

Swiss Leading House

Economics of Education • Firm Behaviour • Training Policies

Working Paper No. 246

**Easing the Commute: The Impact of
Affordable Public Transport on
Apprentice Mobility**

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Please cite as:
"Easing the Commute: The Impact of Affordable Public Transport on Apprentice Mobility." Swiss Leading House "Economics of Education" Working Paper No. 246, 2025. By Henrika Langen and Michael Dörsam.

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The Swiss Leading House on Economics of Education, Firm Behavior and Training Policies is a Research Program of the Swiss State Secretariat for Education, Research, and Innovation (SERI).

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Easing the Commute: The Impact of Affordable Public Transport on Apprentice Mobility*

Henrika Langen[†], Michael Dörsam[‡]

August 7, 2025

Abstract

This paper examines how improved public transportation affordability, resulting from the introduction of the so-called Deutschlandticket, affected the commuting choices of newly commencing apprentices in Germany. Introduced in May 2023, the Deutschlandticket offers nationwide access to local and regional public transport at a flat monthly rate, replacing a previously fragmented fare system and substantially reducing commuting costs, particularly for commutes across transport association boundaries. Using administrative register data on apprenticeship contracts and detailed pre-Deutschlandticket fare information, we assess changes in commuting patterns among new apprentices between 2022 and 2023. Our difference-in-differences analyses show that the Deutschlandticket led to a significant increase of around 21% in commutes on inter-transport-association routes, especially among older apprentices, those with lower school-leaving certificates, and those in certain training occupations. In contrast, we find no significant effect of region-specific Deutschlandticket-related cost savings on commuting distances within single transport associations. Our findings suggest that by reducing financial and informational barriers, the Deutschlandticket expanded access to apprenticeship opportunities and may have helped alleviate regional mismatches, without increasing commuting distances or requiring relocation.

JEL-Code: I21, J61, J24, R23

Keywords: commuting behavior, vocational education and training (VET), D-Ticket, public transportation, Difference-in-Differences

*Acknowledgments: We thank María Fernanda Nerio Morales for her research assistance.

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1 Introduction

In Germany, vocational education and training (VET) plays a crucial role in developing a skilled workforce and maintaining a strong labor market. However, in recent years, an increasing number of apprenticeship positions have remained unfilled due to a lack of suitable candidates, reaching a record high of approximately 73,400 unfilled apprenticeship positions in 2023 (Weller et al. 2024). At the same time, the rate of apprenticeship contract terminations has increased (Bundesinstitut für Berufsbildung 2024) and Germany has seen a rise in the number of 15-24-year-olds classified as NEET, i.e., not in education, employment, or training (Schnelle and Wieland 2024).

Surveys among school graduates and apprentices suggest that their decision to take up an apprenticeship and their motivation to complete it depend largely on whether the apprenticeship aligns with their interests and abilities (Ausbildung.de GmbH 2024; Bertelsmann Stiftung and Institut der deutschen Wirtschaft 2024; Bundesinstitut für Berufsbildung 2018; Haverkamp 2016). However, mismatches between available apprenticeship positions and individual preferences of applicants, as well as logistical challenges such as high commuting costs and poor connectivity, can hinder optimal matching between prospective apprentices and apprenticeship positions (Bundesagentur für Arbeit 2024; Jost et al. 2019). Therefore, increasing apprentice mobility has long been a priority in German policy discussions (Deutscher Bundestag 2018; Cedefop 2022).

Previous studies on apprentice mobility and the regional mismatch between apprenticeship positions and applicants in Germany have typically defined apprentices as "mobile" if they applied for a position located more than 50 or 100 kilometers away from their municipality of residence – that is, if they were willing to relocate for an apprenticeship (see, e.g., Bundesinstitut für Berufsbildung 2014; Matthes and Ulrich 2017; Talmon-Gros et al. 2015). In contrast, our focus is on commuting, i.e., regular travel between the place of residence and the training company, which plays a critical role in expanding access to apprenticeships, improving matches between apprentices and companies, and reducing regional disparities within the VET system (Jost et al. 2019, Bundesagentur für Arbeit 2024).

In 2022, approximately 60% of apprentices in Germany commuted to their training companies, while fewer than 5% of them relocated for their apprenticeship (Schmidt 2024). These figures underscore the central role of commuting and the importance of understanding how its feasibility influences apprenticeship decisions. One way to further improve the mobility of apprentices is by making public transportation more affordable. In a survey among experts in VET policy, research and practice in Germany, 90% agreed that providing discounted and affordable transportation passes is essential to promote mobility among apprentices (Herzer and Ulrich 2020). Young adults share this view, as a separate study found that they ranked financial support—such as a subsidized transport pass—as the second most important factor for increasing their mobility (Talmon-Gros et al. 2015). The relevance of affordable public transportation is further underscored by the age structure of newly commencing apprentices:

in 2023, approximately 27% of new apprentices turned 17 or younger, and 12% turned 16 or younger. Thus, many apprentices are below the legal driving age for at least part—and in some cases a substantial portion—of their apprenticeship. As a result, public transportation is likely to be even more critical for apprentices than for most other workers.

The introduction of the so-called *Deutschlandticket* (hereafter referred to as the D-Ticket) in May 2023 resulted in substantial cost savings not only for regular employees but also for apprentices commuting along most routes. The D-Ticket provides nationwide access to local and regional public transportation through a single, flat-rate monthly pass. Before its implementation, the German fare system was highly fragmented, and discounted transport passes for apprentices were typically valid only within the issuing transport association or a limited part of it. Reduced-fare options for inter-association commutes were rare, often making such commutes considerably more expensive than those within a single transport association. By replacing this fragmented system, the D-Ticket substantially improved the affordability and convenience of commuting, particularly between transport associations. In the following analyses, we exploit this variation in D-Ticket-related improvements across regions and commuting routes.

To evaluate the impact of the D-Ticket on apprentice mobility, we combine data on the price structures and coverage areas of public transport passes available to apprentices before the introduction of the D-Ticket with the data from the Vocational Training Statistics (Berufsbildungsstatistik der Statistischen Ämter des Bundes und der Länder, BBS). The BBS is an annual administrative data set that records all newly signed apprenticeship contracts and includes information on the apprentices' place of residence at the time of contract signing and the location of their training company.

In our first analysis, we exploit the fact that the D-Ticket substantially facilitated commuting across transport association boundaries. To this end, we aggregate apprentice mobility data at the level of commuting routes and classify each route as either inter-association (treatment group) or intra-association (control group). We then analyze changes in mobility between 2022—the year prior to the D-Ticket's introduction—and 2023 using a difference-in-differences (DiD) framework. In addition, we explore heterogeneity in the treatment effect by age, training occupation, and school-leaving certificate.

Our second analysis leverages regional variation in cost savings for intra-association commutes resulting from the introduction of the D-Ticket. In regions where the previous price of apprentice passes exceeded the D-Ticket's monthly rate of €49, the treatment value reflects the corresponding price difference. Transport associations where apprentice passes were already priced at or below €49 prior to the D-Ticket's introduction in May 2023 receive a treatment value of zero. We then estimate the effect of these cost savings on the median commuting distance of newly commencing apprentices within each transport association using a two-way fixed effects (TWFE) model.

We find that the facilitation of inter-association commuting through the D-Ticket led to a

significant increase of approximately 21% in the number of newly commencing apprentices commuting across transport association boundaries. Heterogeneity analyses indicate that this increase was above average among apprentices over the age of 18 (+23%) and those with a lower secondary school degree (+24%). The most pronounced effect heterogeneity, however, is observed across training occupations, with an above-average increase in inter-association commutes among apprentices in industry and trade (+24%), a below-average increase among craft apprentices (+15%), and a decline among apprentices in the public sector (-13%), likely reflecting the influence of unobserved factors. The analysis of D-Ticket-related cost savings reveals no statistically significant effect on the commuting distances of apprentices within transport associations.

The paper proceeds as follows. Section 2 reviews the existing literature on labor market mobility, with a particular focus on apprentices. Section 3 provides an overview of the introduction of the D-Ticket and the institutional framework of the German apprenticeship system. Section 4 describes the data sources, while Section 5 outlines the methodological approach. The findings are presented in Section 6, and the paper concludes with Section 7.

