***	0.016*	0.019***	0.039***	0.014**	0.018	0.0059	-0.024
	(0.0059)	(0.0089)	(0.0064)	(0.012)	(0.0054)	(0.013)	(0.013)	(0.019)
Layoffs, t-3	0.0060	0.0067	0.0060	0.0044	0.0079	-0.0095	-0.013	-0.010
	(0.0051)	(0.0073)	(0.0058)	(0.011)	(0.0062)	(0.014)	(0.012)	(0.023)
Y-Mean	1685.3	833.7	871.9	255.4	404.1	77.3	116.1	62.4
Observations	6907	6794	6855	6610	6763	5828	5303	4746
R-Sq	0.98	0.98	0.98	0.96	0.98	0.94	0.96	0.93
AA/AS								
Layoffs, t-1	0.0011	-0.00079	0.0050	0.0099	0.0023	0.032	-0.015	-0.028
	(0.0068)	(0.0084)	(0.0084)	(0.010)	(0.012)	(0.030)	(0.012)	(0.024)
Layoffs, t-2	0.015	0.016	0.0089	0.024**	0.0012	0.040*	0.00022	-0.025
	(0.010)	(0.012)	(0.0059)	(0.0097)	(0.0065)	(0.022)	(0.011)	(0.025)
Layoffs, t-3	0.00069	-0.00066	-0.0095	-0.0085	-0.0044	-0.0029	-0.0059	-0.0055
	(0.0091)	(0.011)	(0.0098)	(0.015)	(0.012)	(0.020)	(0.011)	(0.019)
Y-Mean	1061.6	676.9	394.7	80.1	184.7	44.2	57.1	26.6
Observations	6335	6270	6285	5833	5928	5250	5045	3836
R-Sq	0.98	0.98	0.98	0.96	0.97	0.93	0.97	0.93
1-4 Year Cert								
Layoffs, t-1	0.030*	0.0093	0.031*	0.028	0.020	0.039	0.11**	0.062
	(0.016)	(0.022)	(0.017)	(0.023)	(0.015)	(0.050)	(0.057)	(0.044)
Layoffs, t-2	0.022**	0.020	0.019**	0.031**	0.0053	0.039	0.063	0.024
	(0.011)	(0.019)	(0.0093)	(0.015)	(0.011)	(0.044)	(0.049)	(0.030)
Layoffs, t-3	0.024*	0.029	0.022**	0.0062	0.022*	-0.0092	0.069	0.070*
	(0.013)	(0.024)	(0.010)	(0.019)	(0.012)	(0.034)	(0.054)	(0.037)
Y-Mean	324.9	96.3	237.9	90.7	122.4	22.3	33.6	21.9
Observations	6767	6336	6676	6111	6386	3688	2210	2805
R-Sq	0.95	0.92	0.95	0.92	0.93	0.88	0.90	0.89
<1 Year Cert								
Layoffs, t-1	0.0067	-0.010	0.023	-0.014	0.059*	0.032	0.013	-0.022
	(0.020)	(0.023)	(0.026)	(0.034)	(0.034)	(0.071)	(0.070)	(0.050)
Layoffs, t-2	0.044***	0.043**	0.047**	0.021	0.075**	-0.012	0.034	0.0030
	(0.016)	(0.021)	(0.020)	(0.030)	(0.034)	(0.040)	(0.054)	(0.043)
Layoffs, t-3	0.017	0.0069	0.024	0.0078	0.027	-0.019	-0.055	0.0067
	(0.015)	(0.020)	(0.020)	(0.031)	(0.029)	(0.036)	(0.061)	(0.055)
Y-Mean	502.8	174.7	379.0	155.9	199.6	50.2	105.6	54.5
Observations	5404	4633	5033	4273	4289	2712	2399	2438
R-Sq	0.95	0.92	0.93	0.89	0.91	0.87	0.90	0.89

Notes: Estimates are from equation 1. Outcome variables are degrees or certificates awarded in a given field, shown at the column head. Panel (a) shows results for all awards, panel (b) shows results for Associates degrees, panel (c) shows results for longer certificates, and panel (d) shows results for short-term certificate programs. All regressions include year and commuting zone fixed effects, commuting zone specific trends and demographic controls. Regressions are weighted by commuting zone population. Standard errors are clustered on commuting zone. *p<0.10, ** p<0.05, *** p<0.01

