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The impact of hiring costs for skilled workers on apprenticeship training: A comparative study*

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Abstract

This study analyzes the relationship between firms' costs of hiring skilled workers and their provision of internal apprenticeship training. Our empirical analysis draws on four waves of firm surveys conducted in Germany and Switzerland that include detailed information on firms' hiring costs for skilled workers and training practices. Using an indicator of labor market tightness as an instrumental variable, we identify a substantial hiring cost elasticity of apprenticeship contracts of 1.4 for Swiss firms. Although we also find a positive and increasing cost elasticity for German firms over time, its magnitude is considerably smaller. Our results are consistent with the perspective that longer-term post-training benefits are more significant in a country with frictions in the labor market and contribute to a better understanding of firms' training behavior.

JEL Classification: J23, J24, J32
Keywords: Hiring costs for skilled workers, apprenticeship training

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1 Introduction

One of the major challenges that many firms in western countries face is a shortage of skilled workers who can meet their specific needs, as repeatedly pointed out in recent years by the European Commission and the Organization for Economic Co-operation and Development (OECD), among others (European Commission, 2023; OECD, 2023). This problem is expected to worsen in the near future as the inadequate number of young cohorts entering labor markets will be unable to compensate for the large number of retiring experienced workers from the baby boomer generation, leaving a gap in the labor market. To alleviate skilled worker shortages, many firms in Germany and Switzerland employ apprenticeship training as a key strategy to secure a steady supply of skilled workers. Apprenticeship training allows firms to train workers according to the standards of the respective national training curriculum for a particular occupation, but with the option to provide additional specific training to meet firms' demand for particular skills. While training contracts end upon graduation, by law, firms can—and often do—retain apprentices as skilled employees by offering them employment directly after completion of training. Thus, firms can benefit economically from offering high-quality training in the workplace that attracts suitable young school leavers, reducing the time and costs associated with hiring skilled workers in the external labor market.

This study analyzes the effect of increased hiring costs on the number of apprenticeship training contracts when local labor markets are tight for German and Swiss firms. These two countries are ideally suited for analyzing the influence of hiring costs on firms' training choices because they have differing degrees of employment protection legislation. Such legislation may affect firms' hiring practices and the overall mobility of employees in the labor market, which also affects firms' willingness to invest in general employee training and that of apprentices in particular (Acemoglu and Pischke, 1998; Dustmann and Schoenberg, 2009; Leuven, 2005). In addition, while data on directly observable hiring costs are scarce in general (Manning, 2011), comparable and representative employer survey data with information on prematch and postmatch hiring costs are available for Germany and Switzerland. Furthermore, both countries have significant firm-based apprenticeship systems, and a large proportion of all skilled workers have acquired vocational

training in a firm combined with instruction in vocational schools in a dual system, where apprentices receive training in the workplace and in vocational school for one to 2 days per week, depending on the occupation. Apprenticeship training programs in Germany and Switzerland are standardized, with national curricula and external exams (Schweri et al., 2021), and diplomas are recognized at the national level. Standardization ensures that skilled workers acquire a broad range of skills that allow them to move between firms in the labor market; therefore, firms that do not provide training also benefit from the influx of newly trained workers. At the same time, the economy as a whole depends on firms' willingness to train workers in the dual education system.[1] The proportion of apprentices in relation to all employees is also comparable in both countries, as it was 4.7% in Germany[2] and 4.3% in Switzerland[3] in 2021. Using two waves of employer surveys for each country (2012 and 2017 for Germany; 2009 and 2016 for Switzerland), we provide the first evidence regarding the significance of hiring costs in the context of the German apprenticeships system, and extend earlier results for Switzerland (Blatter et al., 2016). A strength of our analysis is that we have access to rich and comparable data from employer surveys in the two countries, which allows us to examine the dynamics of apprenticeship markets from a cross-national perspective.

We determine that hiring costs to fill skilled worker vacancies are considerable, amounting to about a quarter of an annual salary in Switzerland and a third of an annual salary in Germany. We also find that a large fraction of these costs is related to the onboarding process, which involves adapting the new hires to firms' production environment, and the costs associated with the disruption of coworkers caused by the new hires' integration. This implies that although skilled workers have acquired relevant occupation specific skills, firms still need to invest significantly in firm- and/or product-specific skills until the new hires reach full productivity. In contrast, apprentices acquire most of these skills in the workplace during their training period, which lasts between 2 and 4 years, depending on the occupation.

[1]For a more detailed discussion of the economics of dual apprenticeship systems we refer to Muehlemann and Wolter (2020). Moreover, Dionisius et al. (2009) and Jansen, Strupler Leiser, Wenzelmann, and Wolter (2015) provide more detailed information about the two countries' apprenticeship systems.

