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DISCUSSION PAPER SERIES

IZA DP No. 17937

Heterogeneous Effects of a Teacher Strike on Education and Labor Market Outcomes

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ABSTRACT

Heterogeneous Effects of a Teacher Strike on Education and Labor Market Outcomes

We study the impact of a teacher strike on students still in compulsory school and about to choose their secondary education track. Using administrative data and a difference-in-differences approach, we estimate the effect of a regional strike in Finland on educational attainment and long-term labor market outcomes. On average, we find no statistically significant effect on attainment across exposed students. However, students from high-income households were more likely to pursue general education rather than vocational degrees, while those from low-income households shifted away from general education. Despite these differences, both groups experienced modest gains in income and employment later in life.

JEL Classification: I21, I24, J24, C23

Keywords: teacher strike, administrative data, effect heterogeneity, difference-in-differences, doubly robust estimation

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1 Introduction

Many essential services, including education, health care, and public safety, rely on public provision. In these sectors, pay and working conditions are commonly set through collective bargaining between public-sector employees and the public employer. In education, teacher strikes are sometimes used to negotiate better working conditions, potentially improving future students' learning (e.g., Lyon et al. 2024; Lyon and Kraft 2024; Gjefsen 2020; Britton and Propper 2016). However, for students who directly experience these strikes, the immediate instructional disruptions can have adverse consequences (Jaume and Willén 2019). Yet, little is known about how the timing of such disruptions, especially when they coincide with key educational transitions, affects students and whether impacts differ by socioeconomic background.

We examine the effects of strike-related disruptions during the final year of comprehensive school on their subsequent educational pathways, attainment, and labor market outcomes. Our empirical strategy exploits a 1984 regional compulsory school teacher strike in Finland.[1] Using nationwide student-level administrative data, we apply a difference-in-differences (DiD) approach, employing both standard and doubly robust estimators. Treatment is defined at the municipality level based on strike exposure, with unaffected municipalities serving as the control group. To include what is typically the time dimension in a DiD setting, we compare two adjacent cohorts: one exposed to the strike in their final year of compulsory education and one that had just completed their compulsory education. Our comprehensive administrative data enables us to examine both short-term educational effects and longer-term educational and labor market outcomes.

Among all students exposed to the strike, we find no statistically significant effects on educational outcomes. However, the strike slightly increased the likelihood of completing general secondary school and marginally reduced vocational certification rates. Although these estimates are not statistically significant, they may reflect a modest shift away from vocational training toward general education. The strike did not affect tertiary degree at-

[1] The students had submitted their applications before the strike started, but they had not yet finalized their choices or accepted offers when the strike took place.

tainment or total years of schooling, suggesting that the strike did not disrupt long-term educational progression. Furthermore, exposure to the teacher strike was associated with higher income and lower unemployment later in life.

Building on prior research that finds educational reforms can affect students differently depending on their socioeconomic background (Buhl-Wiggers et al. 2024; Schochet and Padilla 2022; Choi 2018), we also examine the potential distributional impacts of the strike on students' educational attainment by analyzing treatment effect heterogeneity across household income levels. We find that strike-related school closures affected students' educational pathways differently across income groups. Students from low-income families were by 1.2 to 1.5 percentage points less likely to pursue tertiary education and completed, on average, 0.04 to 0.06 fewer years (14 to 22 days) of education. In contrast, students from high-income families experienced a modest shift toward general education, increasing by 0.8 to 1.0 percentage points — depending on the estimation method — and a decline in vocational training by 1.8 to 2.2 percentage points.

Despite these differences, we find no adverse long-term effects on income or employment for either group. Both low- and high-income students experienced slight improvements in labor market outcomes. The effect estimates suggest an income increase by 0.4 to 2 percent for low-income students and by 1.7 to 2.5 percent for high-income students. Total unemployment between the ages of 28 and 41 is estimated to decrease by up to 0.1 months. These results suggest that the strike may have improved the alignment between students' educational choices and their strengths or circumstances.

We contribute to the economics (Jaume and Willén 2019; Zwerling 2008; Johnson 2011; Baker 2013; Belot and Webbink 2010) and education (Alvarado et al. 2021; Aucejo and Romano 2016; Marcotte and Hemelt 2008; Maldonado and De Witte 2022) literature of school disruptions and reduced instructional time by providing new evidence on the long-term consequences of strike-related school closures. Our findings contrast with much of the existing research, which generally concludes that strike-related school closures negatively affect students' academic performance (Alvarado et al. 2021; Zwerling 2008; Johnson 2011; Baker 2013; Belot and Webbink 2010). Similar negative effects have been found in studies examining reductions in instructional time unrelated to strikes—such as changes in the number

of school days before standardized testing (Aucejo and Romano 2016), snow days (Marcotte and Hemelt 2008), and COVID-19-related school closures (Maldonado and De Witte 2022; Hammerstein et al. 2021; Haelermans et al. 2022). Moreover, while much of the existing literature addresses recurring, short-term, and unpredictable disruptions (Jaume and Willén 2019; Alvarado et al. 2021; Baker 2013; Zwerling 2008; Johnson 2011), the 1984 teacher strike in Finland was a singular, well-defined event that concluded with a settlement between the teachers' union and the state. This context provides a rare opportunity to assess the effects of a coordinated and well-managed labor action.

Unlike earlier studies that examine younger students (Haelermans et al. 2022; Jaume and Willén 2019; Baker 2013; Johnson 2011), a broader age range (Belot and Webbink 2010; Marcotte and Hemelt 2008), or all years of secondary education (Alvarado et al. 2021), our study focuses on a more specific group of older students. This focus allows us to examine how teacher strikes affect access to counseling during a critical decision-making period, rather than classroom learning. Unlike in previous research, the strike we study occurred after students had already applied to secondary or vocational programs. The key disruption was the loss of contact with counselors and teachers during the admissions waiting period, when students often need help evaluating offers or reapplying. Students' reliance on this support likely differed depending on the strength of their home support networks.

Lastly, while the literature on short-term academic outcomes of school disruptions is extensive, evidence on their long-term socioeconomic impacts remains relatively limited and mixed. Two notable exceptions are a study by Jaume and Willén (2019) linking teacher strikes in Argentina to lower future earnings, and one by Pischke (2007) on a school reform in West Germany, which increased grade repetition but showed no lasting effects on income or employment. Our study contributes to this literature in two ways. First, it provides rare evidence on the long-term consequences of school disruptions, complementing these earlier findings. Second, we highlight heterogeneity in these long-term effects across socioeconomic groups, a dimension that has received limited attention in the context of school disruptions. One exception is Haelermans et al. (2022), who examines COVID-19-related school disruptions and finds that short-term standardized test performance declined more among students from low socioeconomic backgrounds, suggesting they were more adversely affected. To our

knowledge, our study is the first to examine such heterogeneity in the context of teacher strikes.