2 Literature

A long-standing body of research shows that commuting costs affect individuals' willingness to commute, thereby influencing their decisions to accept or decline job offers (Eliasson et al. 2003; Manning 2003; Van den Berg and Gorter 1997; Van Ommeren et al. 1999). The extent to which people respond to changes in commuting costs depends on the mode of transportation, geographic region, time frame (short- vs. long-term decisions), and other contextual factors. Overall, individuals tend to be more price-sensitive when using public transportation compared to private cars (for detailed information, see the meta-analyses by Litman 2024 and Wardman 2022). As a result, when public transportation is perceived as affordable, individuals are more likely to choose it over other modes of transportation (Balcombe et al. 2004; Brechan 2017; Busch-Geertsema et al. 2021; Litman 2004). Moreover, the more affordable public transportation becomes, the more likely individuals are to commute longer distances (Loder et al. 2023). At the same time, the share of individuals using public transportation increases when the system offers efficient travel times, direct routes with few transfers, and frequent service (Cantwell et al. 2009; Chakrabarti 2017; Ha et al. 2020; Lunke et al. 2021), where these factors are particularly important for individuals living in rural areas (Fieden and Straub 2023; Pot and Piesch 2024; De Vos et al. 2020).

Commuting behavior has been shown to be heterogeneous with respect to several demographic and geographic characteristics. Regarding rural-urban differences, a recent study based on Dutch data finds that rural residents are generally more willing to accept longer commuting distances (Pot and Piesch 2024). However, the study also shows that longer

commuting distances among rural residents are largely made possible by car use, as the same distances would generally not be accepted when relying on public transportation due to its poor accessibility. With respect to education, several studies have shown that households with higher levels of educational attainment tend to commute longer distances (see, e.g., Groot et al. [2012]; Kersting et al. [2021]; Nobis and Kuhnimhof [2018]). This is largely because wages for knowledge- and skill-intensive occupations vary more significantly across regions than those in less specialized fields (Kersting et al. [2021]). Furthermore, as occupational specialization increases, individuals are less likely to find jobs matching their qualifications within their immediate vicinity. Interestingly, Granato et al. [2009] show that the positive correlation between educational attainment and commuting distances is less pronounced in East Germany than in West Germany, at least in the early 2000s, with lower-skilled workers in the East showing a comparatively stronger tendency to commute. Regarding gender, numerous studies have found that women tend to be less willing to commute than men (see, e.g., Crane [2007]; Le Barbanchon et al. [2021]), which has largely been attributed to their lower wages, the need to balance caregiving and work responsibilities, and the more uniform spatial distribution of occupations traditionally dominated by women (MacDonald [1999]).

The aforementioned research focuses on the commuting behavior of regular workers. To the best of our knowledge, no peer-reviewed studies have yet estimated the relationship between commuting costs and the commuting behavior of apprentices, and only a limited number of studies have investigated how sensitive young people's transportation demand is to price changes. For the UK, an independent report by the Department for Transport found that the price elasticity of public transport demand among 18-25-year-olds is at approximately -0.9, meaning that a 10% increase in the price of youth tickets would lead to a 9% decrease in the number of trips taken per person (Department for Transport [2017]). Similarly, for Beijing, Zhao and Zhang [2019] found that young workers are among the groups most vulnerable to rising ticket prices. Beccaris-Pescatore et al. [2024] found that students in the US are more likely to decide not to enroll or drop out of community college if they perceive commuting costs as too high. Similarly, Dickerson and McIntosh [2013] showed that greater distance to the nearest academic institution significantly decreases the likelihood that young people pursue academic studies. Focusing specifically on public transportation, a study by Hasnine et al. [2018] indicates that post-secondary students in Toronto who commute to school by public transport are highly sensitive to changes in travel time, while Ha et al. [2020] found that the youngest group of commuters in Seoul is particularly likely to travel by car when using public transportation involves more than one transfer. For the context of the German VET system, two studies, while not providing estimates of how transportation costs affect apprentice mobility, emphasize that financial barriers limit the regional mobility of young people seeking apprenticeships (Herzer and Ulrich [2020]; Talmon-Gros et al. [2015]).

Possible reasons for the particularly strong relationship between commuting costs and com-

muting behavior among young adults include their relatively low income, which makes public transport tickets comparatively more expensive for them (Litman [2004]; Paulley et al. [2006]), as well as their greater willingness to walk longer distances (Department for Transport [2017]). As a result, one approach to increasing the willingness of young adults to commute longer distances by public transportation, as proposed by Herzer and Ulrich [2020], is to offer apprentices affordable access to public transport.

In conclusion, public transportation costs—both monetary and time-related costs—have proven to be an important determinant of people’s commuting decisions and their choice of whether or not to use public transportation. Young people, in particular, have been found to be highly sensitive to transportation costs. Therefore, their decision to pursue an apprenticeship and choice of a specific apprenticeship position are likely influenced by fare prices and their perceived affordability.

3 Background

3.1 The Introduction of the D-Ticket in Germany

In response to the sharp increase in energy prices following Russia’s invasion of Ukraine in 2022, the German government introduced a temporary reduction in the energy tax on fuels and a subsidized public transport pass, available to everyone for use on local public transportation. The pass, available in June, July and August 2022, allowed holders unlimited use of local public transportation throughout Germany for €9 per month, making it commonly known as the Nine-Euro-Ticket (Deutsche Welle [2022]).¹ Similar to the reduction of the energy tax on fuels, the pass was initially intended as a temporary measure. However, while in effect, the Minister of Transport, several other politicians, and various organizations called for a permanent version of the pass (tagesschau.de [2022a]; tagesschau.de [2022b]; ZEIT ONLINE [2022a]; ZEIT ONLINE [2022b]). In early November 2022, the federal and state governments agreed to introduce the D-Ticket at a price of €49 per month as a long-term solution. The German Federal Council [2023] approved the bill on 31 March 2023, and the D-Ticket was launched in May 2023. It is available through a subscription system and can be canceled on a monthly basis (German Federal Government [2024b]).

Compared to most annual and monthly regional transport passes available before the introduction of the D-Ticket, which were typically valid only for a limited area, the D-Ticket offered substantial cost savings. Even when used solely within the same area as a previous regional pass, it was often the more affordable option. A comparison with 2022 monthly pass prices in 43 cities showed that, on average, the D-Ticket was 24% cheaper than the corresponding city-specific passes (testberichte.de [2023]). For commuters traveling between cities, the savings were even more pronounced. For example, the regular, non-discounted

¹The plan for the pass was announced on 23 March 2022 and the corresponding bill was passed in May 2022 (German Federal Government [2024a]; German Federal Government [2024b]).

monthly pass for the frequently used 40-minute commute between Cologne and Dusseldorf cost €250 in 2022. While most other major commuter routes were somewhat less expensive, they still often cost two to four times as much as the D-Ticket (rnd [2023]).

Beyond its cost advantages and nationwide coverage, the D-Ticket also simplified the previously complex fare structure in Germany. It replaced a patchwork of regionally valid monthly and annual passes issued by more than 60 different regional transport associations across the country. In most transport associations, monthly and annual passes were available for different travel zones or distances, often with discounts for specific groups such as students, apprentices, college students, the unemployed and people with disabilities. Fare conditions, such as cancellation policies, also varied widely between transport associations. While it was often difficult to find the optimal pass for commuting within a single transport association, the fare system for commuting between places covered by different transport associations was even more challenging, and passes for such commutes were often much more expensive than those for commutes within the area of a transport association.²

For the specific group of apprentices, most transport associations already offered regional public transport passes before the introduction of the D-Ticket, often at significantly lower prices than regular fares. However, passes valid across multiple transport associations were rare, creating a substantial price gap between commuting within a single association and across different ones—an aspect we exploit in this study.

3.2 The German Apprenticeship System

In Germany, apprenticeship training is organized in a publicly regulated dual system and typically lasts three to four years. It combines practical, on-the-job training in companies with classroom instruction at vocational schools, which provide theoretical knowledge related to the training occupation, along with broader general education. Companies decide independently whether to offer apprenticeships and how many apprentices to train. To establish an apprenticeship relationship, companies advertise apprenticeship positions, candidates submit applications, and a bilateral apprenticeship contract is signed with the selected applicant.

