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Beyond windfall gains: The redistribution of apprenticeship costs and vocational education of care workers

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Abstract

In many countries, training subsidies and levy schemes are used to tackle the problem that company-based provision of apprenticeship training is low. In this paper, we consider the introduction of a levy scheme in the care sector and estimate the causal effect exerted by substantial redistribution of care worker apprenticeship costs on the training activity of care facilities. We exploit the fact that the underlying apprenticeship levy was introduced across the German federal states at different points in time. For ambulatory care, we find a positive effect on the probability of hiring new apprentices and on the number of new apprentices. Inpatient care facilities react only at the intensive margin. This suggests that the positive effects in this sector are driven mainly by facilities that have already provided training slots before the reform.

1 | INTRODUCTION

In many countries, policymakers use training subsidies to increase the supply of company-based training and to counter the problem of underinvestment in the provision of training slots (for an overview, see Kuczera 2017). The same applies to levy–grant schemes that redistribute apprenticeship costs between firms that provide training and firms that do not provide training.[1]. Nevertheless, empirical evidence on the causal effects of such instruments on the provision of training slots is very scarce (Bassanini *et al.* 2007).

This paper tackles the question as to whether training levies increase the training activity of firms by considering the introduction of a levy in the apprenticeship market of care workers in Germany as a case study. By doing this, we provide several contributions that are generally relevant for labour and public economics.

First, training levies are used and discussed in many countries and for different occupations and economic sectors (see Kuczera 2017). Therefore our analysis is relevant not only for the care sector but for other sectors and countries as well.

Second, levy schemes are often organized at the level of economic sectors. As a consequence, previous research often compares the sector where the levy was introduced to other sectors not affected by the reform. However, as the literature review below illustrates, the choice of such a control sector is often problematic because of the different composition of the staff and because of diverging pre-reform trends in training activity. In this context, our case study is helpful because the underlying institutional setting provides a new approach by examining the introduction of a training levy within one sector.

To stimulate incentives for company-based training, the German federal government has created the possibility of introducing an obligatory training levy that finances the apprenticeship of geriatric nurses in inpatient and ambulatory care.[2] As a consequence, five federal states introduced such a levy that redistributes the apprentice salary of around €17,000 per apprentice per year between facilities that train and facilities that do not train. We use this exogenous variation in apprenticeship costs and take advantage of the fact that this substantial redistribution of costs was introduced across the federal states at different points in time. The variation in time and regions solves the problem that in related studies an appropriate control group is often missing because levies are usually introduced country-wide and in industries with a labour shortage.

Third, the sector under study is of increasing economic importance. Demographic development increases demand for social care in many countries of middle and high income (for an overview on Europe, see Cangiano 2014). Many countries therefore face the challenge of increasing the labour supply of nurses. In this paper, we focus on geriatric nurses, an important group of skilled workers in the care sector.

Fourth, geriatric nurses are furthermore interesting to consider from a broader perspective because of the quasi-competitive organization of the labour market. In Germany, care providers cannot differentiate themselves much with respect to quality and qualification because nursing charges and nurses' wages are rather sticky. Nursing charges are determined mutually by care providers and representatives of care insurance and social security. Therefore charges and wages are not determined by competitiveness, and care facilities cannot pass on apprenticeship costs to prices for nursing services. This creates disincentives in investing in apprenticeship training and is a source of underprovision of training slots. Our case study therefore examines whether the introduction of a training levy can correct such a situation of market failure.

By estimating dynamic treatment effects as proposed by Sun and Abraham (2021), we find a robust positive effect on the probability of hiring new apprentices and on the number of new apprentices in ambulatory nursing services. In the ambulatory sector, initial training activity before the introduction of the levy was rather low. In inpatient care, effects are smaller and less clear. While the probability of providing apprenticeship training is not affected, the number of new apprentices is affected positively. This sector-specific analysis therefore demonstrates that effects from levy schemes may be very heterogeneous, even in similar sectors. Further analyses confirm that effects are heterogeneous regarding the number of employees in care facilities and local labour shortage. Furthermore, several robustness checks show that these effects are due to the introduction of the levy scheme and are not attributable to other reforms regarding the care sector.

These findings and the quasi-experimental approach extend the current state of research. Alongside some studies that compare training activity of firms belonging to sectors with a training levy and firms that do not (van den Berg *et al.* 2006; Kamphuis *et al.* 2010), three papers attempt to tackle the problem of (un-)observed heterogeneities and selection.[3] Dohlmann Weatherall (2009) evaluates a Danish subsidy introduced in 1997. This subsidy finances a wage based on regular employment to apprentices from the age of 25. Although the positive effects in her difference-in-differences approach are presumably driven by young people under 25 who wait until they become eligible for this programme, her paper emphasizes the need to distinguish

between the immediate effect in the year of introduction of the reform and the effect in the following few years.

Pfeifer (2016) finds heterogeneous effects between different industries by estimating negative effects from abolishing subsidies for new apprentices and completed apprenticeships in Australia. Although the effects may be driven partially by reverse trends between occupations on the National Skill Needs List and other occupations, his paper underlines the role of heterogeneities with respect to firm size. In accordance with this, Westergaard-Nielsen and Rasmussen (2000) show that effects vary by industry by using institutional variation in the amount of relative refunding of apprenticeship costs in different sectors in Denmark. While these empirical papers suffer from the lack of an optimal control group and endogeneity, neither is the theoretical framework able to give a clear response to the question regarding the effectiveness of subsidies. Instead, Acemoglu and Pischke (1999) emphasize the necessity of evaluating the design of training subsidies and levies on a case-by-case basis. Acemoglu and Pischke (1999) also underline the risk of windfall gains, which produce large deadweight losses without affecting training supply provided by companies (see also Bonin *et al.* 2013; Muehlemann and Wolter 2014).[4]

Next to studies that explicitly consider levy schemes and subsidies, the second relevant literature strand consists of papers that consider apprenticeship regulation and other forms of financial incentives. Caicedo *et al.* (2022) consider the introduction of apprentice quotas in Columbia that define minimum and maximum numbers of apprentices that vary by firm size. Furthermore, the reform lowers the minimum wage for apprentices, and firms are fined by a fee if they do not hire the required number of apprentices. Based on their structural model, they simulate the separate effect of the three reforms and alternative forms of apprenticeship regulation. Due to variations in apprenticeship costs, firms in low-skill sectors increase the number of apprentices and tend to hire the maximum number of apprentices allowed. High-skill firms instead reduce the number of apprentices in order to avoid higher apprentice quotas, and often pay the fee in order to avoid the required training activity. In another relevant study, Dostie (2015) examines the effects of a train-or-pay scheme in Canada. He finds no effects on training activity, but firms are substituting classroom training by on-the-job training.

The structure of the paper is as follows. In Section 2, we describe the underlying levy and the apprenticeship market of geriatric nurses in greater detail. Section 3 illustrates data and empirical strategy, with the empirical results being presented in Sections 4 and 5. Finally, Section 6 concludes.

2 | INSTITUTIONAL BACKGROUND

As populations age, a labour shortage for care workers in hospitals and care homes has emerged in many countries. In Germany, the Federal Employment Agency identifies signs of labour shortage for skilled geriatric nurses in each of the 16 federal states, and shows that the shortage is even larger in care homes and home care than it is in hospitals.

The German Geriatric Nursing Care Act (GGNCA) reorganized the apprenticeship system in geriatric nursing. Since 2003, apprenticeships have been regulated at the national level and require an appropriate apprentice salary. Apprenticeship training takes three years, and includes 2500 hours of practical training in care facilities and 2100 hours of theoretical classes at school. Graduates from middle schools or from other forms of ten-year school education that extends to high school are eligible to begin apprenticeships.[5] Apprentices attend practical training in inpatient care facilities or ambulatory nursing services. In 2017, 86.5% of apprentices in inpatient care facilities and 85.0% of apprentices in ambulatory nursing services were apprentices in geriatric nursing (Federal Office of Statistics 2018a,b).

In the German Long-term Care Insurance (LTCI), nursing charges are determined mutually by providers of care insurance, providers of care facilities, and providers of social security (for details on the general system of LTCI, see Geyer and Korfhage 2018). This makes charges and

nurses' wages sticky, and impedes care facilities from passing apprenticeship costs onto prices for nursing services. This circumstance and the high apprenticeship costs generate a competitive disadvantage in the case of supplying apprenticeships, and thus create a disincentive against apprenticeships (Bogai 2017).

To counteract the shortage of skilled geriatric nurses, the GGNCA enables federal states to introduce a training levy. According to this, all inpatient and semi-residential care facilities and ambulatory nursing services pay mandatory contributions, regardless of whether or not they engage in apprenticeships. These regular contributions are used to finance apprentice salaries and costs of continuing vocational education and training (CVET).

Following the introduction of the GGNCA, five federal states introduced compensation payments in the form of the underlying Apprenticeship Levy in Geriatric Nursing (ALGN). These treatment states introduced the ALGN at different points in time, a circumstance that is useful for the sake of building up the quasi-experimental setting. At first, the underlying law became effective in Rhineland-Palatinate in 2005 and in Baden-Wuerttemberg in 2006. North Rhine-Westphalia and Saarland introduced the ALGN in 2012, and Hamburg followed in 2014.[6] One main important fact is that (except in two states) the levy refinances 100% of apprentices salary.[7] The sum that is redistributed between facilities that are engaged in apprenticeship and those that are not is therefore substantial.

There are several arguments and counter-arguments as to whether levy schemes can stimulate training activity of care facilities.

First, Bassanini *et al.* (2007) demonstrate that the optimal instrument compensates only for the gap between firm's marginal costs and marginal benefits, and that the investment decision of firms is affected only if the marginal costs and benefits are affected. If the subsidy exceeds the actual costs, then firms are interested only in receiving the subsidy and see no intrinsic value in training (Dohlmann Weatherall 2009). Such a mechanism would weaken the quality of training but is unlikely in our case because the curriculum is set at the national level and is supervised by quality controls. Furthermore, the sum to be redistributed does not exceed the full amount of overall apprenticeship costs.