[2]Bundesagentur für Arbeit: http://statistik.arbeitsagentur.de

[3]Bundesamt für Statistik: https://www.bfs.admin.ch/

A key challenge in estimating the causal effects of hiring costs on apprenticeship training is the presence of unobserved factors at the firm level that may influence the costs of filling a vacancy and training decisions. High-quality employers may attract more suitable candidates and incur lower hiring costs, while also attracting more suitable young people for apprenticeship positions, establishing a negative correlation between hiring costs and the number of apprenticeships a firm offers. We use an instrumental variable approach to address this endogeneity problem because employer quality is extremely difficult to measure empirically, exploiting variations in exposure to labor market tightness across firms. Our results demonstrate that hiring costs increase significantly with tightness and subsequently have a significant effect on the number of apprentices trained in Swiss firms. The elasticity of the number of apprenticeships offered by a firm with respect to hiring costs is 1.4, indicating a large and meaningful effect. In contrast, we find that hiring costs are less important for German firms.

The remainder of this paper is structured as follows. In the next section, we survey the relevant theoretical and empirical literature that informs our research questions and hypotheses. In Section 3, we introduce the data sources that we use for our empirical analysis and present some descriptive statistics. In Section 4, we detail our identification strategy and the underlying econometric models. Section 5 reports our main results. In Section 6, we discuss the implications of our findings and compare them with previous studies. The final section concludes.

2 Relevant literature

In competitive markets, general training is financed by individuals because they reap all the benefits related to training that increase productivity in the form of higher subsequent wages (Becker, 1964). In competitive apprenticeship training markets, apprentices receive a wage during training, but indirectly pay for their own training to the extent that the difference between the value of their productive work and the training wage exceeds a firm's training expenditure. Indeed, a series of empirical studies in Switzerland show that firms do not incur net costs on average when training apprentices (Gehret et al.,

2019; Muehlemann et al., 2007; Schweri et al., 2003; Strupler and Wolter, 2012), which aligns with Becker's prediction that individuals finance general training when markets are competitive.[4] The Swiss results align with OECD indicators regarding employment protection legislation that consistently ranks Switzerland as among the countries with the least regulated labor markets, similar to the United States and the United Kingdom (Table 1).

In contrast, Germany has a much more regulated labor market, and training firms make on average a net investment in apprenticeship training (von Bardeleben et al. 1991; Beicht et al. 2004, Wenzelmann et al. 2009; Schoenfeld et al. 2020; Jansen, Pfeifer, Schoenfeld, and Wenzelmann 2015), an observation that, among other things, led to the development of the new training literature (Acemoglu and Pischke, 1998, 1999a,b). According to this literature, one of the primary reasons that firms are willing to provide training is the compressed wage structure that arises when the differences between a worker's productivity and wage increase with their skill level, when labor markets are characterized by friction, such as minimum wage or mobility costs (Acemoglu and Pischke 1998, 1999a).[5] Several subsequent papers provide empirical evidence in support of this argument (e.g., Dustmann and Schoenberg 2009; Konings and Vanormelingen 2015; Muehlemann et al. 2013).

Table 1: OECD Employment Protection Legislation Index

	Germany	Switzerland
Individual dismissals (regular contracts)	2.45	1.33
Collective dismissals (additional restrictions)	3.63	3.63
Temporary contracts	1.54	1.50

Notes: Collective dismissals: Version 2 (1998-2019), Individual dismissals and temporary contracts: Version (2008-2019). Source: OECD.Stat, Strictness of employment protection - individual and collective dismissals (regular contracts).

However, other reasons beyond compressed wage structures could explain why firms are willing to make a net investment in apprenticeship training. As argued by Franz and

[4]Based on Swiss employer survey data, Muehlemann et al. (2007) find that expected net training costs are an important determinant of a firm's decision to train apprentices; however, Wolter et al. (2006) show that expected training costs are significantly higher for nontraining firms, indicating that nontraining firms are unable to train profitably as is the case for the observed training firms.

[5]For a detailed survey of this literature, see Leuven (2005), and for its relevance in the context of apprenticeship training, see Muehlemann and Wolter (2020) and Wolter and Ryan (2011).

Soskice (1995), German training firms may be willing to invest in their apprentices to avoid the costs of firm-specific training for externally hired workers. Empirical studies show that such costs can be substantial, even in countries with largely deregulated labor markets such as the United States and the United Kingdom (Barron et al., 1997; Holzer, 1990; Loewenstein and Spletzer, 1999; Manning, 2006; Oi, 1962). However, the cost of filling a skilled worker vacancy tends to be even higher in countries with a vocational training system (Blatter et al., 2012; Muehlemann and Pfeifer, 2016). In the case when training costs exceed hiring costs, a firm will typically refrain from providing internal training and instead hire from the external labor market. Conversely, if net training costs are low, or if external hiring costs exceed the net training costs, then a firm can minimize costs by filling vacancies with former apprentices. However, this assumption has not been empirically tested for the German apprenticeship market. Although Stevens (1994) shows for the United Kingdom that training firms may be willing to invest in training to avoid future hiring costs for skilled workers, the empirical analysis relies on parametric assumptions on the structure of the corresponding costs. For Switzerland, Blatter et al. (2016) were the first to empirically test the association between hiring costs and the number of training positions at the firm level. Using firms' difficulty in hiring adequately skilled labor from external labor markets as an exogenous variation in hiring costs in a type 4 Tobit model, the authors find that a one standard deviation increase in average hiring costs leads to a 0.5 standard deviation increase in the number of apprenticeship positions, representing an economically important effect size.[6] In line with these results, Oswald-Egg and Siegenthaler (2023) find that the "agreement on the free movement of persons" (AFMP) between Switzerland and the European Union led to a reduction in hiring costs for skilled workers for firms located close to the border, which subsequently also reduced incentives to train apprentices to save hiring costs. Similarly, Aepli and Kuhn (2021) find that the share of cross-border workers in firms located close to the