The VET system is a key cornerstone of the German education system and plays a vital role in supplying companies with qualified employees across a wide range of occupations (in 2023, there were 327 officially recognized VET occupations in Germany, Bundesinstitut für Berufsbildung [2023]). Each year, around 500,000 new apprentices start an apprenticeship in one of approximately 420,000 companies—representing around 19% of all companies with employees subject to social insurance contributions (Bundesinstitut für Berufsbildung [2023]). Notably, around 72% of apprentices are hired by their training company immediately upon completing their program, underlining the importance of VET for companies in developing a skilled workforce (Bundesinstitut für Berufsbildung [2022]).

²Many transport associations continue to offer their regional passes even after the introduction of the D-Ticket, but the majority of pass holders have switched to the D-Ticket (DIE ZEIT [2023]).

Individuals can take up an apprenticeship after completing the mandatory 9 to 10 years of complementary schooling, with school-leaving age typically ranging from 15 to 17, depending on state regulations. However, companies may require their apprentices to have completed more years of schooling. In addition, certain occupations impose minimum age restrictions. For example, train conductor apprenticeships require a minimum age of 17, while apprenticeships in the police force, fire brigade, and emergency services require candidates to be at least 18 years old.

In 2023, approximately 27% of apprentices who started their apprenticeship training turned 17 or younger that year, 12% turned 16 or younger, i.e., a significant share of each apprenticeship cohort remains below the legal driving age of 18 for a considerable period during their apprenticeship. As a result, many apprentices must rely on public transportation to reach their training company and/or their vocational school.

The vast majority of apprentices begin their apprenticeship in August or September, typically after completing compulsory or upper secondary school between May and July of the same year. In 2023, 84% of all apprenticeships commenced between August 1 and September 30 (calculated based on BBS data). Most apprenticeship positions are advertised between September of the previous year and February of the year in which the apprenticeship begins, where the exact timing varies by industry (Azubiyo [2025]). For instance, companies in the finance, insurance, and public sector often begin recruiting apprentices as early as September or October. In contrast, recruitment in sectors such as hospitality, healthcare, manufacturing, retail, skilled trades, and IT typically starts in December or January. Larger companies tend to advertise their apprenticeship openings earlier than small- and medium-sized companies. While most application deadlines fall between November and March, many companies continue to fill unoccupied positions throughout the summer.

In the context of the D-Ticket, this means that most applications for apprenticeships starting in 2023 were submitted after the decision to introduce a permanent local transport pass as a successor to the Nine-Euro-Ticket had already been made (the introduction of the D-Ticket was officially approved in early November 2022). For individuals who applied for apprenticeship positions before November 2022, it is highly unlikely that they had to make decisions about offers before the D-Ticket was announced. Moreover, discussions about introducing a permanent successor to the Nine-Euro-Ticket had already begun in the summer of 2022, that is, before the first apprenticeship positions for 2023 were advertised. Overall, we can assume that the majority of individuals planning to start an apprenticeship in 2023 made their decisions with knowledge of the upcoming D-Ticket. However, due to differences in apprenticeship recruitment timelines across industries, the extent to which the D-Ticket could be factored into decision-making likely varied between sectors.

For apprentices starting their apprenticeships in August or September 2022, on the other hand, neither the D-Ticket nor the temporary Nine-Euro-Ticket likely influenced their application decisions. The Nine-Euro-Ticket was only announced at the end of March 2022,

by which point most apprenticeship applications had already been submitted and many decisions regarding offers had been made. Furthermore, the Nine-Euro-Ticket was intended as a temporary measure ending on August 31, 2022, i.e., before most apprenticeships even began. Vague discussions about implementing a successor of the Nine-Euro-Ticket began in July 2022, but the great majority of apprentices had already signed their apprenticeship contracts by then, and only a few late applicants may have applied for remaining positions. Therefore, the 2022 apprenticeship cohort can reasonably be considered unaffected by the D-Ticket in their apprenticeship decisions.

4 Data

For the subsequent analyses, we merge data on the price structure and area of validity of public transport passes offered to apprentices before the introduction of the D-Ticket with annual register data on apprenticeship contracts from the BBS. The BBS contains, among other variables, information on the place of residence of the apprentices and the locations of their training company.

The BBS data includes information on all apprenticeships in Germany that were started, ongoing, successfully completed, or prematurely terminated in a given year. This data is reported by the training companies to regional chambers, collected by the Federal Office of Statistics, and processed by the Federal Institute for Vocational Education and Training (Bundesinstitut für Berufsbildung, BIBB). Since all companies are legally required to report the requested details for each apprentice they contract, the data has the characteristics of administrative register data. It contains information on contract terms, the training occupation and demographic characteristics of each apprentice, as well as the location of the training company and—for apprenticeship cohorts from 2021 onward—the apprentice’s place of residence at the time the contract was signed.

The apprentice’s place of residence at the time of contract signing, as well as the location of their training company, are provided at the municipal level. Using this information, we calculate the straight-line (Euclidean) distance between the geographic center of the municipality of residence and that in which the training company is located for each apprentice.³

It is important to note that the place of residence recorded in the BBS data may no longer reflect the actual living situation of the apprentice when the apprenticeship begins, as apprentices may, for example, have moved out of their parents’ home to start their apprenticeship. Following the argument made by Schmidt [2024], it is highly unlikely that distances of 100 km or more between an apprentice’s recorded place of residence and their training company are commuted daily. Such distances typically suggest inaccuracies in the recorded training

³Technically, the data refer to apprenticeship contracts rather than individual apprentices. In most cases, there is a one-to-one correspondence between contracts and apprentices, but in rare cases—such as when an apprenticeship is terminated and a new one started within the same year—a single person may appear more than once. For simplicity, we refer to the data entries as apprentices in the following.

location—such as the BBS listing the company’s headquarters rather than the actual training site—or that the apprentice has relocated for training. We therefore exclude all observations with distances of 100 km or more between the place of residence and the training company. Although these extreme distances may have little impact on the median commuting distance within each transport association, they are likely to substantially distort the measure of commutes per route in the route-level analysis. This is because small changes in apprentice relocation behavior and/or in the recording of training sites likely cause a large number of routes in the data to shift from zero to a small number of commutes, or vice versa. As a result, the estimated effects would primarily reflect changes in relocation patterns or training site recording, rather than meaningful shifts in daily commuting patterns.

Although apprenticeships combine in-company training with classroom instruction at a vocational school, our analysis focuses on commutes between apprentices’ place of residence and their training company. This choice reflects several practical and conceptual considerations. First, the BBS does not contain information on the specific vocational school attended.⁴ Second, apprentices typically commute more frequently to their training company—usually three to four days per week—while vocational school attendance generally involves fewer commutes, either one to two days per week or concentrated periods of block instruction. Third, and perhaps most importantly, apprentices actively choose their training company, whereas vocational school assignment is largely determined by administrative rules. For these reasons, we consider commuting to the training company the more relevant dimension for studying the impact of the D-Ticket on apprentice mobility.

We collected information on public transport passes available to apprentices prior to the introduction of the D-Ticket by directly contacting transport associations. Approximately 50% of the associations provided the requested details on pricing and area of validity. For the remaining associations, we conducted supplementary online research, including the use of archived websites via the Wayback Machine. In total, we were able to obtain information for an area covering approximately 98.5% of the German population.

In some cases, pre-D-Ticket public transport passes for apprentices were issued not by local transport associations but by the federal state.⁵ Additionally, apprentices in certain counties had access to passes from two different associations. To account for these deviations from the general transport association map, we expand transport association boundaries to reflect the maximum validity area of apprentice passes. Furthermore, certain counties are not part of any transport association. Most of these non-affiliated counties had county-level apprentice passes in place. In the route-level analysis, we treat each of these counties as a separate

⁴In most cases, apprentices are assigned to the nearest vocational school to the training company that offers instruction for their specific training occupation, typically located within the same administrative district; requests to attend a different school—e.g., one closer to home—must be formally submitted and justified.