Second, previous research indicates that tax-funded one-time payments per apprentice that amount to only a small fraction of apprenticeship costs merely create windfall gains without affecting company-based training supply (Muehlemann and Wolter 2014). However, in our case study, apprentice salaries, which are about €17,000 per apprentice per year, are redistributed. The sum of redistribution is therefore substantial. This levy scheme is thus likely to produce incentives to increase the training activity of firms. Moreover, in contrast to subsidies financed by public means, care facilities that provide training derive a benefit from the levy in this instance. However, the levy also penalizes facilities that do not provide training.

Third, Kuczera (2017) concludes that the larger the apprenticeship costs and the labour shortage, the more likely a levy will be to affect company-based training. In our case, both the apprenticeship costs and the labour shortage are large. Positive impacts of training levies are also more likely if poaching is more common in the sector, and this is the case in the sector of care workers due to a labour shortage and poor working conditions in many care facilities. Last, but not least, levies are effective if both the employee's and employer's side are involved in the construction of the levy system, which was the case in our setting.[8]

3 | EMPIRICAL STRATEGY AND DATA

3.1 | Empirical strategy

In order to identify the effect of the introduction of the ALGN on training activity of care facilities, we exploit the fact that the reform was implemented across the federal states

at different points in time. In our empirical analysis, we consider recent developments in difference-in-differences techniques and two-way fixed effects designs. De Chaisemartin and D'Haultfoeuille (2020), Goodman-Bacon (2021) and others consider explicitly the case when there is treatment heterogeneity and variation in treatment timing. They show that the treatment effect in event study designs can be biased if the effect is heterogeneous between groups and over time. De Chaisemartin and D'Haultfoeuille (2020) derive that the average treatment effect is a weighted sum of the treatment effects in each group at each period.

In order to take this into account and to examine whether our average treatment effect is biased by effects from other periods, we estimate dynamic treatment effects by using the interaction-weighted estimator proposed by Sun and Abraham (2021). We use the interaction-weighted estimator with binary indicators. The binary treatment indicator $ALGN_{jt}^{\tau}$ indicates whether a care facility is located in a treatment state, and τ indicates relative time to treatment over the time period from $\underline{\tau}$ to $\overline{\tau}$. Here, $\tau = 0$ indicates the period of treatment, and the period two years before the treatment ($\tau = -2$) is used as the reference period:

$$y_{ijt} = \alpha_i + \sum_{\tau=\underline{\tau}}^{\overline{\tau}} \beta_\tau \; ALGN_{jt}^{\tau} + X_{it}'\gamma + R_{kt}'\delta + \theta_j + \lambda_t + \varepsilon_{ijt}. \tag{1}$$

The outcome y_{ijt} indicates whether care facility i located in federal state j provides training to at least one new apprentice (extensive margin) and how many new apprentices are employed at the facility (intensive margin) in year t.[9] For y_{ijt}, we use flow variables because these map the immediate effect of the introduction of the levy scheme more accurately than the stock of apprentices (see Schumann 2017). Note again that apprenticeship training in geriatric nursing takes three years.

Equation (1) also controls for characteristics of facilities X_{it}' and regional characteristics R_{kt}' at the level of counties (k) provided by the Federal Statistical Office and the Federal Employment Agency. According to Schumann (2017), we control for the number of school graduates per county k.[10] Furthermore, R_{kt}' includes the regional number of care-dependent persons per 1000 inhabitants above the age of 64, the number of nurses per 100 care-dependent persons in inpatient and ambulatory facilities, and the number of slots in care facilities per 1000 inhabitants above the age of 64.[11] The set R_{kt}' further controls for local unemployment rate in order to capture the general economic development across counties. Time fixed effects λ_t control for general trends common in all states, and federal state fixed effects θ_j account for time-invariant factors that affect the apprenticeship market differently by state. Finally, we cluster standard errors at the level of the underlying treatment, which is the level of federal states.

Although there are several approaches that tackle the problem of effect heterogeneity, we focus on the approach by Sun and Abraham (2021). First, Sun and Abraham (2021) estimate explicitly the dynamic path of treatment effects. By doing this, they consider the problem when treatment effects are contaminated by effects from other periods. Thus their estimator fits well to our underlying questions. Second, the interaction-weighted estimator allows the use of never-treated groups as a control group and therefore rules out using already-treated groups as controls. This is important because we have a long observation period. Third, our application considers a binary treatment whose treatment intensity does not change over time and where several states are never treated. However, to account for other recent approaches, we also verify our results by applying the imputation estimator proposed by Borusyak *et al.* (2022).

3.2 | Data

We use data from the weakly anonymous Establishment History Panel (BHP 7521) for the period 2002–18 (Ganzer *et al.* 2022).[12] The BHP is a 50% sample of all establishments located

in Germany with at least one employee subject to social security or, since 1999, one marginal part-time employee as of 30 June of a given year. The main advantages are the high degree of quality and reliability, the panel character, and the large sample size (e.g. with 1.5 million establishments captured in 2018). The five-digit classification of economic activities (WZ08 classification) identifies inpatient and semi-residential care facilities (WZ08: 87100, 87300) and ambulatory nursing services (WZ08: 88101). The working sample is large enough to examine heterogeneous effects regarding characteristics of establishments and regional conditions at the level of counties. Furthermore, sampling ensures that small care facilities are also part of the sample (Spengler 2008).

For each care facility, the core file of BHP 7521 and the extension file on worker flows provide information on the number of apprentices (stock) and the number of new apprentices (flow). The administrative character of the dataset ensures that this information is very accurate. Consequently, the share of apprentices relative to the whole number of employees (around 3% in ambulatory nursing services, and 7% in inpatient care facilities) is very similar compared to the administrative statistics on caring provided by the Federal Office of Statistics (2018a,b).

3.3 | Descriptive evidence and threats to identification

Table 1 provides a summary of establishment characteristics and regional variables. First, the table legitimizes separate analysis of ambulatory and inpatient facilities. There are large differences in training activity between these two sectors. Furthermore, the composition of ambulatory and inpatient facilities varies in accordance with several characteristics, for example with regard to wages, number of employees and form of employment. Second, descriptive statistics highlight a number of typical features of the labour market of care workers, for example a large share of women and of part-time employment.

Figure 1 illustrates the share of care facilities that hire at least one new apprentice per year. In ambulatory nursing services (Panel A), this share is at a rather low level of about 13% five years before the treatment. Until the introduction of the ALGN, this initial level is followed by a smooth positive trend in the share of facilities providing training. The introduction of the levy creates a significant jump in the share of care facilities that hire at least one new apprentice. Such a jump can not be seen in control states where a smooth positive trend in the share is present during the whole observation period. However, the jump mainly occurs one year after the reform. In the year of the treatment, the share increases by 2.5 percentage points. One year after the reform, the increase amounts to 11.8 percentage points compared to the last year before the treatment.

Panel B of Figure 1 clarifies that the initial level of training activity differs by sector. While in ambulatory nursing services the pre-treatment level does not exceed 15% in treatment states, the initial training activity is around 55% in inpatient care facilities. Another fact to note is that the trend in the share of inpatient care facilities that hire at least one new apprentice is more fuzzy in both treatment and control states. However, a jump around the treatment can also be seen in this sector. This increase is of lower magnitude than in ambulatory nursing services but is present nevertheless. One year after the treatment, the share increased by 5.3 percentage points compared to the last year before the introduction of the levy.

Regarding the intensive margin in Figure 2, the graph for ambulatory nursing services is well comparable to the extensive margin in Figure 1. A smooth positive trend before the reforms is followed by a significant jump around the treatment. Also, there is a clearer jump in the inpatient sector. The number increases by 19.9%, from 1.4 apprentices one year before the treatment, to 1.7 one year after the treatment.

The descriptive figures give us cause to suppose that the introduction of the levy affected training activity positively, in particular in ambulatory nursing services. The effect seems to be larger in the year after the reform. One reason for this circumstance is that some federal states introduced

TABLE 1 Descriptive Statistics of Care Facilities, by Treatment Status

	Ambulatory				Inpatient			
	Treatment		Control		Treatment		Control	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Panel A: Training activity								
Share of facilities hiring new apprentices	22.3	(41.6)	12.4	(33.0)	58.9	(49.2)	45.4	(49.8)
No. of new apprentices (including zero)	0.5	(1.5)	0.2	(1.4)	1.7	(2.7)	1.0	(2.3)
No. of new apprentices (excluding zero)	1.4	(2.3)	1.0	(3.0)	2.2	(3.0)	1.6	(2.7)
Panel B: Characteristics of care facilities								
Care facility size (in %):								
Max. 9 employees	17.7	(38.2)	22.1	(41.5)	3.7	(18.9)	4.3	(20.2)
10–24 employees	37.0	(48.3)	39.3	(48.8)	12.1	(32.7)	15.3	(36.0)
25-49 employees	26.8	(44.3)	23.7	(42.5)	24.5	(43.0)	30.8	(46.2)
50–99 employees	12.5	(33.1)	10.2	(30.2)	37.6	(48.4)	34.7	(47.6)
Min. 100 employees	5.9	(23.6)	4.7	(21.2)	22.1	(41.5)	14.9	(35.6)
Average age	42.2	(4.9)	42.9	(5.0)	42.7	(3.8)	43.1	(3.9)
Share of women (%)	83.3	(14.8)	84.7	(15.2)	82.3	(11.4)	81.9	(11.8)
Share of employees with German citizenship (%)	33.6	(22.5)	34.2	(25.5)	33.9	(19.1)	39.1	(22.3)
Staff composition by formal education (%):								
Low/intermediate secondary degree	8.9	(10.0)	7.1	(9.3)	14.9	(8.7)	11.0	(8.7)
Upper secondary/vocational degree	80.2	(17.2)	81.5	(17.7)	75.7	(11.5)	80.1	(11.9)
University/college degree	8.7	(13.1)	9.3	(14.0)	8.0	(9.8)	7.5	(9.8)
Gross median daily pay rate of full-time employees (€)	77.6	(27.7)	70.9	(28.1)	87.6	(23.1)	77.5	(22.9)
Staff composition by form of employment (%):								
Regular	66.2	(18.5)	73.1	(19.2)	77.9	(13.1)	83.0	(12.5)
Full-time	36.0	(23.2)	36.9	(26.0)	36.3	(20.1)	41.6	(23.3)
Part-time	30.9	(22.9)	36.8	(26.5)	42.3	(20.7)	41.8	(24.3)
Marginal part-time	30.3	(18.6)	24.7	(19.2)	14.7	(13.1)	12.1	(12.2)
Panel C: Regional variables of counties								
No. of school graduates	4729.7	(3655.4)	5423.0	(8896.0)	4175.0	(2985.2)	3940.4	(7109.1)
No. of care-dependent persons per 1000 inhabitants above age 64	155.1	(32.8)	164.8	(37.7)	154.7	(32.7)	162.8	(36.6)
No. of nurses per 100 care-dependent persons in inpatient/ambulatory facilities	49.8	(10.9)	50.1	(13.6)	96.8	(10.8)	85.5	(11.5)
No. of slots in inpatient facilities per 1000 inhabitants above age 64	50.2	(7.5)	53.2	(12.0)	50.7	(8.2)	56.5	(12.5)
Unemployment rate (%)	7.4	(3.1)	7.9	(3.9)	6.7	(2.8)	7.3	(3.7)
Observations	27,721		35,311		32,118		42,740	
No. of facilities	3313		4553		3043		4321	