[6] Aepli and Kuhn (2021), also using Swiss employer survey data, report that average hiring costs at the occupation level are negatively correlated with a firm's demand for apprentices, which at first sight is in contrast to the results of Blatter et al. (2016). However, Aepli and Kuhn (2021) do not explicitly account for endogeneity issues regarding the association of hiring costs and the number of apprentices at the firm level. In fact, we can replicate a negative correlation between hiring costs and its training decision for 2009 in Appendix Table A.1, which highlights the importance of identifying exogenous variations in hiring costs to infer causal effects.

border negatively affects a firm's demand for apprentices, and that the increase in the share of cross-border workers in such firms due to the AFMP had a more negative effect in occupations where firms faced high hiring costs.

3 Data

We use data on the costs and benefits of apprenticeship training from four representative firm-level surveys. For Switzerland, the surveys were conducted in 2009 (Strupler and Wolter, 2012) by the Center for Research in Economics of Education at the University of Bern and in 2016 (Gehret et al., 2019) by the Swiss Federal University for Vocational Education and Training (SFUVET). For Germany, the surveys refer to the reference years 2012-2013 (Jansen, Pfeifer, Schoenfeld, and Wenzelmann, 2015) and 2017-2018 (Schoenfeld et al., 2020) and were conducted by the Federal Institute for Vocational Education and Training (BIBB). All surveys are based on separate random samples. Due to the time gaps between the Swiss and German surveys and marginal differences in relevant variable measurement, we present the analyses for each survey separately.

The final 2009 Swiss sample includes 1,598 training firms and 2,549 nontraining firms. The 2016 Swiss sample includes 3,036 training and 1,509 nontraining firms. The German sample is somewhat smaller, with 1,434 training firms and 367 nontraining firms in 2012 and 1,807 training firms and 470 nontraining firms in 2017, and training firms are over-represented.[7] From the initial samples, we exclude firms that did not recruit skilled workers in the reference occupation and period or that have missing values in relevant variables. We also exclude firms that claimed zero total recruitment costs because at least marginal costs should arise (e.g., setting up the contract).

The survey method in Switzerland changed from a written postal survey to an online survey, while both waves in Germany used computer-assisted personal interviews. The firm representative answering the questionnaires usually was the person responsible for training decisions or the person in charge of personnel decisions in general. In some cases (e.g., large firms), two or more firm representatives participated in the interview or

[7]The oversampling of training firms was due to the focus of the surveys on training costs and benefits. We use sampling weights to address differences in sample probabilities in each step of the analysis.

completed the questionnaire.

Regarding the content of the survey, most of the questions refer to a specific training occupation. For firms that trained apprentices in several occupations, a relevant occupation is chosen randomly at the beginning of the interview. For nontraining firms, the relevant occupation is determined by the occupation of the last hired skilled worker. The primary focus of the surveys is the costs and benefits of apprenticeship training. The underlying concept was developed in the 1970s by the Edding expert commission (*Sachverstaendigenkommission*) and since then used and enhanced in various surveys in Germany and Switzerland (for a recent overview, see Muehlemann and Wolter, 2020). The surveys contain information on the number of skilled workers with a vocational qualification that a firm has recruited in a defined period and the associated recruitment costs.[8]

To the best of our knowledge, the cost–benefit surveys in the German-speaking countries are the only surveys that provide rich data on the training and recruitment of skilled workers at an occupational level.

3.1 Calculating hiring costs

Following Muehlemann and Strupler Leiser (2018), the total hiring costs (C_i) for a new hire by firm i includes the three components search costs (s_i), adaptation costs (a_i) and disruption costs (r_i) as follows:

$$C_i = s_i + a_i + r_i \tag{1}$$

where s_i includes the costs of posting a vacancy (n_i) and the personnel costs of the recruitment process, which are calculated by the time employees from different skill categories (g; management, skilled labor, and administrative staff) spend in the recruitment process (t_i^g) multiplied by their corresponding average hourly wages w_i^g.[9] We also denote the costs of external advisors or placement agencies as e_i. In summary, search costs can be written as follows:

[8]For the German 2017/18 survey, the information refers to the last hired skilled worker.