⁵This was the case in Thuringia, Saxony, Mecklenburg-Western Pomerania, Berlin and Brandenburg, as well as Saxony-Anhalt, while in North Rhine-Westphalia, a statewide pass was available in addition to regionally valid passes issued by transport associations.

transport association. For the cost-savings analysis, we incorporate the prices of county-level passes where such information is available. For consistency, we continue to refer to all redefined areas simply as transport associations. In total, we distinguish 80 of such transport associations.

The design of apprentice transport passes varied considerably across transport associations. In 33% of all transport associations, a flat-rate pass was available that covered the entire region served by the association, with 2022 prices for these passes ranging from €32 in Berlin and Brandenburg to €93.50 for passes covering North Rhine-Westphalia, as offered to apprentices in the Aachen region. Other associations used a zone-based pricing model, in which the region was divided into fare zones and the cost of the pass depended on the number of zones crossed during the apprentice’s commute. These passes could be considerably more expensive. For example, a pass covering the entire Ingolstadt transport association cost up to €327.25.

The data on apprenticeships and pre-D-Ticket apprentice transport passes is further merged with a set of control variables at district level, specifically, school leaver density and company density, provided by the Federal Statistics Office.

4.1 Data Aggregation

In order to assess the effect of facilitated inter-association commuting in our main analysis, we aggregate the data at the level of commuting routes. For every pair of municipalities between which at least one apprentice of the 2022 or 2023 cohorts commuted, we define a unique route identifier i , disregarding the direction of commuting. In the resulting dataset, we define a binary treatment variable indicating whether a given route crosses transport association boundaries (treatment group) or lies entirely within a single transport association (control group). The outcome is the number of newly commencing apprentices in a given year who commute along route i .

For our second analysis, the analysis of the effect of D-Ticket-related cost savings on intra-association commuting, we reduce our data to newly commencing apprentices who commute within a single transport association in order to then aggregate it at the transport association level. We focus on intra-association commutes because reliable estimates of D-Ticket-related cost savings are only available for this type of commuting. Furthermore, the shift toward inter-association commuting, which we examine in the main analysis, may vary systematically across transport associations, depending on the cost of apprentice passes prior to the D-Ticket. In associations where passes were relatively expensive, apprentices may have already been more inclined to commute across association boundaries. As a result, the marginal effect of the D-Ticket in encouraging inter-association commutes may have been smaller. Conversely, in associations that previously offered cheaper passes, the D-Ticket may have created a stronger incentive to take up training positions in other associations. Choosing an apprenticeship outside one’s home association due to the D-Ticket is likely

associated with shorter commuting distances, as apprentices may have selected nearby alternatives just beyond the boundary of their home association. This could lead to a larger increase in inter-association commuting—and a corresponding decrease in average commuting distance—in associations with lower cost savings from the D-Ticket, which again would bias our estimates. Another source of potential bias arises from the fact that the propensity for inter-association commuting is likely higher in smaller associations or those with many apprentices living near boundaries—both factors potentially related to pre-D-Ticket pass costs. To avoid these confounding influences, we limit the analysis to intra-association commutes. Even when excluding inter-transport association commutes, a potential source of bias remains. The D-Ticket may exert a stronger pull towards inter-association routes for apprentices who, in its absence, would have accepted longer intra-association commutes. If this pull varies across transport associations, it could distort the estimates. To account for this, we include the share of newly commencing apprentices per transport association who commuted on an inter-association route in 2022 and 2023 as a control variable.

We define the median commuting distance of newly commencing apprentices as the outcome variable. In order to quantify the D-Ticket-induced price reduction for commuting within a single transport association, we employ three approaches to derive a representative apprentice pass price for associations that offer multiple pricing options. As our baseline approach, we approximate the price of a 20 km commute within each transport association area to account for the considerable variation in the size of these areas.⁶ In addition, we calculate the average price of all zone passes and the maximum price, i.e. the price for a pass that covers the whole transport association area. For regions where apprentices can purchase transport passes from two transport associations, we compute the pre-D-Ticket apprentice pass price as the average price of a 20 km pass in both associations, the average of the two average prices, and the higher of the two maximum prices.

For our first heterogeneity analysis, we further aggregate the data at the transport association \times age group level, distinguishing between individuals who turn 17 or younger, 18, and 19 or older in the year they begin their training.⁷ For the other two heterogeneity analyses, we aggregate the data at the transport association \times occupational sector level and the transport association \times school-leaving certificate level, respectively.

As we only have the municipality of residence and the municipality where the training company is located, we cannot determine whether commuting within one municipality was affected by the introduction of the D-Ticket. In some larger cities with extensive urban areas, such as Munich and Hamburg, where apprentice pass prices before the D-Ticket

⁶To do so, we determine the price for an apprentice pass from the city that is at the center of the transport authority area to three places approximately 20 km away (measured as straight-line distance) and determine the average apprentice pass price for these three commutes.

⁷The BBS data includes only the year of birth, so we treat those turning 18 separately from those turning 17 or younger and those turning 19 or older, as individuals turning 17 or younger are for sure unable to drive for at least part of their apprenticeship. For those turning 18, it is unclear whether they reach driving age before or after the apprenticeship begins, while those turning 19 or older could potentially have had the option to commute by car from the start.

were as high as €100 and €160 per month, respectively, the D-Ticket may have made previously unaffordable apprenticeship opportunities within the same city accessible to some individuals. By not capturing the effect of the D-Ticket on intra-municipal commutes, our analysis puts more emphasis on apprentices in rural and non-metropolitan areas and may therefore underestimate the overall impact of the D-Ticket.

4.2 Descriptive Statistics

Table 1 presents the descriptive statistics for the route-level analysis of the effect of the facilitation of inter-association commuting that resulted from the introduction of the D-Ticket. It shows that the majority of commuting routes (74.5%) lie within transport associations. There are, on average, about 4 to 5 times as many newly commencing apprentices commuting per inter-association route than per observed intra-association route. Between 2022 and 2023, the number of apprentices per intra-association route increased slightly from 4.67 to 4.78, coinciding with a general rise in overall apprenticeship numbers. In comparison, the number of newly commencing apprentices per inter-association route rose more markedly from 0.99 to 1.17 per route.

Variables	2022		2023	
# of apprentices per intra-association route	4.67	(61.42)	4.78	(63.40)
# of apprentices per inter-association route	0.99	(2.39)	1.17	(2.48)
% of inter-association routes	25.48		25.48	
Median commuting distance	7.03	(14.39)	6.62	(12.99)
Median intra-association commuting distance	6.38	(12.07)	6.10	(11.03)
Median inter-association commuting distance	24.76	(24.15)	17.98	(22.49)
N	131,903		131,903	

Table 1: Descriptive statistics for the variables used in the route-level analysis of the D-Ticket’s effect on inter-association commuting, as well as median commuting distances in 2022 and 2023. The statistics are based on data aggregated at the commuting route level and include all routes used by at least one apprentice who began an apprenticeship in either year. Routes of 100 km or more are excluded. Standard deviations are reported in parentheses.

The table also shows that the median commuting distance for newly commencing apprentices decreased from 7.03 km in 2022 to 6.62 km in 2023. This overall decrease was driven in large part by a significant drop in the median inter-association commuting distance, which fell from 24.76 km to 17.98 km over the same period. This sharp decline in inter-association commuting distances, alongside the rising share of inter-association commutes, suggests that more apprentices living near transport association boundaries chose to take up apprenticeships in neighboring transport associations in 2023. In many cases, these cross-boundary opportunities may have been geographically closer than comparable positions within their home associations, resulting in overall shorter commuting distances.

Figure 1 shows the share of newly commencing apprentices who commute on inter-association

routes by county of residence. Given that we exclude routes of 100 km or longer, counties in the center of large transport associations have no newly commencing apprentices commuting on inter-association routes—neither in 2022 nor in 2023. This is the case for several counties in North-Rhine-Westfalia, in the west of Germany, in Eastern Germany, as well as in Schleswig-Holstein in the north.