Notes: Care facilities in the treatment group are facilities located in federal states that introduced the ALGN (Baden-Wuerttemberg, Hamburg, North Rhine-Westphalia, Rhineland-Palatinate and Saarland). Facilities in the control group are facilities located in federal states that did not introduce the ALGN (Bavaria, Berlin, Brandenburg, Hessen, Lower Saxony, Mecklenburg-Hither Pomerania, Saxony-Anhalt, Schleswig-Holstein, Thuringia).

Sources: Establishment History Panel 1975–2021 (BHP 7521); Regional Database of the Federal Statistical Office and the Federal Employment Agency.

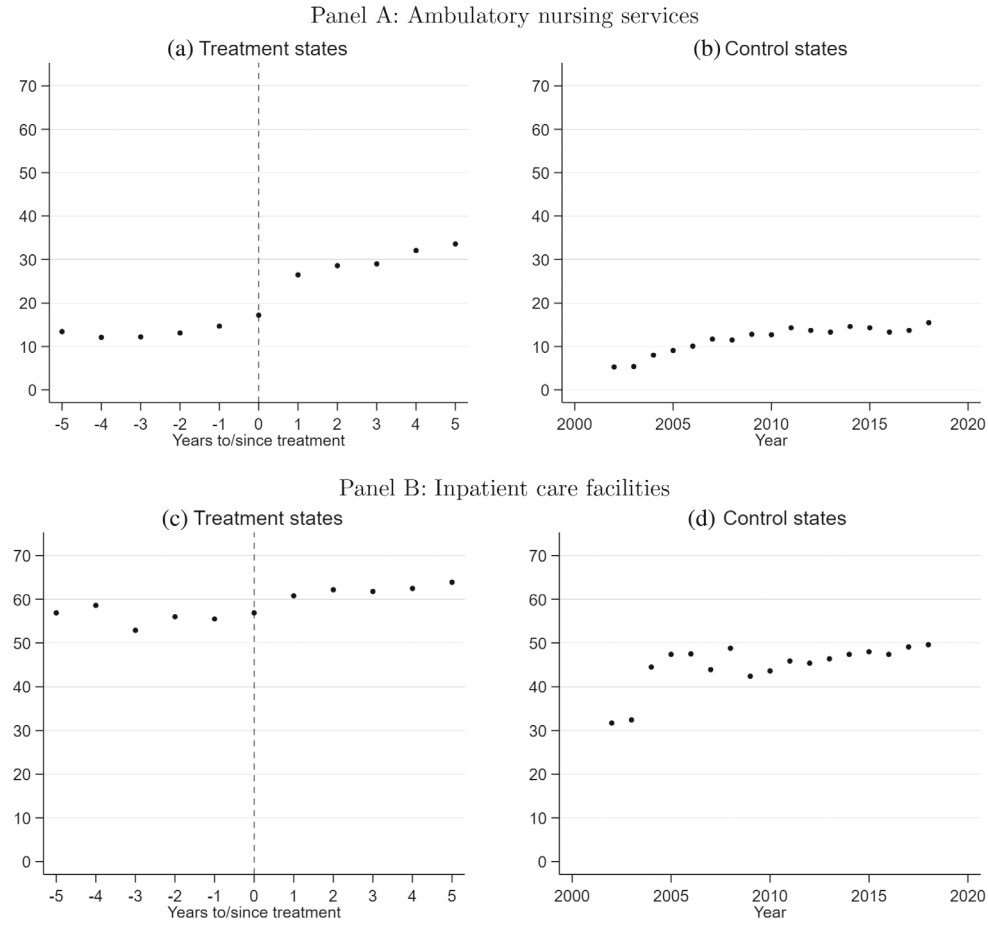

FIGURE 1 Share of care facilities that hire at least one new apprentice, by treatment status. *Notes*: The graphs display the share of care facilities that hire at least one new apprentice (in %). (a) Number for the treatment states with respect to the years to or since the treatment. The vertical dashed line shows the time of introducing the ALGN in treatment states. (b) Because no levy was introduced in control states, the share of care facilities that hire at least one new apprentice is displayed with respect to years. Source: Establishment History Panel 1975–2021 (BHP 7521); own illustration.

the levy in the middle of the year (e.g. North Rhine-Westphalia). It is therefore likely that in the year of the reform, some care facilities made their hiring decisions in the spring, before the levy came into force. Another reason is that previous research supposes that firms sometimes first await the functionality of the levy system and do not adjust their recruitment policy immediately. Bosch (2010) assumes that firms observe whether the levy scheme is sustainable—for instance, whether the levy is not abolished after the next election in the federal state. This reflects the need for estimating dynamic treatment effects and the importance of considering how treatment effects evolve over time.

The identification strategy is based on the common trend assumption. While the initial training activity of ambulatory nursing services is rather comparable between treatment and control federal states in Figures 1 and 2, the same applies to the trend before the reform.[13] The application of the event study design in Section 4 supports this descriptive evidence. The treatment effects in the pre-treatment periods are all insignificant. This supports our argument that estimation of treatment effects does not suffer from general time trends in training activities or diverging trends in training activity by treatment status.

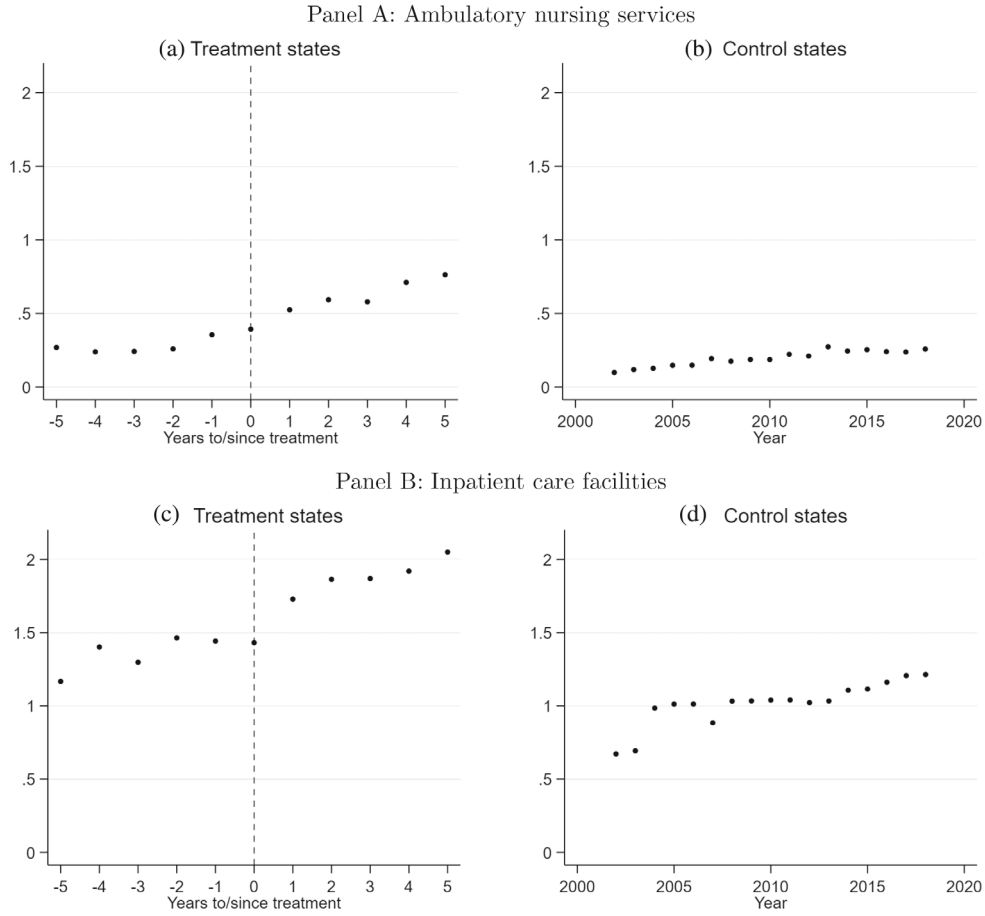

FIGURE 2 The number of new apprentices per care facility, by treatment status. *Notes*: The graphs display the number of new apprentices per care facility. (a) Number for the treatment states with respect to the years to or since the treatment. The vertical dashed line shows the time of introducing the ALGN in treatment states. (b) Because no levy was introduced in control states, the number of new apprentices is displayed with respect to years. Source: Establishment History Panel 1975–2021 (BHP 7521); own illustration.