[9]The Swiss surveys include three job categories for involved employees: management, skilled workers in the considered occupation, and skilled workers in human resource management, and skilled workers are treated as one group in German surveys.

$$s_i = n_i + \sum_{g=1}^{3}(t_i^g \times w_i^g) + e_i \tag{2}$$

Adaptation costs arise because a newly hired skilled worker is not immediately fully productive.[10] In the surveys, firms report for how many days (d_i^a) a newly hired employee is less productive than an average skilled worker, with several reasons why a new hire may initially be less productive. One is firm-specific human capital, such as learning the firm culture, learning production processes, and becoming acquainted with work colleagues.[11] Measurement differs on this issue between Swiss and German surveys. In Germany, the survey respondents are asked to assess the relative productivity (p_i) of a new hire at the beginning of the adaptation period and the duration of the adaptation period (d_i^a). Conversely, participants in the Swiss surveys are asked to give their best estimate of the average relative productivity decrease ($1-\bar{p}_i$) during the adaptation period. We assume a linear increase in productivity during the adaptation period in Germany to calculate the value of the production loss, which is lost production time in days ($d_i^a \times (1-\bar{p}_i)$) multiplied by the daily wage of the skilled worker (w_i).[12] The survey also includes information about external training costs for new hires. First, direct training costs (c_i^t) are incurred for training personnel, travel costs, or course fees. Second, indirect costs are incurred as the firm pays the worker a daily salary (w_i) during the number of training days d_i^t.

Therefore, the adaptation costs (a_i) can be written as the sum of the productivity loss and the direct and indirect costs for external training courses as follows:

$$a_i = d_i^a \times (1 - \bar{p}_i) \times w_i + d_i^t \times w_i + c_i^t \tag{3}$$

[10] Adaptation costs can also be interpreted as a reduced benefit from employing the new hire compared to an internal skilled worker.

[11] Our estimates correspond to the true adaptation costs in the case where skilled worker wages are equal to skilled worker productivity; however, when wages are set below productivity, our estimates provide a lower bound for the true adaptation costs, as the firm only obtains a fraction of the difference between productivity and wage during the adaptation period.

[12] For example, if a new hire has an initial productivity of $p_i = 60\%$ in comparison to an incumbent worker and the adaptation period is 4 months until reaching 100% productivity, the German survey assumes that the productivity increases by 10%-points in each month, so that the productivity is 70% at the beginning of the second month, 80% in the beginning of the third month, and 90% in the beginning of the fourth month of the adaptation period. Therefore, the average relative productivity difference to a skilled worker during the adaptation period was $(1 - \bar{p}_i) = -25\%$, which corresponds to the measure that Swiss firms were asked to report directly.

The third aspect of hiring costs arises when incumbent workers are disrupted during work by new hires. During such disruptions, incumbent workers might provide newly hired workers with relevant orientation to the production process and are for that reason less productive. The disruption costs are expressed as follows:

$$r_i = h_i^r \times w_i^w \tag{4}$$

where h_i^r denotes the number of hours all incumbent workers[13] in firm i provide informal training to new hires (and cannot adequately perform their regular tasks), and w_i^w denotes the wage of the respective incumbent workers.

3.2 Descriptive statistics

In this section, we first present the descriptive statistics of our datasets by country, focusing on the primary variables of interest for our analysis. Table 2 details the summary statistics for Switzerland, revealing that adaptation costs are the most significant component of hiring costs in Switzerland, accounting for around 60% of recruitment costs, whereas search costs are considerably less significant, averaging between 2,700 and 3,700 euros, or just over half a skilled worker's monthly salary. Swiss nontraining firms had average hiring costs of almost 20,000 euros in 2009, which dropped to 16,700 euros in 2016. In line with these results, the share of nontraining firms that reported difficulties in hiring suitable skilled workers on the external labor market dropped from 0.39 in 2009 to 0.34 in 2016. Moreover, the number of new hires in the corresponding occupation that the firms were assigned to report on in the survey remained almost constant, at 2.9 new hires. Swiss training firms have lower average costs to fill skilled worker vacancies compared with nontraining firms, amounting to about 16,100 euros in 2009 and 15,800 euros in 2016. While adaptation and disruption costs remained at a similar level, search costs dropped by more than 20%. At the same time, the number of new hires decreased from 5.2 in 2009 to 4.4 in 2016, while the share of training firms that report difficulties with hiring suitable skilled workers remained at 0.56 in both periods. To the extent that search

[13]We distinguish between managers, skilled, and unskilled workers.