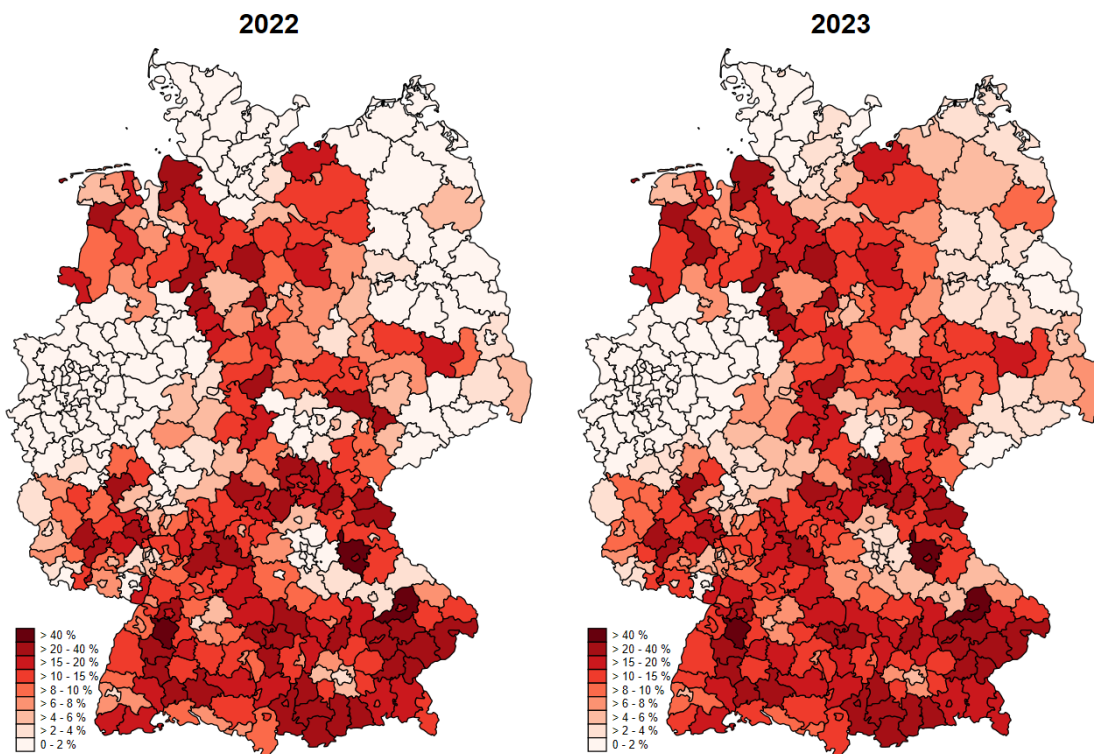


Figure 1: Geographic distribution of the share of newly commencing apprentices commuting on inter-association routes by county of residence in 2022 and 2023. Commuting routes of 100 km or more are excluded.

More interesting—especially when looking at trends over time—is the share of inter-association commuters in boundary regions and smaller associations. In these areas, we can observe a general increase in the share of newly commencing apprentices who commute across association boundaries. Moreover, in Eastern Germany, several associations that had less than 2.5% of new apprentices commuting to other associations in 2022 saw that share rise to between 2.5% and 5% by 2023.

For the second analysis on the impact of D-Ticket-related cost savings for intra-association transportation, Figure 2 illustrates the geographical distribution of pre-D-Ticket apprentice transport pass prices. The figure shows substantial regional variation in pricing structures, which is especially evident when considering the maximum prices of the pre-D-Ticket passes. Across all three price specifications, a clear pattern emerges: apprentice pass prices were consistently much lower in Eastern Germany, as well as in certain regions in central and southern Germany. This is largely attributable to the fact that in these regions transport associations (or in the case of Eastern Germany, states) offered a single, comparatively affordable pass that was valid across the entire transport association (or state).

When taking a closer look at our main specification, i.e., the average price of an apprentice pass for a 20 km commute, we observe that pre-D-Ticket apprentice passes were particularly expensive in southwestern Germany, the Hamburg metropolitan area in the north, and in certain counties in Bavaria. In these regions, the price for a 20 km apprentice pass could reach as much as €120-150. Additionally, the figure highlights for which counties we were unable to obtain data. These are primarily located in southern Bavaria, where several counties are not covered by any transport association.

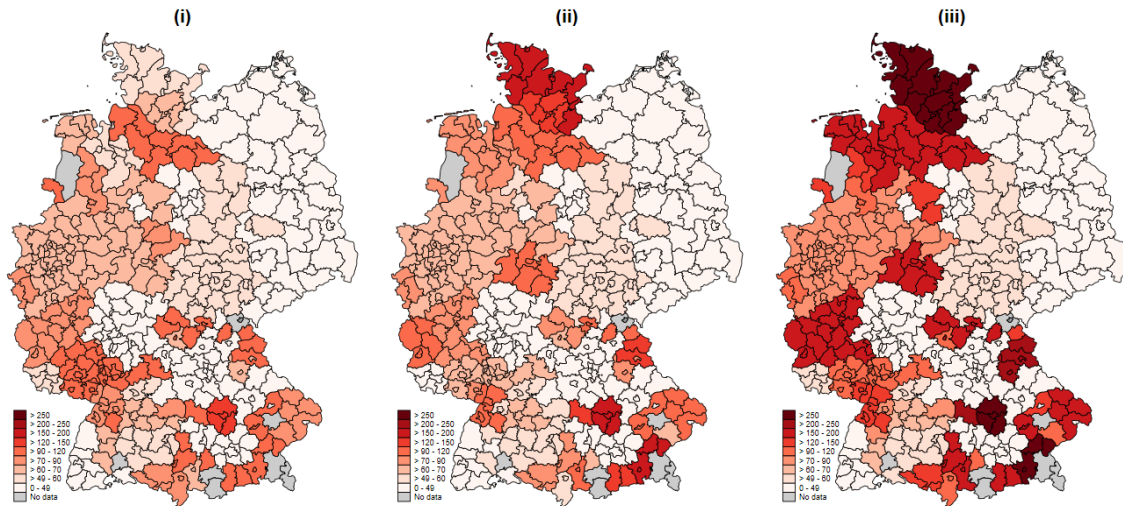


Figure 2: Geographic distribution of 2022 apprentice transportation pass prices across counties, showing (i) the average price for a 20 km commute, (ii) the overall average price, and (iii) the maximum price charged for an apprentice pass.

Additionally, Figure [A.1](#) in the appendix shows the median commuting distance of newly commencing apprentices by county of residence. Commuting distances are especially long in Eastern Germany, particularly in the areas surrounding Berlin—a pattern likely driven by low population and company density in the region. While less pronounced, the figure also shows longer commuting distances in counties bordering Munich in the south and in parts of northern Germany. In contrast, apprentices residing in geographically smaller counties—typically metropolitan areas known as *kreisfreie Städte* (urban counties)—tend to have substantially shorter commuting distances. However, while it is likely true that apprentices in metropolitan areas do commute shorter distances, the distances we observe are artificially low compared to those of apprentices in rural areas. This is because we can only identify the municipality of residence and the location of the company, and if both are within the same metropolitan area, we record the commuting distance as 0 km, even though actual travel distances within these areas can still be substantial.

Table [A.1](#) in the appendix provides some additional descriptive statistics for the second analysis. It shows that the median intra-association commuting distance decreased slightly from 5.95 km in 2022 to 5.78 km in 2023. The average price for a 20 km commute (€68.49), the overall average price (€73.88) and the average maximum price (€113.30) for the pre-D-Ticket apprentice transport passes were significantly higher than the price of the D-Ticket

(€49). The table also reports the share of transport associations that offered apprentice passes at or below the price of the D-Ticket, which ranged between 25% and 29%, depending on the specific price metric used. The fact that there are only slight differences in this measure depending on which price specification is used can be attributed to the fact that the associations offering the most affordable transport passes typically issued a single pass valid across the entire association.

Finally, Table [A.2](#) presents the share of newly commencing apprentices commuting via inter-association routes across the three dimensions considered in our effect heterogeneity analysis: age, occupational sector and school-leaving certificate. The table shows partly substantial differences in the share of new apprentices commuting across transport association boundaries. Furthermore, in nearly all categories—except for the public service sector—the share of inter-association commuters increased between 2022 and 2023. In 2022, inter-association commuting was particularly common among apprentices who turned 17 or younger in the year they started their apprenticeship, those training in the public service or agriculture sectors, and those with an intermediate secondary school certificate. Conversely, the share of inter-association commuters was especially low among apprentices who were 19 or older, those in the craft sector or liberal professions, and those with a lower secondary school certificate.

