From Classroom to Clinic

The Impact of Employer Influenced Vocational Education on Youth Unemployment and Labor Supply of Assistant Nurses

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Abstract

This study assesses the *Vård- och omsorgscollege* (VOC) program in Sweden, which integrates the skill demands of local healthcare employers with local vocational education. Utilizing a staggered Difference-in-Difference approach, this study reveals that the program has significantly reduced youth unemployment and enhanced the labor supply of assistant nurses, with a pronounced impact on female participants. This study suggests that the improvements in employment outcomes arise from an enhanced educational relevance of the vocational education and an improved job-matching, rather than an increase in the number of graduates.

Keywords: Vocational Education, Youth Unemployment, Healthcare Sector, Job Matching, Difference-in-Differences

JEL code: I11, J24, I28, J21

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1 Introduction

There is a persistent shortage of labor in the Swedish healthcare sector (Swedish Association of Local Authorities and Regions, 2022). Recent projections indicate that these issues are expected to intensify, with an increasing demand for healthcare due to an aging population and a diminishing inflow of personnel in the healthcare sector. At the same time, Sweden struggle with high rates of youth unemployment. For example, in February 2024, the youth unemployment rate in the Sweden was 25 percent, significantly higher than the unemployment rates for the overall workforce, with rates particularly pronounced among individuals without a college degree.

In this paper, I analyze a policy initiative in Sweden aimed at reducing youth unemployment and enhancing the labor supply of assistant nurses. The program, known as *Vård- och omsorgscollege* (VOC), allows local healthcare employers to shape the curriculum of nearby vocational institutions. By aligning educational programs with the specific skill demands of the healthcare sector, VOC seeks to address structural mismatches in the local labor market and ensure a reliable supply of labor in healthcare (Föreningen Vård- och omsorgscollege, 2024). Sweden's healthcare system operates on a decentralized model, with responsibilities for the hospitals, healthcare centers, and elderly care managed by the 290 municipalities and 21 regions. Since the inception of VOC in 2008, the number of participating municipalities has gradually increased to 232, primarily offering vocational education at the high school level.

Notably, the Swedish healthcare sector is dominated by women, who make up 90 percent of assistant nurses and 88 percent of registered nurses (Statistics Sweden, 2024). One important distinction between the two occupations is that a registered nurse requires an academic education while an assistant nurse only requires a high school education. Similarly, data show that 24 percent of female high school graduates, and 9 percent of their male counterparts, enter the workforce as assistant nurses. This gender distribution highlights a significant demographic likely to be impacted by the VOC program. As VOC primarily offers high school education, its programs are expected to have a considerable effect on female high school graduates.

The staggered introduction of this policy mimics a natural experiment which allows me to measure the causal effect of the policy on labor market outcomes. Using a staggered

Difference-in-Difference strategy and the estimator proposed by Callaway and Sant'Anna (2021), I formulate an empirical strategy to measure the effects at the municipality and regional levels.

I find a positive effect on labor market participation of 3.4 percentage points for women aged 20-24 with at most a high school degree. Further, I find negative effects on the unemployment rate of approximately 2 percentage points for both genders, with a larger effect for women. Additionally, I find positive effects on the labor supply of assistant nurses of 2 percent, where the effect is solely driven by women. Lastly, I find no economically significant effect on wages for men or women.

Examining potential channels, the analysis first demonstrates that the VOC program successfully decreased the unemployment rate within municipalities. This suggests that the program improved job matching, easing the transition from graduation to employment. Furthermore, I find that the policy significantly increased the labor market participation, particularly among women aged 20-24, indicating that the policy effectively addressed labor shortages by also drawing more young women to the labor market. Additionally, I observe no significant changes in educational attainment, suggesting that the observed improvements in labor market outcomes are not attributed to increases of overall graduates from high school or vocational university education.

This study contributes to the existing literature examining wage dynamics and labor shortages within sectors, incorporating recent studies on active labor market programs (ALMPs) and their distinct impacts on unemployment and job matching. The vocational education provided by VOC can be considered a type of ALMP. The discussion on ALMPs in meta-analyses such as Card et al. (2010), Card et al. (2018), and Vooren et al. (2019), highlights the heterogeneity between different ALMPs and their effects on unemployment and job matching. The literature points out the importance of target demographics, timing, and institutional settings to determine the effectiveness of ALMPs. An important distinction between the VOC program and traditional on-the-job training programs lies in the delivery of training. In traditional settings, employers provide training directly at the workplace. Conversely, in the VOC program, healthcare providers shape the vocational education to better match their specific skill demands. Moreover, since first-year high school students in Sweden are typically 16 years old, the VOC program allows healthcare providers to engage with potential future employees at an earlier stage, enabling an

early screening. This early engagement represents a notable difference from the ALMPs previously explored in the literature.

Further, this paper contributes to the ongoing research on the effectiveness of ALMPs on the youth and other disadvantaged job seekers (Caliendo and Schmidl, 2016; Carranza et al., 2022; Wheeler et al., 2022). The importance of such programs is heightened by the consistently high unemployment rates that disproportionately affect young people in Europe (OECD, 2016). Focusing on the Swedish setting, recent analyses delve into the efficacy of a state-sponsored summer work initiative for teenagers and another public employment scheme aimed at immigrants (Mörk et al., 2022; Knutsson and Tyrefors, 2024). These studies suggest only modest long-term benefits in employment from such interventions.

Moreover, my study aligns with previous research addressing the broader issues of aggregate skill mismatch and skill shortages (Cappelli, 2015; Brunello and Wruuck, 2021; Baley et al., 2022), particularly its relationship with aggregate unemployment (Şahin et al., 2014; Barnichon and Zylberberg, 2019; Sasser Modestino et al., 2020). This body of literature propose that skill mismatches significantly contribute to both structural and frictional unemployment. My contribution examines the effectiveness of the VOC program in mitigating these skill mismatches. My research demonstrates that the VOC program has not only successfully reduced youth unemployment but also increased labor market participation rates, indicating an effective reduction in aggregate skill shortages and primarily addressing structural unemployment. Moreover, my results suggest that the program enhances job matching by introducing employers to students early in their vocational training, which aids in better screening and thus reduces frictional unemployment. This aspect of my research connects with various studies exploring policy measures designed to lessen unemployment by addressing labor market mismatches (Altmann et al., 2018; Marinescu and Rathelot, 2018; Ben Dhia et al., 2022; Kiss et al., 2023).

Finally, my research builds upon the findings from studies like Combes et al. (2015) and Combes et al. (2018), which analyze the impact of wage competition on nurse shortages in the English and French labor markets. These studies address the significant role that both wage competitiveness and non-pecuniary benefits play in labor market dynamics, demonstrating that even modest increases in wage competitiveness can substantially ease staff shortages. Similarly, Eberth et al. (2016) highlights the importance of workplace

characteristics and individual preferences, showing the considerable elasticity of labor supply in response to non-wage benefits.

The rest of the paper is structured as follows: I discuss the institutional background in Section 2. In Section 3 I discuss the data, and follow up with the empirical method in Section 4. I show the results in Section 5, after which I conclude with a discussion, policy implications, and potential future research in Section 6.

