FRIEDRICH-ALEXANDER-UNIVERSITÄT ERLANGEN-NÜRNBERG

Lehrstuhl für VWL, insbes. Arbeitsmarkt- und Regionalpolitik
Professor Dr. Claus Schnabel

Diskussionspapiere
Discussion Papers

NO. 99

Personnel policy adjustments when apprentice positions are unfilled: Evidence from German establishment data

TINA HINZ

SEPTEMBER 2016

ISSN 1615-5831

Editor: Prof. Dr. Claus Schnabel, Friedrich-Alexander-Universität Erlangen-Nürnberg

Personnel policy adjustments when apprentice positions are unfilled: Evidence from German establishment data*

Tina Hinz[a]

Abstract: German firms have increasing difficulties in filling apprentice positions. I study how firms adjust their personnel policies when they face unfilled apprentice positions. Using the IAB Establishment Panel (2008-2014) and applying fixed effects panel estimations, I find that small firms react by hiring more unskilled workers. I do not observe an intensified use of personnel policies directed at the existing workforce, such as further training, retention of apprenticeship graduates or conversion of fixed-term into permanent contracts. Moreover, the results do not indicate that firms with unfilled apprentice positions turn away from apprenticeship training. My findings suggest that most training firms may not regard unfilled apprentice positions as a serious problem (so far).

Zusammenfassung: Deutsche Betriebe haben immer größere Schwierigkeiten ihre Ausbildungsstellen zu besetzen. Dieses Papier untersucht, wie Betriebe ihre personalpolitischen Maßnahmen anpassen, wenn Ausbildungsstellen unbesetzt bleiben. Unter Verwendung des IAB-Betriebspanels (2008-2014) und Schätzung mit betriebsfixen Effekten zeigt sich, dass kleine Firmen mehr geringqualifizierte Beschäftigte einstellen. Betriebe reagieren nicht mit einer intensiveren Nutzung von Maßnahmen der betrieblichen Weiterbildung, Übernahme von Auszubildenden oder Entfristung von Beschäftigten. Zusätzlich gibt es kein Anzeichen dafür, dass Betriebe mit unbesetzten Ausbildungsstellen ihre Ausbildungsaktivität verringern. Somit deuten die Ergebnisse darauf hin, dass Ausbildungsbetriebe mit unbesetzten Ausbildungsstellen (noch) keinen Handlungsbedarf sehen.

JEL Classification: I29, J24, J63, M53

Keywords: apprenticeship training, personnel policy, Germany

* I thank Mario Bossler, Tor Eriksson, Daniel Lechmann, Claus Schnabel, Nils Westergard-Nielsen, participants at the University of Zurich (March 2016) and at the 22nd BGPE-Workshop (June 2016) for useful comments as well as Antonia Birkeneder for valuable research assistance.

[a] University of Erlangen–Nürnberg, Chair of Labour and Regional Economics, Lange Gasse 20, 90403 Nuremberg, Germany, e-mail: tina.hinz@fau.de

1 Introduction

The training of apprentices is one important pillar of the German labor market and of the educational system. Each year about two-thirds of school graduates use apprenticeship training as a stepping-stone into the labor market. Apprenticeship training is stated to be a major explanation for low youth unemployment in Germany (Dietrich & Möller, 2016; Zimmermann et al., 2013). From the firms' perspective, apprenticeship training is an effective measure to ensure a skilled future workforce (Bellmann & Hübler, 2014) and is a driver for innovation (Rupietta & Backes-Gellner, 2012). Hence, a well-working market for apprentices should be of interest for training firms but also of general interest.

Recently, the situation on this market has changed completely. For a number of years firms received an excessive number of applications for their apprentice positions. Then, since 2009/2010, an increasing share of training firms has been unable to fill their apprentice positions (Backes-Gellner, 2014; Bundesinstitut für Berufsbildung, 2016). The share of firms with unfilled apprentice positions has increased by ten percentage points since 2008. In 2014, every fifth training firm had unfilled apprentice positions.

There are few studies on the characteristics of firms with unfilled apprentice positions (Dummert et al., 2014; Troltsch et al., 2012). Common findings are that East German firms, smaller firms, and firms in the craft sector are most likely to have unfilled apprentice positions. In addition, Troltsch et al. (2012) show that the probability of having unfilled apprentice positions is positively associated with the required job qualifications.

So far, there is no evidence how firms cope with the situation of unfilled apprentice positions. I use the current situation as a backdrop and provide first evidence whether and how firms adjust their personnel policies when unfilled apprentice positions occur.[1] Since apprenticeship training is widely used by German firms, training firms need to react when it comes to a situation with involuntary unfilled apprentice positions. One possible reaction is to adjust the firms' personnel policies, which I analyze in this study. To do so, I use the IAB Establishment Panel, a large German establishment survey. The data allow to track

[1] A related study by Bellmann et al. (2016) investigates the determinants of the firms' retention of apprenticeship graduates using the IAB Establishment Panel and applying a count data model. The authors find no significant effect of unfilled apprentice positions on the number of retained apprentices. In contrast to Bellmann et al. (2016), the focus of my study is not only on retention but also on other personnel policies. In addition, I identify effects by the variation over time.

firms over time and I exploit the within-firm variation of apprentice positions and personnel policy measures. In particular, I investigate adjustments directed at the existing workforce, such as the retention of apprenticeship graduates, conversion of fixed-term into permanent contracts, and the provision of further training, as well as hiring of new workers. Further, I examine whether firms with unfilled apprentice positions turn away from apprenticeship training, i.e., whether they decrease the number of offered apprentice positions.

My results point at no or only small adjustments when unfilled apprentice positions arise. There is no evidence for a more intense use of personnel policies directed at the existing workforce and only small increases in hires of unskilled workers. The findings indicate that unfilled apprentice positions are not severe enough to force firms to change their personnel policies.

The paper proceeds as follows: The next section briefly describes the German apprenticeship system and the recent development leading to the increase in unfilled apprentice positions. Section 3 discusses adjustment possibilities of firms when unfilled apprentice positions arise and derives hypotheses for the empirical analysis. Section 4 outlines the data and sampling restrictions. Section 5 and 6 present the descriptive and multivariate results. The last section concludes.

2 Apprenticeship training in Germany

The German apprenticeship system is a dual training system with well-defined skills that are trained within three to three and a half years. The general structure of an apprenticeship training program is defined by external institutions (including the chamber of industry and commerce) and combines education at vocational schools with working at a firm. It ensures occupation-specific skills that are transferable across firms. Hence, the apprenticeship training skills are mostly general human capital because they are visible not only to the training firm but also to other agents in the market. During the training period the training firm needs to make investments, which vary in volume and duration for different occupations but also across firms (Wolter & Ryan, 2011). The size of training investments and whether firms can recoup these costs during the training period

are one reason why some firms train and others abstain from training (Mohrenweiser & Backes-Gellner, 2010; Zwick, 2007).[2]

For firms that engage in apprenticeship training, the training literature distinguishes two perspectives on apprentices within the firm (Wolter & Ryan, 2011). Apprenticeship training may either be regarded as an investment into firms' human capital and their future skilled workforce (i.e., investment strategy) or training of apprentices may have a production-oriented motivation (i.e., substitution strategy).[3] In the investment strategy, firms regard apprentices as an investment in future skilled personnel. However, since apprenticeship training is mostly general, a sufficient condition for the investment strategy is that firms intend to retain their apprentices after graduation to refinance their training investments and ensure that the skills are useful in the training firm (Wolter & Ryan, 2011; Mohrenweiser & Backes-Gellner, 2010). In the substitution strategy, apprentices may be regarded as substitutes for workers, sometimes phrased as 'cheap labor' (Lindley, 1975). In this case, it is more beneficial for firms to employ apprentices in the production process than to hire regular workers from the labor market (Wolter & Ryan, 2011). Firms with a substitution strategy belief that training costs pay off during the training period. That implies that the sum of training costs are lower than the productivity of the apprentices. Hence, the majority of these firms do not retain their apprenticeship graduates.