5 Methodological Approach

In our main analysis, we take advantage of the fact that the D-Ticket significantly facilitated commuting between different transport associations. We examine whether the introduction of the D-Ticket led to an increase in commutes on routes for which it was previously difficult and expensive to obtain transport passes. To further estimate the extent to which cost savings for commuting have influenced apprentices’ willingness to accept longer commutes, we conduct a second analysis in which we exploit the fact that the D-Ticket resulted in varying levels of cost reduction for commutes within individual transport associations.

To assess the effect of facilitated inter-association commutes through the introduction of the D-Ticket on the commuting behavior of apprentices, we estimate a DiD model using data aggregated at the commuting route level. The DiD model is specified as follows:

$$Y_{it} = \alpha_i + \beta(D_i \times T_t) + \gamma D_i + \delta T_t + \epsilon X_{it} + \varepsilon_{it} \quad (1)$$

where Y_{it} denotes the number of newly commencing apprentices that commute on route i in year $t \in \{2022, 2023\}$, α_i denotes the route-specific fixed effects and D_{it} is the binary treatment variable that takes the value 1 for inter-transport-association routes, and 0 for intra-association routes. T_t takes the value 0 in $t = 2022$, and 1 in $t = 2023$. Finally, X_{it} captures the average density of companies and the average density of school leavers in the counties of residence of apprentices commuting along route i in year t , and ε_{it} is the error

term.

Following the approach proposed by [Chen and Roth \(2024\)](#), we estimate the DiD model by means of a pseudo-Poisson fixed effects estimation approach. This is because linear regression is unsuitable in our context, as the average number of commuters per intra-association route is about 4 times higher than that per inter-association route (see [Table 1](#)). In addition, standard Poisson regression is inappropriate due to overdispersion, i.e. the variance in the number of commuters per route substantially exceeds the mean.

In the analysis of the D-Ticket-induced cost savings for commuting, the treatment variable captures the extent of price reductions for apprentice transport passes. Transport associations where the D-Ticket led to a price reduction, i.e., where pre-D-Ticket apprentice passes were more expensive than the D-Ticket, are assigned a positive treatment value equal to the price difference. In contrast, associations where apprentice passes were already priced at or below the D-Ticket cost prior to its introduction in May 2023 are assigned a treatment value of zero.⁸

The model outlined below is estimated using three different definitions of the pre-D-Ticket apprentice pass price: (1) the average price for a pass covering a 20 km commute, (2) the average price of all apprentice passes offered, and (3) the price of a pass valid throughout the entire transport association area. In all three specifications, associations experiencing a price reduction are considered treated, while the others are considered untreated.

We estimate the following TWFE model by means of linear fixed effects regression:

$$Y_{it} = \alpha_i + \lambda_t + \beta D_{it} + \gamma X_{it} + \varepsilon_{it}, \quad (2)$$

where Y_{it} denotes the average intra-association commuting distance of newly commencing apprentices in the transport association i in year $t \in \{2022, 2023\}$, α_i captures association-specific fixed effects and λ_t represents year fixed effects. D_{it} is the treatment variable that takes the value 0 in $t = 2022$ and, for the associations treated in 2023, corresponds to the difference between the pre-D-Ticket apprentice pass price and the D-Ticket price. X_{it} is a vector of control variables and ε_{it} is the error term.

5.1 Robustness Checks

Given that we only observe the apprentices' municipalities of residence from 2021 onward, we are unable to conduct extensive pre-treatment parallel trend tests. Instead, we run a simple placebo test using the two available pre-treatment years, 2021 and 2022. For both analyses,

⁸This coding choice ensures robustness in the TWFE framework we employ by providing a valid control group of truly untreated units. As emphasized by [Callaway et al. \(2024\)](#), the inclusion of a sufficiently large group of zero-treated observations reduces the risk that the estimator places disproportionate and sometimes negative weights on certain treated units, thereby distorting the average treatment effect. Moreover, in cases where pre-D-Ticket passes were cheaper, those lower-cost options generally remained available after the D-Ticket's introduction, implying that apprentices in these associations did not experience actual cost savings.

we estimate the effect of a placebo treatment which is equal to the actual D-Ticket-induced treatment value of each observational unit, but assigned to begin in 2022.

In implementing these placebo tests, we assume that transport association boundaries in 2021 are identical to those in 2022, even though some apprentice passes did expand their coverage between 2021 and 2022. This coding choice is deliberate: the placebo test is not intended to measure all pre-policy changes in commuting patterns, but rather to detect any systematic differences in trends between treated and untreated routes prior to the introduction of the D-Ticket.

For the analysis of facilitated inter-association commuting, this implies that any increase in commuting between locations where commuting was facilitated due to association mergers or boundary expansions in 2022 is not captured in the placebo test, as such routes are coded as intra-association. In the analysis of D-Ticket-induced cost savings on intra-association commuting, the actual price savings when comparing 2021 and 2023 may be substantially higher than the assigned treatment intensity for certain routes which newly become intra-association in 2022. However, this does not undermine the validity of the placebo test, as long as the occurrence of association mergers or boundary changes between 2021 and 2022 is not systematically correlated with the magnitude of D-Ticket-induced cost reductions.

The placebo tests are based on data from a period during which the COVID-19 pandemic significantly influenced employee mobility patterns⁹. However, there is no evidence to suggest that the pandemic affected the (placebo-)treated areas differently than the untreated ones. As a result, the placebo test's validity is not compromised by the temporal overlap with the Covid-19 pandemic.

6 Findings

6.1 Treatment Effect Estimates

Table 2 presents the estimation results of our main analysis, which examines the Average Treatment Effect on the Treated (ATET) of the facilitation of inter-association commuting brought about by the introduction of the D-Ticket. The effect estimate is highly significant and indicates a substantial positive impact of the D-Ticket on the number of newly commencing apprentices commuting along inter-transport association routes. On average, the number of new apprentices commuting across transport association boundaries increased by approximately 21%.

⁹By spring 2022, mandatory remote work had ended (Bundesregierung 2022). However, long-term behavioral changes had emerged, with employees commuting less frequently and hybrid work becoming the norm (ZEW 2024). Public transport usage began to recover, temporarily aided by the Nine-Euro-Ticket in summer 2022, though it remained below pre-pandemic levels (Bundesamt 2024).

	ATET Estimate		Placebo Estimate		
	(1)	(2)	(1)	(2)	
Inter-Association \times Year 2023	.1876*** (.0068)	.1926*** (.0068)	Inter-Association \times Year 2022	-.0189** (.0064)	-.0209** (.0062)
Year 2023	-.0226*** (.0020)	-.0331*** (.0024)	Year 2022	.0074** (.0029)	.0098** (.0025)
Density School Leavers		✓	Density School Leavers		✓
Density Companies		✓	Density Companies		✓
N	263,806	263,806	N	255,964	255,964

Table 2: DiD estimates from Pseudo-Poisson fixed effects regressions of the number of newly commencing apprentices per route on the interaction between an indicator for routes crossing transport association boundaries (inter-association routes) and a time dummy, along with year fixed effects. Model (2) additionally includes controls for the density of school leavers and companies (see Equation [1](#)); Model (1) is estimated without covariates. The left panel reports the ATET of the D-Ticket introduction in 2023, using data from 2022 and 2023. The right panel presents placebo estimates based on a placebo treatment in 2022, using data from 2021 and 2022. Robust standard errors are reported in parentheses. Significance levels: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

This finding suggests that the D-Ticket enabled apprentices to take up positions in areas that had previously been difficult and costly to reach due to the fragmented fare systems across transport associations. By facilitating inter-association commutes, the D-Ticket led to apprenticeship arrangements that would not have occurred otherwise. This is especially noteworthy given that the median commuting distance—particularly on inter-association routes—actually decreased between 2022 and 2023 (see Table [1](#)), indicating that the D-Ticket opened up new, more accessible apprenticeship opportunities for apprentices living near the boundaries of transport associations.