Table 2: Descriptive statistics for Swiss firms

	Wave 2009				Wave 2016			
	Non-training firm		Training firm		Non-training firm		Training firm	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Training firm	0		1		0		1	
Number of apprentices (in training occupation)	0		2.93	3.11	0		2.47	2.67
Search costs	3516.14	5998.41	3686.00	4890.15	2698.62	3464.86	2884.49	3556.60
Adaptation costs	11995.10	14082.38	9012.62	9478.90	10106.93	14540.47	9444.87	10512.07
Disruption costs	4265.47	3630.26	3451.93	3197.29	3862.34	5589.14	3513.31	4564.63
Total hiring costs	19776.71	18284.18	16150.55	13505.21	16667.88	18416.04	15842.67	14256.12
Difficulties finding skilled workers	0.39		0.56		0.34		0.56	
Monthly gross wage in occupation	5671.00	1219.19	5504.30	1116.03	5487.74	1304.84	5280.12	981.35
Number of employees in occupation	5.34	10.98	18.95	146.70	7.36	124.12	11.64	26.36
Number of new hires in occupation	2.94	3.85	5.21	18.33	2.87	4.63	4.42	8.60
Cantonal share of cohort age 15-24	0.17	0.02	0.18	0.02	0.17	0.02	0.17	0.02
Observations	2549		1598		1509		3036	

Source: Wave 2009: Strupler and Wolter (2012); Wave 2016: Gehret et al. (2019)

Table 3: Descriptive statistics for German firms

	Wave 2012/13				Wave 2017/18			
	Non-training firm		Training firm		Non-training firm		Training firm	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Training firm	0		1		0		1	
Number of apprentices (observed training occupation)	0		2.54	6.58	0		2.44	5.04
Search costs	925.45	2023.73	1116.92	1791.91	1236.95	2445.71	1144.37	1816.37
Adaption costs	3413.17	5514.84	3700.84	4713.86	4114.15	5943.09	3779.84	5919.62
Disruption costs	3981.28	6202.02	4841.85	7769.76	5751.34	9516.60	5044.33	8473.62
Total hiring costs	8319.90	11563.58	9659.61	11289.26	11102.43	14906.55	9968.54	13431.14
Vacancy $>$ 8 weeks	0.23		0.25		0.45		0.52	
Monthly gross wage in occupation	2124.27	741.40	2348.16	565.47	2560.73	812.11	2582.62	625.99
Number of employees in occupation	4.98	10.85	16.21	100.44	5.53	17.73	13.59	99.25
Number of new hires in occupation	2.46	5.08	3.29	6.88	1.55	4.89	1.65	3.65
Regional share of youth*	7.66	1.42	7.94	1.17	15.92	1.84	16.38	1.48
Observations	367		1434		470		1807	

Notes: Cohort age 18-24 in wave 2012-13; cohort age 15-24 in wave 2017-18. Source: Wave 2012-13: (Jansen, Pfeifer, Schoenfeld, and Wenzelmann, 2015); Wave 2017-18: Schoenfeld et al. (2020).

costs exhibit a convex wage structure, the drop in the number of new hires can explain the decrease in search costs (Blatter et al., 2012). Finally, the number of apprentices in training firms decreased from 2.93 in 2009 to 2.47 in 2016, which may be partially explained by the slight decrease in the local share of young individuals due to demographic changes.

Table 3 provides equivalent descriptive information for Germany, revealing that hiring costs for nontraining firms increased from 8,300 euros in 2012–2013 to 11,100 euros in 2017–2018, almost doubling the share of firms that were unable to fill vacancies within 8 weeks from 0.23 to 0.45. Training firms experienced a similar increase in hiring difficulties from 0.25 to 0.52; however, without experiencing a significant increase in average hiring costs (9,700 euros in 2012–2013 vs. 10,000 euros in 2017–2018). These findings suggest that training firms did not increase recruitment efforts in response to a tighter external labor market. Instead, many positions simply went unfilled, as the average number of new hires in the corresponding occupation in the 2017–2018 wave was only 1.65, compared with 3.29 in the 2012–2013 wave, and the number of trained apprentices slightly decreased from 2.54 to 2.44. Similar to Swiss firms, search costs are quantitatively less important in Germany compared to adaptation and disruption costs, and amount to about 10% of total hiring costs. Disruption costs are the most important component of hiring costs and account for about half of the costs to fill a skilled worker vacancy.

4 Identification strategy

This study endeavors to estimate the association of hiring costs for skilled workers and firms' demand for apprentices among the population of firms that hired at least one skilled worker from the external labor market in a three-year period (i.e., for which we observe hiring costs)[14] Although we have data from two periods for each country, we are unable to perform panel analysis because no establishment indicator is available to track firms over time; therefore, we estimate separate regression models for each country and each

[14]Previous studies show that small firms that did not hire externally do not differ in terms of their expected hiring costs when including control variables for firm size and occupation (Blatter et al., 2016), which alleviates selection concerns based on unobserved heterogeneity.

cross section. Hence, we estimate four regression models, including i) Swiss firms in 2012, ii) Swiss firms in 2016, iii) German firms in 2012, and iv) German firms in 2017.