In the last years, training firms were facing different situations when hiring apprentices. In the early 2000s, training firms had more apprenticeship applicants than vacant apprentice positions (Zwick, 2007). Firms had low recruiting costs for apprentices and could choose appropriate candidates. Since the training period 2009/2010, an increasing share of firms has been unable filling their vacant apprentice positions. Over subsequent years the share of firms facing unfilled apprentice positions has steadily increased to about twenty percent in 2014 (see below).

There are several plausible reasons for the increasing share of firms with unfilled apprentice positions. First, the demographic change in Germany, i.e., smaller birth cohorts, leads to fewer school graduates. Second, Backes-Gellner (2014) discusses a

[2] Another strand of the literature investigates firm-level benefits and costs of apprenticeship training (Muehlemann & Wolter, 2014; Busemeyer et al., 2012; Mohrenweiser & Zwick, 2009; Fougère & Schwerdt, 2002).

[3] Other training strategies may relate to firms' reputation or labor market segmentation (see Niederalt, 2004).

plausible change in preferences of school graduates and an increasing intention to start tertiary school.[4] Along these lines, the share of school graduates starting a university education increases. However, there is no evidence that unfilled apprentice positions evolved from firm-specific reasons, e.g., changes in institutions, in firms' attractiveness, or rigid or decreased apprentice pay. By contrast, apprentice pay has increased during the last years (Bundesinstitut für Berufsbildung, 2016). A cross-sectional analysis of the IAB Establishment Panel 2013 shows that the majority of firms with unfilled apprentice positions have not raised their standards when hiring new apprentices. Instead, firms report no suitable applicants (78 percent) or too few applicants (33 percent) as the major reasons for their unfilled apprentice positions.[5]

3 Firms' personnel policy adjustments and hypotheses

When firms face unfilled positions, their labor input is lower than expected. From the firms' perspective, there are different channels to address this situation.[6] Therefore, I distinguish between adjustments directed at the existing workforce and enlargement of the workforce by hiring.

The advantage of personnel policy adjustments directed at the existing workforce is that the personnel has already acquired firm-specific human capital. Thus transaction costs are lower compared to new hires. In addition, there will be no costs of search and hiring. Possible personnel policy adjustments directed at the existing workforce are to retain apprenticeship graduates, to convert fixed-term into permanent contracts, and to provide further training.

The first possibility is to retain more apprenticeship graduates. In general, this personnel policy is more likely if training costs are not paid off during the training period or the firm follows an investment strategy of training (Mohrenweiser & Backes-Gellner,

[4] In some German states, the school years until university entrance qualification ('Abitur') were reduced by one year, which implies lower costs of schooling.

[5] Results are descriptive statistics for the analysis sample. Other categories are applicant rejected the offer, firm refused applicants, and other reasons. Multiple answers are possible. Results are available upon request.

[6] Besides firm-level adjustments, other possibilities to cope with the increasing incidence of firms with unfilled apprentice positions are changes in apprenticeship institutions. An example is a combination of apprenticeship training and A-level qualification ('Berufsabitur'), a recently proposed idea by the German craft sector association.

2010), and if hires of regular workers are too expensive. Stevens (1994) argues that high hiring costs for skilled workers increase the probability of retaining apprenticeship graduates. This notion is underpinned by Bellmann et al. (2016). The authors show a positive association between the number of retained apprenticeship graduates and the demand for skilled workers as well as the share of unfilled positions for skilled workers.

Summing up, the arguments lead to

Hypothesis 1. *When unfilled apprentice positions arise, firms retain more apprenticeship graduates.*

A second possibility to cope with unfilled apprentice positions is to convert fixed-term contracts of workers into permanent contracts.[7] From the firms' perspective, fixed-term workers have two main purposes. They could either be used to screen potential employees or to flexibly satisfy a short- and medium-run labor demand (Hohendanner & Gerner, 2010). However, this pool of workers with firm-specific human capital may also be used to overcome the situation with unfilled apprentice positions. Thus

Hypothesis 2. *Firms with unfilled apprentice positions more often convert fixed-term contracts into permanent contracts.*

Both adjustment are only possible if there are apprenticeship graduates and fixed-term workers to retain. A third adjustment directed at the existing workforce is to increase the provision of further training. The aim of further training may be either to provide (low skilled) workers with knowledge and skills for tasks otherwise done by the apprentices or to extend employment durations of otherwise retiring workers (Berg et al., 2015; Picchio & van Ours, 2013).[8]

[7] By German law, fixed-term contracts have a maximum duration of two years. If the firm wants to employ these workers any further, the contracts need to be converted into permanent contracts.

[8] Contrary to Berg et al. (2015) and Picchio and van Ours (2013), Boockmann et al. (2012) find no association between further training targeted at older employees and their employment durations.

Hypothesis 3: *Firms with unfilled apprentice positions intensify further training activities.*

Another adjustment directed at the existing workforce is an increase in apprentice pay. Apprentice pay is regulated by collective agreements in Germany. For the period from 2005 to 2014, official statistics show that the collective apprentice pay increases more than the consumer price index and also more than the collective negotiated wages of regular workers (Bundesinstitut für Berufsbildung, 2016). Despite this increase in apprentice pay, the share of firms with of unfilled apprentice positions increased.[9] Other likely mechanisms to react to unfilled apprentice positions are to adjust working conditions, extend the working hours (e.g., overtime hours, longer weekly working hours), or postpone retirement decisions of older workers.[10]

Apart from adjustments directed at the existing workforce, firms may increasingly hire new workers in a situation with unfilled apprentice positions. Empirical evidence shows that firms regard training and retaining of apprentices as a substitute to hiring (Blatter et al., 2016, 2012) or as alternative recruitment strategies (Bellmann et al., 2014). Firms decide whether to hire or to train workers based on the costs of hiring (Blatter et al., 2016) or uncertainty about the business development (Bellmann & Janik, 2007). Blatter et al. (2012) show that hiring costs increase with the positions' skill requirements.

The hiring behavior may reflect the firms' training strategies. Firms with a substitution strategy more likely hire unskilled workers because they view apprentices as a substitute to these. On the other hand firms with an investment strategy of training may hire skilled workers as a reaction to unfilled apprentice positions because they regard apprentices as potential future workers (Mohrenweiser & Backes-Gellner, 2010; Lindley, 1975).

Hypothesis 4a: *Firms with unfilled apprentice positions hire more unskilled workers.*

Hypothesis 4b: *Firms with unfilled apprentice positions hire more skilled workers.*

---

[9] There is empirical evidence that wages are not the most important mechanism to react to labor scarcity (Fang, 2009).

[10] Using the IAB Establishment Panel, I cannot analyze the effects of unfilled apprentice positions on individuals' wages as well as working conditions and working time. The latter two are not measured precisely enough for the purpose of my study.

A third personnel policy adjustment is a change in the offered apprentice positions. In a situation with involuntary unfilled apprentice positions, search and hiring costs for new apprentices will not pay off. One likely reaction is to reduce the offers of apprentice positions. It follows

Hypothesis 5: *When unfilled apprentice positions arise, firms reduce their apprenticeship training activities in future periods.*

4 Data and sample definition

I use the IAB Establishment Panel to test the relationship between unfilled apprentice positions and personnel policy adjustments by exploiting the within-firm variation over the period from 2008 to 2014.[11] The IAB Establishment Panel is an annual survey that records information about firm characteristics, policies, employment, and personnel strategies. It covers about 16,000 establishments in Germany with at least one employee liable to social security contributions. My analysis focuses on apprenticeship training firms, which I define as firms with at least one apprentice. In line with the literature, I exclude the public sector because personnel strategies may not be comparable with private, profit-maximizing firms. Table A1 summarizes the definition of variables and reports descriptive statistics.