Table A4: Effect of Mass Layoffs on Post-secondary outcomes, including controls

	(1)	(2)	(3)	(4)	(5)
Total Enrollment					
Layoffs, t-1	0.308***	0.00221	0.00386	0.0106	0.0114
	(0.0273)	(0.00588)	(0.00613)	(0.00756)	(0.00775)
Layoffs, t-2	0.133***	-0.00750	-0.00728	0.00208	0.00309
	(0.0124)	(0.00519)	(0.00528)	(0.00590)	(0.00612)
Layoffs, t-3	0.205***	-0.0138	-0.0135	-0.00166	-0.000748
	(0.0247)	(0.00976)	(0.00947)	(0.00719)	(0.00672)
Total Awards					
Layoffs, t-1	0.247***	-0.00449	-0.00417	0.00294	0.00293
	(0.0255)	(0.00731)	(0.00708)	(0.00717)	(0.00747)
Layoffs, t-2	0.142***	0.00962	0.00929	0.0138**	0.0139**
	(0.0100)	(0.00608)	(0.00572)	(0.00571)	(0.00614)
Layoffs, t-3	0.168***	-0.00462	-0.00387	0.000305	0.000326
	(0.0201)	(0.00725)	(0.00669)	(0.00540)	(0.00525)
AA/AS Awards					
Layoffs, t-1	0.262***	-0.0113	-0.0103	-0.00565	-0.00888
	(0.0250)	(0.00800)	(0.00765)	(0.00929)	(0.0101)
Layoffs, t-2	0.135***	-0.00195	-0.00231	0.00127	0.00214
	(0.0126)	(0.00705)	(0.00721)	(0.00765)	(0.00822)
Layoffs, t-3	0.185***	-0.0209*	-0.0215*	-0.0183	-0.0143
	(0.0225)	(0.0123)	(0.0129)	(0.0123)	(0.0110)
1-4 year certification					
Layoffs, t-1	0.210***	0.0218	0.0224	0.0309*	0.0294
	(0.0397)	(0.0167)	(0.0162)	(0.0166)	(0.0181)
Layoffs, t-2	0.127***	0.0103	0.0114	0.0216**	0.0207*
	(0.0140)	(0.00933)	(0.00928)	(0.0105)	(0.0113)
Layoffs, t-3	0.128***	0.0122	0.0123	0.0216*	0.0235*
	(0.0248)	(0.0108)	(0.0107)	(0.0115)	(0.0124)
<1 year certification					
Layoffs, t-1	0.162**	-0.0121	-0.00983	0.00789	0.0101
	(0.0738)	(0.0203)	(0.0205)	(0.0205)	(0.0203)
Layoffs, t-2	0.154***	0.0626***	0.0620***	0.0383**	0.0373**
	(0.0229)	(0.0208)	(0.0191)	(0.0153)	(0.0163)
Layoffs, t-3	0.164***	0.0423	0.0437	0.0122	0.00892
	(0.0441)	(0.0317)	(0.0294)	(0.0153)	(0.0147)
CZ Fixed Effects		X	X	X	X
Year Fixed Effects		X	X	X	X
Demographics			X	X	
CZ Trends				X	X

Notes: Outcome variable is listed at top of panel. The first column just includes lags of log mass layoffs, while the second column adds CZ and year fixed effects. Column 3 adds controls for the age distribution, racial makeup, and share male of the CZ, while column 4 adds CZ-specific trends. The sum of the effects is at the bottom of the table. Standard errors are clustered at the commuting zone level. *p<0.10, ** p<0.05, *** p<0.01

Table A5: Mass Layoffs and Two-Year College Degrees and Certificates, by Program Type, Before and After 2007