Our paper proceeds as follows. Section 2 provides the essential details of the Finnish educational system and the 1984 teacher strike. Section 3 describes the administrative data and variables used in the analysis, and presents descriptive statistics. We outline our empirical strategy for estimating the strike's impact in Section 4. Section 5 presents our results, and Section 6 concludes.

2 Institutional Background

2.1 The Finnish Education System

In the Finnish education system, compulsory schooling begins in the summer of the year a child turns seven and concludes at the end of the calendar year in which they turn 16. As a result, each school cohort aligns with a single birth cohort. From February to March of their last year of compulsory education, students can apply to secondary education institutions via a centralized application and admission system.[2] The secondary level of education is divided into two main tracks: general and vocational. The general track, sometimes called high school, the academic track, or gymnasium, prepares students for higher tertiary education. The vocational track provides training for specific occupations (Silliman and Virtanen 2022). The majority of students go on to either general education or vocational training.[3]

There are no centralized final exams or standardized tests at the end of comprehensive school in Finland. Admission to secondary education is based on the final assessment certificate issued by the comprehensive school. This certificate indicates how well the student has met the objectives of the comprehensive school curriculum across various subjects throughout their education (European Commission 2023). Students submit their secondary education applications between February and March. Secondary education institutions announce their acceptance decisions in June of the same year. Students can then decide whether to ac-

[2]The centralized application and admission system was introduced between 1973 and 1979 and was, therefore, well established by the time of the teacher strike (Suhonen and Karhunen 2019).

[3]Only around 18 % of the 25- to 34-year-olds in Finland had no secondary education degree during our study period (1995) (Statistics Finland 2007).

cept the offered spot or reapply if they are not admitted (Huttunen et al. 2023). At the time of the 1984 teacher strike, students received application guidance mainly from school counselors and advisors at the employment office, who used regional selection guides. Application announcements appeared in newspapers and were broadcast on the radio (Suhonen and Karhunen 2019).

The Finnish education system is decentralized, almost entirely publicly provided, publicly funded, and tuition-free at all levels of education. Private schools have a small market share: from pre-primary to general secondary schools, private funding accounts for only 1 % (European Commission 2024). The general curriculum for comprehensive education is determined at the national level (European Commission 2024), and local municipalities are responsible for delivering education and employing teachers as part of the public workforce (OECD 2020).

2.2 The Teacher Strike

We study the effects of a comprehensive school teacher strike that began on April 1 1984. The strike involved public school teachers in four municipalities: Helsinki, Vantaa, Vaasa, and Imatra. As a result of the strike, public comprehensive schools in these municipalities were closed. The strike did not affect high schools, vocational education institutes, or private schools. On April 16 1984, teachers in nine additional municipalities (Espoo, Kauniainen, Tampere, Turku, Forssa, Kuopio, Äänekoski, Uusikaarlepyy, and Kemi) joined the strike (Helsingin Sanomat 1984), bringing the total number of affected students to approximately 160,000. Our treatment municipalities include all these 13 municipalities. The strike ended on May 2 1984, following a mediation proposal by National Mediator Teuvo Kallio. After this resolution between the OAJ and the government, no further teacher strikes occurred in Finland for over 30 years (Yle 2015).

The strike was initiated and coordinated by the Finnish Trade Union of Education (OAJ) in response to a wage dispute. The OAJ demanded a monthly salary increase of 1,000 marks and additional compensation for attending meetings. For reference, the average monthly salary for men in industrial jobs at the time was 5,200 marks.

The strike affected a comparably diverse range of the 465 Finnish municipalities, encom-

passing urban, suburban, and rural areas with varying population densities.[4] However, no municipalities in remote regions, such as the vast majority of those in Northern Finland and island municipalities, were affected by the strike (Helsingin Sanomat 1984). Furthermore, since the three largest cities in Finland were included in the strike, a disproportionately high number of students from urban areas experienced strike-related school closures, making the group of affected students little representative of the overall Finnish student population. This limited representativeness is not a concern in our DiD framework, as identification relies on comparing changes over time between adjacent cohorts within treated municipalities to the corresponding difference within control municipalities—thereby controlling for time-invariant differences in municipality characteristics.

The teacher strike coincided with a key educational transition period when students transitioned from comprehensive school to secondary school. The strike began shortly after students in their final year of compulsory education had submitted their secondary education applications. Although post-secondary admission decisions were not made until June, the strike occurred during a key period when students were contemplating their post-compulsory education options. During this time, their access to school-based guidance and counseling was reduced due to the strike. With the strike ending on May 2 and students completing the 9th grade later that month, they had little opportunity to reconnect with counselors before making final decisions about their next stage of education.

3 Data

We use de-identified, population-wide, student-level administrative data from Statistics Finland containing student education and labor market outcomes for the years 1997 to 2008. We focus on students who were aged 15 to 17 at the time of the teacher strike (birth cohorts 1967–1968) and were therefore either in their final year of compulsory education (9th grade) or had recently transitioned to secondary education or the labor market. Comparing two adjacent age groups offers two advantages. The first benefit is methodological: it allows us to include what is typically the time dimension in a DiD setting. The second one is economic:

[4] We use the 1980 municipality classification from our census data in the analysis.

it enables us to study the impact of the strike on students during a critical educational transition period.

We consider several indicators of educational attainment, all of which are measured by the age of 40. Our first two measures focus on the short-term impacts of the teacher strike. The first is an indicator for completing general secondary education, measured by whether a student passed the matriculation exam at the end of the general secondary education track, which corresponds to the attainment of a secondary education credential. Our second measure indicates whether a student completed a vocational education program. To capture the longer-term impact of the strike on educational attainment after secondary education, we construct an indicator of whether a student obtained any tertiary education degree, as well as a measure capturing the standard duration of study for the highest degree each student achieved.

To assess the impact of the strike on students' long-term income, we calculate each student's average yearly real income from 1997 to 2008 (when they were aged 28 to 41), adjusted to 1990 price levels. Our income measure includes wages and salaries, but not social benefits. Lastly, to evaluate the impact on unemployment, we calculate the total number of months an individual was unemployed between 1997 and 2008 (when students were 28 to 41 years old). To account for pre-strike differences among students, we use 1980 census data to create variables for student and family characteristics.