We first estimate a linear probability model (LPM) to analyze how firms' training decisions depend on hiring costs for skilled workers. Second, we estimate a Poisson count data model to account for the nature of the dependent variable in the models on the number of apprentices trained. y is the number of apprentices in the Poisson regression model, where $E[y|\mathbf{x}] = \exp(\mathbf{x}'\beta)$ and $u = y - \exp(\mathbf{x}'\beta)$, where x includes controls for the number of skilled workers, the number of new hires, four categories of firm size, occupational groups, sectors, and the proportion of local adults[15] in most of our estimates. An omitted variable bias arises if employer quality is unobserved, as high-quality employers offer more attractive employment opportunities and are expected to find it easier and less expensive to fill a vacancy with suitably skilled workers and these new hires possibly also require less training during the onboarding period (i.e., formal training courses and informal training provided by coworkers) (Bartel et al. 2014, Loewenstein and Spletzer 1999). Although such heterogeneity at the firm level is unobserved in our data, it may influence the number of interested applicants willing to accept a job offer, as at least some information about employer quality can be revealed during the interview process. Consequently, low-quality employers will find it more difficult and more expensive to fill vacancies. At the same time, a similar pattern may be observed for filling apprenticeship training positions, resulting in low-quality employers having a lower probability of successfully filling training vacancies. At a descriptive level, this could lead to a negative correlation between hiring costs and the number of apprenticeship contracts concluded at the firm level; therefore, a downward bias in a simple regression of the number of apprenticeship contracts on observed hiring costs.

To avoid biased estimates, we apply an instrumental variable strategy. To consistently estimate our coefficients of interest, we need an instrument $\mathbf{z}$ that satisfies $E[u|\mathbf{z}] = 0$ (Cameron and Trivedi 2005; Mullahy 1997). Our instruments capture difficulties between firms in labor market tightness. For Swiss firms, we employ a variable that indicates whether a firm faced difficulties in finding adequately skilled workers in the local labor

[15]In Switzerland local units are the Cantons, and in Germany, the federal states.

market.[16] For German firms, the surveys included information on whether a firm successfully filled a skilled worker vacancy within 8 weeks and we use this variable as an instrument for hiring costs. Intuitively, we are interested in the association between a change in hiring costs caused by a changing labor market environment, as previously documented by Muehlemann and Strupler Leiser (2018). In our context, we use the variations in hiring costs due to circumstances in the external labor market to identify the effect of hiring costs on firms' number of concluded apprenticeship contracts.[17] Both variables indicate the level of firms' difficulty with hiring skilled workers from the external labor market, but it is not directly related to the number of apprenticeship contracts concluded by a firm. A firm's difficulties with hiring skilled workers due to a tight labor market is unlikely to be correlated with a firm's difficulties with finding suitable apprentices, since the latter is strongly related to demographic change in the number of local young people, while the former is predominantly driven by the business cycle.

5 Results

The results in Tables 4 and 5 clearly show that Swiss firms that experienced difficulties in finding suitable skilled workers in the local labor market incurred higher hiring costs in 2009 and 2016, which aligns with previous empirical studies (e.g., Muehlemann and Strupler Leiser, 2018). The economic significance was moderately strong as firms that experienced difficulties in finding skilled workers incurred 25% (47%) higher hiring costs in 2009 (2016). The results of our instrumental variable regressions reveal that the variation in hiring costs induced by local labor market tightness has a statistically significant and positive association with both firms' training decisions and the number of apprentices hired. We determine that a 10% increase in hiring costs is associated with a 4.8% (2.9%) increase in the probability of a firm training at least one apprentice in 2009 (2016), which is a moderately strong effect size (Table 4, IV LPM). Conversely, our Poisson IV regression

[16]This binary indicator for labor market tightness is used as an instrumental variable for hiring costs in Blatter et al. (2016).

[17]Ideally, we would observe such changes in a longitudinal setting, exploiting a measure of labor market tightness at the occupation level in a local labor market. However, we only observe hiring costs and the number of apprenticeship contracts at the firm level in the cross section. Therefore, our instrument exploits information on the tightness of the labor market at the firm and the occupation level.

reveals that the hiring cost elasticity of apprenticeships was large, at 1.4 in both survey periods (Table 4, IV Poisson; Table 5, IV Poisson).

For Germany, we find that firms that were unable to successfully fill a vacancy within 8 weeks incurred 75% higher hiring costs in 2012 (Table 6) and 58% higher hiring costs in 2017 (Table 7). However, the labor market tightness-induced change in hiring costs was not associated with a statistically significant increase in firms' probability of training apprentices (Table 6, IV LMP), nor with firms' number of apprentices (Table 6, IV Poisson) in 2012. However, we find a positive and statistically significant point estimate for firms' training decision for 2017 as a 10% increase in average hiring costs is associated with a 1.6% increase in the probability of training at least one apprentice (Table 7, IV LPM). However, the effect size is considerably lower than our estimates for Swiss firms and also weaker in terms of statistical significance. Furthermore, our Poisson IV regression shows a positive association between hiring costs and the number of apprentices at the firm level; however, the coefficients are not statistically significant in 2012 (Table 6, IV Poisson) or in 2017 (Table 7, IV Poisson).