	Total	Career-Technical	Constr./ Manufac.	Health	IT	Public/ Protect.	Family/Personal
All Awards							
Layoffs, t-1xPost-2007	0.0000623	0.00733	0.0411***	-0.00856	-0.0447**	0.0420*	0.0810**
	(0.0106)	(0.00903)	(0.0155)	(0.0114)	(0.0224)	(0.0237)	(0.0351)
Layoffs, t-2xPost-2007	-0.00986	-0.00613	-0.0248*	-0.000782	0.0158	-0.0144	-0.0399
	(0.00717)	(0.00797)	(0.0141)	(0.00717)	(0.0218)	(0.0181)	(0.0276)
Layoffs, t-3xPost-2007	0.0199**	0.0160	0.00362	0.0179*	0.0408	-0.000640	0.00531
	(0.00872)	(0.0115)	(0.0144)	(0.00996)	(0.0285)	(0.0193)	(0.0280)
Observations	6902	6891	6654	6799	5863	5330	4763
AA/AS							
Layoffs, t-1xPost-2007	-0.0134	-0.0141	-0.00873	-0.0159	-0.0913***	0.0187	0.0551
	(0.0246)	(0.0242)	(0.0269)	(0.0291)	(0.0299)	(0.0282)	(0.0414)
Layoffs, t-2xPost-2007	0.00667	0.0131	0.0106	0.00988	0.00621	-0.00258	0.0112
	(0.0172)	(0.0163)	(0.0235)	(0.0191)	(0.0264)	(0.0163)	(0.0357)
Layoffs, t-3xPost-2007	0.0176	0.0213**	0.0175	0.0226*	0.0628	0.0183	0.0321
	(0.0107)	(0.00966)	(0.0127)	(0.0121)	(0.0399)	(0.0274)	(0.0315)
Observations	6331	6299	5863	5953	5282	5076	3872
1-4 Year Cert							
Layoffs, t-1xPost-2007	0.0301	0.0210	0.0199	0.0213	-0.00565	0.130	0.119**
	(0.0247)	(0.0269)	(0.0294)	(0.0279)	(0.0447)	(0.0863)	(0.0551)
Layoffs, t-2xPost-2007	0.00134	-0.00459	0.00953	-0.00147	0.0612	-0.139*	-0.0822
	(0.0158)	(0.0151)	(0.0217)	(0.0176)	(0.0580)	(0.0755)	(0.0610)
Layoffs, t-3xPost-2007	0.0162	0.0305	0.0192	0.0222	0.0173	0.0423	-0.0225
	(0.0248)	(0.0215)	(0.0263)	(0.0165)	(0.0660)	(0.0678)	(0.0585)
Observations	6763	6736	6162	6445	3722	2225	2827
<1 Year Cert							
Layoffs, t-1xPost-2007	0.0426	0.0600	0.103***	-0.0143	0.00199	0.00786	0.115
	(0.0290)	(0.0406)	(0.0363)	(0.0514)	(0.0764)	(0.0889)	(0.0898)
Layoffs, t-2xPost-2007	-0.0775***	-0.0756**	-0.0317	-0.0533*	0.0370	-0.0636	-0.124**
	(0.0300)	(0.0377)	(0.0346)	(0.0281)	(0.0634)	(0.0664)	(0.0594)
Layoffs, t-3xPost-2007	0.0185	-0.0367	-0.0234	0.00339	0.0161	0.0161	-0.0376
	(0.0286)	(0.0437)	(0.0341)	(0.0446)	(0.0723)	(0.112)	(0.0640)
Observations	5405	5058	4302	4318	2722	2420	2446

Notes: Estimates are from equation 1. Outcome variables are total fall enrollment (panel A) and first-time fall enrollment (panel B) for demographic subgroups, listed at column head. All regressions include year and commuting zone fixed effects, commuting zone specific trends. Regressions are weighted by commuting zone population. Standard errors are clustered on commuting zone. *p¡0.10, ** p¡0.05, *** p¡0.01

Table A6: Mass Layoffs and Two-Year College Enrollment, Degrees and Certificates, County-Level Analysis