The dependent variables are personnel policy measures. In detail, I consider the retention of apprenticeship graduates, conversion of fixed-term into permanent contracts, further training[12], and hiring of workers. I distinguish between hires of skilled and unskilled workers. The former requires no apprenticeship training, whereas skilled workers have at least completed apprenticeship training or higher education. Further, I investigate the changes in the number of offered apprentice positions. In the empirical part, I construct

[11] Data access was provided via on-site use at the Research Data Centre (FDZ) of the German Federal Employment Agency (BA) at the Institute for Employment Research (IAB) and subsequently remote data access. Units of observations are establishments, which are workplaces not firms. For further data information see Ellguth et al. (2014) and Fischer et al. (2009).

[12] In the IAB Establishment Panel, the information on further training can be reported as the number of trained employees or the number of participants in further training. As suggested by Stegmaier (2012), I follow the imputation proposed by Düll and Bellmann (1998) to derive the number of trained employees.

the dependent variables as shares of the firm size in the previous year.[13] Thus, the outcome variable reveals the extent to which firms hire workers relative to their (past) firm size. The advantage of the relative measure is that the heterogeneity in costs and benefits of personnel policies is taken into account.

The main explanatory variable refers to unfilled apprentice positions within the firm. Therefore, I use the number of offered and unfilled apprentice positions each year.[14] I exploit the incidence of unfilled apprentice positions as the explanatory variable, i.e., to have at least one unfilled apprentice position in the current training year.

The IAB Establishment Panel surveys the information on firms' apprenticeship training retrospectively for the latest training period, which always starts in autumn the year before. It implies that the number of posted and unfilled apprentice positions refer to this point in time. The personnel policies refer to the first half of each year. This setting ensures the chronological order of the unfilled positions on the firms' adjustments but might underestimate the effects. However, the first six month of a year should capture most of the firms' adjustments when unfilled apprentice positions arise in autumn the year before.[15]

5 Descriptive evidence

This section provides a brief descriptive overview of the training firms and their personnel policy measures. Table 1 gives some general information about the firms' apprenticeship training activities over time. The number of training firms decreased by about 15 percent during the period from 2008 to 2014 (column 1) and the average number of apprentices varies over time (column 2a). In general, training firms may not offer apprenticeship training each year.[16] In a given year, about 59 percent of the training firms offer apprentice positions. Among those firms, the average (median) number of offered positions is 7.7 (2.5).

[13] The firm size of the current year is unfeasible because the hires or retained workers would be included in this measure. For the sake of comparability, I stick to the same denominator when focusing on further training and offered apprentice positions.

[14] All firms complying statutory provisions of vocational training are asked for the number of offered apprentice positions and the number of signed contracts. The exact wording changes over the survey waves. In some years, firms are asked to indicate the filled, in other years the unfilled positions.

[15] For the changes of the offered apprentice positions, I use the next year's wave of the data.

[16] As an apprenticeship training period last for about three years, some firms might hire new apprentices only every second or third year. Most of the training firms provide apprenticeship training at regular intervals.

Table 2 allows a first inspection of firms with unfilled apprentice positions for the period from 2008 to 2014. Their share increased by ten percentage points: In the year 2008 about 11 percent of training firms were unable to fill all offered apprentice positions. In the most recent year 2014, every fifth training firm had at least one unfilled apprentice position (see also Dummert et al., 2014).[17] Moreover, among those firms with at least one unfilled apprentice position the average number decreased over time, but the median remained stable at one or two unfilled apprentice positions each year (column 2, 4). Figure 1 displays the increase in the share of firms with unfilled apprentice positions separately for four different firm size categories. The largest rise is observed for firms with 50 to 199 employees. In this category the share of training firms with unfilled apprentice positions increased by 14.3 percentage points.

Table 3 presents pooled averages of personnel policy measures separately for firms with and without unfilled apprentice positions. For the full sample (Panel A) firms differ in all categories pointing at level differences in these personnel policy measures. However, the differences are not always in the direction as stated by the hypotheses. Firms with unfilled apprentice positions more often convert fixed-term into permanent contracts and also tend to hire more unskilled as well as skilled workers. In contrast to the hypotheses, firms increase (and not decrease) their number of offered apprentice positions.

Panel B of Table 3 shows pooled averages of personnel policy measures by the four firm size categories. The descriptive evidence is mixed regarding direction of effects and effect size. For example, firms with and without unfilled apprentice positions show no differences in the retention of apprenticeship graduates. One exemption is the largest group (>199 employees), but the effect size is rather small. A second interesting result is the difference in hires of unskilled workers. Small and very large firms with unfilled apprentice positions hire significantly more unskilled workers than firms of the same size but without unfilled apprentice positions.

[17] The official report uses other cut-off days than the IAB Establishment Panel. Thus the numbers of firms with unfilled apprentice positions differ (see Bundesinstitut für Berufsbildung, 2016).

6 Regression analysis

The next step is to test whether unfilled apprentice positions lead to adjustments in personnel policies within the firm. I am interested in the coefficient δ when estimating

$$Y_{it} = \beta_0 + \delta * D_{it} + X_{it}\beta + \gamma_t + \alpha_i + \epsilon_{it}.$$

The regression explains the change in the outcome variable Y_{it}, which comprises personnel policy measures relative to all employees in the previous year (see section 4). I control for a vector of firm-specific characteristics X_{it} and the indicator for unfilled apprentice positions D_{it}, which takes the value 1 if a firm has at least one unfilled apprentice positions in the respective year and 0 otherwise.[18] Further, the specification includes year dummies γ_t, firm-specific fixed effects α_i, and an idiosyncratic error term ϵ_{it}. I apply fixed effects panel regression methods to exploit the within-firm variation whether or not the firm has unfilled apprentice positions. The period of analysis is from 2008 to 2014.[19]

I control for firm-specific characteristics that might have an influence on the personnel policies of firms, including the workforce structure (i.e., share of apprentices, unskilled workers, and workers with fixed-term contracts), indicators for apprenticeship graduates, temporary workers, whether workers left the firm, and for vacancies in the current year. Further, I control for the firm's expectation about the business volume and employment prospects in order to capture some general economic developments of the firm.[20] Although institutional characteristics of a firm clearly matter when investigating apprenticeship training and personnel policies, I do not control for the existence of works council and collective bargaining because these do not vary much within a firm (see Addison et al., 2014, 2013) and are therefore captured by the fixed effect. The same holds for other time-invariant characteristics, e.g., industry or the location of the firm. Table A2 compares the average characteristics for firms with and without unfilled apprentice positions.

[18] As a sensitivity estimation I use the intensity of unfilled apprentice positions relative to firm size in the previous year, see Table A3. Results are equal in economic terms, except for the offered apprentice positions. For a discussion see below.

[19] Restricting the sample to the post-crisis years 2011-2014 does not change the results. Another sensitivity analysis includes an additional indicator for unfilled apprentice positions in the previous year. Full sample results remain comparable in economic terms (see Table A3).

[20] In the full sample (Table 4, column 1b) and the heterogeneous analyses (Table 6), I additionally control for ten firm size categories: 1-5, 5-9, 10-19, 20-49, 50-99, 100-199, 200-499, 500-999, 999-4,999, and more than 4,999 employees.