The advantage of our administrative data is that our measures are not subject to the issues commonly encountered in survey data, such as recall errors or over- or under-reporting. Our income data is also not top-coded. For a more detailed sample and variable description, see Section A of the appendix.

3.1 Descriptive Statistics

Table 1 presents the comparisons of all of our outcomes and covariates in treated and untreated municipalities. We also present comparisons between students in the final year of compulsory education (9th grade) and those in the post-compulsory cohort.

We find that the outcomes and covariates are very similar between the students in the final-year and the post-compulsory cohort, aside from the post-compulsory cohort being

slightly larger. Additionally, final-year students have somewhat more grandparents and fewer siblings, both of which are statistically significant differences. These patterns are not surprising, given that 9th-grade students were younger when these covariates were measured. The small but statistically significant difference in educational attainment between the two cohorts can be attributed to the general increase in educational attainment over time. The difference in income between the two cohorts from 1997 to 2008 can be explained by the fact that the older cohort had already spent one additional year in the labor market by that time. Any of these cohort-level differences are not a concern for identification, as our DiD framework relies on comparing changes across cohorts within municipalities.

Table 1 also shows that the differences between students in treated and untreated municipalities are substantially larger. Academic educational attainment is higher in treated municipalities, while vocational training is more prevalent in untreated municipalities. These differences are statistically significant at the 0.1 percent level. Specifically, the likelihood of obtaining a vocational training degree is 5 percentage points higher in the control group. By contrast, the chances of completing general secondary education and earning a tertiary degree are 8 and 5 percentage points higher, respectively, in the treatment group.

The household and regional covariates also differ between treated and control municipalities. Since the three largest cities in Finland are included in the treatment group, a greater proportion of students in this group reside in urban areas. Consistent with the urban nature of treated municipalities, family size and household size are also smaller in the treated municipalities. Monthly household income per member is approximately 29 % higher in treated municipalities — averaging 4,433 marks compared to 3,440 marks in unaffected areas. Additionally, parental education levels are higher in treated municipalities: on average, mothers have 0.5 more years of schooling and fathers 0.7 more years than their counterparts in control municipalities.

TABLE 1: Comparisons of outcomes and covariates between treatment and control municipalities and the final-year and post-compulsory cohorts.

Variable	Mean	Treated	Control	Diff.	p-val.	Final-year	Post-comp	Diff.	p-val.
Outcomes									
General secondary education	0.434	0.496	0.414	0.08	0.00	0.436	0.433	0.00	0.24
Vocational secondary education	0.600	0.566	0.613	-0.05	0.00	0.593	0.609	-0.02	0.00
Tertiary education	0.266	0.301	0.256	0.05	0.00	0.273	0.260	0.01	0.00
Years of education	13.16	13.35	13.10	0.25	0.00	13.18	13.13	0.05	0.00
Income	10.27	10.29	10.26	0.03	0.00	10.26	10.27	-0.02	0.00
Months unemployed	1.10	1.05	1.11	-0.06	0.00	1.11	1.09	0.02	0.15
Household and regional covariates									
Female	0.490	0.490	0.491	0.00	0.79	0.491	0.490	0.00	0.76
HH Income/member	3,688	4,433	3,440	993	0.00	3,704	3,673	31	0.01
Mother: Homemaker	0.113	0.095	0.119	-0.02	0.00	0.116	0.111	0.00	0.00
Months unemployed	0.019	0.011	0.022	-0.01	0.00	0.019	0.019	0.00	0.92
(Self-) Employed	0.798	0.829	0.787	0.04	0.00	0.798	0.797	0.00	0.46
Education years	12.58	12.94	12.44	0.51	0.00	12.59	12.58	0.01	0.39
Education unknown	0.615	0.562	0.632	-0.07	0.00	0.604	0.625	-0.02	0.00
Father: homemaker	0.001	0.001	0.001	0.00	0.09	0.001	0.001	0.00	0.85
Months unemployed	0.010	0.009	0.011	0.00	0.00	0.010	0.010	0.00	0.43
(Self-) Employed	0.798	0.765	0.809	-0.04	0.00	0.804	0.792	0.01	0.00
Education years	13.10	13.61	12.89	0.72	0.00	13.09	13.11	-0.03	0.15
Education unknown	0.625	0.559	0.647	-0.09	0.00	0.617	0.633	-0.02	0.00
# of siblings, same HH	1.395	1.049	1.510	-0.46	0.00	1.374	1.415	-0.04	0.00
# of adult siblings, same HH	0.294	0.192	0.327	-0.14	0.00	0.254	0.331	-0.08	0.00
# of alive grandparents	2.25	2.27	2.24	0.02	0.02	2.32	2.18	0.14	0.00
# of grandp., same HH	0.014	0.005	0.017	-0.01	0.00	0.017	0.011	0.01	0.00
# of HH members	4.56	4.11	4.71	-0.60	0.00	4.55	4.58	-0.03	0.00
Regional population: 200-499	0.026	0.005	0.033	-0.03	0.00	0.027	0.026	0.00	0.15
500-999	0.033	0.005	0.042	-0.04	0.00	0.033	0.033	0.00	0.99
1,000-4,999	0.153	0.024	0.197	-0.17	0.00	0.155	0.152	0.00	0.09
5,000-19,999	0.149	0.023	0.191	-0.17	0.00	0.151	0.147	0.00	0.01
20,000-49,999	0.128	0.116	0.133	-0.02	0.00	0.129	0.128	0.00	0.49
50,000-99,999	0.066	0.054	0.070	-0.02	0.00	0.066	0.066	0.00	0.58
100,000+	0.444	0.773	0.334	0.44	0.00	0.438	0.449	-0.01	0.00
Regional unemployment rate	0.036	0.026	0.039	-0.01	0.00	0.036	0.036	0.00	0.40
Regional average of years of education	12.44	12.84	12.31	0.53	0.00	12.439	12.437	0.00	0.36
Observations	141,620	35,813	105,807			69,533	72,087		

Notes: Final-year refers to the cohort that was in 9th grade during the strike. *Post-comp* refers to the post-compulsory cohort that is one year older and finished compulsory school in the year before the strike. *General secondary education* refers to completing the final exam in general secondary school, *Vocational secondary education* to obtaining a vocational training certificate, and *Tertiary education* to earning a tertiary degree (at least a Bachelor's degree), all three assessed at age 40. *Years of education* captures the standard duration of study associated with an individual's highest educational qualification, also assessed at age 40. *Income* is the monthly income from 1997 to 2008 transformed using inverse hyperbolic sine (arcsinh) and adjusted to 1990 price levels. *Months unemployed* refers to the total months of unemployment between 1997 and 2008. The p-value indicates the significance of the independent sample t-test.