A further threat to the identification strategy would be if labour shortage for skilled geriatric nurses developed in a different way in treatment states than in control states. The Regional Database of the German Federal Statistical Office provides two useful indicators for labour shortage for skilled geriatric nurses at the county level: the number of persons in need of care related to the number of caring slots, and the inverse number of employees in ambulatory or inpatient care facilities related to the number of care-dependent persons. Both indicators include a number capturing the demographic change and labour supply measured in skilled staff or caring slots. Both indicators increase if the need for skilled nurses increases.

Figures A1 and A2 in the Appendix demonstrate that labour shortage develops in a U-shaped pattern during the observation period by using the first indicator (the number of persons in need of care related to the number of caring slots).[14] Although some slight differences in the initial level of labour shortage appear, the development between the treatment and the control group is rather similar.[15]

An explanation for why some federal states introduced the levy scheme and some did not is the political agenda of the governments of the states. Generally, social democratic and left-wing parties are less sceptical towards redistribution than liberal or conservative parties. However, only

three treatment states are governed by the German social-democratic party (SPD). One further difference is that all treatment states are located in West Germany.[16] Whether an exclusive focus on West Germany changes our estimation results is examined in detail in the second subsection of Section 5.

Finally, to exclude anticipation effects, it is required that the time lag is not too long between the decision to introduce the levy scheme and the first contribution to pay. In each treatment state, this was the case. To illustrate this, we can take the largest federal state as one example. Although the first draft of the law was finalized in July 2011 in North Rhine-Westphalia, the enactment of the law has been unsettled for a long time. First, parliamentary hearings with 16 different organizations attending took place in 2011. Second, the election of the parliament in North Rhine-Westphalia in May 2012 interrupted the enactment process, while the law became effective shortly after the re-election of the government.

4 | EMPIRICAL RESULTS

Figures 3 and 4 illustrate our baseline results based on applying the interaction-weighted estimator by Sun and Abraham (2021). The two figures respectively display pre-treatment and post-treatment estimates of β_τ after controlling for facility-level characteristics and regional variables summarized in Table 1, and fixed effects for time and federal states.

The probability of hiring at least one new apprentice is significantly affected in ambulatory nursing services (Figure 3(a)). The introduction of the levy scheme increases the probability of hiring at least one new apprentice by about 1.4 percentage points in the year of the reform, and by 8.0 percentage points in the first year after the reform. This effect is smaller than the descriptive effect in panel A of Figure 1. Comparing the effect size of 8.0 percentage points to the mean share of ambulatory nursing services training new apprentices during 2002–18 (16.8%) illustrates that the effect size is substantial. In the subsequent periods, the effect size stays at this high level. Pre-treatment estimates are not significantly different from zero, which confirms that the introduction of a training levy could not be anticipated, and the assumption of parallel trends holds.

The reform also significantly increases the number of new apprentices in Figures 3(b) and 3(c). If we exclude ambulatory nursing services without any training activity in Figure 3(c), then the introduction of the training levy significantly increases the number of new apprentices by 0.43 apprentices in the first year after the reform. Relative to the mean number of new apprentices in ambulatory nursing services during 2002–18 (1.2 new apprentices), this is an effect of 35.9%. These results illustrate that the introduction of the levy scheme affects both the extensive and intensive margins of the provision of training slots in the sector of ambulatory nursing services. Furthermore, the effect in the first year after the reform is larger than the immediate effect. In the subsequent years, effect size stays significant and at a similar level as in the first year after the reform.

Effects for inpatient care facilities are different. In Figure 4(a), there is no significant treatment effect on the probability of hiring at least one new apprentice in the short run and in the longer run. Regarding the intensive margin, there appears to be a significant effect in the first year after the reform. One year after the reform, the number of new apprentices is increased by 0.23 apprentices if we exclude inpatient care facilities without any training activity (Figure 4(c)). Relative to the mean number of new apprentices in inpatient care facilities during 2002–18 (1.89 new apprentices), this is an effect of 11.9%. This effect stays significant and of similar size in the subsequent years. Results of Figure 4 therefore suggest that the positive effects at the intensive margin are driven mainly by inpatient care facilities that have already provided training slots before the reform. Similarly as in ambulatory nursing services, the effect appears mainly in the first year after the reform and in the subsequent years. This is consistent with descriptive evidence in Figures 1

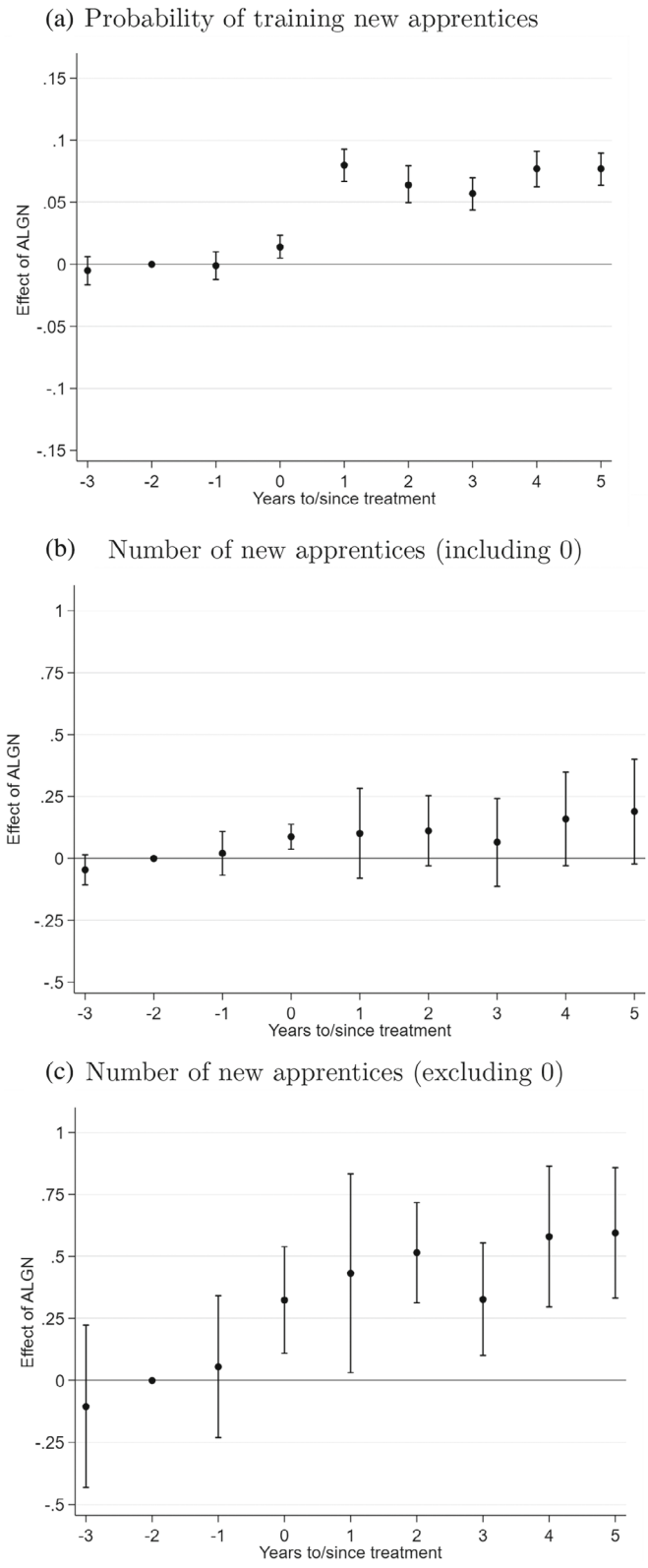

FIGURE 3 Treatment effects by time horizon for ambulatory nursing services. *Notes*: The figure displays dynamic treatment effects of introducing the ALGN in period $\tau = 0$ on training activity of care facilities in pre-reform and post-reform periods by using the interaction-weighted estimator by Sun and Abraham (2021). Never-treated groups are used as the control group, and the period two years before treatment is used as the reference period. Confidence intervals are calculated at the 95% level. Each estimate presented here controls for variables at the facility level and regional variables at the level of counties given in Table 1. Moreover, time and federal states fixed effects are included, and clustered standard errors at the level of federal states are used. Sources: Establishment History Panel 1975–2021 (BHP 7521); Regional Database of the Federal Statistical Office and the Federal Employment Agency.