2 Background

2.1 Institutional Background

The Vård- och omsorgscollege (VOC) program was initiated in 2008, and is composed of representatives from municipalities, labor unions, and The Swedish Association of Local Authorities and Regions. The purpose of the collaboration is to ensure a robust skill and labor supply in the healthcare sector focusing on assistant nurses. To accomplish this VOC aims to strengthen the alignment of the vocational education and the local labor market demands, by involving local healthcare employers in the curriculum of the education. Besides influencing the education itself, the VOC program contains elements of traditional on-the-job training. For instance, local employers supply the practical elements of the education with tools and medical supplies. Students are also usually offered summer jobs and part time jobs at the local employers.

Upon completion of their studies, graduates from a VOC program are awarded a certificate, signifying they have completed a VOC vocational education. This certification serves as a signal to local employers that the VOC graduate possesses the competencies they demand, easing the process of matching graduates with potential employers.

Furthermore, VOC also provides validation of competencies acquired through practical experience in the healthcare and social care sectors. This validation process is a comprehensive assessment of an individual's skills and knowledge acquired outside formal education. Based on the outcomes of the assessments, individuals can receive high school grades or certificates, substantiating their proficiency in the relevant field.

2.2 Expected Outcomes of the Vocational Education

Participating in VOC is expected to strengthen the link between the vocational healthcare education offered and the needs of the healthcare sector in a municipality. Drawing from existing research, I anticipate that the VOC program serves as an alternative to on-the-job training, leading to an improved job matching of assistant nurses.

A majority of VOC certified institutions are high schools. In Sweden, students who graduate from vocational high schools are not directly eligible for university education (MYH, 2021). Graduates from such programs are therefore more likely to enter the labor market immediately after completing their high school education. Given that the majority of VOC education providers offer vocational high school education, it is reasonable to anticipate an impact on the labor market outcomes among recent high school graduates. To account for this, I will focus the analysis on individuals aged 20-24 with a high school degree. Further, the impact of the policy is expected to occur three years after the policy implementation, aligning with the duration of a Swedish high school program.

The policy is anticipated to boost the labor supply in the healthcare sector through various mechanisms. The first mechanism involves the increased relevancy of the education offered by the VOC program, which may redirect students from other vocational fields toward healthcare education. This redirection is expected to increase the proportion of individuals studying and graduating from vocational healthcare programs compared to other vocational fields. The second mechanism propose that the VOC program draws individuals who do not possess a high school degree into vocational healthcare education, suggesting a general rise in vocational education enrollment. These two channels are likely to result in a greater number of graduates and potential workers in the healthcare sector. The third mechanism suggests that even if the program does not attract more students, it enhances the competencies of those studying vocational healthcare education. This scenario would not result in an increase in the number of graduates, but rather in an improvement of their skills, thereby easing their entry into the labor market.

3 Data

3.1 Policy Data

Since the establishment of VOC in 2008 until 2021, 232 out of Sweden's 290 municipalities have participated. Within these municipalities, 423 VOC-certified educators provide vocational healthcare education, with the majority offering high school education.

The largest portion of the municipalities joined VOC between 2008 and 2013. Although data on VOC is available until 2022, this analysis focuses on data up to 2021 due to limitations in other variables. The data regarding which municipality participated in the program and when was self-constructed and gathered from the VOC website. A geographical representation of when each municipality gained treatment is presented in Figure A1 of Appendix A.

3.2 Outcome Variables

This study primarily assesses the impact of the policy by examining labor market outcomes at the municipality level. Additionally, I explore educational outcomes to evaluate potential mechanisms to the results. Due to limitations in data availability, the analysis will also be extended to the regional level, which includes Sweden's 21 regions, each comprising several municipalities. Analyzing at the municipality level is preferred since the treatment occurs at this level. Nonetheless, I also anticipate observable effects at the regional level, given that the treatment often spreads in waves through neighboring municipalities within a region. I will elaborate on the methodological distinctions between these levels of analysis in Section 4. I draw data from Statistics Sweden (2021)'s open database.

The labor market outcomes include the average wage rate in a municipality, total unemployment rate, defined as the share of all unemployed individuals in a municipality a given year, and total labor market participation, defined as the share of all individuals in a municipality who have worked a given year. The data on wages, unemployment rate and labor market participation is further specified to focus on individuals aged 20-24 with a high school degree, representing the subgroup most likely to be affected by the policy. Further, I analyze the sector-specific outcomes using data on assistant nurses. I use data

on average wage rate of assistant nurses, and labor supply of assistant nurses, defined as the ratio of individuals employed as assistant nurses in a municipality over the total labor supply. Lastly, I segment the data based on gender to account for potential heterogeneous effects.

To estimate the effects of unemployment rate, labor market participation, and wages, the analysis will be conducted at the more preferred municipality-level. However, due to the lack of available data on labor supply and wages for assistant nurses at the municipal level, these outcomes will be assessed at the regional level.

This study also includes an analysis of educational outcomes using data on the proportion of the municipal population with a high school degree or a vocational university degree. These variables enable an evaluation of individuals' preferences for vocational education following the implementation of the policy. Furthermore, I include data on municipal spending on healthcare and labor market programs, sourced from annual municipal reports. This data will provide insight into municipal investment in healthcare and locally conducted labor market programs that may be correlated with the timing of the policy.

Descriptive statistics for all outcome variables are located in Table B1 of Appendix B.

3.3 Covariates and Time Period

To account for potential confounders, I include covariates that could influence the outcomes at both municipal and regional levels. These covariates are:

1. Average income and overall population size, which are log-transformed to correct for distributional skewness,
2. The proportion of the working-age population (ages 20-64), and
3. The proportion of individuals without a high school degree.

These variables are chosen for their relevance to the economic well-being of the municipalities and regions, and their likely impact on policy decision-making.

The study period ranges from 1997 to 2021 for municipalities, due to data availability constraints. This 25-year period provides sufficient pre- and post-treatment periods, allowing for a thorough examination of parallel trends and dynamic effects of the treatment

through an event study. For the regional analysis, the dataset extends from 2000 to 2021, providing an analysis of 21 regions over a 22-year span.

Descriptive statistics for all covariates are located in Table B1 of Appendix B.

4 Empirical Strategy

4.1 Main Empirical Strategy

The staggered implementation of the policy across municipalities implies that they were exposed to the policy at different periods. To isolate the policy effect, I exploit the variation in a staggered difference-in-differences model with a binary treatment. The standard approach for estimating the average treatment effect using a difference-in-differences strategy, is by employing a two-way fixed effects (TWFE) regression model. This model compares outcomes between municipalities receiving different levels of treatment over time, adjusting for both group-specific and time-specific fixed effects. However, the TWFE model assumes a uniform treatment effect, an assumption that may not hold in scenarios of staggered adoption. As pointed out by Goodman-Bacon (2021) and de Chaisemartin and d'Haultfoeuille (2020), this can introduce biased results, given the method's inclusion of all potential 2x2 differences-in-differences comparisons.

To circumvent the bias raised from the TWFE method, this study adopts an estimator proposed by Callaway and Sant'Anna (2021), which compares the outcomes of municipalities treated in a given year against those who are not yet treated. Initially, it evaluates the differences in outcomes between the post-treatment year and the year prior to treatment for the treated group. These differences are then compared to those not yet treated over the same period. The Average Treatment Effect on the Treated (ATT) is then calculated using the doubly robust estimation method suggested by Callaway and Sant'Anna (2021). Additionally, the ATTs for each treatment and outcome year combination are aggregated to produce an event study estimate. Lastly, the average ATTs for all years prior- and post treatment are calculated.