	(1)	(2)	(3)	(4)	(5)	(6)
	Fall Enrollment		Associate's Degrees and Certificates			
	Total	First-Time	Total	AA/AS	1-4 Year Cert	<1 Year Cert
Layoffs, t-1	0.010*	0.020**	0.00074	-0.0034	0.0096	0.010
	(0.0063)	(0.0083)	(0.0049)	(0.0043)	(0.012)	(0.015)
Layoffs, t-2	0.0039	0.017**	0.0075	0.0022	0.015	0.0071
	(0.0043)	(0.0074)	(0.0046)	(0.0035)	(0.0092)	(0.012)
Layoffs, t-3	-0.0031	-0.0058	-0.00035	-0.0036	0.0096	-0.0012
	(0.0060)	(0.0064)	(0.0039)	(0.0036)	(0.0095)	(0.011)
Y-Mean	5985.5	1052.7	825.8	580.6	162.1	281.7
Observations	13936	13916	13861	11416	13223	9496
Year FEs	X	X	X	X	X	X
County FEs	X	X	X	X	X	X
County Trends	X	X	X	X	X	X

Notes: Estimates are from equation 1, but with observation level being the county rather than commuting zone. Outcome variables are listed at column head. All regressions include year and county fixed effects, county specific trends. Regressions are weighted by county population. Standard errors are clustered on commuting zone. *p<0.10, ** p<0.05, *** p<0.01

Table A7: Mass Layoffs and Two-Year Community College Enrollment, Degrees and Certificates; Consistent Sample

	(1)	(2)	(3)	(4)	(5)	(6)
	Fall Enrollment		Associate's Degrees and Certificates			
Layoffs, t-1	0.0050	0.024**	0.0012	-0.0033	0.032	0.0061
	(0.0053)	(0.012)	(0.0063)	(0.0061)	(0.022)	(0.021)
Layoffs, t-2	0.0038	0.019**	0.016**	0.014	0.021	0.044**
	(0.0049)	(0.0093)	(0.0064)	(0.012)	(0.014)	(0.018)
Layoffs, t-3	0.0027	-0.0081	0.0043	0.00075	0.031*	0.013
	(0.0064)	(0.0086)	(0.0062)	(0.0097)	(0.017)	(0.016)
Y-Mean	15902.2	2740.2	2169.2	1245.2	395.1	528.9
Observations	4969	4969	4969	4969	4969	4969
R-Sq	0.99	0.98	0.99	0.98	0.95	0.95
Year FEs	X	X	X	X	X	X
CZ FEs	X	X	X	X	X	X
CZ Trends	X	X	X	X	X	X

Notes: Outcome variables are listed at the top of each column, and are the log counts of the corresponding outcome. Estimates are from equation 1. All regressions include year and commuting zone fixed effects, commuting zone specific trends, and demographic controls. Regressions are weighted by commuting zone population. Sample only includes commuting zones that have all of the outcome variables. Standard errors are clustered on commuting zone. *p<0.10, ** p<0.05, *** p<0.01

Table A8: Enrollment, Heterogeneity by Gender and Race

	(1)	(2)	(3)	(4)	(5)	(6)		
	Overall			White and Asian		Black, Hispanic, or Other Race		
	Men	Women	Total	Men	Women	Total	Men	Women
Total Fall Enrollment								
Layoffs, t-1	0.0145*	0.0147**	0.0150*	0.0142*	0.0157**	0.0128*	0.0125	0.0129*
	(0.00767)	(0.00678)	(0.00770)	(0.00827)	(0.00773)	(0.00729)	(0.00795)	(0.00698)
Layoffs, t-2	0.00983*	0.00976	0.00998	0.0104	0.0112	0.00866	0.00900	0.00854
	(0.00594)	(0.00593)	(0.00647)	(0.00654)	(0.00682)	(0.00621)	(0.00644)	(0.00632)
Layoffs, t-3	0.00601	0.00601	0.00442	0.00539	0.00493	0.00874	0.00777	0.00899
	(0.00548)	(0.00515)	(0.00504)	(0.00536)	(0.00504)	(0.00639)	(0.00632)	(0.00638)
Y-Mean	5202.4	7074.5	3811.4	1521.9	2317.0	8309.6	3628.4	4694.9
Observations	6908	6908	6843	6774	6807	6917	6905	6906
R-sq	0.988	0.988	0.992	0.990	0.991	0.987	0.986	0.986
First-Time Fall Enrollment								
Layoffs, t-1	0.0292***	0.0276***	0.0278**	0.0302**	0.0289**	0.0260**	0.0264**	0.0257**
	(0.0111)	(0.0107)	(0.0126)	(0.0135)	(0.0125)	(0.0103)	(0.0104)	(0.0104)
Layoffs, t-2	0.0241***	0.0211***	0.0224**	0.0270***	0.0192**	0.0220***	0.0239***	0.0211***
	(0.00817)	(0.00775)	(0.00902)	(0.00959)	(0.00892)	(0.00767)	(0.00785)	(0.00781)
Layoffs, t-3	-0.00556	-0.00578	-0.00631	-0.00808	-0.00505	-0.00272	-0.00374	-0.00408
	(0.00771)	(0.00727)	(0.00727)	(0.00803)	(0.00729)	(0.00851)	(0.00869)	(0.00844)
Y-Mean	1012.2	1144.0	703.5	317.8	394.5	1429.3	690.2	744.1
Observations	6902	6905	6808	6708	6737	6907	6878	6888
R-sq	0.977	0.978	0.983	0.980	0.983	0.974	0.972	0.973
Year FEs	X	X	X	X	X	X	X	X
CZ FEs	X	X	X	X	X	X	X	X
CZ Trends	X	X	X	X	X	X	X	X