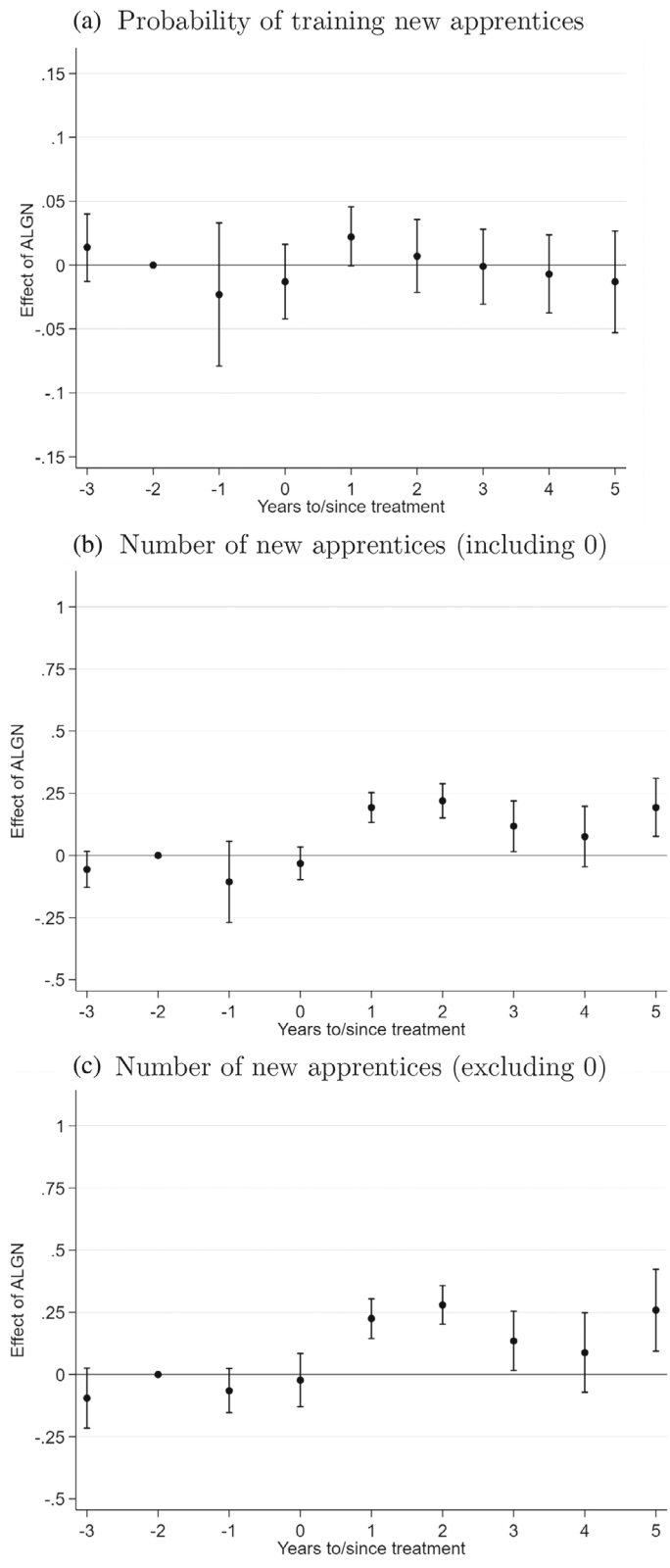

FIGURE 4 Treatment effects by time horizon for inpatient care facilities. *Notes*: See Figure 3.

and 2. We explain this by the implementation of the levy and by the fact that employers do not react immediately to the reform (see the final subsection of Section 3).[17]

Tables A3 and A4 in the Appendix show how estimates change if we gradually add care facility and county characteristics. In ambulatory nursing services, the effect on the probability of hiring new apprentices in the first year after the reform decreases from 12.0 to 7.9 percentage points after adding facility characteristics. Regarding regional differences, model (3) of Table A3 shows that the effect is barely affected after adding regional characteristics. This is also true for the intensive margin in both sectors in ambulatory and inpatient care facilities. Although apprentices account for only a small share of the overall staff of a care facility, it may be that some covariates such as mean age or mean education are also affected by introducing the training levy (through spillover effects). In order to check whether the decrease in the treatment effect after adding covariates is affected by this circumstance, we re-estimate equation (1) by using the first lag of care facility and regional covariates instead of contemporaneous values of covariates. However, the treatment effects stay robust. In ambulatory nursing services, the significant positive effect on the probability of hiring new apprentices in the first year after the reform changes from 8.0 to 7.4 percentage points. In the inpatient sector, the significant positive effect on the number of new apprentices is also barely affected (0.19 versus 0.20).

5 | FURTHER ANALYSES

Previous research underlines that the effect of levy schemes can be heterogeneous with respect to firm size. In addition, it is sensible to expect that the effects vary by the degree of local labour shortage in geriatric nursing. Those questions are tackled in greater detail in the first subsection. Furthermore, the second subsection considers several sensitivity analyses. In the following, we examine the robustness and the heterogeneity of our results by considering our outcomes in the first year after the reform ($\tau = 1$).

5.1 | Heterogeneities

We examine whether the treatment effect masks heterogeneities across the distribution of labour shortage of care workers. This is important to ask, since additional apprenticeship slots are more desirable where the need for skilled geriatric nurses is larger. To approximate the need for nurses, we again use the number of persons in need of care related to the number of caring slots. Because of the endogeneity of this number, we use the values of the last pre-treatment year 2004.[18] We presume that the effects of the levy scheme are stronger where the number of persons in need of care related to the number of caring slots is larger.

We separate estimation by quartiles regarding the number of persons in need of care related to the number of caring slots. In ambulatory nursing services, the levy scheme significantly affects the probability of hiring new apprentices in all quartiles (see panel A of Table 2). Regarding the intensive margin, effects are present in all quartiles, except for the first quartile. The positive effects of the levy scheme are therefore not driven by particular regions and are instead found for the majority of the sample. Moreover, in the third and fourth quartiles, the effect size is larger than in the first two quartiles. Although it is not a linear relationship, this shows that the results are larger where the number of persons in need of care related to the number of caring slots is larger.

The stratification with respect to the number of persons in need of care related to the number of caring slots is also informative for inpatient care facilities. The effects at the intensive margin (models (5) and (6)) are present in almost all quartiles. However, the effect sizes cannot confirm our expectation that the effects are larger where the number of persons in need of care related to the number of caring slots is larger. Regarding the extensive margin, there are no hints at any

TABLE 2 Heterogeneities with Respect to Labour Shortage of Care Workers in Counties and Size of Care Facilities

	Ambulatory			Inpatient		
	Prob. of hiring	No. of new apprentices		Prob. of hiring	No. of new apprentices	
	new apprentices	incl. zero	excl. zero	new apprentices	incl. zero	excl. zero
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: No. of persons in need of care related to the number of caring slots in counties						
First quartile	0.024*	−0.092	−0.036	0.045*	0.200**	0.299***
	(0.011)	(0.074)	(0.304)	(0.021)	(0.075)	(0.084)
Second quartile	0.051**	0.155***	0.560*	−0.034	0.064	0.117**
	(0.022)	(0.041)	(0.265)	(0.023)	(0.077)	(0.047)
Third quartile	0.145***	0.265***	0.273	0.013	0.252***	0.326**
	(0.025)	(0.052)	(0.240)	(0.015)	(0.065)	(0.147)
Fourth quartile	0.065***	0.341***	0.730**	−0.012	−0.170**	−0.107
	(0.017)	(0.057)	(0.269)	(0.019)	(0.058)	(0.070)
Panel B: No. of employees per care facility						
Max. 9 employees	0.045***	0.086***	0.400**	0.015	0.122	−0.134
	(0.008)	(0.020)	(0.138)	(0.019)	(0.100)	(0.411)
10–24 employees	0.094***	−0.174	−0.550	0.008	0.055	0.163*
	(0.015)	(0.232)	(0.522)	(0.016)	(0.034)	(0.088)
25–49 employees	0.062***	0.243***	0.512***	0.014	0.158***	0.207***
	(0.012)	(0.027)	(0.094)	(0.018)	(0.039)	(0.038)
50–99 employees	0.125**	0.556***	0.987***	0.022	0.287***	0.369***
	(0.043)	(0.098)	(0.249)	(0.023)	(0.056)	(0.059)
Min. 100 employees	0.159**	−0.108	−0.198	0.034	0.066	0.103
	(0.053)	(0.252)	(0.651)	(0.028)	(0.126)	(0.146)

Notes: Standard errors clustered at the level of federal states in parentheses.
The table displays treatment effects of introducing the ALGN on training activity in the first year after the treatment by using the interaction-weighted estimator by Sun and Abraham (2021). Never-treated groups are used as the control group, and the period two years before treatment is used as the reference period. Each model controls for variables at the facility level and regional variables at the level of counties given in Table 1. Moreover, time and federal states fixed effects are included.
In panel A, regressions are stratified with regard to the number of persons in need of care related to the number of caring slots. In the first row, the first quartile of this indicator of labour shortage is considered. In panel B, regressions are stratified with regard to the number of employees in care facilities.
Sources: Establishment History Panel 1975–2021 (BHP 7521); Regional Database of the Federal Statistical Office and the Federal Employment Agency.
*, **, *** indicate $p < 10\%$, $p < 5\%$, $p < 1\%$, respectively.

positive effects on the probability of hiring new apprentices. The insignificant treatment effect at the extensive margin presented in Figure 4 is therefore not the result of uncovered heterogeneity in this case.

The size of care facilities is the second characteristic that potentially masks heterogeneity in the average treatment effect. In the ambulatory sector, significant effects on the probability of hiring new apprentices are found for each group (see panel B of Table 2). However, the effect size differs by size of care facilities and ranges from 4.5 to 15.9 percentage points. The results for the intensive margin verify that results are not driven by very small facilities. Instead, significant effects on the number of apprentices are found for care facilities with fewer than ten employees and with 25–99 employees. In inpatient care facilities, the positive effects regarding the number of new apprentices are driven mainly by medium-size facilities with 25–99 employees.

5.2 | Sensitivity tests

Five econometric issues are addressed in this section.

First, in 2010, a minimum wage in the caring sector was introduced. The wage was set at €8.50 in federal states of West Germany, and €7.50 in East Germany. Although the low level of minimum wage is likely to affect wages only of auxiliary nurses and not skilled nurses, this reform affects the budget of care facilities. An effect of this reform on the training activity of care facilities is therefore possible.

The data surveyed by Boockmann *et al.* (2011) and Harsch and Verbeek (2012) show that in West Germany, the minimum wage was binding only for a very low share of below 10%. In East Germany, 28.4% of employees in ambulatory nursing services and 17.6% of employees in inpatient nursing services were affected by the minimum wage. Because our data at the level of establishments give information only about gross daily wages of full-time employed persons, we cannot identify which persons and establishments are affected by the minimum wage introduction. However, because the minimum wage was binding only for a large share of workers in East Germany, the pure consideration of West Germany is an appropriate robustness check. Furthermore, this focus on West Germany is helpful because the levy scheme was implemented exclusively in federal states of West Germany. Panel A of Table 3 shows that the positive effect on the probability of hiring new apprentices and on the number of new apprentices is robust in ambulatory nursing services. For inpatient care facilities, the coefficients are also comparable to those displayed in Figure 4. Furthermore, there is a weakly significant positive effect on the probability to train new apprentices (model (4) of Table 3).