The event study framework utilized in this analysis incorporates an event time window of 10 periods prior and post treatment for municipalities. This design ensures a balanced count of treated municipalities within pre-treatment ATT calculations and allowing for an analysis of dynamic post-treatment effects. This methodology is employed at the

municipality-level, leveraging a binary treatment variable that marks a municipality as treated (1) in the year it receives treatment, and untreated (0) for those not yet- or never treated. I refer to this method as the *Main Municipal Method*. I cluster the standard errors at the municipality-level.

In this analysis, I evaluate the policy's effect primarily through the Average Post-Treatment Effect on the Treated (ATT_{APT}). For robustness, I also include estimates of the simple ATT (ATT_{simple}). The crucial distinction between ATT_{APT} and ATT_{simple} lies in their calculation methods. ATT_{simple} is calculated as the weighted average of all group-time average treatment effects, which often disproportionately weights earlier-treated municipalities. In contrast, ATT_{APT} is calculated by first determining the average treatment effect for each municipality across all time periods and then averaging these effects across municipalities. This method accounts for the dynamic nature of the treatment across different times, offering a more representative estimate of the average treatment effect. Comparing the results from both ATT_{APT} and ATT_{simple} is crucial to ensure consistency and validate the robustness of the findings.

The specification for the event study model is as follows:

$$Y_{it} = \alpha_i + \gamma_t + \sum_{e=-10}^{t=-1} \delta_e D_{it}^e + \sum_{e=0}^{10} \beta_e D_{it}^e + \lambda X_{it}' + \varepsilon_{it} \tag{1}$$

Where Y_{it} is the outcome for the municipality i at year t, α_i and γ_t are the group fixed effects and the time fixed effects, X_{it}' is a vector of municipality observed characteristics, D_{it}^e is an indicator for a municipality i being e periods away from the initial treatment at year t, and ε_{it} are the robust standard errors. The coefficients of interest are β_e where $e > 0$, which represents the average post-treatment ATTs, and δ_e where $e < 0$, which represents the average pre-treatment ATTs.

4.2 Alternate Empirical Strategy

Given the data constraints outlined in Section 3, this study extends to additional empirical strategies for the regional analysis. The first method employs a binary treatment variable, triggered by the initial treatment of any municipality within a region. This method is designed to capture the policy's earlier impacts but carries a risk of inaccurately categorizing entire regions as treated based on a single municipality's treatment

status. Conversely, the second method adopts a more conservative approach, considering a region treated only after 30 percent of the regional population has been treated. While this approach mitigates the overgeneralization risk of the first method, it might overlook earlier policy effects. Thus, both methods have specific drawbacks. However, assuming uniform policy efficiency across municipalities, the first method could provide a closer approximation of the policy's aggregate regional effect. Consequently, the first method will be the primary method for the regional-level assessment. I refer to the first method as the *Main Regional Method* and the second method as the *Conservative Method*. Lastly, the standard errors are clustered at the regional level.

5 Results

5.1 Identifying Assumptions

The main identifying assumption for this analysis is the parallel trends assumption. This assumption implies that, in the absence of treatment, the outcome trends of the treated and untreated groups would have been similar, indicating that the treatment is the only differentiating factor. While it is impossible to validate this assumption definitively, its credibility can be strengthened by providing evidence of insignificant trend differences between the groups prior to treatment. To assess this, I will analyze the average pre-treatment ATT event study estimates, as outlined by Callaway and Sant'Anna (2021), complemented by graphical analyses.

The statistically insignificant differences in the average pre-treatment ATTs, shown for both genders in Table 1 and segmented into genders in Table B2 of Appendix B, support the validity of the parallel trends assumption across all outcome variables. Evaluating the pre-treatment point estimates that are insignificantly different from zero, as presented in Figures 1 and 2, further validates these findings.

Table 1: Parallel Trends

Method: Coefficient:	Main Municipal Pre-treat	Main Regional Pre-treat	Conservative Pre-treat
Unemployment Rate (Total)	−0.106		
	(0.040)		
Labor Market Participation (Total)	−0.003		
	(0.050)		
Wages (Total)	−0.000		
	(0.000)		
Labor Supply of Assistant Nurses (Total)		0.000	0.000
		(0.001)	(0.001)
Wages of Assistant Nurses (Total)		−0.000	−0.000
		(0.000)	(0.001)

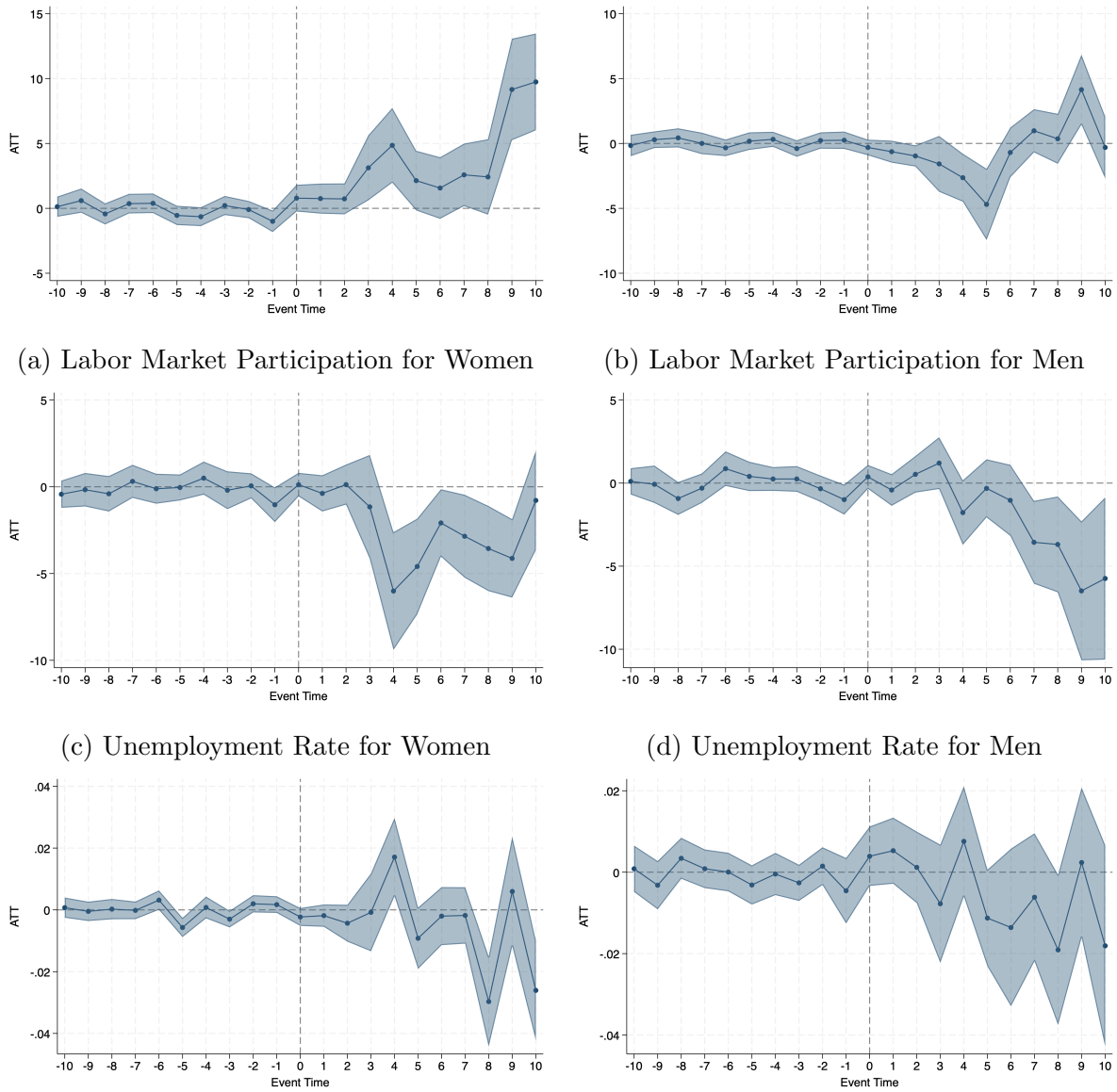
Notes: Coefficients are gathered from a staggered difference-in-differences event study analysis, using the estimator proposed by Callaway and Sant'Anna (2021). Pre-treat coefficient shows the average pre-treatment ATTs. All estimates control for municipality-observed characteristics. Municipality/Regional-level clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