The multivariate results are presented for the full sample (Table 4, column 1a and 1b) and separately by four different firm size categories (Table 4, column 2a - 2d). The separate regressions by firm size are useful to account for the different levels and developments of firms with unfilled apprentice positions as discussed in section 5. Moreover, strategies of personnel policies (see Table 5) and apprenticeship training vary by firm size (Bellmann et al., 2014; Mohrenweiser & Backes-Gellner, 2010). Full sample regressions are prone to blur these effects.[21]

6.1 Results

The first three panels of Table 4 refer to the personnel policy adjustments directed at the existing workforce, as stated in hypotheses 1 to 3. The first personnel policy adjustment is whether firms retain more apprenticeship graduates when unfilled apprentice positions arise (Table 4, Panel I). The regression results reveal a zero effect on the retention of apprenticeship graduates. For the full sample the standard error is rather small, which leads to the interpretation that firms do not change their retention behavior if unfilled apprentice positions occur. The interpretation is also supported in separate regressions by firm size. Hence, I do not find evidence in support of hypothesis 1, which is in line with results by Bellmann et al. (2016).

The second personnel policy adjustment directed at the existing workforce is the conversion of fixed-term contracts into permanent contracts to keep workers with firm-specific human capital in the firm. Panel II shows that the estimated coefficient is close to zero, i.e., firms with unfilled apprentice positions do not change the share of converted contracts. The result is also supported in regressions by firm size. Thereby, hypothesis 2 cannot be confirmed by the data.

Another adjustment directed at the existing workforce is further training to increase the skill level of the existing workforce. Panel III shows the estimated coefficient of the effect on further training. It is negative and statistical significant for the full sample (column 1b), for small firms, and for large firms (column 2a, 2d). The results imply that firms provide less (rather than more) further training when unfilled apprentice positions arise.

[21] The firm size categories are average firm sizes of each firm over the analysis period. For brevity, I only report the coefficient of the unfilled apprentice positions. The full regression results are available upon request.

For medium-size firms the effect is estimated imprecisely (columns 2b and 2c). Thus, hypothesis 3 is not supported by the data. In summary, firms do not react to unfilled apprentice positions by an intensified use of personnel policies directed at the existing workforce.

These results lead to the question whether firms react by enlarging their workforce (Table 4, Panel IV and V). The results point towards a positive and significant relationship between unfilled apprentice positions within the firm and the share of hired unskilled workers (p-value: 0.03). Firms with at least one unfilled apprentice position increase the share of hires of unskilled workers by 0.4 percentage points (the estimated coefficient corresponds to an increase by about 14 percent). The results by firm size show that the effect is mostly driven by small firms. These small firms increase the share of hires by three percentage points (p-value: 0.02, relative effect size: 55 percent). Interestingly, larger firms (50-199 employees) decrease their hires of unskilled workers by 0.3 percentage points (p-value: 0.05) when unfilled apprentice positions arise. Thus, my results confirm hypothesis 4a. By contrast, when looking at hires of skilled workers (Table 4, Panel V), the full sample results provide evidence that firms do not react to unfilled apprentice positions by hiring more skilled workers. Hypothesis 4b is not supported.

The final personnel policy under study is a change in the number of offered apprenticeship training places (Table 4, Panel VI). Unfilled apprentice positions are positively associated with the number of offered training positions, but the estimates do not reach conventional levels of statistical significance. Only larger firms (50-199 employees) respond to unfilled apprentice positions with a statistically significant increase in the offered training places (p-value: 0.006). The effect is rather small (0.5 percentage points). I conclude that the results do not confirm hypothesis 5. If any, the estimates show a small-scale, positive relationship, i.e., an increase in offered apprentice positions when unfilled apprentice positions arise within a firm.[22] These results are in line with Troltsch et al. (2012), but contrary to Mohr et al. (2015).[23]

[22] As a sensitivity regression, I use the share of unfilled apprentice positions relative to firm size (Table A3, column 2). Here, the estimated effect on the share of offered apprentice positions is negative and significant, which is contrary to the main result (see Table A3, column 1). It suggests that the indicator for unfilled apprentice positions might be too rough here.

[23] Troltsch et al. (2012) show descriptive evidence that firms with unfilled apprentice positions do not change their training behavior in comparison to firms without unfilled positions for the training period

Summing up, although an increasing share of training firms has been affected by unfilled apprentice positions in recent years, I do not find any strong incidence for reactions of firms with respect to plausible personnel policy adjustments. If at all, firms adjust by hiring more unskilled workers when unfilled apprentice positions arise. This finding provides some insights about apprenticeship training strategies of firms because it points towards a substitution strategy of training (see section 2). Precisely, smaller firms are more likely to employ apprentices as substitutes to low skilled workers and less often regard apprentices as an investments in their future workforce (Mohrenweiser & Backes-Gellner, 2010). Now, in a situation where firms are unable to staff their apprentice positions they employ unskilled workers as an alternative to apprentices.[24]

6.2 Heterogeneous effects

Next, I investigate whether there are heterogeneous effects in the personnel policy adjustments with respect to the firms' location and for firms in the craft sector, which is the backbone of apprenticeship training in Germany. A descriptive inspection shows that East German firms are more likely to have unfilled apprentice positions than firms located in West Germany (Figure 2). For both groups, the share of firms with unfilled apprentice positions increases over time, which is in line with previous studies (Dummert et al., 2014; Troltsch et al., 2012). In contrast to the general development, the share of firms in the craft sector with unfilled apprentice positions is high already in 2008. It even decreased somewhat over time.

Table 5 presents the pooled averages of personnel policy measures for the three subgroups. The personnel policies directed at the existing workforce differ between East and West German firms. For example, West German firms with unfilled apprentice positions retain more apprenticeship graduates than the West German firms without unfilled apprenticeship graduates. This different is not observed for East German firms. Concerning hiring, firms with unfilled apprentice positions increasingly hire unskilled workers irrespective of the firms' location. Firms in the craft sector with unfilled apprentice

2010. Mohr et al. (2015) provide descriptive evidence that a too low number of applicants is the second major reason for a decrease in the provision of apprenticeship training in German training firms.

[24] However, the conventional indicator for training strategies is the firms' intensity to retain apprenticeship graduates. I find no reaction of firms in this respect.

positions hire more skilled workers compared to those firms without unfilled apprentice positions. In general, the descriptive differences for the three subgroups are not always in the direction as stated by the hypotheses.

Table 6 presents the results of the fixed effect estimations for West and East Germany (column 2a and 2b) as well as for the craft sector (column 3). For the adjustments directed at the existing workforce (Panel I to III) the only statistical difference is in the use of further training. It turns out that the negative effect is only significant for firms located in East Germany and insignificant for West German firms. The effect for East German firms is driven by medium-size (10-49 employees) and very large firms (>199 employees).[25] Firms in the craft sector show the same pattern as those in the full sample, indicating a zero effect of unfilled apprentice positions on the retention intensity of apprenticeship graduates and the conversion of fixed-term contracts.

Concerning hiring (Table 6, Panel IV and V), the separate regressions by regions show that West German firms (but not firms in East Germany) increasingly hire unskilled workers when unfilled apprentice positions arise, but the effect is small (0.8 percentage points). This effect is driven by a significant increase of hires in small West German firms. The separate regressions for the craft sector also show a small and marginal significant relation of unfilled apprentice positions to hires of unskilled (p-value: 0.04) and skilled workers (p-value: 0.06). Although both effects are small in size, it indicates that firms in the craft sector also adjust by hiring skilled workers, which is not the case for firms in the full sample. Finally, the effect on the share of offered apprentice positions is statistical insignificant for East and West German firms as well as for firms in the craft sector.

Summing up, the effects for the three sub-samples of firms are in line with the overall picture. Firms with unfilled apprentice positions do not seem to respond much by an adjustment of their personnel policies when unfilled apprentice positions arise. One exemption is a slight increase in the hires of unskilled workers.