In summary, our results show a robust association between hiring costs and firms' training decisions and the number of apprenticeship contracts concluded. However, although our estimates also indicate a positive association of hiring costs and firms' training activity in Germany, it is much weaker and less consistent compared with Switzerland. Finally, the LPM and Poisson regression results in Appendix Tables A.1 and A.2 highlight the efficacy of using instrumental variable regression to account for unobserved heterogeneity at the firm level, since the point estimates are not only close to zero, but at times are even negative for both countries in each period. However, as noted, the observed correlation between hiring costs and firms' training activities can be expected to be negative when high-quality employers find it easier (thus, cheaper) to hire skilled workers in the external labor market and suitable apprentices in the training market.

Table 4: Hiring costs and training – Switzerland, wave 2009

	ln(Hiring costs) (1st stage)	Training decision (IV LPM)	Apprentices (IV Poisson)
Hiring difficulties	0.220***		
	(0.052)		
ln(Hiring costs)		0.482***	1.359***
		(0.166)	(0.559)
R^2	0.224		
Observations	4147	4147	4147
F-statistic	18.0		

Notes: Hiring costs are defined as the costs to successfully fill a skilled worker vacancy, divided by the monthly wage. Robust standard errors in parentheses. Control variables: number of skilled workers, number of new hires, firm size categories, 16 occupational fields, 5 sectors, and the cantonal population share of 15 - 24 year old individuals. $*$: significant at 10 percent, $**$: significant at 5 percent, $***$: significant at 1 percent.

Table 5: Hiring costs and training – Switzerland, wave 2016

	ln(Hiring costs) (1st stage)	Training decision (IV LPM)	Apprentices (IV Poisson)
Hiring difficulties	0.388***		
	(0.047)		
ln(Hiring costs)		0.286***	1.383***
		(0.066)	(0.269)
R^2	0.149		
Observations	4545	4545	4545
F-statistic	18.0		

Notes: Hiring costs are defined as the costs to successfully fill a skilled worker vacancy, divided by the monthly wage. Robust standard errors in parentheses. Control variables: number of skilled workers, number of new hires, firm size categories, 16 occupational fields, 5 sectors, and the cantonal population share of 15 - 24 year old individuals. $*$: significant at 10 percent, $**$: significant at 5 percent, $***$: significant at 1 percent.

Table 6: Hiring costs and training – Germany, wave 2012-13

	ln(Hiring costs) (1st stage)	Training decision (IV LPM)	Apprentices (IV Poisson)
Vacancy duration > 8 weeks	0.562***		
	(0.063)		
ln(Hiring costs)		0.023	0.096
		(0.080)	(0.431)
R^2	0.151		
Observations	1801	1801	1801
F-statistic	18.0		

Notes: Hiring costs are defined as the costs to successfully fill a skilled worker vacancy, divided by the monthly wage. Robust standard errors in paretheses. Control variables: number of skilled workers, number of new hires, firm size categories, 9 occupational fields, 5 sectors, and the regional population share of 18 - 24 year old individuals. $*$: significant at 10 percent, $**$: significant at 5 percent, $***$: significant at 1 percent.

Table 7: Hiring costs and training – Germany, wave 2017-18

	ln(Hiring costs) (1st stage)	Training decision (IV LPM)	Apprentices (IV Poisson)
Vacancy duration >8 weeks	0.456***		
	(0.055)		
ln(Hiring costs)		0.163**	0.409
		(0.066)	(0.414)
R^2	0.071		
Observations	2277	2277	2277
F-statistic	18.0		

Notes: Hiring costs are defined as the costs to successfully fill a skilled worker vacancy, divided by the monthly wage. Robust standard errors in paretheses. Control variables: number of skilled workers, number of new hires, firm size categories, 9 occupational fields, 5 sectors, and the regional population share of 15 - 24 year old individuals. $*$: significant at 10 percent, $**$: significant at 5 percent, $***$: significant at 1 percent.

6 Discussion

Based on theoretical considerations and the empirical literature, we expected to find a statistically significant association between skilled worker hiring costs and firms' training practices in Switzerland and Germany. However, according to our empirical results, a tightness-induced increase in hiring costs is relevant to firms' training choices in the Swiss context, but has a relatively minor impact on the German apprenticeship market. The firm survey data also include subjective assessments of firms' training motives, which reveal the relative significance of differing motives. We find that a minority (36% in 2012 and 39% in 2017) of German employers considered saving hiring costs to be a significant incentive for offering apprenticeship training (Jansen, Pfeifer, Schoenfeld, and Wenzelmann, 2015, Wenzelmann and Schoenfeld, 2022), which aligns with our baseline results indicating that hiring costs are not a primary determinant to German firms' training practices. In contrast, the majority of German employers (83% in 2012 and 89% in 2017) indicated that a key motivation for training apprentices was to secure future needs for skilled workers.[18] While we do not have conclusive evidence for the causes of the variations in our findings across the two countries, we can speculate on some potentially important factors. First, while German and Swiss apprenticeship systems share many features, they also have some notable differences that could explain the discrepancy in the effects of hiring costs on the number of trained apprentices. German firms make substantial net investments in apprenticeship training of 6,500 euros per year on average (Schoenfeld et al., 2020). In contrast, apprenticeship training in Switzerland results in an average net benefit of 3,000 euros for training firms (Gehret et al., 2019). A primary reason for this large difference was found to be the wage structure as apprentice pay relative to skilled worker pay is considerably higher in Germany, where apprentice pay is predominantly subject to collective bargaining agreements (Dionisius et al., 2009). Therefore, from an economic perspective, German firms seek to recover training costs by retaining apprentices as skilled