4 Empirical strategy and identification

We estimate the effect of the teacher strike on educational and labor market outcomes using a DiD approach. Our strategy takes advantage of the fact that compulsory school teachers went on strike in some municipalities in 1984, but not in others. We consider municipalities where strike-related school closures occurred as our treatment group, and all other municipalities as our control group. To include what is typically the time dimension in a DiD setting, we compare two adjacent age groups: a cohort that was in compulsory school in 1984 and was therefore directly exposed to the strike, and one that had already transitioned to secondary school or entered the labor market. Specifically, we estimate the following specification:

$$y_i = \beta_1 d_i + \beta_2 c_i + \beta_3 d_i \times c_i + X_i'\gamma + \epsilon_i, \tag{1}$$

where y_i is the education or labor market outcome of interest of student i, d_i is a dummy variable indicating whether student i attended school in a treated municipality ($d_i = 1$) or not ($d_i = 0$), and c_i is a binary indicator equal to 1 if the student was part of the final-year cohort (grade 9) during the teacher strike, and 0 otherwise. We include a set of pre-strike controls, X_i, at the individual and municipality levels to control for possible age cohort and municipality differences in the outcomes and to reduce noise. The error term, ϵ_i, is estimated with clustering at the municipality level because the treatment was assigned at that level (Bertrand et al. 2004).

The coefficient of interest β_3 captures the average treatment effect of the teacher strike on the treated (ATT). The key underlying assumption is the common trend assumption, which states that, in the absence of treatment, the difference in outcomes between the two age cohorts would have evolved similarly in the treatment and control group. In the context of our application, this implies that, had the teacher strike not occurred, the difference in outcomes between the younger and older cohorts would have been the same in treated and untreated municipalities.

We estimate the equation (1) with and without the pre-strike controls X_i, and report the results in Section 5. The differences between the treatment and control groups shown in the descriptive statistics (Table 1) make it challenging to confidently assume that the common

trend assumption holds without further adjustment. Therefore, we include municipality-level covariates in estimating the DiD model — namely, variables capturing socioeconomic characteristics and the population size of the area where each student lived. Doing so helps to account for potential differences in outcome development that would still have occurred in the absence of the strike due to the structural differences between the two groups. Even if the observed covariate differences do not directly influence outcome trends, including them in the estimation reduces noise.

In addition to possible concerns about differences between treated and untreated municipalities, the common trend assumption may only hold for students with similar pre-strike characteristics. For instance, differences in educational outcomes between age groups could depend on family background, as the overall increase in educational attainment in Finland may have been more or less pronounced among students from economically disadvantaged households. To address this concern, we control for the students' sociodemographic characteristics, such as sex, household income per member, parents' educational attainment, parents' employment status, and number of household members.

We also run a placebo test to estimate the difference in outcomes between the final-year and post-compulsory cohorts during the years before the teacher strike, i.e., from 1980 to 1983, and plot the results in an event study plot. Since neither of these cohorts was affected by the strike nor exposed to it later as they had already completed compulsory schooling, their outcomes should follow similar trajectories over time if the common trends assumption holds. We document the results of this placebo test in Section 5.

In addition to the parallel trends assumption, the DiD approach also relies on the common support assumption. This requires that for every observed student in the final-year cohort in treated municipalities, there are comparable observations - with similar characteristics in terms of the considered covariates - in the final-year and post-compulsory cohorts in untreated municipalities, as well as in the post-compulsory cohort in treated municipalities. The small number of covariates relative to the sample size suggests that the common support assumption holds, at least approximately (Angrist and Pischke 2009).

Finally, the DiD setting also requires the no anticipation assumption to hold.[5] In our con-

[5]In the classical DiD setting involving a time component, this assumption implies that students do not

text, this assumption implies that the older cohort in treated municipalities was unaffected by the teacher strike in comprehensive schools. This assumption is likely to hold, since the teacher strike did not directly affect general secondary and vocational education. However, individuals in the post-compulsory cohort may have been indirectly impacted by the strike, for instance, if they had younger siblings in need of care or were exposed to discussions about the strike. If the strike had an indirect effect on the older cohort in the same direction as on the younger cohort, this would likely lead to an underestimation of the true treatment effect; if the effect were in the opposite direction, it could result in an overestimation. Nevertheless, such indirect effects are likely to be limited in scope and should not pose a major threat to the validity of the estimates.

In addition to the standard DiD approach, we apply the more advanced doubly robust DiD approach by Sant'Anna and Zhao (2020), which relaxes key identifying assumptions of DiD by allowing for treatment effect heterogeneity.[6] As demonstrated in our analysis of effect heterogeneity, these assumptions do not necessarily hold in our context. Making use of our comprehensive administrative data, we apply a doubly robust DiD estimator that allows for effect heterogeneity across students and municipalities (Sant'Anna and Zhao 2020). This two-step procedure involves first estimating models for the outcome and the propensity score, where the former is estimated using a linear regression, while for the latter, the inverse probability tilting estimator introduced by Graham et al. (2012) is used. In a second step, the fitted values for the outcome and propensity score are plugged into the doubly robust DiD estimator, which enables consistent estimation of the ATT as long as either the propensity score model or the outcome model is correctly specified.

Similar to the standard DiD approach, the doubly robust DiD approach relies on the assumptions of common support and no anticipation. However, the common support assumption is more demanding for the doubly robust DiD approach because the estimator can become unstable when there is weak overlap in covariates — that is, when the propensity score is very close to zero or one for specific values of X (Heiler and Kazak 2021; Ma et al.

foresee their treatment during the pre-treatment period in a way that influences their pre-treatment outcome.

[6]The standard DiD approach is based on the assumptions that the relationship between the outcome and the covariates X_i is the same in both the treatment and control group, and that the treatment effect is homogeneous across different values of X_i.

2023). To avoid the propensity scores from clustering near zero or one, we adjust the set of covariates used in the doubly robust estimation by excluding municipality-level variables because these variables are strongly correlated with treatment assignment and would otherwise result in highly polarized propensity scores.

5 Results

5.1 Average effects of the strike

Table 2 displays the ATT of the teacher strike on short-term education outcomes and long-term education and labor market outcomes. The results are consistent in sign and similar in magnitude across all three estimation approaches (Models 1–3). Furthermore, the results from our placebo tests indicate no violations of the common trend assumption, reinforcing the validity of our research design (Figure 1).