[25] Results by firm size for the different groups are available upon request.

7 Conclusion

This paper presents first evidence on personnel policy adjustments of firms that are unable to fill their apprentice positions in Germany. The decrease in potential apprentices is of high relevance because the apprenticeship system is one important institution of the German labor market and the educational system. During the last years unfilled apprentice positions are an uprising phenomenon.

Using the within-firm variation of unfilled apprentice positions over time, my results do not reveal an intensified use of personnel policies directed at the existing workforce when apprentice positions are unfilled. However, small firms (in particular in West Germany and in the craft sector) cope with unfilled apprentice positions by an increase in the hires of unskilled workers. My results also do not indicate that firms with unfilled apprentice positions turn away from apprenticeship training. Overall, the results seem to suggest that German training firms do not regard unfilled apprentice positions as a serious problem (so far).

There are some caveats regarding my research that may be addressed by future work. First, my list of personnel policies is incomplete. Further plausible reactions of firms may be an change in hours worked or a redistribution of tasks within the firm. Second, I cannot observe a change in wages of employees or in apprentice pay. Further research could investigate productivity effects of unfilled apprentice positions or whether the apprentice-firm match quality changed in response to the unfilled apprentice positions.

Tables and Figures

Table 1: Apprentices and offered apprentice positions over time

	All training firms	Number of apprentices			Offered apprentice positions			
					share of firms	number (if at least 1)		
Year	no.	mean	std.dev.	median	in %	mean	std.dev.	median
	(1)	(2a)	(2b)	(2c)	(3a)	(3b)	(3c)	(3d)
2008	6,655	14.511	58.847	3	57.99	8.232	28.426	3
2009	6,546	14.279	61.245	3	56.78	7.963	27.784	3
2010	6,131	12.988	52.976	3	59.03	7.202	24.176	2
2011	5,863	13.787	55.893	3	58.59	7.849	25.262	2
2012	5,916	13.673	53.289	3	60.84	7.906	27.470	3
2013	5,817	13.313	53.302	3	60.32	7.076	24.549	2
2014	5,643	12.135	53.420	3	—	—	—	—

Note: A training firm is defined as a firm with at least one apprentice in the current workforce.

Data source: IAB Establishment Panel, 2008-2014. Own calculations.

Table 2: Training firms with unfilled apprentice positions over time

	Unfilled apprentice positions			
	share of firms	number (if at least 1)		
Year	in %	mean	std.dev.	median
	(1)	(2)	(3)	(4)
2008	10.83	3.025	7.904	1
2009	12.08	3.070	9.256	1
2010	15.64	2.608	6.976	1
2011	17.94	2.459	7.198	1
2012	19.19	2.364	4.676	2
2013	20.73	2.341	3.521	2
2014	21.87	2.220	3.089	1

Data source: IAB Establishment Panel, 2008-2014. Own calculations.

Table 3: Personnel policies of training firms with and without unfilled apprentice positions

	Firms without unfilled apprentice positions		Firms with unfilled apprentice positions		t-test
	mean (1)	std.dev. (2)	mean (3)	std.dev. (4)	mean diff. (1)-(3)
Panel A: Full sample					
Retention of apprenticeship graduates	0.040	0.245	0.032	0.072	0.008 **
Conversion of fixed-term contracts (into permanent contracts)	0.012	0.052	0.015	0.049	-0.003 ***
Further training	0.447	0.706	0.407	0.528	0.040 ***
Hires of unskilled workers	0.024	0.153	0.029	0.136	-0.005 **
Hires of skilled workers	0.048	0.143	0.053	0.111	-0.005 ***
Offered apprentice positions	0.079	0.632	0.121	1.020	-0.042 ***
Panel B: By firm size					
1-9 employees					
Retention of apprenticeship graduates	0.200	0.685	0.140	0.238	0.060
Conversion of fixed-term contracts (into permanent contracts)	0.010	0.104	0.017	0.105	-0.007 *
Further training	0.748	1.359	0.633	1.101	0.115 **
Hires of unskilled workers	0.040	0.272	0.065	0.309	-0.025 **
Hires of skilled workers	0.094	0.313	0.115	0.248	-0.020 *
Offered apprentice positions	0.228	1.300	0.496	2.598	-0.268 ***
10-49 employees					
Retention of apprenticeship graduates	0.054	0.292	0.042	0.041	0.012
Conversion of fixed-term contracts (into permanent contracts)	0.012	0.037	0.015	0.042	-0.003 ***
Further training	0.449	0.616	0.401	0.441	0.048 ***
Hires of unskilled workers	0.022	0.139	0.028	0.099	-0.006 *
Hires of skilled workers	0.049	0.099	0.061	0.102	-0.012 ***
Offered apprentice positions	0.095	0.668	0.134	0.969	-0.039 *
50-199 employees					
Retention of apprenticeship graduates	0.020	0.018	0.020	0.018	0.000
Conversion of fixed-term contracts (into permanent contracts)	0.014	0.036	0.015	0.037	-0.002 **
Further training	0.374	0.394	0.375	0.384	-0.001
Hires of unskilled workers	0.023	0.128	0.022	0.106	0.001
Hires of skilled workers	0.038	0.069	0.041	0.064	-0.003 *
Offered apprentice positions	0.034	0.052	0.052	0.095	-0.018 ***
>199 employees					
Retention of apprenticeship graduates	0.014	0.013	0.015	0.015	-0.001 ***
Conversion of fixed-term contracts (into permanent contracts)	0.012	0.029	0.015	0.029	-0.003 ***
Further training	0.336	0.323	0.353	0.342	-0.016 *
Hires of unskilled workers	0.016	0.070	0.022	0.074	-0.006 ***
Hires of skilled workers	0.030	0.042	0.032	0.048	-0.002 *
Offered apprentice positions	0.023	0.021	0.031	0.050	-0.009 ***

Note: Asterisks indicate significance levels: *** p<0.01, ** p<0.05, * p<0.1. Personnel policy measures are measured relative to all employees in the previous year.

Data source: IAB Establishment Panel, 2008-2014. Own calculations.