The 'Training and Qualification Campaign for Geriatric Care' during 2012 and 2015 is the second political intervention (for more details, see Slotala 2020) that may confound the estimates. The programme promoted continuing training in geriatric nursing provided by the Federal Employment Agency. However, this programme was implemented in all federal states, and Slotala (2020) provides descriptive statistics demonstrating that the use of CVET subsidies was below average in North Rhine-Westphalia, the largest federal state in the treatment group that implemented the ALGN around the programme implementation. This scheme is thus unlikely to drive the results presented.

Second, in panel B of Table 3, we use stocks of apprentices instead of flows. The significant positive effects for ambulatory nursing services remain. However, standard errors are larger. Presumably, this is consistent with the thoughts expressed in the first subsection of Section 3, and shows that using flow variables is more appropriate and gives more precise estimates. This reason also explains the changed estimates for inpatient care facilities.

Third, we examine whether the effects are driven by selective market entry and exit. The introduction of the levy scheme may cause financially weak facilities to leave the market while other facilities enter. In particular, the ambulatory care sector is characterized by high volatility and by a high number of newly emerging facilities. To examine the pattern of attrition, the administrative character of the BHP data is very useful because participation in the survey is obligatory. The average number of years for which care facilities are part of the dataset is larger in inpatient care facilities (about 12.7 years) than in ambulatory nursing facilities (11.2 years). However, in both sectors, the average number of participation years does not differ significantly between treated and control care facilities. In panel C of Table 3, we consider exclusively care facilities that have been part of the market for at least 10 years.[19] The treatment effect stays very robust in significance, and the magnitudes change only very slightly.

Fourth, although the descriptive statistics do not hint at a violation of the common trend assumption, we perform additional checks. In panel D of Table 3, we add interactions between a time trend and pre-reform controls of care facility characteristics and counties. Again, we choose 2004 as the pre-reform year. However, the results do not change if we choose any other

TABLE 3 Sensitivity Checks

	Ambulatory			Inpatient		
	Prob. of hiring	No. of new apprentices		Prob. of hiring	No. of new apprentices	
	new apprentices	incl. zero	excl. zero	new apprentices	incl. zero	excl. zero
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: West Germany only						
ALGN	0.081***	0.084	0.384**	0.022*	0.188***	0.206***
	(0.006)	(0.100)	(0.171)	(0.011)	(0.031)	(0.039)
Panel B: Stock variables						
ALGN	0.052***	0.137	0.686***	−0.036	0.125	0.005
	(0.008)	(0.114)	(0.120)	(0.023)	(0.123)	(0.120)
Panel C: Attrition (part of panel for ≥ 10 years)						
ALGN	0.089***	0.061	0.371*	0.015	0.198***	0.227***
	(0.010)	(0.105)	(0.199)	(0.012)	(0.028)	(0.034)
Panel D: Interactions between time trend and pre-reform controls						
ALGN	0.080***	0.082	0.356*	0.026**	0.202***	0.237***
	(0.007)	(0.088)	(0.194)	(0.011)	(0.030)	(0.039)
Panel E: Estimates weighted by firm size						
ALGN	0.112***	0.196	0.580**	0.020	0.377***	0.294**
	(0.018)	(0.293)	(0.244)	(0.012)	(0.104)	(0.125)

Notes: Standard errors clustered at the level of federal states in parentheses.
The table displays treatment effects of introducing the ALGN on training activity in the first year after the treatment by using the interaction-weighted estimator by Sun and Abraham (2021). Never-treated groups are used as the control group, and the period two years before treatment is used as the reference period. Each model controls for variables at the facility level and regional variables at the level of counties given in Table 1. Moreover, time and federal states fixed effects are included.
The table performs sensitivity analyses considering the sample of 7866 ambulatory nursing services in Table A3 of the Appendix, and of 7364 inpatient care facilities in Table A4. In panels A and C, the sample is reduced. If East Germany is excluded (panel A), then we consider a sample of 6771 ambulatory nursing services and 6530 inpatient care facilities. If care facilities are excluded that were part of the panel for only 9 years or less (panel C), then the sample is reduced to 2897 ambulatory nursing services and 4301 inpatient care facilities. In panel A, estimation is performed only for care facilities in West Germany. In panel B, the outcomes that describe the training activity of care facilities are used as stock variables instead of flow variables. In panel C, we account for selective attrition. This panel considers only care facilities that have been part of the dataset for at least 10 years. In panel D, we added interactions between a time trend and pre-reform (year 2004) controls of care facility characteristics and counties to the regression. In panel E, we re-estimate the effect of the levy scheme by weighting our estimates by the number of employees per care facility.
Sources: Establishment History Panel 1975–2021 (BHP 7521); Regional Database of the Federal Statistical Office and the Federal Employment Agency.
*, **, *** indicate $p < 10\%$, $p < 5\%$, $p < 1\%$, respectively.

pre-reform year. In both sectors, the estimates regarding the number of new apprentices slightly increase.

Finally, Panel E of Table 3 tackles again the issue that our sample is heterogeneous with respect to firm size. Table 2 uncovered heterogeneous effects with regard to the number of employees. In particular, there is a substantial share of facilities with fewer than ten employees in ambulatory nursing services (see Table 1). If we assign an equal weight to all care facilities, then it may be that the effects are driven by very small care facilities if those care facilities are the most likely to react to the introduction of the levy scheme. However, if we weight our estimations by the number of employees of care facilities, then the effects for both sectors stay significant and the magnitude of the effects increases.

6 | CONCLUSION

Although training subsidies and levies are part of labour market policy in many countries (see, for example, Gasskov 1998; Müller and Behringer 2012; Kuczera 2017), evidence on the empirical effects of such instruments is sparse. We provide evidence that the redistribution of apprenticeship costs can stimulate the training activity of care facilities. For ambulatory care, we find a robust positive effect on the probability of hiring new apprentices and on the number of new apprentices. By accounting for the dynamic path of the treatment effect, we demonstrate that those effects appear from the first year after the reform. Inpatient care facilities adjust their recruitment strategy less strongly. While the probability of providing apprenticeship training is not affected in this sector, positive effects on the number of new apprentices emerge in the first year after the reform. This sector-specific analysis therefore demonstrates that effects from levy schemes can be very heterogeneous, even in related sectors. The initial level of training activity affects our results. While in the ambulatory sector the share of facilities hiring at least one new apprentice does not exceed 15% before the introduction of the levy, the initial level is above 50% in inpatient care facilities. The potential of increasing training activity was therefore larger in the ambulatory than in the inpatient sector. Another perspective of heterogeneity is provided by the stratifications with respect to facility size and regional labour shortage. As far as ambulatory nursing services are concerned, we find that the results are confirmed for the majority of groups. In inpatient care facilities, heterogeneity is larger. Our focus on the effects on training activity prevented considering the question as to whether the training levy created spillover effects and affected the overall size of staff and staff composition with respect to qualification. This important question deserves more attention by future research in order to get full understanding of the effects of introducing a training levy.

This paper shows that a levy scheme targeted at a sector with a large need to boost training supply can be useful. These implications go beyond the German context. Alongside the fact that our research tackles a research gap, where previous studies were inconclusive, the sector under consideration is of large and increasing economic relevance worldwide. In many countries of middle and high income, increasing the labour supply of caregivers became an important task due to population aging. Furthermore, there are discussions in many countries and economic sectors as to whether levy schemes can increase the provision of company-based training slots. Such levies are often organized at the sector level. Our institutional setting provides a new methodological approach in this context. Because some federal states introduced the levy and some did not, we consider causal effects within one sector.

Our paper also clarifies several issues that should be considered when recommending a training levy to other sectors and countries. First, in this paper, we considered a specific training levy targeted at one single sector characterized by large labour shortage. Second, the amount of apprenticeship costs that is redistributed is substantial in our case. Both features make a levy more likely to produce the intended effects (Kuczera 2017). Third, in the pre-reform periods, the large majority of employers' associations agreed with the fact that care facilities that do not train should contribute to the apprenticeship costs. The levy was therefore not introduced in the face of general resistance from employers' associations. Finally, in contrast to subsidies financed by public means, the levy rewards care facilities that provide training slots but also penalizes facilities that do not provide training. This is also one further interesting feature of the underlying reform. The reimbursements of apprentice salaries are financed only by care facilities, without any additional public funds. This therefore provides one useful example to show that no public funds are required to create financial incentives for providing additional training.

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NOTES

[1] Throughout the paper, we use the term levy–grant scheme in accordance with Bassanini *et al.* (2007): levy schemes 'require firms to pay a tax and obtain resources to award grants to support training (levy–grant schemes)'. Levy–grant schemes are different to train-or-pay schemes, 'which impose a tax on firms if they do not meet a predetermined level of training' (Bassanini *et al.* 2007).

[2] In the following, inpatient and semi-residential care facilities and ambulatory nursing services are summarized as care facilities.

[3] Empirical studies on the effects of training levies and subsidies focus mainly on continuing vocational education and training (CVET) because of useful discontinuities in different programmes. For instance, Görlitz (2010) considers voucher programmes for employees in Germany, and uses variation in eligibility with respect to time, region and firm size. A similar instrument for Switzerland is used by Messer and Wolter (2009) and Schwerdt *et al.* (2012). Further studies that consider financial incentives for CVET are Leuven and Oosterbeek (2004), Görg and Strobl (2006), and Hidalgo *et al.* (2014). Apprenticeship training of young school graduates cannot always be defined strictly separately from CVET. This is the case when firms provide training to low-skilled workers already employed at the firm (e.g. see Abramovsky *et al.* 2011). Another strand of literature with minor relevance for us concerns experiments where the effect of participating in training on employment, wages and further labour market outcomes is estimated. For recent evidence and current literature reviews, see Crepon and Premand (2019), and Alfonsi *et al.* (2020).

[4] One example of this is the German apprenticeship bonus introduced in 2008 that pays a one-off lump sum of €4000–6000 to firms that provide additional apprenticeship places to young people in need of support.

[5] Alternatively, graduating from high school is sufficient to reach eligibility if the person has completed a two-year apprenticeship or is authorized to work as auxiliary nurse (for more details, see Zöller 2017).