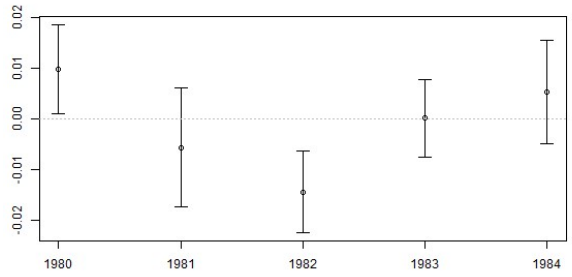
Although neither of the effect estimates is statistically significant, our results in Table 2 suggest that the strike increased the likelihood of completing the final general secondary school exam by 0.5 percentage points and decreased the likelihood of obtaining a vocational secondary education certificate by 1 percentage point, although neither effect estimate is statistically significant. This implies that the teacher strike did not prevent affected students from continuing along the general secondary education track; in fact, it appears that, although statistically insignificant, the closures may have even encouraged students to remain in general education. In terms of the long-term education outcomes, the estimated effect of the strike on the likelihood of obtaining a tertiary degree is essentially zero, and the effect on overall years of education is slightly negative — ranging from a decrease of 0.008 to 0.017 years depending on the estimation method used — but also statistically insignificant.

TABLE 2: Impact of teacher strike on education and labor market outcomes.

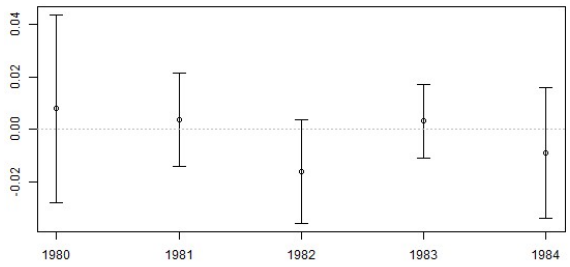
	Model 1	Model 2	Model 3
Short-term outcomes			
General secondary education	0.005	0.005	0.005
	(0.006)	(0.005)	(0.006)
Vocational secondary education	-0.010	-0.009	-0.009
	(0.011)	(0.013)	(0.011)
Long-term education and labor market outcomes			
Tertiary education	0.001	0.000	0.001
	(0.005)	(0.004)	(0.006)
Education years	-0.014	-0.017	-0.008
	(0.023)	(0.017)	(0.029)
Income	0.012	0.010	0.020
	(0.009)	(0.008)	(0.011)
Months unemployed	-0.072*	-0.081*	-0.085*
	(0.031)	(0.036)	(0.029)
Controls:			
Student-level	No	Yes	Yes
Municipality-level	Yes	Yes	No
Observations	138,587	138,587	138,587

Notes: Each column reports the ATT estimates from a distinct DiD specification. Model 1 refers to the results from estimating Equation 1 without covariates X_i, and Model 2 to the results from estimating Equation 1 with the full set of covariates. Model 3 refers to the estimates obtained using the doubly robust DiD approach, excluding municipality-level variables to avoid clustering of propensity scores near zero or one. Standard errors, clustered at the municipality level, are provided in parentheses. Short-term outcomes include an indicator for completing the final exam in general secondary school and obtaining a vocational training certificate. Long-term education and labor market outcomes include an indicator for completion of a tertiary degree (at least a Bachelor's degree) and overall educational attainment in years, both assessed by the age of 40. In addition, the table reports the ATT estimates on average annual income (arcsinh-transformed and adjusted to 1990 price levels), and total months of unemployment, both measured the years between 1997 and 2008. Standard errors, clustered at the municipality level, are provided in parentheses. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

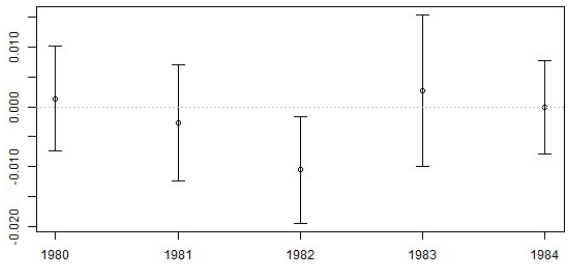
FIGURE 1: Comparison of pre-treatment outcomes of the students in final-year and post-compulsory cohorts (years before the teacher strike from 1980 to 1984).



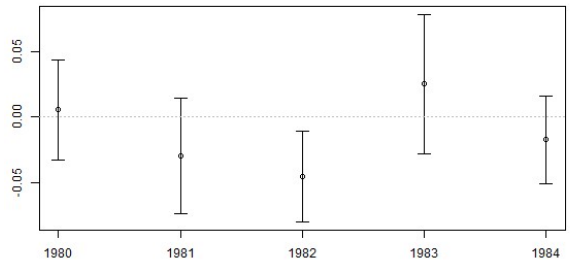
(A) General secondary education



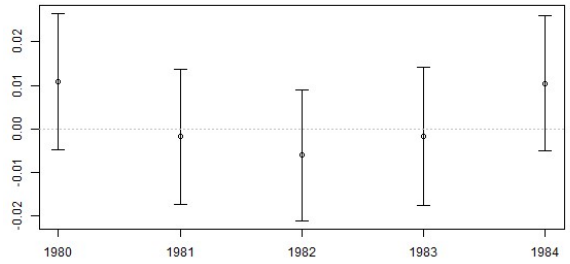
(B) Vocational secondary education



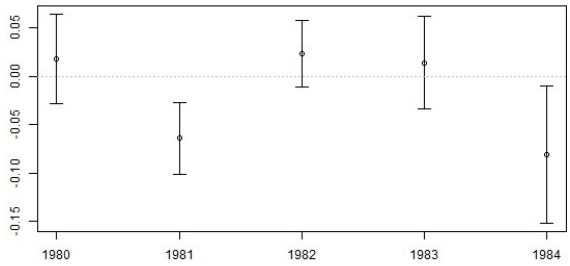
(C) Tertiary education



(D) Education years



(E) Income



(F) Months unemployed

Notes: The figure plots the placebo ATT estimates obtained by estimating Equation 1 with the full set of covariates for students in final-year and post-compulsory cohorts in the four years before the teacher strike (from 1980 to 1984). The bars represent the 95 % confidence interval. Short-term outcomes include an indicator for completing the final exam in general secondary school and obtaining a vocational training certificate. Long-term education and labor market outcomes include an indicator for completing a tertiary degree and total years of education, both measured by age 40, as well as the average annual income and total months of unemployment, both measured between 1997 and 2008. Income is arcsinh-transformed and adjusted to 1990 price levels.