Table 4: Personnel policy adjustments of firms with unfilled apprentice postions

	Full sample		By firm size			
			1-9	10-49	50-199	>199
	(1a)	(1b)	(2a)	(2b)	(2c)	(2d)
Panel I: Retention of apprenticeship graduates						
Unfilled apprentice	0.0003	0.0015	0.0127	0.0000	-0.0006	0.0002
positions (0/1)	(0.0010)	(0.0014)	(0.0165)	(0.0034)	(0.0006)	(0.0003)
	[0.7433]	[0.2870]	[0.4398]	[0.9983]	[0.2937]	[0.4863]
Controls	no	yes	yes	yes	yes	yes
Number of obs.	18,843	18,843	1,401	4,909	6,475	6,058
Number of firms	6,932	6,932	840	2,094	2,180	1,818
Panel II: Conversion of fixed-term contracts (into permanent contracts)						
Unfilled apprentice	0.0011	0.0010	0.0156	-0.0008	-0.0010	0.0001
positions (0/1)	(0.0010)	(0.0011)	(0.0094)	(0.0010)	(0.0012)	(0.0010)
	[0.2931]	[0.3698]	[0.0971]	[0.4302]	[0.3772]	[0.9225]
Controls	no	yes	yes	yes	yes	yes
Number of obs.	26,435	26,435	3,766	8,084	8,127	6,458
Number of firms	9,372	9,372	1,953	2,963	2,556	1,900
Panel III: Further training						
Unfilled apprentice	-0.0081	-0.0217	-0.1467	-0.0185	0.0054	-0.0197
positions (0/1)	(0.0089)	(0.0088)	(0.0636)	(0.0116)	(0.0107)	(0.0102)
	[0.3619]	[0.0131]	[0.0211]	[0.1119]	[0.6116]	[0.0549]
Controls	no	yes	yes	yes	yes	yes
Number of obs.	25,645	25,645	3,745	8,008	7,903	5,989
Number of firms	9,219	9,219	1,946	2,948	2,506	1,819
Panel IV: Hires of unskilled workers						
Unfilled apprentice	0.0035	0.0039	0.0357	0.0018	-0.0030	0.0019
positions (0/1)	(0.0019)	(0.0019)	(0.0156)	(0.0018)	(0.0015)	(0.0018)
	[0.0575]	[0.0344]	[0.0223]	[0.3096]	[0.0461]	[0.2860]
Controls	no	yes	yes	yes	yes	yes
Number of obs.	25,926	25,926	3,704	7,895	7,967	6,360
Number of firms	9,298	9,298	1,939	2,931	2,534	1,894
Panel V: Hires of skilled workers						
Unfilled apprentice	0.0020	0.0017	0.0061	0.0033	-0.0018	0.0003
positions (0/1)	(0.0016)	(0.0016)	(0.0116)	(0.0030)	(0.0018)	(0.0014)
	[0.2001]	[0.2877]	[0.5978]	[0.2590]	[0.3325]	[0.8375]
Controls	no	yes	yes	yes	yes	yes
Number of obs.	26,037	26,037	3,707	7,928	8,003	6,399
Number of firms	9,272	9,272	1,930	2,924	2,528	1,890
Panel VI: Offered apprentice positions						
Unfilled apprentice	0.0101	0.0173	0.0720	0.0199	0.0050	-0.0002
positions (0/1)	(0.0114)	(0.0132)	(0.1045)	(0.0268)	(0.0018)	(0.0005)
	[0.3742]	[0.1899]	[0.4908]	[0.4575]	[0.0060]	[0.7310]
Controls	no	yes	yes	yes	yes	yes
Number of obs.	19,263	19,263	2,736	5,928	5,931	4,668
Number of firms	7,038	7,038	1,476	2,220	1,926	1,416

Note: Fixed effects regression with clustered robust standard errors in parentheses (cluster: firm) and p-values in squared brackets for the period 2008-2014. Controls include the share of apprentices, share of unskilled workers, and share of fixed-term workers all measured in the previous year, expectation about employment growth and business volume development, indicators for workers leaving the firm, current vacancies, temporary workers, apprenticeship graduates, and years. Firm size (ten categories) is included in column 1b. Analysis period is 2008-2013 in Panel VI. The sub-groups by firm size (column 2a-2d) are average firm sizes of each firm over the analysis period. Dependent variables are measured relative to all employees in the previous year.

Data source: IAB Establishment Panel, 2008-2014. Own calculations.

Table 5: Personnel policies of training firms with and without unfilled apprentice positions by heterogenous groups

	Firms without unfilled apprentice positions		Firms with unfilled apprentice positions		t-test
	mean (1)	std.dev. (2)	mean (3)	std.dev. (4)	mean diff. (1)-(3)
Panel A: By German regions					
West					
Retention of apprenticeship graduates	0.043	0.268	0.028	0.049	0.015 ***
Conversion of fixed-term contracts (into permanent contracts)	0.012	0.073	0.012	0.034	0.000
Further training	0.446	0.863	0.386	0.574	0.060 ***
Hires of unskilled workers	0.014	0.084	0.018	0.103	-0.004 **
Hires of skilled workers	0.052	0.174	0.056	0.118	-0.004
Offered apprentice positions	0.081	0.634	0.145	1.353	-0.064 **
East					
Retention of apprenticeship graduates	0.039	0.236	0.036	0.087	0.004
Conversion of fixed-term contracts (into permanent contracts)	0.012	0.040	0.018	0.059	-0.006 ***
Further training	0.448	0.630	0.427	0.479	0.021 *
Hires of unskilled workers	0.028	0.173	0.039	0.161	-0.011 ***
Hires of skilled workers	0.046	0.127	0.051	0.105	-0.005 **
Offered apprentice positions	0.079	0.631	0.096	0.470	-0.018
Panel B: Craft sector					
Retention of apprenticeship graduates	0.049	0.116	0.050	0.118	-0.001
Conversion of fixed-term contracts (into permanent contracts)	0.010	0.053	0.014	0.043	-0.003 ***
Further training	0.403	0.526	0.402	0.574	0.001
Hires of unskilled workers	0.017	0.116	0.021	0.085	-0.004
Hires of skilled workers	0.052	0.147	0.063	0.141	-0.012 ***
Offered apprentice positions	0.091	0.201	0.114	0.174	-0.023 ***

Note: Asterisks indicate significance levels: *** p<0.01, ** p<0.05, * p<0.1. Personnel policy measures are measured relative to all employees in the previous year.

Data source: IAB Establishment Panel, 2008-2014. Own calculations.

Table 6: Personnel policy adjustments by firms' location and for the craft sector

	Full sample (as in Table 4, column 1b)	West	East	Craft sector
	(1)	(2a)	(2b)	(3)
Panel I: Retention of apprenticeship graduates				
Unfilled apprentice	0.0015	0.0026	0.0009	0.0044
positions (0/1)	(0.0014)	(0.0019)	(0.0021)	(0.0033)
	[0.287]	[0.1763]	[0.6602]	[0.1840]
Controls	yes	yes	yes	yes
Number of obs.	18,843	12,621	6,222	4,312
Number of firms	6,932	4,660	2,272	1,657
Panel II: Conversion of fixed-term contracts (into permanent contracts)				
Unfilled apprentice	0.0010	0.0017	0.0000	0.0010
positions (0/1)	(0.0011)	(0.0018)	(0.0008)	(0.0013)
	[0.3698]	[0.3511]	[0.9930]	[0.4520]
Controls	yes	yes	yes	yes
Number of obs.	26,435	17,199	9,236	6,709
Number of firms	9,372	6,226	3,147	2,399
Panel III: Further training				
Unfilled apprentice	-0.0217	-0.0066	-0.0357	-0.0069
positions (0/1)	(0.0088)	(0.0103)	(0.0147)	(0.0130)
	[0.0131]	[0.5201]	[0.0151]	[0.5974]
Controls	yes	yes	yes	yes
Number of obs.	25,645	16,617	9,028	6,619
Number of firms	9,219	6,103	3,117	2,382
Panel IV: Hires of unskilled workers				
Unfilled apprentice	0.0039	0.0083	-0.0011	0.0039
positions (0/1)	(0.0019)	(0.0034)	(0.0012)	(0.0019)
	[0.0344]	[0.0135]	[0.3416]	[0.0386]
Controls	yes	yes	yes	yes
Number of obs.	25,926	16,851	9,075	6,560
Number of firms	9,298	6,173	3,126	2,384
Panel V: Hires of skilled workers				
Unfilled apprentice	0.0017	0.0015	0.0022	0.0068
positions (0/1)	(0.0016)	(0.002)	(0.0026)	(0.0036)
	[0.2877]	[0.4709]	[0.3880]	[0.0592]
other controls	yes	yes	yes	yes
Number of obs.	26,037	16,909	9,128	6,600
Number of firms	9,272	6,152	3,121	2,379
Panel VI: Offered apprentice positions				
Unfilled apprentice	0.0173	0.0012	0.0436	-0.0006
positions (0/1)	(0.0132)	(0.0043)	(0.0313)	(0.0086)
	[0.1899]	[0.7850]	[0.1634]	[0.9417]
Controls	yes	yes	yes	yes
Number of obs.	19,263	12,297	6,966	4,967
Number of firms	7,038	4,571	2,468	1,837

Note: Fixed effects regression with clustered robust standard errors in parentheses (cluster: firm) and p-values in squared brackets for the period 2008-2014. All regressions include control variables as in Table 4, column 1b. Further notes see Table 4.