[18]Corresponding data for Swiss training firms for this exact question are not available; however, the main qualitative motive for offering apprenticeship training in Switzerland in 2004 was to ensure the availability of skilled workers in the region and/or industry, while the avoidance of a high fluctuation rate was considerably less significant. These findings are consistent with the fact that only 35.5% of Swiss apprentices were still employed with their training firm one year after graduation (Muehlemann et al. 2007).

workers (Muehlemann and Wolter, 2020; Muehlemann et al., 2010). However, as shown in our analysis, hiring costs alone are not large enough to cover the net training costs, even if a firm were to retain all of its apprentices. Consequently, for German firms, the benefits of training and retaining apprentices may depend less on the immediate savings of hiring costs through retention of apprentices, but more on the medium- to long-term returns of retaining former apprentices as skilled workers. In particular, theory and empirical studies stress that the prevalence of unions in Germany can induce compressed wage structures that enable firms to extract rent that increases by the level of skills of employees, which provides incentives to offer and finance apprenticeship training (Acemoglu and Pischke, 1999b). Dustmann and Schoenberg (2009) provide credible empirical evidence that wage compression is an important reason why German firms provide apprenticeship training.

However, a compressed wage structure may also characterize the Swiss labor market, particularly because unions are not the only reason that wages can be compressed. According to Acemoglu and Pischke (1998, 1999b), another important type of friction in the labor market is mobility costs, which may also lead to compressed wage structures, even in countries that have a highly developed public transportation system and a lightly regulated labor market, as is the case in Switzerland. Muehlemann et al. (2013) provide empirical evidence that Swiss employers have monopsony power not only over skilled workers, but also over apprentices. However, according to their results, firms' monopsony power diminishes considerably in the local number of employers in a particular region. As a result, Swiss training firms located in more competitive markets cannot rely on substantial post-training benefits on average. Nevertheless, as shown by Blatter et al. (2016) who use data similar to ours for 2000 and 2004, Swiss firms provide more training when faced with increasing hiring costs. Therefore, we find that the positive effect of hiring costs on apprenticeship training provision also holds in 2009 and 2016.

7 Conclusions

This study analyzes the relationship between firms' hiring costs for skilled workers and training practices. Our empirical analysis used four waves of employer surveys conducted

in Germany and Switzerland and applied instrumental variable regressions, using measures of labor market tightness as instruments for firms' costs to fill skilled worker vacancies. Mirroring previous studies, we find a robust and positive association between external hiring costs and the number of apprentices in Swiss training firms; however, for Germany, we find novel results revealing a positive but much weaker relationship between hiring costs and firms' training practices. While our results strengthen the perspective that firms tend to increase training engagement when facing increased hiring costs, they also suggest that this relationship does not necessarily hold for apprenticeship training in general. This indicates the need for further investigations of the specific mechanisms underlying firms' training decisions, especially in the German context, in which training firms must rely on other sources of post-training benefits to recoup initial training costs.

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A Additional tables and figures

Table A.1: Hiring costs and training – Switzerland

	Training decision (OLS)		Apprentices (Poisson)	
	2009	2016	2009	2016
ln(Hiring costs)	-0.030**	0.015**	-0.050	0.038
	(0.014)	(0.008)	(0.037)	(0.041)
Constant	-0.332**	-0.071	-2.214***	-2.213***
	(0.153)	(0.085)	(0.377)	(0.300)
R^2	0.280	0.301		
Observations	4147	4545	4147	4545

Notes: Robust standard errors in parentheses. Control variables: number of skilled workers, number of new hires, firm size categories, 16 occupational fields, 5 sectors, and the cantonal population share of 15 - 24 year old individuals. $*$: significant at 10%, $**$: significant at 5%, $***$: significant at 1%.

Table A.2: Hiring costs and training – Germany

	Training decision (OLS)		Apprentices (Poisson)	
	2012	2017	2012	2017
ln(Hiring costs)	0.012	-0.021*	0.070	-0.083*
	(0.017)	(0.011)	(0.064)	(0.050)
Constant	0.227	-0.092	-1.361***	-2.765***
	(0.181)	(0.150)	(0.438)	(0.729)
R^2	0.123	0.090		
Observations	1801	2277	1801	2277

Notes: Robust standard errors in parentheses. Control variables: number of skilled workers, number of new hires, firm size categories, 16 occupational fields, 5 sectors, and the regional population share of 18 -24 (2012) resp. 15 - 24 (2017) year old individuals. $*$: significant at 10%, $**$: significant at 5%, $***$: significant at 1%.