Regarding the long-term effects of the teacher strike on labor market outcomes, the estimates suggest that the teacher strike was associated with a 1 to 2 percent increase in income and a reduction of 0.07 to 0.09 months in unemployment between the ages of 28 and 41. While the reduction in unemployment is statistically significant, the income effect is not. These results may be explained by the shift away from vocational training and toward general education among students directly affected by the strike.

Contrary to most previous research on the effects of teacher strikes (e.g., Jaume and Willén 2019; Zwerling 2008; Johnson 2011; Baker 2013; Belot and Webbink 2010), we find no evidence that the teacher strike had adverse effects on educational attainment or long-term economic outcomes of the affected student population on average.

5.2 Heterogeneity by family income.

Motivated by previous research showing that the effect of educational reforms on students can differ depending on their socioeconomic background (Buhl-Wiggers et al. 2024; Schochet and Padilla 2022; Choi 2018), we study whether the teacher strike had different effects on students from households with different incomes. Table 3 displays the the ATT separately for two groups of students defined based on 1980 per-member household income.[7]

[7]We group students based on pre-treatment characteristics by using per-member household income from the 1980 census, i.e. the last census before the strike. We categorize students as low-income if their 1980 per-member household income was below the municipality average; otherwise, we consider students high-income. Using municipality-level averages allows us to capture relative socioeconomic status within students' local contexts, which may be more relevant for access to education and labor market opportunities than national benchmarks. Moreover, this classification ensures that the high- and low-income groups are balanced across municipalities, helping us isolate income-related heterogeneity from differences driven by municipality-level factors.

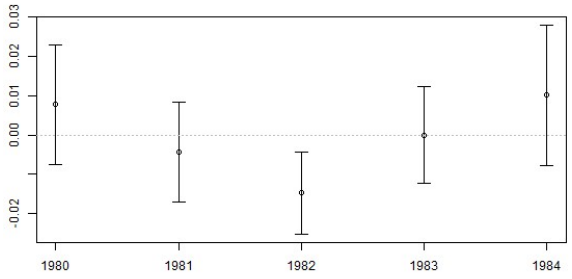
TABLE 3: Effect estimates for students from high- and low-income households.

	Model 1		Model 2		Model 3	
	High-income	Low-income	High-income	Low-income	High-income	Low-income
Short-term outcomes						
General secondary education	0.008	-0.004	0.010	0.001	0.009	0.001
	(0.009)	(0.007)	(0.009)	(0.006)	(0.008)	(0.010)
Vocational secondary education	-0.022	0.006	-0.021	0.002	-0.018	-0.004
	(0.013)	(0.015)	(0.014)	(0.016)	(0.016)	(0.017)
Long-term education and labor market outcomes						
Tertiary education	0.011	-0.014*	0.011	-0.012	0.010	-0.013
	(0.007)	(0.007)	(0.006)	(0.007)	(0.009)	(0.010)
Education years	0.014	-0.062**	0.017	-0.051**	0.009	-0.040
	(0.040)	(0.023)	(0.033)	(0.022)	(0.044)	(0.044)
Income	0.004	0.017	0.005	0.017	0.020	0.025
	(0.014)	(0.011)	(0.013)	(0.010)	(0.016)	(0.016)
Months unemployed	-0.056	-0.074	-0.078	-0.089*	-0.089*	-0.108*
	(0.034)	(0.040)	(0.042)	(0.040)	(0.037)	(0.050)
Controls:						
Student-level	No	No	Yes	Yes	Yes	Yes
Municipality-level	Yes	Yes	Yes	Yes	No	No
Observations	69,445	69,142	69,445	69,142	69,445	69,142

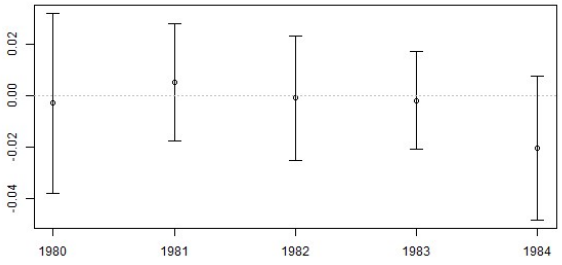
Notes: Each column separately reports the coefficients from the DiD regressions for students from high- and low-income households. Students are classified as low-income if their 1980 per-member household income was below the municipality average; otherwise, they are considered high-income. Model 1 refers to the ATT estimates from Equation 1 without covariates X_i, and Model 2 to those from estimating Equation 1 with the full set of covariates. Model 3 refers to the estimates obtained using the doubly robust DiD approach, excluding municipality-level variables to avoid clustering of propensity scores near zero or one. Short-term outcomes include an indicator for completing the final exam in general secondary school and obtaining a vocational training certificate. Long-term education and labor market outcomes include an indicator for completion of a tertiary degree (at least a Bachelor's degree) and overall educational attainment in years, both assessed by the age of 40. In addition, the table reports the ATT estimates on average annual income (arcsinh-transformed and adjusted to 1990 price levels), and total months of unemployment, both measured the years between 1997 and 2008. Standard errors, clustered at the municipality level, are provided in parentheses. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

The placebo tests show no violation of the common trend assumption (Figures 2 and 3). Across both income groups, the pre-treatment estimates fluctuate around zero, and none of the coefficients are statistically significant. This suggests that prior to the strike, there were no systematic differences in the development of cohort differences between the treatment and control group within each income group, supporting the parallel trends assumption underlying our DiD approach.

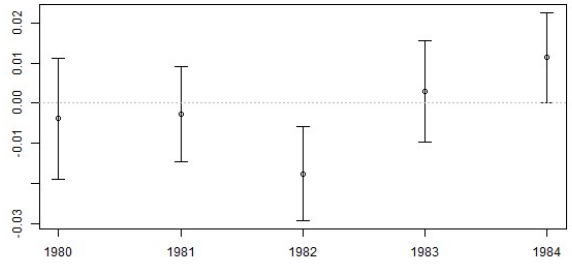
FIGURE 2: Comparison of pre-treatment outcomes for the high-income students of the final-year and post-compulsory cohorts (years before teacher strike from 1980 to 1984).