Data source: IAB Establishment Panel, 2008-2014. Own calculations.

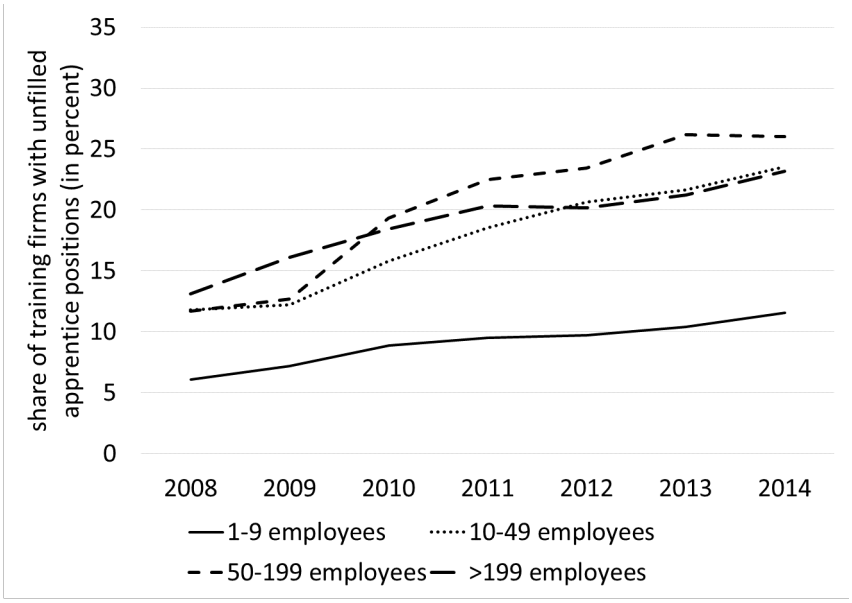

Figure 1: Training firms with unfilled apprentice positions by firm size over time
Data source: IAB Establishment Panel, 2008-2014. Own calculations.

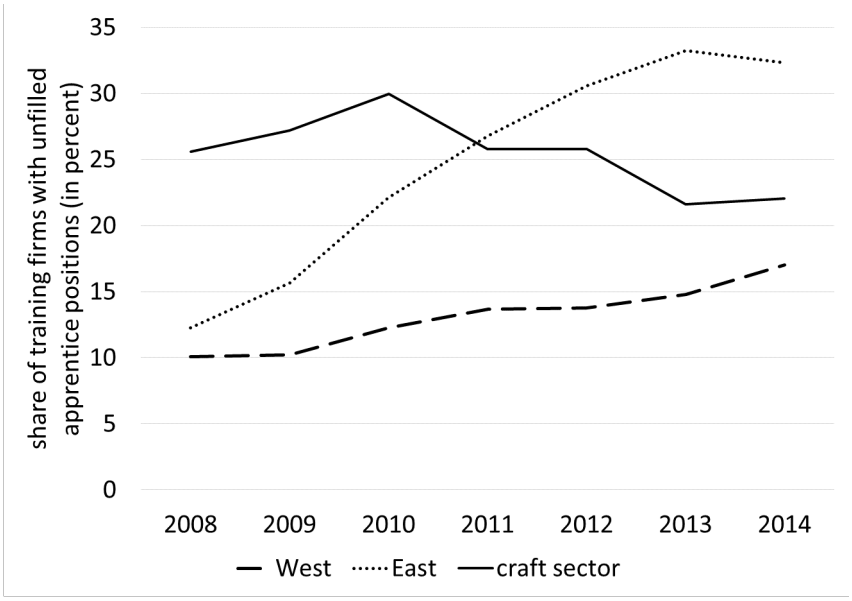

Figure 2: Training firms with unfilled apprentice positions by firm's location and for the craft sector over time
Data source: IAB Establishment Panel, 2008-2014. Own calculations.

References

Addison, J. T., Bryson, A., Teixeira, P., Pahnke, A., & Bellmann, L. (2013). The Extent of Collective Bargaining and Workplace Representation: Transitions between States and their Determinants. A Comparative Analysis of Germany and Great Britain. *Scottish Journal of Political Economy*, *60*(2), 182–209.

Addison, J. T., Kölling, A., & Teixeira, P. (2014). *Changes in Bargaining Status and Intra-Plant Wage Dispersion in Germany: A Case of (Almost) Plus Ça Change?* IZA Discussion Paper No. 8359.

Backes-Gellner, U. (2014). *Benefits of Apprenticeship Training and Future Challenges - Empirical Results and Lessons from Switzerland and Germany.* Leading House Working Paper No. 97.

Bellmann, L., Dummert, S., & Mohr, S. (2016). Übernahme nach erfolgreichem Ausbildungsabschluss? Betriebliche Determinanten für die Weiterbeschäftigung im Ausbildungsbetrieb. *Zeitschrift für Berufs- und Wirtschaftspädagogik*, *112*(2), 184–210.

Bellmann, L., Grunau, P., Troltsch, K., & Walden, G. (2014). Make or buy: train in-company or recruit from the labour market? *Empirical Research in Vocational Education and Training*, *6*(9).

Bellmann, L., & Hübler, O. (2014). The Skill Shortage in German Establishments Before, During and After the Great Recession. *Jahrbücher für Nationalökonomie und Statistik*, *234*(6), 800–828.

Bellmann, L., & Janik, F. (2007). To recruit skilled workers or to train one's own? Vocational training in the face of uncertainty as to the rate of retention of trainees on completion of training. *Zeitschrift für ArbeitsmarktForschung*, *40*(2-3), 205–220.

Berg, P. B., Hamman, M. K., Piszczek, M. M., & Ruhm, C. J. (2015). *The Relationship between Establishment Training and the Retention of Older Workers: Evidence from Germany.* NBER Working Paper No. 21746.

Blatter, M., Muehlemann, S., & Schenker, S. (2012). The costs of hiring skilled workers. *European Economic Review*, *56*(1), 20–35.

Blatter, M., Muehlemann, S., Schenker, S., & Wolter, S. C. (2016). Hiring costs for skilled workers and the supply of firm-provided training. *Oxford Economic Papers*, *68*(1), 238–257.

Boockmann, B., Fries, J., & Göbel, C. (2012). *Specific measures for older employees and late career employment.* ZEW Discussion Paper No. 12-059.

Bundesinstitut für Berufsbildung. (2016). *Datenreport zum Berufsbildungsbericht 2016. Informationen und Analysen zur Entwicklung der beruflichen Bildung.*

Busemeyer, M. R., Neubäumer, R., Pfeifer, H., & Wenzelmann, F. (2012). The transformation of the German vocational training regime: evidence from firms' training behaviour. *Industrial Relations Journal*, *43*(6), 572–591.

Dietrich, H., & Möller, J. (2016). Youth unemployment in Europe – business cycle and institutional effects. *International Economics and Economic Policy*, *13*(1), 5–25.

Düll, H., & Bellmann, L. (1998). Betriebliche Weiterbildungsaktivitäten in West- und Ostdeutschland. *Mitteilungen aus der Arbeitsmarkt- und Berufsforschung*, *31*(2), 205–225.

Dummert, S., Frei, M., & Leber, U. (2014). *Berufsausbildung in Deutschland: Betriebe und Beschäftigte finden schwerer zusammen, dafür sind Übernahmen häufiger denn je.* IAB-Kurzbericht 20/2014.

Ellguth, P., Kohaut, S., & Möller, I. (2014). The IAB Establishment Panel - methodological essentials and data quality. *Zeitschrift für ArbeitsmarktForschung*, *47*(1), 27–41.