An additional assumption for the analysis is that there are no compositional changes in the municipalities after the treatment. Essentially, the policy should not influence the characteristics of the municipalities aside from its direct effects. To assess this, I explore the policy's effect on net domestic migration per municipality. A lack of significant compositional shifts post treatment would be shown by stable migration patterns across municipalities. The event study analysis reveals no significant effects, see Table B4 of Appendix B, providing validity towards this assumption.

5.2 Main Results

5.2.1 Municipal Result

Having provided evidence towards the validity of the identifying assumptions, the following results present the effects of participating in VOC on labor market outcomes, using municipality-level data. In Figure 1, I compile the event study figures with 95% confidence intervals, showing labor market participation, unemployment rate, and logged wages for women (left column) and men (right column):



(a) Labor Market Participation for Women

(b) Labor Market Participation for Men

(c) Unemployment Rate for Women

(d) Unemployment Rate for Men

(e) Log Wages for Women

(f) Log Wages of Men

Figure 1: Labor Market Participation, Unemployment rate, and Wages

Firstly, Figure 1 shows that the point estimates are insignificantly different from zero prior to the treatment. Secondly, three years post-treatment, the point estimates differ significantly from zero, consistent with the length of Swedish vocational high school education. For instance, there is a notable increase in labor market participation for women, as shown in Figure 1a, and a significant decrease in the unemployment rate for women, as depicted in Figure 1c, both occurring three years post-treatment.

The effects on men are however less pronounced; labor market participation, presented in Figure 1b, initially decreases but then continues to increase in later post-treatment periods. Additionally, the reduction in the unemployment rate for men occurs much

later in the post-treatment period, as shown in Figure 1d. Lastly, the results indicate substantial post-treatment variation in wages for both men and women, as seen in Figures 1e and 1f, suggesting no significant overall increase or decrease.

Correspondingly, the main results presented in Table 2 reaffirm these findings. Table 2 is divided into three panels where Panel A displays the total effects, Panel B and Panel C displays the effect on women and men respectively. From the total effects, the analysis shows a significant decrease in the unemployment rate among individuals aged 20-24 with a high school degree of approximately 2.2 percentage points. This effect is consistent for the ATT_{APT} event study estimates in Column 1, and the ATT_{simple} estimates displayed in Column 2. Additionally, the analysis shows a smaller but statistically significant effect on labor market participation of approximately 1 percentage point. Further, the analysis shows no statistically significant effects on wages.

The results in Panels B and C indicate a significant difference between the effects on women and men, with women experiencing greater benefits from the policy. Firstly, the policy leads to a more pronounced decrease in unemployment rates for women of approximately 2.5 percentage points, compared to 1.9 percentage points for men. Secondly, the policy's impact on labor market participation is solely driven by women, showing an increase of about 3.4 percentage points, while the analysis shows statistically insignificant results for men. Relating this result to the decrease in the unemployment rate, two conclusions can be drawn: first, the policy not only reduced the unemployment rate for women through improved job matching but also attracted more women to the labor market. Second, the policy reduced the unemployment rate for men without increasing their labor market participation, suggesting that while job matching improved, it did not draw more men into the workforce.

Lastly, the analysis shows a statistically significant but economically insignificant decrease in wages for women, by roughly 0.3 percent relative to the mean. The analysis shows statistically insignificant results on wages for men.

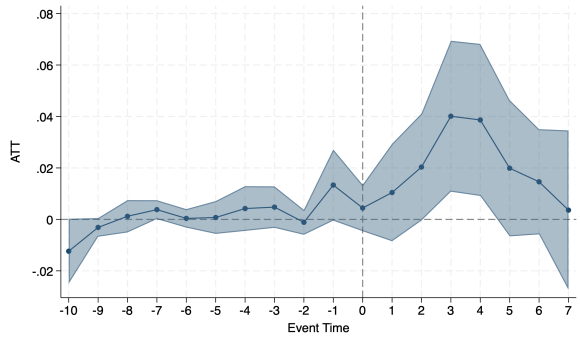
Table 2: Main Municipal Results

	Unemployment Rate		Labor Market Participation		Wages	
Panel A: Total	ATT_{APT}	ATT_{simple}	ATT_{APT}	ATT_{simple}	ATT_{APT}	ATT_{simple}
Treatment	-2.193^{***}	-1.720^{***}	1.116^{***}	0.849^{**}	-0.003	-0.002
	(0.595)	(0.511)	(0.430)	(0.393)	(0.004)	(0.002)
Mean dep. var.	29.91	29.91	72.59	72.59	1.60	1.60
Observations	7,244	7,244	7,244	7,244	7,244	7,244
Panel B: Women	ATT_{APT}	ATT_{simple}	ATT_{APT}	ATT_{simple}	ATT_{APT}	ATT_{simple}
Treatment	-2.461^{***}	-2.301^{***}	3.440^{***}	3.100^{***}	-0.004^{**}	-0.004^{*}
	(0.688)	(0.673)	(0.856)	(0.815)	(0.002)	(0.002)
Mean dep. var.	28.69	28.69	70.40	70.40	1.48	1.48
Observations	7,244	7,244	7,244	7,244	7,244	7,244
Panel C: Men	ATT_{APT}	ATT_{simple}	ATT_{APT}	ATT_{simple}	ATT_{APT}	ATT_{simple}
Treatment	-1.902^{***}	-1.299^{**}	-0.576	-0.817	-0.005	-0.003
	(0.676)	(0.556)	(0.577)	(0.557)	(0.005)	(0.002)
Mean dep. var.	30.96	30.96	74.31	74.31	1.71	1.71
Observations	7,244	7,244	7,244	7,244	7,244	7,244

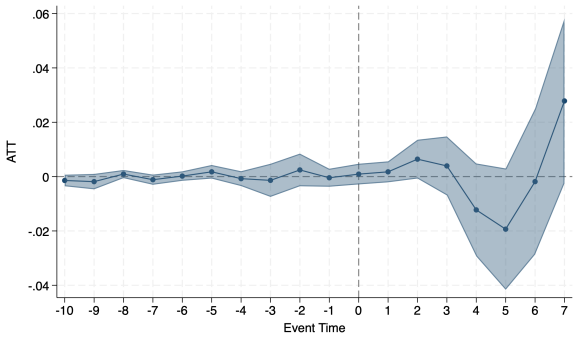
Note: Coefficients are gathered from a staggered difference-in-differences event study analysis, using the estimator proposed by Callaway and Sant'Anna (2021). ATT_{APT} coefficient shows the average post-treatment ATTs. The ATT_{simple} coefficients show the ATT for all groups across all periods. All estimates control for municipality-observed characteristics. Standard errors in parentheses, *** p<0.01, ** p<0.1, * p<0.1.