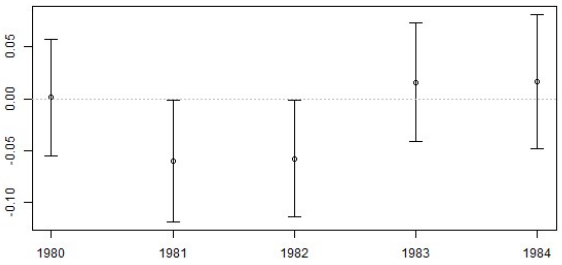
(A) General secondary education



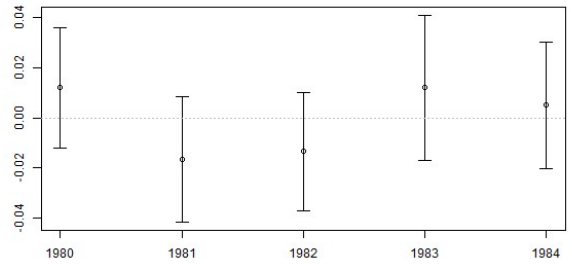
(B) Vocational secondary education



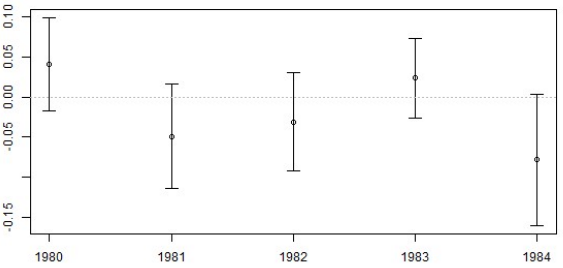
(C) Tertiary education



(D) Education years



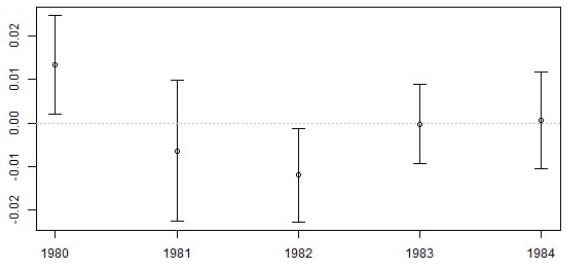
(E) Income



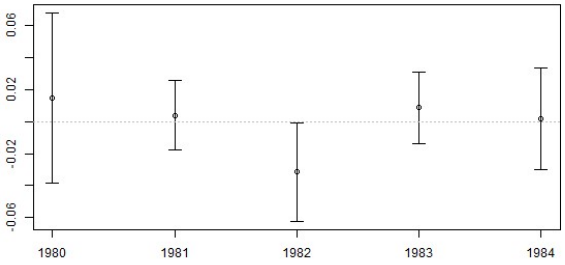
(F) Months unemployed

Notes: The figure plots the placebo ATT estimates obtained by estimating Equation 1 with the full set of covariates for high-income students in final-year and post-compulsory cohorts in the four years before the teacher strike (from 1980 to 1984). Students are classified as high-income if their 1980 per-member household income was at or above the municipality average. The bars represent the 95 % confidence interval. Short-term outcomes include an indicator for completing the final exam in general secondary school and obtaining a vocational training certificate. Long-term education and labor market outcomes include an indicator for completing a tertiary degree (at least a Bachelor's degree) and overall educational attainment in years, both assessed by the age of 40, and the average annual income (arcsinh-transformed and adjusted to 1990 price levels), and total months of unemployment, both measured the years between 1997 and 2008.

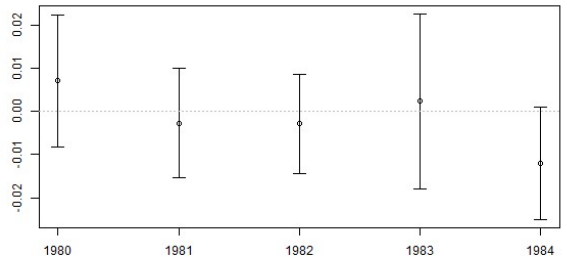
FIGURE 3: Comparison of pre-treatment outcomes for the low-income students of the final-year and post-compulsory cohorts (years before teacher strike from 1980 to 1984).



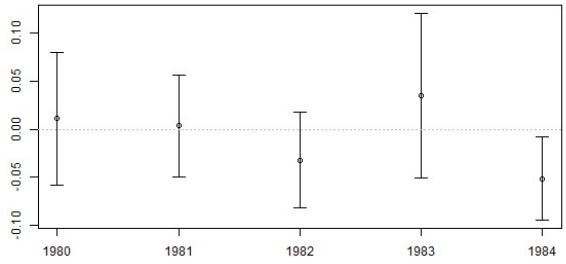
(A) General secondary education



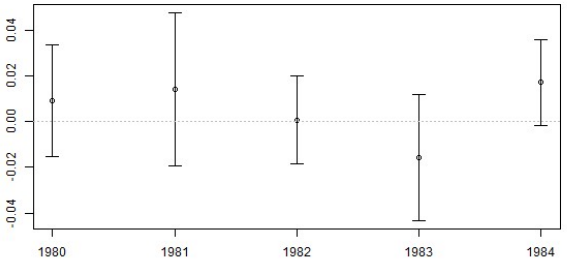
(B) Vocational secondary education



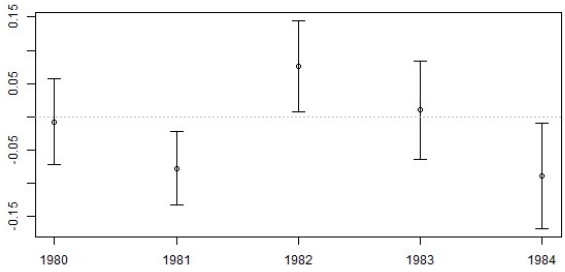
(C) Tertiary education



(D) Education years



(E) Income



(F) Months unemployed

Notes: The figure plots the placebo ATT estimates obtained by estimating Equation 1 with the full set of covariates for low-income students in final-year and post-compulsory cohorts in the four years before the teacher strike (from 1980 to 1984). Students are classified as low-income if their 1980 per-member household income was below the municipality average. The bars represent the 95 % confidence interval. Short-term outcomes include an indicator for completing the final exam in general secondary school and obtaining a vocational training certificate. Long-term education and labor market outcomes include an indicator for completing a tertiary degree (at least a Bachelor's degree) and overall educational attainment in years, both assessed by the age of 40, and the average annual income arcsinh-transformed and adjusted to 1990 price levels), and total months of unemployment, both measured the years between 1997 and 2008.

We find that students from low-income households were more likely to face adverse effects from strike-related school closures in terms of their likelihood of pursuing general secondary and academic education. Table 3 shows that the overall shift from vocational to general education in response to the strike was driven solely by students from high-income households. Depending on the estimation method used, we find that these students are 0.8 to 1.0 percentage points more likely to obtain a general secondary degree and 1.8 to 2.2 percentage points less likely to earn a vocational degree, although these differences are not statistically significant. In contrast, for students from low-income households, the teacher strike had little to no effect on the likelihood of pursuing either a general secondary or vocational education degree.