The right-hand panel of Table [2](#) displays the results of a placebo test using data from the two years prior to the introduction of the D-Ticket, 2021 and 2022. In this specification, we regress the number of newly commencing apprentices per route on the interaction term between a dummy variable for inter-association routes and a year indicator equal to one for 2022 and zero for 2021. The estimated effect of this placebo treatment is statistically significant and negative, but substantially smaller in absolute terms than the estimated effect of the actual introduction of the D-Ticket. The fact that the placebo effect estimate is of the opposite sign compared to the ATET from the main analysis and is nearly 10 times smaller in absolute terms suggests that the observed increase in inter-association commuting is unlikely to be driven by pre-existing differential trends.

	Avg. Price 20km		Avg. Price		Max. Price	
	(1)	(2)	(1)	(2)	(1)	(2)
Commuting Distance [km]	.0021	.0020	-.0003	-.0003	.0003	.0003
(s.e.)	(.0020)	(.0021)	(.0012)	(.0012)	(.0006)	(.0006)
Density Companies		✓		✓		✓
Density School Leavers		✓		✓		✓
Share inter-assoc. Commutes		✓		✓		✓
Year FE	✓	✓	✓	✓	✓	✓
N	158		158		158	

Table 3: TWFE regression results based on transport association-level data from 2022 and 2023. The dependent variable is the price difference between the pre-D-Ticket apprentice pass and the D-Ticket, where the pre-D-Ticket price is defined in three alternative ways: (i) the average price for a 20 km commute, (ii) the overall average price of all apprentice passes, and (iii) the maximum price of any apprentice pass within an association. Model (2) in each column is estimated according to Equation 2, including covariates for company density, school leaver density, the share of inter-association commutes, and year fixed effects. Model (1) reports the effect estimates from the corresponding specification without covariates. Standard errors are clustered at the transport association level. Significance levels: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 3 displays the estimated ATET of the D-Ticket-induced cost reduction for apprentice transport passes on the median intra-association commuting distance undertaken by newly commencing apprentices. The results for the corresponding robustness check are reported in Table B.3 in the appendix. The main treatment specification using the average price reduction for 20 km commutes yields a point estimate that is of the anticipated sign but not statistically significant. Contextualized against the average savings of €30 compared to 2022 prices of 20 km apprentice passes among treated individuals (i.e., those in associations where pre-D-Ticket prices exceeded the D-Ticket price), the estimate implies a negligible increase of approximately 20 meters in commuting distance per euro saved.

ATET estimates from the alternative treatment definitions—using the average or maximum pre-D-Ticket pass prices—are likewise statistically insignificant. We therefore conclude that cost reductions for intra-association commutes did not lead to a measurable change in apprentices’ commuting distances. The results for the placebo test of this second analysis are provided in Table B.3 in the appendix.

6.2 Effect Heterogeneity

Tables C.4, C.5, and C.6 in Section C of the appendix report ATET estimates of the D-Ticket-induced facilitation of inter-association commuting for subgroups defined by age, occupational sector, and school-leaving certificate, respectively, alongside the corresponding placebo test results. Across all three dimensions, the results reveal some statistically significant heterogeneity in treatment effects, with the effect of the D-Ticket on inter-association commutes varying particularly strongly depending on the sector in which the apprenticeship is being undertaken.

Table [C.4](#) shows that the effect of the D-Ticket on inter-association commuting was particularly pronounced (+23%) among apprentices who turned 19 years or older in the year when their apprenticeship began. However, the effect difference of 3 percentage points between those turning 19 or older and those turning younger than 19 is relatively small compared to the overall population effect estimate (21%), suggesting that the D-Ticket also significantly increased inter-association commuting among younger apprentices. The relatively strong effect among older apprentices runs counter to our initial hypothesis: since the legal driving age in Germany is 18, we had expected this group to be less reliant on public transportation and thus less affected by the introduction of the D-Ticket. The placebo test estimates for all three age groups are small in absolute terms and show the opposite sign of the effect estimates, supporting the robustness of our findings.

The heterogeneity analysis by occupational sector (Table [C.5](#)) indicates that the D-Ticket particularly encouraged inter-association commuting among apprenticeships in agriculture (+41%), and in industry and trade (+24%). However, while the placebo estimate for the industry and trade sector is unremarkable, that for the agriculture sector already shows a large and significant positive effect of the 2022 placebo treatment, indicating that the estimated effect likely overstates the true impact of the D-Ticket on inter-association commuting in agriculture. The effect on the craft sector is below average (+15%), and among apprentices in public services, the D-Ticket is even associated with a negative effect on inter-association commuting (-13%), where in both cases the placebo estimates do not call the results into question. One possible explanation for the absence of a positive effect in the public sector is that this sector had already subsidized transport passes for apprentices prior to the introduction of the D-Ticket. As a result, the share of inter-association commuters was already relatively high among public service apprentices before 2023 (see Table [A.2](#)). However, transport pass subsidies were also common among private-sector training companies, and the subsidized passes available for inter-association commutes were generally still more expensive than the D-Ticket. Thus, pre-existing subsidies alone are unlikely to fully explain the negative effect observed. The finding remains difficult to explain and likely reflects other sector-specific institutional or geographic factors.

Finally, Table [C.6](#) compares the impact of the D-Ticket across newly commencing apprentices with different levels of school-leaving certificates. The results indicate that the D-Ticket had a significantly stronger effect on inter-association commuting among apprentices with a lower secondary education (+24%) compared to those with intermediate (+20%) or higher secondary education (+21%), where the placebo test results are unremarkable.

7 Conclusion

In this paper, we examined how increased affordability of public transportation, brought about by the introduction of the D-Ticket, affected the commuting choices of newly com-

mencing apprentices in Germany. We find that the D-Ticket significantly increased the number of apprentices commuting across transport association boundaries, i.e., on routes that had previously been more expensive and where finding suitable transport passes was more challenging, given that discounted apprentice passes were typically valid only within the issuing transport association or state. Specifically, the number of commutes on inter-association routes rose by approximately 21% following the D-Ticket's introduction, with the largest increases in inter-association commuting observed among older apprentices, those with lower secondary school degrees, as well as apprentices in agriculture and in industry and trade.

In contrast, we find no statistically significant impact of D-Ticket-related cost savings on commuting distances within single transport associations, despite substantial cost reductions in some regions. This suggests that while the D-Ticket facilitated access to training opportunities in neighboring transport associations, it did not fundamentally increase apprentices' willingness to commute longer distances. In fact, the average commuting distances declined between 2022 and 2023, likely driven by a shift toward shorter, cross-boundary commutes among apprentices living near transport association boundaries.

Our findings highlight the importance of affordable public transportation with a transparent and unified fare structure in expanding spatial access to VET. By replacing Germany's previously fragmented system of transport passes with a standardized, nationwide flat-rate model, the D-Ticket made cross-association commutes more manageable and more predictable in terms of costs. This enabled apprentices to consider a broader range of training opportunities beyond their home transport association. In doing so, the D-Ticket may have helped reduce regional mismatches in the German apprenticeship market without requiring young people to commute longer distances or even relocate. By lowering financial and informational barriers to commuting, the D-Ticket may have improved both the efficiency and inclusiveness of the VET system.