5.2.2 Regional Results

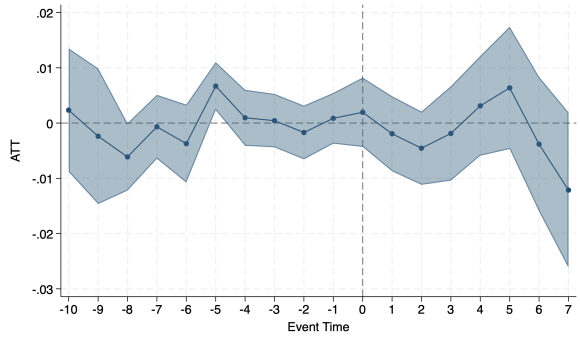
In Figure 2, I compile the event study figures with 95% confidence intervals, using the main regional method for men and women. The event study figures using the conservative regional method is presented in Figure A2 of Appendix A. Female assistant nurses are in the left column and male assistant nurses are in the right column:



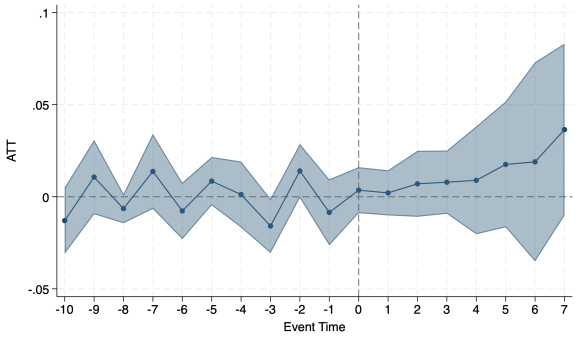
(a) Labor Supply of Female Assistant Nurses



(b) Labor Supply of Male Assistant Nurses



(c) Log Wages of Female Assistant Nurses



(d) Log Wages of Male Assistant Nurses

Figure 2: Labor Supply and Wages of Assistant Nurses (Main Regional Method)

From Figure 2, the analysis shows, similar to the municipal results, that the point estimates are insignificantly different from zero prior to treatment and significantly different post-treatment. Further, the positive effect on labor supply, as seen in Figure 2a, is more pronounced for women than for men, who are depicted in Figure 2b. The analysis also shows insignificant differences in post-treatment wages for both genders, reflecting the findings at the municipality-level.

In Table 3, the coefficients for the regional methods are presented. The effects are as in at the municipality-level, segmented into three panels showing the total and heterogeneous effects. From the total effects of the main regional method the analysis shows a significant increase in the share of assistant nurses over the total labor supply by approximately 2

percentage points. This effect is in line with the conservative method but with a slightly lesser effect. Consistent with the municipality-level findings, neither regional methods demonstrates significant effects on total wages for assistant nurses.

Table 3: Main Regional Results

	Labor Supply (AN)		Wage (AN)	
Panel A: Total	ATT_{APT}	ATT_{simple}	ATT_{APT}	ATT_{simple}
Treatment (Main Regional)	0.019***	0.019***	−0.004	−0.001
	(0.006)	(0.006)	(0.004)	(0.003)
Treatment (Conservative)	0.016***	0.017***	−0.004	−0.004
	(0.005)	(0.006)	(0.003)	(0.003)
Mean dep. var.	0.38	0.38	9.99	9.99
Observations	462	462	457	457
Panel B: Women	ATT_{APT}	ATT_{simple}	ATT_{APT}	ATT_{simple}
Treatment (Main Regional)	0.019***	0.021***	−0.004	0.002
	(0.006)	(0.006)	(0.004)	(0.004)
Treatment (Conservative)	0.014**	0.017**	−0.002	−0.002
	(0.005)	(0.003)	(0.003)	(0.002)
Mean dep. var.	0.43	0.43	9.99	9.99
Observations	462	462	457	457
Panel C: Men	ATT_{APT}	ATT_{simple}	ATT_{APT}	ATT_{simple}
Treatment (Main Regional)	0.004	0.002	0.018	0.018
	(0.004)	(0.005)	(0.013)	(0.010)
Treatment (Conservative)	0.004	0.002	−0.024**	−0.024**
	(0.004)	(0.004)	(0.009)	(0.009)
Mean dep. var.	0.04	0.04	10.03	10.03
Observations	462	462	457	457

Note: Coefficients are gathered from a staggered difference-in-differences event study analysis, using the estimator proposed by Callaway and Sant'Anna (2021). ATT_{APT} coefficient shows the average post-treatment ATTs. The ATT_{simple} coefficients show the ATT for all groups across all periods. *AN* refers to Assistant Nurses. All estimates control for region-observed characteristics. Region-level clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

The results in Panel B emphasize the gender-specific nature of these effects, being solely driven by women. The analysis shows a significant increase in labor supply of approximately 2 percentage points for women while the results for men in Panel C remain statistically insignificant, consistent with both regional methods. Further, the analysis shows statistically insignificant effects on wages for women and an economically insignificant decrease of 0.24 percent relative to the mean for men.

5.3 Evidence on Mechanisms

5.3.1 Educational Outcomes

Having provided evidence of improved labor market outcomes, I now explore potential mechanisms underlying these results. The first mechanism I consider is the educational outcomes of students following policy implementation. One potential channel is that the policy might have expanded the labor supply of assistant nurses by increasing interest in vocational healthcare education. To assess this, I replace the left-hand side of Equation 1 with the percentage of graduates from both vocational universities and high schools.

Ideally, I would specifically examine data on participation in vocational healthcare education to determine whether the policy redirected students from other vocational fields towards healthcare, or if it generally increased interest in vocational education. Unfortunately, due to data limitations, I can only review aggregated outcomes across all fields.[1]

According to the findings presented in Table 4, there is no significant change in the share of graduates from vocational education in municipalities after participating in VOC. This outcome suggests that the increased labor supply of assistant nurses is unlikely to be driven by greater enrollment in vocational education.

Another potential mechanism is an increase in the labor supply due to higher graduation rates among vocational education students. This hypothesis suggests that, while enrollment numbers in vocational education may remain steady, the number of students graduating and entering the labor market could have increased. To test this hypothesis, I applied the same analytical approach to assess the graduation rates from vocational universities. As indicated in Table 4, the analysis shows no significant evidence to support this hypothesis.

[1] I contacted Statistics Sweden for this data, but they were unable to provide it.