[6] We exclude two federal states from our analysis. Bremen primarily introduced compensation payments for the apprenticeship in auxiliary nursing. Saxony introduced the ALGN, but the Federal Administrative Court declared its law void because of an absence of evidence of shortage of skilled geriatric nurses (German Federal Parliament 2010).

[7] Whereas Hamburg, North Rhine-Westphalia and Saarland refund the full amount of apprentice salary, including social security contributions, Baden-Wuerttemberg and Rhineland-Palatinate refund only a fraction and exhibit differences in the relative refunding between inpatient and ambulatory facilities. The second difference is that Hamburg, Rhineland-Palatinate and Saarland introduced compensation payments for both training geriatric nurses and auxiliary nursing. These and more details about how the levy works and how it is implemented in practice can be found in Table A1 in the Appendix.

[8] During the construction of the ALGN, delegates from care facilities and ambulatory services attended parliamentary hearings. A further aim was to create trust in the ALGN via transparent communication by the authority responsible, e.g. by annual reports on the utilization of the financial funding and on effective administration in managing the levy. In this context, numerous studies suggest that training levies can stimulate company-based training if the levy is not considered as a pure tax from the perspective of firms, and if the firms feel that they have been incorporated in setting up the levy scheme (e.g. van den Berg *et al.* 2006; Kuczera 2017).

[9] To keep analysis simple without compromising the general validity of the results, we apply ordinary least squares instead of logit or probit to model the probability of hiring new apprentices.

[10] Itemizing this number by type of school does not affect the empirical results in a noteworthy way.

[11] Note that we extrapolate these three variables because they are captured only biennially.

[12] Data access to BHP 7521 (DOI: 10.5164/IAB.BHP7521.de.en.v1) was provided via on-site use at the Research Data Centre of the German Federal Employment Agency at the Institute for Employment Research and via remote data access.

[13] In inpatient care facilities of the control group, training activity seems to increase considerably from 2003 to 2004. This increase is absent for the treatment group in Figures 1 and 2 only because we organize descriptive statistics for the treatment states with respect to time to/since treatment. However, this initial increase in 2004 is also visible in treatment states when we organize descriptive statistics for the treatment group with respect to years. This is therefore no issue regarding parallel trends. Those results are available upon request.

[14] This finding can be confirmed by using the inverse number of employees in ambulatory or inpatient care facilities related to the number of care-dependent persons. Results are available from the author upon request.

[15] Although initial differences are no threat to our empirical strategy as long as their trend is comparable between treatment and control states, we provide further evidence on initial differences. In Table A2 of the Appendix, we regress a time-invariant treatment dummy for the pre-reform period 2002–4 on characteristics of care facilities and regions. The

dummy equals 1 if the facility is located in one of the federal states that introduced the levy scheme after 2004. Results illustrate that the pre-reform composition of ambulatory nursing services in the treatment group does not differ significantly from the composition of the control group. Exclusions are the average size of care facility and the daily pay rate, which presumably can be attributed to the fact that the levy scheme has not been introduced in any federal state in East Germany.

[16] One reason for this may be that East Germany is more affected by the sector-specific minimum wage introduced to the care sector in July 2010 and policymakers in East Germany could interpret the levy scheme and the minimum wage as a double burden to care facilities.

[17] Other estimators—e.g. those proposed by de Chaisemartin and D'Haultfoeuille (2020), Callaway and Sant'Anna (2021), Goodman-Bacon (2021) and Borusyak *et al.* (2022)—do not change our results in a noteworthy way. For instance, the imputation estimator proposed by Borusyak *et al.* (2022) does not significantly change the effect size, and the confidence intervals are only a bit tighter. For instance, the treatment effect at the extensive margin in the ambulatory sector in the first year after the reform of 8.2 percentage points is slightly larger compared to the interaction-weighted estimator (8.0 percentage points). When using the estimator of Borusyak *et al.* (2022), the precision gains decrease in the longer run compared to the interaction-weighted estimator.

[18] The following conclusions can be confirmed by using the second indicator for labour shortage (inverted number of employees in ambulatory or inpatient care facilities related to the number of care-dependent persons).

[19] Alternative regressions use the average number of years of being part of the dataset as the threshold. However, those estimates do not change the following findings significantly.

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APPENDIX

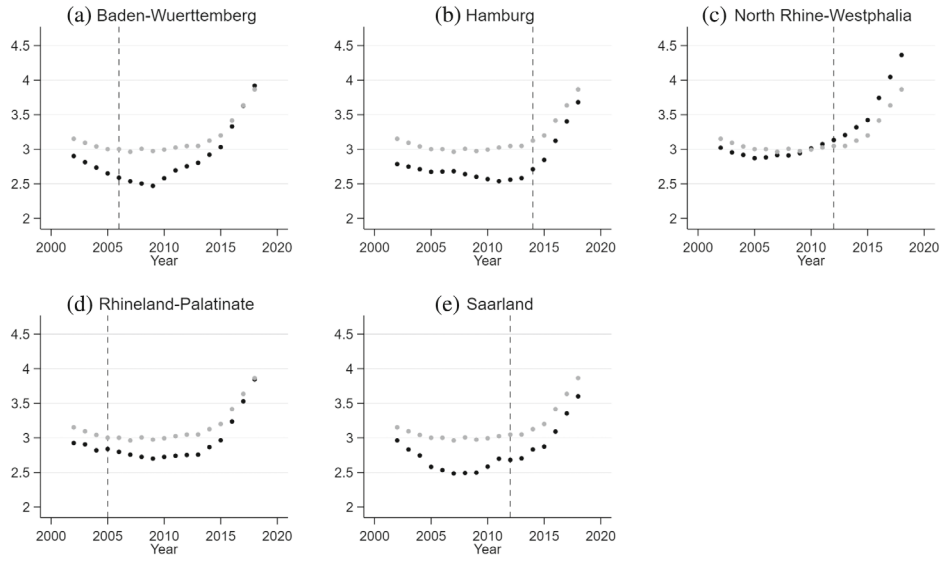

FIGURE A1 Ambulatory nursing services. *Notes*: The graphs display the number of persons in need of care related to the number of caring slots for the sample considering ambulatory nursing services. The black dots give the number in the underlying treatment state, and the grey dots give the number in the control states. The vertical dashed line shows time of introducing the ALGN in treatment federal states. Source: Establishment History Panel 1975–2021 (BHP 7521); Regional Database of the Federal Statistical Office and the Federal Employment Agency; own illustration.

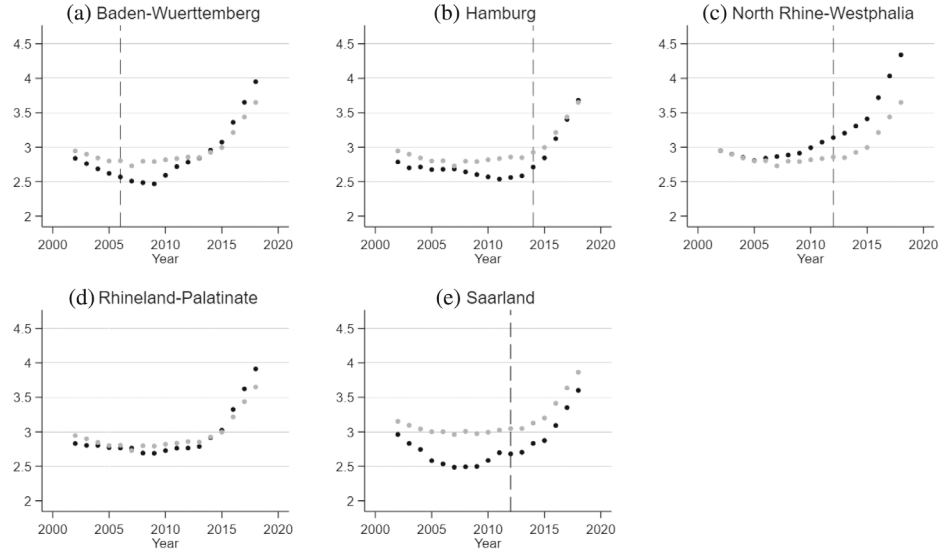

FIGURE A2 Inpatient care facilities. *Notes*: The graphs display the number of persons in need of care related to the number of caring slots for the sample considering inpatient nursing services. The black dots give the number in the underlying treatment state, and the grey dots give the number in the control states. The vertical dashed line shows time of introducing the ALGN in treatment federal states. Source: Establishment History Panel 1975–2021 (BHP 7521); Regional Database of the Federal Statistical Office and the Federal Employment Agency; own illustration.

TABLE A1 Features of the Apprenticeship Levy of Geriatric Nurses, by Federal States

Federal state (1)	Year of introduction (2)	Basis of levy contribution: Inpatient (3)	Basis of levy contribution: Ambulatory (4)	Amount of refunding (%)[a]: Inpatient (5)	Amount of refunding (%)[a]: Ambulatory (6)	Auxiliary nursing levy (7)
Baden-Wuerttemberg	2006	Annual no. of persons cared for	Annual no. of home visits, including body-related nursing procedures due to §§ 36, 38, 39 SGB XI	35	70	No
Hamburg	2014	Annual revenue due to §§ 41–43, 45b, 64g, 64h, 64i, 65, 66 SGB XII	Annual revenue due to §§ 36, 45b SGB XI and §§ 64b, 66 SGB XII	100	100	Yes
North Rhine-Westphalia	2012	Annual average no. of full inpatient slots	Annual nursing points due to SGB XI	100	100	No
Rhineland-Palatinate	2005	Full inpatient slots on 1 August	Operational revenue due to § 89 (1) SGB XI	50	80	Yes
Saarland	2012	Full inpatient slots on 31 October	Operational revenue due to § 89 (1) SGB XI	100	100	Yes

Notes

[a] The relative amount of refunding refers to the refunding of apprentice salary. Regarding the refunding of continuing training costs, each federal state refunds 100%.