The observed effect heterogeneity by income group also extends to longer-term educational outcomes, i.e. tertiary attainment and total years of education. While the strike appears to have increased both outcomes for high-income students, it reduced the probability of earning a tertiary degree among low-income students by approximately 1.2 to 1.4 percentage points and decreased their average years of education by 0.04 to 0.06 years—equivalent to up to 22 days. The reduction in tertiary attainment is statistically significant in the standard DiD model without covariates, while the decrease in years of education is significant in the standard DiD model estimated both with and without covariates.

Despite the teacher strike reducing the likelihood that low-income students pursue tertiary education, this decrease does not appear to have led to long-term economic disadvantages compared to their high-income peers. For both groups, the strike resulted in slightly higher earnings and lower unemployment in the long run. Strike-related closures are estimated to have increased the income of high-income students by 0.4 to 2 percent, and that of low-income students by 1.7 to 2.5 percent. We also find that unemployment decreased by 0.06 to 0.09 months for high-income students and by 0.07 to 0.11 months for low-income students. For both groups, the estimates from the doubly robust approach are statistically significantly different from zero, and for low-income students, this also holds for the difference-in-differences model with covariates.

6 Conclusion

We examined how exposure to strike-related school closures affected students' educational pathways, attainment, and long-term labor market outcomes in Finland. Using a DiD framework and comprehensive administrative data, we estimated the effect of the strike on students aged 15 to 16, for whom the strike coincided with a critical decision-making period regarding their educational trajectories. This focus distinguishes our study from previous research, which primarily investigates younger or more broadly defined student populations and estimates the effects of reduced instructional time. Moreover, unlike recurring, short-term, and unpredictable disruptions examined in prior studies, the 1984 teacher strike was a singular, well-defined event that ended in a formal settlement between the teachers' union and the state. Our study further contributes to the literature by examining the long-term socioeconomic effects of school disruptions and exploring how these effects vary by household income.

Our results showed that the teacher strike had heterogeneous effects across income groups. For students from low-income households, the strike led to a 1.2 to 1.4 percentage point decrease in the likelihood of obtaining a tertiary degree and a decrease of 0.04 to 0.06 years in total years of education. In contrast, among high-income students, the strike increased the probability of completing general secondary and tertiary education by about 1 percentage point and decreased vocational enrollment by approximately 2 percentage points. The differences in post-compulsory educational choices across income groups did not, however, translate into differences in long-term labor market outcomes. On the contrary, we found that both income and employment improved regardless of socioeconomic background. These results are consistent across both the standard DiD and the doubly robust DiD framework.

One possible explanation for the positive impact of the strike on long-term labor market outcomes among both high- and low-income students is that it may have led to a better alignment between students' educational choices and their individual preferences and aptitudes. The income gains observed among students from low-income households, despite a decrease in tertiary educational attainment, may reflect earlier entry into the labor market. Such early workforce participation could have resulted in longer labor market experience

by the time the income was observed, leading to higher observed earnings without necessarily indicating a sustained increase in lifetime income. This interpretation aligns with prior evidence suggesting that vocational training can yield persistent labor market benefits, particularly for students whose abilities or aspirations are better suited to those pathways, with this advantage persisting at least into the mid-thirties (Silliman and Virtanen 2022). However, Heinesen and Stenholt Lange (2022) find that such early-career income gains from vocational education apply primarily to men, with no similar benefit for women and negative effects on income by age 40 for both women and men.

Our findings show that school disruptions can affect students differently, with particularly adverse impacts on educational attainment among those from low-income households. These students completed fewer years of education, which may have consequences not fully reflected in income and employment outcomes in early adulthood. This suggests that reduced access to school-based guidance during key decision periods may lead to longer-term disadvantages, including effects beyond the observed labor market outcomes and across generations. While these lie outside the scope of our analysis, they warrant further research. More broadly, our results suggest that education policy and strike contingency planning should consider not only the length and scope of school closures, but also their timing and how impacts may differ across student backgrounds.

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Appendix

A Data and sample construction

We use de-identified data containing the 1980 census on family relationships and FOLK datasets covering the years 1997 to 2008.[8] All data sources are provided by Statistics Finland. Using these data we construct the outcome variables as follows. Educational attainment is quantified using indicators for whether a student completed the matriculation exam at the end of general secondary school, obtained a tertiary degree, and/or completed a vocational education program by the age of 40. Additionally, we create a variable for years of education, estimated based on the student's highest completed degree and the standard duration of study associated with this degree. To assess long-term income, we calculate each student's average annual real income from 1997 to 2008, i.e., when the students under study were 28 to 41 years old, using income data reported to tax authorities. Real income is adjusted for inflation using the 1990 Consumer Price Index (CPI). Lastly, we construct a measure of unemployment, defined as the total number of months a student was unemployed between 1997 and 2008.

We use 1980 census data to create variables for students' characteristics as well as the family and household traits to control for pre-strike differences among students. The main mother and/or father figure of each student is defined as a parent residing in the same household as the student in 1980. These main parental figures may be biological or adoptive parents, or the biological/adoptive parent's partner living in the same household as the child.[9] Siblings living in the same household as the student are defined as all household members who share at least one parent with the student. Younger (half-)siblings born to the student's main parent figure(s) between 1981 and 1983 are identified using the 1985 family tie data set. Students' living grandparents are defined as the parents of the main parent

[8]The 1980 census is based on the Finnish Population Information System. The FOLK datasets compile information from multiple sources, including the Finnish Population Information System, tax records, and the Register of Completed Education and Degrees.

[9]In Finland, people in same-sex relationships were not allowed to adopt their partner's biological children in 1980, so all identified adoptive mothers in our data are female and adoptive fathers male, while the social parent of a child may be of any sex.

figure(s), whether or not they live in the same household as the student, as well as other household members.

For household covariates, we construct measures of the total number of (half-)siblings and adult /half-)siblings living in the same household, along with the number of grandparents alive in 1980, those residing in the household, and the overall number of household members. Household income per member is calculated by summing the wage, entrepreneurial, capital, and pension income of all adult household members and dividing this by the total number of individuals in the household. In addition, we use the 1980 census data to construct measures for the education level and employment status of the main parent figure(s).

Finally, we construct regional covariates using the 1980 census. These include the size of the municipality or urban area in which the family resided, the regional unemployment rate and the average level of educational attainment (measured in years).