Table 4: Mechanisms to the Main Results

Variable:	High School		Vocational University		Graduation Rate		LM Spending		HC Spending	
Coefficient:	ATT_{APT}	ATT_{simple}	ATT_{APT}	ATT_{simple}	ATT_{APT}	ATT_{simple}	ATT_{APT}	ATT_{simple}	ATT_{APT}	ATT_{simple}
Treatment	−0.011	−0.018	0.006	0.005	0.012	0.013	−0.123	−0.058	0.143	0.127
	(0.110)	(0.107)	(0.006)	(0.005)	(0.008)	(0.020)	(0.394)	(0.381)	(0.103)	(0.096)
Mean dep. var.	55.74	55.74	0.05	0.05	0.28	0.28	1.46	1.46	3.10	3.10
Observations	7,244	7,244	2,127	2,127	1,870	1,870	6,377	6,377	6,358	6,358

Note: Coefficients are gathered from a staggered difference-in-differences event study analysis, using the estimator proposed by Callaway and Sant'Anna (2021). Table B3 provides evidence towards the parallel trends assumption. ATT_{APT} coefficient shows the average post-treatment ATTs. The ATT_{simple} coefficients show the ATT for all groups across all periods. *High School* and *Vocational University* refers to share of graduates from the respective ones. *LM Spending* refers to municipality spending on labor market programs, and *HC Spending* refers to municipality spending on healthcare. All estimates control for municipality-observed characteristics. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

The results from this analysis suggests that the primary findings of this study are not attributed to shifts in educational choices. Rather, the evidence implies that the observed improvements are more likely due to enhancements in the quality and relevance of education, which in turn increases the employability of graduates. However, due to the inability to separate the sample specifically by educational attainment in healthcare vocational education, there might still be an inflow of students in this area. This represents a limitation of these findings, leaving the true effect on educational attainment unclear.

5.3.2 Alternative Mechanisms

I proceed to investigate whether the observed improvements in labor market outcomes can be attributed to an expansion of the healthcare sector in municipalities affected by the policy. It is possible that the broader skills acquired by students might increase labor demand, thereby increasing municipal investments in healthcare. To test this, I replace the left hand side of Equation (1) with healthcare spending at the municipality-level. After log-transforming the data, I present the findings in Table 4. The resulting coefficient is small and statistically insignificant, indicating that the policy does not significantly impact municipal investments in the healthcare sector.

Lastly, it is crucial to evaluate the potential influence of other labor market programs that might correlate with the timing of the VOC program. The decision of a municipality to participate in VOC may also reflect a broader tendency to engage with various labor market policies, which could help explain the observed results. To investigate this possibility, I apply the main method to analyze municipal expenditures on labor market programs. The findings, presented in Table 4, show no significant effects, suggesting that no concurrent policies influenced the outcomes during the same period.

5.4 Robustness Checks

To assess the robustness of the main results, I apply the regional methods to examine the impact on labor market outcomes for preschool teachers, focusing solely on women. Given that preschool teachers in Sweden share a similar gender composition and academic requirements with assistant nurses but are not targeted by this policy, I expect to observe no significant effects on their labor supply and wages post-treatment.

The findings, presented in Table 5, indicate a minor, statistically significant but eco-

nomically insignificant decrease in labor supply of 0.4 percentage points using the main regional method, with no significant impact observed using the conservative approach. Additionally, the wage effects are statistically insignificant for the main regional method and exhibit low statistical significance but remain economically insignificant, with an increase of 0.1 percent relative to the mean using the conservative method.

These results indicate that the policy's implementation has statistically weak and economically insignificant effects on the labor supply and wages of preschool teachers, thereby reinforcing the robustness of the main findings.

Table 5: Regional Robustness Results

Variable:	Labor Supply (PT)		Wage (PT)	
Coefficient:	ATT_{APT}	ATT_{simple}	ATT_{APT}	ATT_{simple}
Treatment (Main Regional)	-0.004^{*}	-0.005^{**}	-0.000	-0.001
	(0.002)	(0.002)	(0.005)	(0.004)
Treatment (Conservative)	-0.004	-0.002	0.011^{*}	0.010^{*}
	(0.003)	(0.002)	(0.006)	(0.005)
Mean dep. var.	0.09	0.09	10.10	10.10
Observations	462	462	457	457

Note: Coefficients are gathered from a staggered difference-in-differences event study analysis, using the estimator proposed by Callaway and Sant'Anna (2021). ATT_{APT} coefficient shows the average post-treatment ATTs. The ATT_{simple} coefficients show the ATT for all groups across all periods. PT refers to Preschool Teachers. All estimates control for region-observed characteristics. Region-level clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Additionally, I conduct two placebo tests at the municipality level to further validate the findings. The first placebo test evaluates the impact on the unemployment rate among individuals aged 20-24 with a university degree. Given the nature of Swedish vocational education, as discussed in Section 2, the policy is unlikely to significantly affect the labor market outcomes of university graduates. I begin by confirming the validity of the parallel trends assumption, demonstrating no significant pre-treatment ATTs, as shown in Table B3. Furthermore, the results presented in Table B4 reveal no significant effect on the unemployment rate among the placebo group.

The second placebo test exploits the fact that the policy primarily affects younger individuals. Thus, I estimate the impact on the unemployment rate and labor market participation among individuals aged 45-55 with a high school degree, who are not likely to participate in vocational education due to their age. I begin by validating the parallel

trends assumption, as evidenced in Table B3. Further, the findings displayed in Table 6 indicate no significant changes in unemployment rates and labor market participation for women and the overall population. However, for men, the analysis shows a small positive coefficient in the unemployment rate with slight statistical significance using the ATT_{simple} estimate. Given that this effect is contrary to the negative impact observed in the main results, and considering its low economic and statistical significance, it suggests there is no violation of the test.

Overall, the results from the two placebo tests further strengthen the robustness of the main results.

Table 6: Municipal Robustness Results

	Unemployment Rate (45-54)		Labor Market Participation (45-54)	
Panel A: Total	ATT_{APT}	ATT_{simple}	ATT_{APT}	ATT_{simple}
Treatment	0.169	0.182	−0.107	−0.107
	(0.194)	(0.184)	(0.143)	(0.135)
Mean dep. var.	11.13	11.13	85.51	85.51
Observations	7,244	7,244	7,244	7,244
Panel B: Women	ATT_{APT}	ATT_{simple}	ATT_{APT}	ATT_{simple}
Treatment	−0.240	−0.202	0.153	0.141
	(0.222)	(0.208)	(0.215)	(0.200)
Mean dep. var.	10.72	10.72	84.34	84.34
Observations	7,220	7,220	7,244	7,244
Panel C: Men	ATT_{APT}	ATT_{simple}	ATT_{APT}	ATT_{simple}
Treatment	0.387	0.497*	−0.219	−0.217
	(0.268)	(0.281)	(0.175)	(0.164)
Mean dep. var.	11.55	11.54	86.57	86.57
Observations	7,239	7,239	7,244	7,244

Note: Coefficients are gathered from a staggered difference-in-differences event study analysis, using the estimator proposed by Callaway and Sant'Anna (2021). ATT_{APT} coefficient shows the average post-treatment ATTs. The ATT_{simple} coefficients show the ATT for all groups across all periods. All estimates control for municipality-observed characteristics. Municipality-level clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

6 Discussion

This study shows that the VOC program has significantly decreased youth unemployment and increased the labor supply of assistant nurses without depressing wages. This

finding aligns with prior research indicating that job or labor market training tailored to local employers can enhance job matching and local skill supply, particularly through improved employer screening processes. Notably, the program's most pronounced effect was observed among high school graduates, suggesting that institutions influenced by VOC are more effective at producing employable graduates compared to standard vocational high schools.