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A Descriptive Statistics

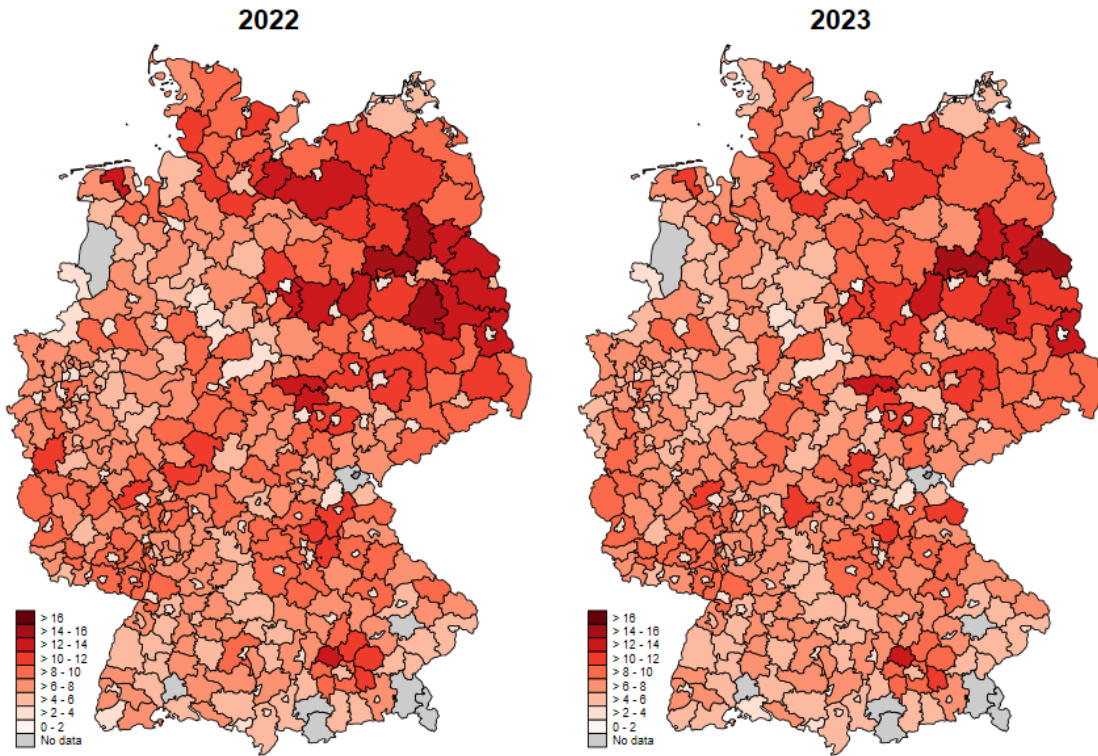


Figure A.1: Geographic distribution of median intra-association commuting distances among newly commencing apprentices in 2022 and 2023. Routes of 100 km or more are excluded. Counties lacking data on pre-D-Ticket apprentice transport pass prices are marked as "No data" and excluded from the analysis.

Variables	2022	2023
Median intra-association commuting distance [km]	5.95 (1.85)	5.78 (1.64)
∅ Average 20km apprentice pass price [€]	68.49 (26.29)	
∅ Average apprentice pass price [€]	73.88 (39.27)	
∅ Maximum apprentice pass price [€]	113.30 (76.59)	
% of associations with average 20 km pass price \leq €49	27.85	
% of associations with average apprentice pass price \leq €49	29.11	
% of associations with maximum apprentice pass price \leq €49	25.31	
N	79	79

Table A.1: Descriptive statistics for the variables used in the analysis of the D-Ticket's effect on commuting cost reductions. All values are calculated using data aggregated at the transport association level. Standard deviations are reported in parentheses where applicable.

	% of apprentices commuting on inter-association routes			
	2022		2023	
By age:				
younger than 18 years	6.75	(25.09)	7.91	(26.98)
18 years old	6.58	(24.80)	7.68	(26.63)
older than 18 years	6.55	(24.74)	7.90	(26.97)
By occupational sector:				
Industry & Trade	7.11	(25.71)	8.62	(28.07)
Craft	5.74	(23.25)	6.51	(24.67)
Agriculture	8.76	(28.27)	11.98	(32.47)
Public Service	9.23	(28.95)	7.99	(27.12)
Liberal Professions	4.99	(21.77)	5.92	(23.60)
By school-leaving certificate:				
Lower Secondary	5.79	(23.35)	7.07	(25.64)
Intermed. Secondary	7.05	(25.59)	8.31	(27.60)
Higher Secondary	6.91	(25.36)	8.16	(27.38)

Table A.2: Descriptive statistics for the share of newly commencing apprentices commuting on inter-association routes in 2022 and 2023. The table reports average shares by age group, occupational sector, and school-leaving certificate. The sample includes all apprentices who began an apprenticeship in 2022 or 2023 and excludes those with commuting routes of 100 km or more. Standard deviations are shown in parentheses.

B Robustness Checks

	Avg. Price 20km		Avg. Price		Max. Price	
	(1)	(2)	(1)	(2)	(1)	(2)
Commuting Distance [km] (s.e.)	-.0014 (.0023)	-.0015 (.0024)	-.0002 (.0012)	-.0004 (.0015)	-.0003 (.0006)	-.0003 (.0007)
Density Companies		✓		✓		✓
Density School Leavers		✓		✓		✓
Share inter-assoc. Commutes		✓		✓		✓
Year FE	✓	✓	✓	✓	✓	✓
N	158		158		158	

Table B.3: Placebo test results from TWFE regression based on transport association-level data from the pre-treatment periods, 2022 and 2023. The dependent variable is the price difference between the pre-D-Ticket apprentice pass and the D-Ticket, where the pre-D-Ticket price is defined in three alternative ways: (i) the average price for a 20 km commute, (ii) the overall average price of all apprentice passes, and (iii) the maximum price of any apprentice pass within an association. Model (2) in each column is estimated including covariates for company density, school leaver density, the share of inter-association commutes, and year fixed effects. Model (1) reports the estimates from the corresponding specification without covariates. Standard errors are clustered at the transport association level. Significance levels: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

C Heterogeneity Analyses

ATET Estimates		Placebo Estimates	
	Inter-Association × Year 2023		Inter-Association × Year 2022
Younger than 18 years	.1757*** (.0111)	Younger than 18 years	-.0275* (.0113)
18 years old	.1728*** (.0148)	18 years old	-.0143 (.0150)
Older than 18 years	.2067*** (.0088)	Older than 18 years	-.0187* (.0081)

Table C.4: DiD estimates from Pseudo-Poisson fixed effects regressions of the number of newly commencing apprentices per route on the interaction between an indicator for routes crossing transport association boundaries (inter-association routes) and a year dummy, alongside additional covariates (see Equation [1](#)). Estimates are reported separately by age group. The left panel shows the ATET of the D-Ticket introduction in 2023, using data from 2022 and 2023. The right panel presents placebo estimates based on a placebo treatment in 2022, using data from 2021 and 2022. Robust standard errors are in parentheses. Significance levels: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

ATET Estimates		Placebo Estimates	
	Inter-Association × Year 2023		Inter-Association × Year 2022
Industry & Trade	.2134*** (.0087)	Industry & Trade	-.0346*** (.0094)
Craft	.1405*** (.0119)	Craft	.0045 (.0143)
Agriculture	.3463*** (.0306)	Agriculture	.1327** (.0430)
Public Service	-.1418*** (.0367)	Public Service	.0058 (.0406)
Liberal Professions	.1908*** (.0233)	Liberal Professions	-.1229 (.2423)

Table C.5: DiD estimates from Pseudo-Poisson fixed effects regressions of the number of newly commencing apprentices per route on the interaction between an indicator for routes crossing transport association boundaries (inter-association routes) and a year dummy, alongside additional covariates (see Equation [1](#)). Estimates are reported separately by occupational sector. The left panel shows the ATET of the D-Ticket introduction in 2023, using data from 2022 and 2023. The right panel presents placebo estimates based on a placebo treatment in 2022, using data from 2021 and 2022. Robust standard errors are in parentheses. Significance levels: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

ATET Estimates		Placebo Estimates	
	Inter-Association × Year 2023		Inter-Association × Year 2022
Lower Secondary	.2171*** (.0129)	Lower Secondary	-.0067 (.0167)
Intermed. Secondary	.1827*** (.0090)	Intermed. Secondary	-.0363*** (.0102)
Higher Secondary	.1893*** (.0116)	Higher Secondary	.0122 (.0147)

Table C.6: DiD estimates from Pseudo-Poisson fixed effects regressions of the number of newly commencing apprentices per route on the interaction between an indicator for routes crossing transport association boundaries (inter-association routes) and a year dummy, alongside additional covariates (see Equation [1](#)). Estimates are reported separately by school leaving certificate. The left panel shows the ATET of the D-Ticket introduction in 2023, using data from 2022 and 2023. The right panel presents placebo estimates based on a placebo treatment in 2022, using data from 2021 and 2022. Robust standard errors are in parentheses. Significance levels: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.