Notes: Outcome variables are listed at the top of each column, and are the log counts of the corresponding outcome. Estimates are from equation 1. All regressions include year and commuting zone fixed effects, commuting zone specific trends. Standard errors are clustered on commuting zone. *p<0.10, ** p<0.05, *** p<0.01

Table A9: Heterogeneity by Types of Workers Laid Off

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Gender			Race/Ethnicity			Age Categories		
	Male	Female	White	Black	Hispanic	Under 30	30-44	45-54	55 and over
A. Total Enrollment									
Layoffs, t-1	0.013*	0.015**	0.010	0.010	0.024**	0.015*	0.014*	0.013*	0.014**
	(0.0069)	(0.0073)	(0.0067)	(0.0064)	(0.0095)	(0.0079)	(0.0077)	(0.0072)	(0.0068)
Layoffs, t-2	0.010*	0.0084	0.0069	0.0068	0.013**	0.011*	0.010	0.0076	0.0089
	(0.0058)	(0.0062)	(0.0056)	(0.0055)	(0.0067)	(0.0065)	(0.0064)	(0.0059)	(0.0057)
Layoffs, t-3	0.0048	0.0059	0.0056	0.0067	0.0045	0.0049	0.0070	0.0058	0.0045
	(0.0064)	(0.0051)	(0.0058)	(0.0057)	(0.0048)	(0.0055)	(0.0058)	(0.0057)	(0.0066)
Y-Mean	12257.5	12257.5	12257.5	12257.5	12257.5	12257.5	12257.5	12257.5	12257.5
Observations	6923	6923	6923	6923	6923	6923	6923	6923	6923
R-Sq	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
B. Fall Enrollment									
Layoffs, t-1	0.028**	0.024**	0.028**	0.017*	0.035***	0.031***	0.029***	0.026**	0.028***
	(0.011)	(0.0098)	(0.011)	(0.0098)	(0.013)	(0.011)	(0.011)	(0.011)	(0.011)
Layoffs, t-2	0.026***	0.016**	0.023***	0.018**	0.020**	0.026***	0.026***	0.024***	0.023**
	(0.0081)	(0.0075)	(0.0079)	(0.0083)	(0.0079)	(0.0087)	(0.0083)	(0.0090)	(0.0088)
Layoffs, t-3	-0.0034	-0.0097	-0.0016	-0.011	-0.010	-0.0067	-0.0044	-0.0041	-0.0059
	(0.0076)	(0.0076)	(0.0078)	(0.0079)	(0.0088)	(0.0078)	(0.0080)	(0.0080)	(0.0085)
Y-Mean	2155.2	2155.2	2155.2	2155.2	2155.2	2155.2	2155.2	2155.2	2155.2
Observations	6922	6922	6922	6922	6922	6922	6922	6922	6922
R-Sq	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
C. Awards									
Layoffs, t-1	0.0037	0.0030	0.0042	0.00096	0.0046	0.0057	0.0046	0.0041	0.0064
	(0.0074)	(0.0076)	(0.0072)	(0.0070)	(0.011)	(0.0084)	(0.0081)	(0.0076)	(0.0073)
Layoffs, t-2	0.020***	0.019***	0.020***	0.018***	0.020**	0.020***	0.021***	0.018***	0.022***
	(0.0067)	(0.0064)	(0.0064)	(0.0066)	(0.0077)	(0.0071)	(0.0069)	(0.0068)	(0.0064)
Layoffs, t-3	0.0044	0.0073	0.0068	0.0072	0.0072	0.0039	0.0063	0.0067	0.0071
	(0.0057)	(0.0054)	(0.0056)	(0.0056)	(0.0047)	(0.0057)	(0.0057)	(0.0061)	(0.0061)
Y-Mean	1685.3	1685.3	1685.3	1685.3	1685.3	1685.3	1685.3	1685.3	1685.3
Observations	6907	6907	6907	6907	6907	6907	6907	6907	6907
R-Sq	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98