The findings indicate that the VOC program not only meets the skill demands of the local healthcare sector but also plays a crucial role in improving gender-specific labor market outcomes. This is particularly relevant in contexts where the labor force is predominantly female, as is the case in the Swedish healthcare sector. The absence of significant wage impacts may indicate a previously unmet demand for labor in the healthcare sector, which the VOC program helps to satisfy. It might also reflect the structured wage-setting mechanisms in Sweden's public sector, where wages are often negotiated at the national or regional level, limiting the potential for local wage fluctuations.

Additionally, the analysis revealed no increase in the enrollment or graduation rates from vocational high schools or universities post-treatment. These findings suggest that the improved labor market outcomes are likely due to an increased quality and relevance of the vocational education rather than an increase in the number of graduates. However, the potential inflow of students within healthcare vocational education, which could not be specifically separated in the sample, represents a limitation and introduces uncertainty regarding the full impact on educational attainment.

The policy implications of this study are profound. Given the ongoing challenges of skill and labor shortages in the healthcare sector, these findings reinforce the importance of vocational education as a strategic tool for mitigating these issues. It is recommended that local governments and policymakers continue to support and potentially expand such educational initiatives in collaboration with healthcare employers, ensuring that curricula align closely with local labor market demands.

Future researchers should consider investigating enrollment in specific vocational education subjects to gain better insights into the educational outcomes of the VOC program. Moreover, important questions arise concerning the trade-offs involved in specialized vocational education, where training tailored to specific employers replaces a broader general education. If the education is overly specialized, it could lead to occupation-switching

problems if economic conditions shift or if employers exit the local market. Lastly, while this study focuses on analyzing aggregate outcomes at the municipality level, there is a significant opportunity for future research to explore long-term, individual-level outcomes for graduates, which could provide a deeper understanding of the broader and more nuanced impacts of these targeted training programs.

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A. Appendix - Figures

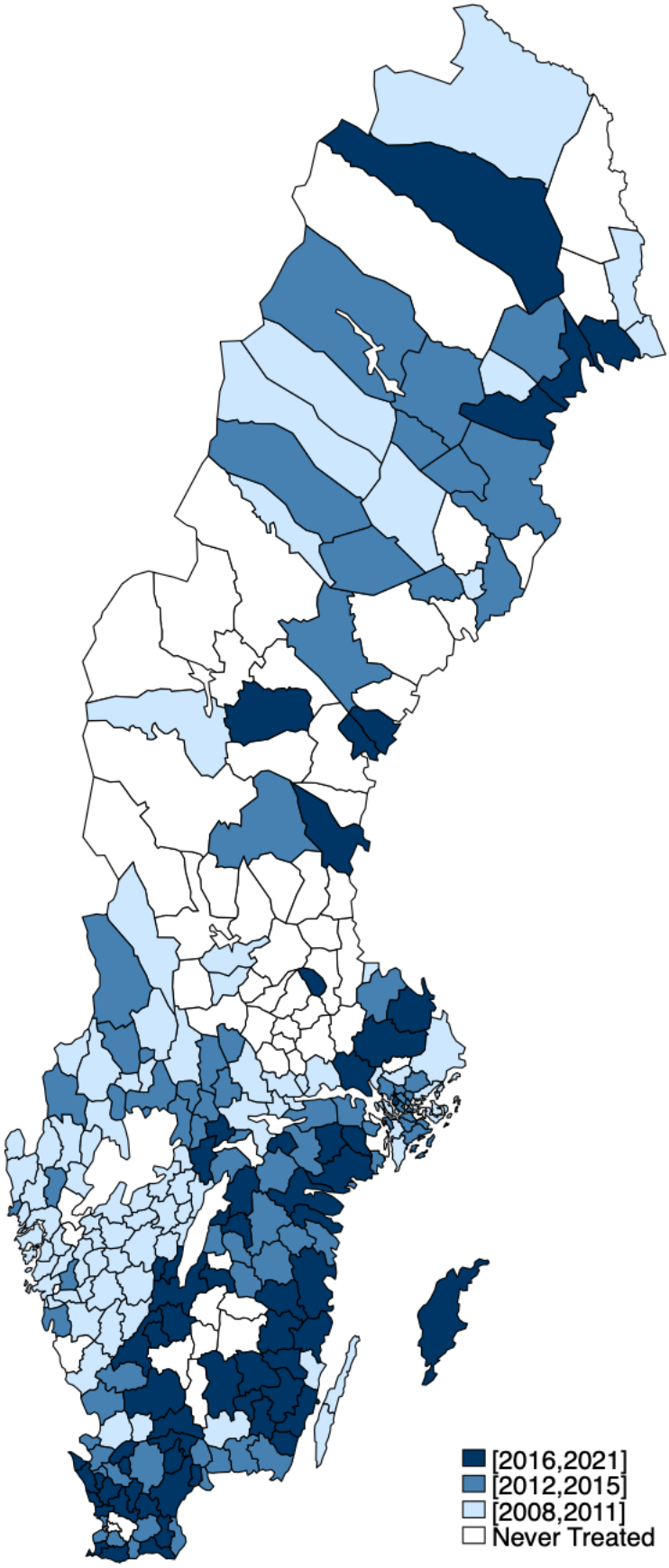
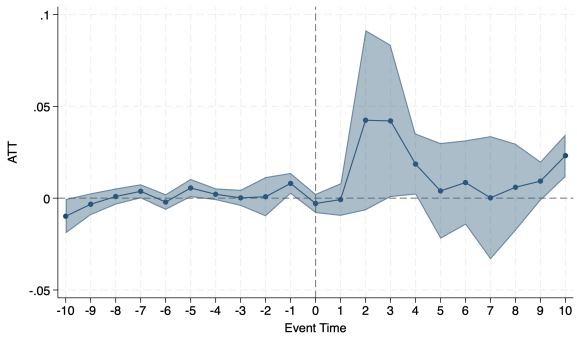
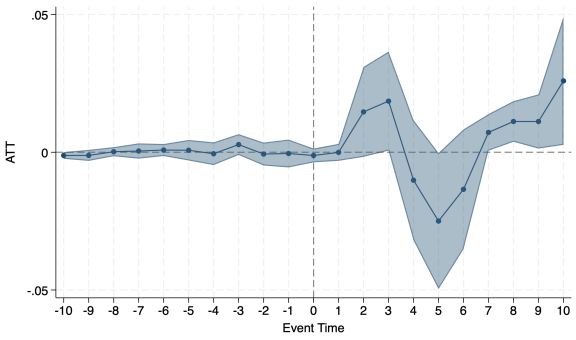


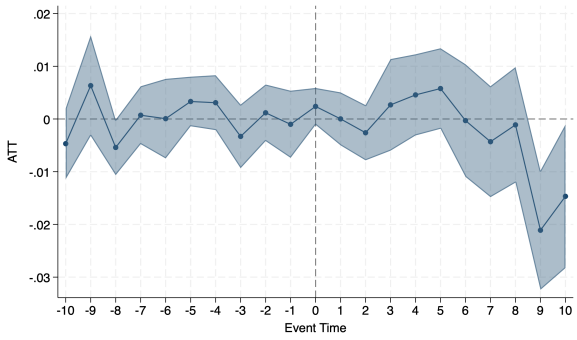
Figure A1: Graphical representation of municipalities participating in VOC from 2008-2021