Before contributions have to be paid, the amounts of apprenticeship and CVET costs are assessed by the responsible administration. This levy pot is determined by the number of apprentices in geriatric care, their annual apprentice salaries according to the collective agreement, and the amount of CVET costs. After the sum of the levy pot has been determined, the pot is distributed to the two care sectors of inpatient/semi-residential care facilities and ambulatory nursing services according to the ratio of (auxiliary and skilled) nurses in the sector to the overall number of employed nurses. Afterwards, every care facility pays a contribution according to the basis variable and its sector. For instance, in North Rhine-Westphalia, the largest federal state in Germany, the contribution depends on the number of caring slots for inpatient and semi-residential facilities filled on average per year and on the amount of nursing points gathered for ambulatory service facilities per year. Nursing points are an indicator to capture nursing services that considers the kind of service and the degree of care dependency of the patient. To determine the contribution per facility, the underlying basis variable is related to the respective number of the whole care sector.

TABLE A2 Balance of the Treatment: Probability of Treatment Status, by Characteristics of Care Facilities and Regions

	Ambulatory		Inpatient	
	Coeff.	SE	Coeff.	SE
Panel A: Characteristics of care facilities				
Care facility size (reference: min. 100 employees):				
Max. 9 employees	−0.135**	(0.056)	−0.054	(0.075)
10–24 employees	−0.059	(0.065)	−0.042	(0.045)
25–49 employees	−0.044	(0.074)	−0.072*	(0.036)
50–99 employees	−0.031	(0.040)	−0.010	(0.025)
Average age	−0.010	(0.006)	−0.004	(0.004)
Share of women	0.024	(0.055)	0.159	(0.116)
Share of employees with German citizenship	0.188	(0.299)	0.418	(0.429)
Staff composition by formal education:				
Low/intermediate secondary degree	0.052	(0.187)	0.721*	(0.350)
Upper secondary/vocational degree	−0.107	(0.254)	0.326	(0.444)
University/college degree	−0.141	(0.266)	0.648	(0.497)
Gross median daily pay rate, full-time employees	0.003***	(0.001)	0.005*	(0.003)
Staff composition by form of employment:				
Regular	0.062	(0.267)	−0.818	(0.555)
Full-time	−0.095	(0.752)	−0.004	(1.405)
Part-time	−0.248	(0.441)	0.227	(1.278)
Marginal part-time	0.172	(0.535)	−0.143	(1.164)
Panel B: Regional variables of counties				
No. of school graduates ∗ 1000	−0.003	(0.006)	0.006	(0.007)
No. of care-dependent persons per 1000 inhabitants above age 64	−0.006***	(0.002)	−0.005**	(0.002)
No. of nurses per 100 care-dependent persons in inpatient/ambulatory facilities	0.005	(0.005)	0.017**	(0.007)
No. of slots in inpatient facilities per 1000 inhabitants above age 64	−0.002	(0.005)	−0.003	(0.004)
Unemployment rate (%)	−0.010	(0.023)	0.012	(0.027)
Year fixed effects	Yes		Yes	
R^2	0.152		0.287	
Observations	7443		8758	
No. of facilities	2907		3165	

Notes: Standard errors clustered at the level of federal states in parentheses. By applying linear regression, the table regresses a time-invariant treatment dummy on characteristics of care facilities and regions for the period 2002–4. During this observation period, the levy scheme had not been introduced to any of the federal states. The outcome equals 1 if the care facilities are located in a federal state that introduced the levy scheme after 2004. Thus it is 1 if the care facilities are located in Baden-Wuerttemberg, Hamburg, North Rhine-Westphalia, Rhineland-Palatinate or Saarland.

Sources: Establishment History Panel 1975–2021 (BHP 7521); Regional Database of the Federal Statistical Office and the Federal Employment Agency.

*, **, *** indicate $p < 10\%$, $p < 5\%$, $p < 1\%$, respectively.

TABLE A3 Empirical Effects of the ALGN on Training Activity of Ambulatory Care Facilities

	Probability of hiring new apprentices			Number of new apprentices					
				including zero			excluding zero		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\tau = -3$	−0.004	−0.005	−0.005	−0.012	−0.049	−0.046	−0.103	−0.112	−0.105
	(0.006)	(0.005)	(0.005)	(0.034)	(0.031)	(0.031)	(0.176)	(0.167)	(0.167)
$\tau = -1$	0.00004	−0.001	−0.001	−0.004	0.017	0.020	0.071	0.156	0.055
	(0.006)	(0.005)	(0.005)	(0.031)	(0.044)	(0.045)	(0.167)	(0.206)	(0.146)
$\tau = 0$	0.027***	0.014***	0.014***	0.130***	0.089***	0.087***	0.397**	0.339**	0.324***
	(0.006)	(0.004)	(0.004)	(0.013)	(0.023)	(0.023)	(0.085)	(0.100)	(0.099)
$\tau = 1$	0.120***	0.079***	0.080***	0.230***	0.101	0.101	0.607***	0.430**	0.432**
	(0.004)	(0.005)	(0.006)	(0.062)	(0.081)	(0.084)	(0.161)	(0.173)	(0.185)
$\tau = 2$	0.136***	0.065***	0.064***	0.339***	0.114*	0.111	0.892***	0.535***	0.515***
	(0.006)	(0.007)	(0.007)	(0.029)	(0.064)	(0.065)	(0.075)	(0.092)	(0.093)
$\tau = 3$	0.143***	0.058***	0.057***	0.337***	0.068	0.065	0.799***	0.351***	0.327***
	(0.009)	(0.006)	(0.006)	(0.033)	(0.080)	(0.082)	(0.058)	(0.092)	(0.105)
$\tau = 4$	0.183***	0.078***	0.077***	0.492***	0.164*	0.159*	1.124***	0.612***	0.580***
	(0.007)	(0.006)	(0.007)	(0.029)	(0.086)	(0.088)	(0.109)	(0.122)	(0.131)
$\tau = 5$	0.191***	0.079***	0.077***	0.544***	0.195*	0.189*	1.174***	0.641***	0.594***
	(0.009)	(0.007)	(0.006)	(0.039)	(0.100)	(0.098)	(0.087)	(0.107)	(0.122)
Observations	63,032	63,032	63,032	63,032	63,032	63,032	16,783	16,783	16,783
No. of care facilities	7866	7866	7866	7866	7866	7866	3480	3480	3480
Year & federal states fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Care facility size	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls		Yes	Yes		Yes	Yes		Yes	Yes
Regional variables			Yes			Yes			Yes

Notes: Standard errors clustered at the level of federal states in parentheses. The table displays dynamic treatment effects of introducing the ALGN in period $\tau = 0$ on training activity of care facilities in pre-reform and post-reform periods by using the interaction-weighted estimator by Sun and Abraham (2021). Never-treated groups are used as the control group, and the period two years before treatment is used as the reference period. In columns (1)–(3), the dependent variable is a binary indicator as to whether or not the care facility provides apprenticeships. In columns (4)–(9), the number of apprentices (excluding and including facilities that do not train) is used as the outcome. Table 1 gives an overview on control variables at the facility level and regional variables at the level of counties.
Sources: Establishment History Panel 1975–2021 (BHP 7521); Regional Database of the Federal Statistical Office and the Federal Employment Agency.
*, **, *** indicate $p < 10\%$, $p < 5\%$, $p < 1\%$, respectively.

TABLE A4 Empirical Effects of the ALGN on Training Activity of Inpatient Care Facilities

	Probability of hiring new apprentices			Number of new apprentices including zero			Number of new apprentices excluding zero		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\tau = -3$	0.010	0.014	0.014	−0.075	0.072	−0.056	−0.118*	−0.094	−0.095
	(0.016)	(0.013)	(0.012)	(0.044)	(0.052)	(0.033)	(0.057)	(0.054)	(0.056)
$\tau = -1$	0.027	−0.030	−0.023	0.088	−0.109	−0.106	−0.021	−0.071	−0.065
	(0.046)	(0.032)	(0.029)	(0.115)	(0.071)	(0.083)	(0.036)	(0.042)	(0.041)
$\tau = 0$	−0.019	−0.013	−0.013	−0.049	−0.028	−0.032	0.013	−0.016	−0.023
	(0.014)	(0.014)	(0.014)	(0.035)	(0.030)	(0.030)	(0.054)	(0.045)	(0.049)
$\tau = 1$	0.019	0.009	0.022*	0.247***	0.203***	0.193***	0.411***	0.284***	0.225***
	(0.013)	(0.010)	(0.011)	(0.025)	(0.016)	(0.028)	(0.036)	(0.029)	(0.037)
$\tau = 2$	0.022	−0.0001	0.007	0.321***	0.227***	0.220***	0.486***	0.305***	0.280***
	(0.014)	(0.012)	(0.013)	(0.029)	(0.023)	(0.032)	(0.040)	(0.033)	(0.036)
$\tau = 3$	0.004	−0.011	−0.001	0.186***	0.123***	0.118**	0.331***	0.160***	0.135**
	(0.013)	(0.012)	(0.014)	(0.035)	(0.027)	(0.047)	(0.040)	(0.044)	(0.055)
$\tau = 4$	0.002	−0.018	−0.007	0.167***	0.083**	0.076	0.302***	0.115*	0.088
	(0.014)	(0.012)	(0.014)	(0.037)	(0.031)	(0.056)	(0.051)	(0.060)	(0.074)
$\tau = 5$	−0.007	−0.022	−0.013	0.264***	0.201***	0.193***	0.462***	0.277***	0.259***
	(0.019)	(0.016)	(0.018)	(0.043)	(0.030)	(0.054)	(0.058)	(0.063)	(0.076)
Observations	74,858	74,858	74,858	74,858	74,858	74,858	51,884	51,884	51,884
Number of care facilities	7364	7364	7364	7364	7364	7364	5786	5786	5786
Year & federal states fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Care facility size	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls		Yes	Yes		Yes	Yes		Yes	Yes
Regional variables			Yes			Yes			Yes

Notes: See Table A3.