Notes: All regressions include year and commuting zone fixed effects, commuting zone specific trends, and demographic controls. Regressions are weighted by commuting zone population. Standard errors are clustered on commuting zone. *p<0.10, ** p<0.05, *** p<0.01

B Local unemployment rates and educational production

A commonly used approach in the literature is to regress educational enrollment on the unemployment rate in the following way:

$$y_{ct} = \alpha + \beta U_{ct} + \Gamma X_{ct} + \gamma_c + \eta_t + \varepsilon_{ct} \tag{3}$$

where y_{ct} is the logged value of a certain educational outcome and U_{ct} is the local unemployment rate. The matrix X_{ct} contains labor market covariates, γ_c are local area fixed effects and η_t are year fixed effects. This is a generalized form of the estimating equation in Betts and McFarland (1995).

There are, however, considerable concerns in explicitly estimating equation 3, though some variation of it is used with considerable frequency in the literature. First, enrollment in college mechanically increases the unemployment rate since those individuals are no longer counted as being in the labor force. Second, the unemployment rate, particularly at sub-state geographies, is measured with considerable error (Hoynes, 2000), and therefore would lead β to be biased towards zero. We discuss these issues in more depth in prior work (Foote, Grosz and Stevens, 2018).

Table B1 displays estimates of equation 3 for the main outcomes. Although noisy, the coefficient in column 2 suggests that a one percentage point increase in the unemployment rate is associated with a 2.83 percentage point increase in first-time fall enrollment, which is roughly similar to the main result in Betts and McFarland (1995).

Using mass layoffs as an instrument for the unemployment rate makes the main outcome of interest, first time fall enrollment, larger and statistically significant. It suggests that an increase in the unemployment rate of one percentage point leads to a 16.1 percent increase in first-time enrollment. We also find an increase in medium-term certificates, and positive but statistically insignificant increases in other types of degrees and certificates.

Table B1: Unemployment Rate and Two-Year College Enrollment

	(1)	(2)	(3)	(4)	(5)	(6)
	Fall Enrollment		Associate's Degrees and Certificates			
	Total	First-Time	Total	AA/AS	1-4 Year Cert	<1 Year Cert
OLS						
Unemp. Rate, t-1	-1.43*	2.83**	-1.41	-1.01	4.08	-4.45*
	(0.78)	(1.15)	(1.02)	(1.14)	(2.57)	(2.50)
Y-Mean	11976.4	2125.1	1636.5	1036.5	320.7	484.4
N	7875	7875	7862	7210	7679	6049
2SLS						
Unemp. Rate, t-1	6.01	16.1***	1.33	-2.00	15.7*	2.03
	(4.29)	(4.69)	(4.24)	(4.54)	(8.24)	(11.9)
Y-Mean	11976.4	2125.1	1636.5	1036.5	320.7	484.4
N	7875	7875	7862	7210	7679	6049
Year FEs	X	X	X	X	X	X
CZ FEs	X	X	X	X	X	X
CZ Trends	X	X	X	X	X	X

Notes: Outcome variables are listed at the top of each column, and are the log counts of the corresponding outcome. Estimates are from equation 3. All regressions include year and commuting zone fixed effects, commuting zone specific trends. Regressions are weighted by commuting zone population. Standard errors are clustered on commuting zone. Estimates in the 2SLS panel use the number of workers laid off as an instrument. *p<0.10, ** p<0.05, *** p<0.01