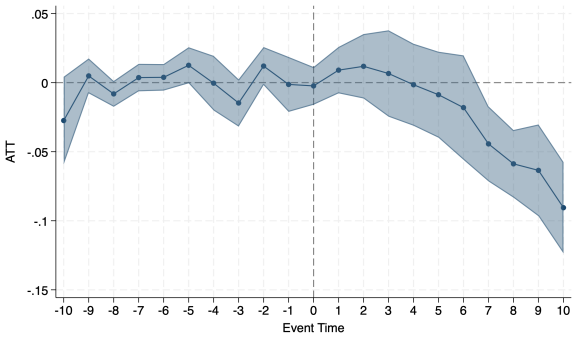
(a) Labor Supply of Female Assistant Nurses



(b) Labor Supply of Male Assistant Nurses



(c) Log Wages of Female Assistant Nurses



(d) Log Wages of Male Assistant Nurses

Figure A2: Labor Supply and Wages of Assistant Nurses (Conservative Regional Method)

B. Appendix - Tables

Table B1: Descriptive Statistics

VARIABLES	N	Mean	SD	Min	Max
Labor Market Participation (Men)	7,244	74.31	7.94	30.80	97.80
Labor Market Participation (Total)	7,244	72.59	7.51	31.10	93.80
Labor Market Participation (Women)	7,243	70.40	8.29	31.70	100
Labor Market Participation 45-54 (Men)	7,244	86.58	4.49	55.50	97.30
Labor Market Participation 45-54 (Total)	7,244	85.51	3.65	61.50	94.40
Labor Market Participation 45-54 (Women)	7,244	84.35	3.39	67	94.40
Labor Supply of Preschool Teachers	462	0.09	0.02	0.04	0.14
Labor Supply of Assistant Nurses (Men)	462	0.04	0.02	0.01	0.11
Labor Supply of Assistant Nurses (Women)	462	0.43	0.07	0.29	0.54
Labor Supply of Assistant Nurses (Total)	462	0.39	0.06	0.25	0.49
log Average Income	7,244	5.44	0.24	4.85	6.47
log Healthcare Spending	6,358	3.09	0.74	-2.45	8.24
log Labor Market Program Spending	6,373	10.22	1.77	-18.33	4.68
log Population	7,244	9.84	0.94	7.78	13.79
log Wage (Men)	7,244	1.71	0.21	1.16	3.23
log Wage (Total)	7,244	1.61	0.20	1.13	3.01
log Wage (Women)	7,244	1.49	0.20	1.03	2.71
log Wage of Preschool Teachers	457	10.07	0.20	9.68	10.53
log Wage of Assistant Nurses (Men)	457	10.03	0.17	9.65	10.34
log Wage of Assistant Nurses (Women)	457	9.99	0.18	9.66	10.30
log Wage of Assistant Nurses (Total)	457	9.99	0.18	9.65	10.29
Net Domestic Migration	7,242	-0.19	0.71	-3.49	3.58
Share of Population Aged 20–64	7,244	0.55	0.03	0.45	0.67
Share of Population with a High School Degree	7,244	55.74	6.75	23.10	72.50
Share of Population without a High School Degree	7,244	16.77	6.58	2.30	39.70
Vocational University Graduates	2,470	0.05	0.06	0	0.55
Vocational University Graduation Rate	2,174	0.28	0.19	0	1
Unemployment Rate (Men)	7,238	30.97	12.13	4.90	81.50
Unemployment Rate (Total)	7,243	29.92	11.69	5.20	75.70
Unemployment Rate (Women)	7,204	28.69	12.02	3.40	76.90
Unemployment Rate (University)	5,880	16.01	8.8	1.50	60.50
Unemployment Rate 45-54 (Men)	7,239	11.55	4.8	2.80	44.70
Unemployment Rate 45-54 (Total)	7,244	11.14	3.72	3.50	40.30
Unemployment Rate 45-54 (Women)	7,220	10.72	3.14	2.60	33.70

Notes: The descriptive statistics represent the entire sample. *N* denotes the number of observations in the dataset, *Mean* represents the average value of each variable, *SD* indicates the standard deviation, and *Min* and *Max* refer to the minimum and maximum values of each variable, respectively.

Table B2: Parallel Trends Heterogeneous

Method: Coefficient:	Municipality Pre-treat	Main Regional Pre-treat	Conservative Pre-treat
Unemployment Rate (Women)	−0.091		
	(0.066)		
Unemployment Rate (Men)	−0.067		
	(0.066)		
Labor Market Participation (Women)	−0.102		
	(0.074)		
Labor Market Participation (Men)	0.080		
	(0.054)		
Log Wages (Women)	−0.000		
	(0.000)		
Log Wages (Men)	−0.000		
	(0.000)		
Labor Supply of Assistant Nurses (Women)		0.001	0.001
		(0.001)	(0.001)
Labor Supply of Assistant Nurses (Men)		0.000	0.000
		(0.000)	(0.000)
Log Wages of Assistant Nurses (Women)		−0.000	−0.000
		(0.001)	(0.000)
Log Wages of Assistant Nurses (Men)		−0.000	−0.000
		(0.000)	(0.000)

Notes: Coefficients are gathered from a staggered difference-in-differences event study analysis, using the estimator proposed by Callaway and Sant'Anna (2021). Pre-treat coefficient shows the average pre-treatment ATTs. All estimates control for municipality-observed characteristics. Municipality/Regional-level clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table B3: Parallel Trends Mechanisms & Robustness

Method:	Main Municipal	Main Regional	Conservative
Coefficient:	Pre-treat	Pre-treat	Pre-treat
Unemployment Rate (University)	−0.113		
	(0.081)		
Unemployment Rate (55-64)	0.019		
	(0.022)		
Unemployment Rate Men (55-64)	0.036		
	(0.028)		
Unemployment Rate Women (55-64)	0.025		
	(0.019)		
Labor Market Participation (55-64)	−0.029		
	(0.022)		
Labor Market Participation Men (55-64)	−0.034		
	(0.029)		
Labor Market Participation Women (55-64)	−0.025		
	(0.020)		
Labor Market Spending	−0.033		
	(0.025)		
Healthcare Spending	0.004		
	(0.007)		
Net Domestic Migration	−0.001		
	(0.005)		
High School Graduates	0.014		
	(0.012)		
Vocational University Graduates	0.001		
	(0.001)		
Vocational University Graduation Rate	−0.001		
	(0.008)		
Labor Supply of Preschool Teachers		−0.001	−0.000
		(0.000)	(0.000)
Wages of Preschool Teachers		0.000	−0.000
		(0.000)	(0.001)

Notes: Coefficients are gathered from a staggered difference-in-differences event study analysis, using the estimator proposed by Callaway and Sant'Anna (2021). Pre-treat coefficient shows the average pre-treatment ATTs. All estimates control for municipality-observed characteristics. Municipality/Regional-level clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table B4: Municipal Robustness Results

Variable:	Unemployment Rate (University)		Net Domestic Migration	
Coefficient:	ATT_{APT}	ATT_{simple}	ATT_{APT}	ATT_{simple}
Treatment	0.069	−0.039	0.008	0.010
	(0.448)	(0.449)	(0.053)	(0.051)
Mean dep. var.	0.007	0.007	0.194	0.194
Observations	6,667	6,667	7,242	7,242

Note: Coefficients are gathered from a staggered difference-in-differences event study analysis, using the estimator proposed by Callaway and Sant'Anna (2021). ATT_{APT} coefficient shows the average post-treatment ATTs. The ATT_{simple} coefficients show the ATT for all groups across all periods. All estimates control for municipality-observed characteristics. Municipality-level clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.