Fang, T. (2009). Workplace responses to vacancies and skill shortages in Canada. *International Journal of Manpower*, *30*(4), 326–348.

Fischer, G., Janik, F., Müller, D., & Schmucker, A. (2009). The IAB Establishment Panel things users should know. *Schmollers Jahrbuch. Zeitschrift für Wirtschafts- und Sozialwissenschaften*, *129*(1), 133–148.

Fougère, D., & Schwerdt, W. (2002). Are apprentices productive? *Konjunkturpolitik*, *48*(3-4), 317–346.

Hohendanner, C., & Gerner, H.-D. (2010). Die Übernahme befristet Beschäftigter im Kontext betrieblicher Personalpolitik. *Soziale Welt*, *61*(1), 27–50.

Lindley, R. M. (1975). The Demand for Apprentice Recruits by the Engineering Industry, 1951–71. *Scottish Journal of Political Economy*, *22*(1), 1–24.

Mohr, S., Troltsch, K., & Gerhards, C. (2015). *Rückzug von Betrieben aus der beruflichen Ausbildung: Gründe und Muster.* BIBB Report No. 4.

Mohrenweiser, J., & Backes-Gellner, U. (2010). Apprenticeship training: for investment or substitution? *International Journal of Manpower*, *31*(5), 545–562.

Mohrenweiser, J., & Zwick, T. (2009). Why do firms train apprentices? The net cost puzzle reconsidered. *Labour Economics*, *16*(6), 631–637.

Muehlemann, S., & Wolter, S. C. (2014). Return on investment of apprenticeship systems for enterprises: Evidence from cost-benefit analyses. *IZA Journal of Labor Policy*, *3*(25).

Niederalt, M. (2004). *Zur ökonomischen Analyse betrieblicher Lehrstellenangebote in der Bundesrepublik Deutschland.* Frankfurt/Main: Lang.

Picchio, M., & van Ours, J. C. (2013). Retaining through training even for older workers. *Economics of Education Review*, *32*, 29 – 48.

Rupietta, C., & Backes-Gellner, U. (2012). *High quality workplace training and innovation in highly developed countries.* Leading House Working Paper No. 74.

Stegmaier, J. (2012). Effects of Works Councils on Firm-Provided Further Training in Germany. *British Journal of Industrial Relations*, *50*(4), 667–689.

Stevens, M. (1994). An Investment Model for the Supply of Training by Employers. *The Economic Journal*, *104*(424), 556–570.

Troltsch, K., Gerhards, C., & Mohr, S. (2012). *Vom Regen in die Traufe? Unbesetzte Ausbildungsstellen als künftige Herausforderung des Ausbildungsstellenmarktes.* BIBB Report No. 19.

Wolter, S. C., & Ryan, P. (2011). Apprenticeship. In E. Hanushek, S. Machin, & L. Woessmann (Eds.), *Handbook of the economics of education* (Vol. 3, pp. 521–576). Elsevier Science.

Zimmermann, K. F., Biavaschi, C., Eichhorst, W., Giulietti, C., Kendzia, M. J., Muravyev, A., Pieters, J., Rodríguez-Planas, N., & Schmidl, R. (2013). Youth Unemployment and Vocational Training. *Foundations and Trends in Microeconomics*, *9*(1-2), 1–157.

Zwick, T. (2007). Apprenticeship training in Germany - investment or productivity driven? *Zeitschrift für ArbeitsmarktForschung*, *40*(2/3), 193–204.

Appendix

Table A1: Variable definitions and descriptive statistics, 2008-2014

Variable	Short definition	mean	std.dev.	median
Firms characteristics				
Firms with unfilled apprentice positions	Indicator variable, 1 if firm has at least one unfilled apprentice position	0.214	0.410	0
Unfilled apprentice positions (no.)	Number of unfilled apprentice positions	2.528	6.120	3
Apprentices (no.)	Number of apprentices (reference date: 30.06.)	13.561	55.801	3
Firm size (no.)	Number of employees, excl. apprentices (reference date: 30.06.)	237.120	1291.264	49
Current apprenticeship graduates (d)	Indicator variable, 1 if firm has apprenticeship graduates	0.649	0.477	1
Expectations about employment growth: equal (d)	Indicator variable, 1 if firms expect the employment to remain equal	0.661	0.473	1
Expectations about employment growth: increase (d)	Indicator variable, 1 if firm expect employment to increase	0.170	0.376	0
Expectations about employment growth: decrease (d)	Indicator variable, 1 if firm expect the employment to decrease	0.100	0.300	0
Expectations about employment growth: unsure (d)	Indicator variable, 1 if firms has unsure expectations about employment growth	0.068	0.251	0
Expectations about business volume development: equal (d)	Indicator variable, 1 if firms expect their business volume to develop equally	0.480	0.500	0
Expectations about business volume development: increased (d)	Indicator variable, 1 if firms expect their business volume to increase	0.264	0.441	0
Expectations about business volume development: decreased (d)	Indicator variable, 1 if firms expect their business volume to decrease	0.177	0.382	0
Expectations about business volume development: don't know (d)	Indicator variable, 1 if firms is unsure about their business vol. development	0.073	0.261	0
Workers leaving the firm (d)	Indicator variable, 1 if workers left firm in first two-quarters	0.653	0.476	1
Current vacancies (d)	Indicator variable, 1 if firm has at least one vacant position	0.353	0.478	0
Temporary workers (d)	Indicator variable, 1 if firm has temporary workers	0.253	0.435	0
Apprentices (share)	Share of apprentices to all employees (both measured in the previous year)	0.091	0.109	0.059
Unskilled workers (share)	Share of unskilled workers to all employees (measured in the previous year)	0.153	0.211	0.059
Fixed-term workers (share)	Share of fixed-term workers to all employees (measured in the previous year)	0.063	0.119	0.016
West Germany (d)	Indicator variable, 1 if firm is located in West Germany	0.667	0.471	1
Craft sector (d)	Indicator variable, 1 if firm is in the craft sector	0.264	0.441	0
Personnel policy measures				
Retention of apprenticeship graduates (share)	Share of retained apprentices to all employees (measured in the previous year)	0.043	0.212	0.017
Conversion of fixed-term into permanent contracts (share)	Share of converted fixed-term contracts to all employees (measured in the previous year)	0.012	0.051	0
Further training (share)	Share of employees with further training to all employees (measured in the previous year), ref. date training: first two-quarters	0.449	0.684	0.250
New hires of unskilled workers (share)	Share of hires of unskilled workers to all employees (measured in the previous year)	0.025	0.147	0
New hires of skilled workers (share)	Share of hires of skilled workers to all employees (measured in the previous year)	0.052	0.148	0.013
Offered apprentice positions (share)	Share of offered apprentice positions to all employees (measured in the previous year)	0.083	0.650	0.026

Note: Expectations about employment growth refers to current versus next year. Expectations about business volume development refers to current versus previous year. Employment variables are always measured on reference date June 30th. Abbreviations: no. - number, d - dummy variable, share - share relative to all employees in the previous year.
Data source: IAB Establishment Panel, 2008-2014. Own calculations.

Table A2: Characteristics of training firms with and without unfilled apprentice positions

	Firms without unfilled apprentice positions		Firms with unfilled apprentice positions		t-test
	mean	std.dev.	mean	std.dev.	mean diff.
	(1)	(2)	(3)	(4)	(1)-(3)
Apprentices (no.)	16.118	61.821	16.982	60.921	-0.864
Firm size (no.)	289.698	1497.752	289.698	1170.476	27.153
Current apprentice graduates (d)	0.709	0.454	0.749	0.434	-0.040 ***
Expect. about employment growth: equal (d)	0.659	0.474	0.659	0.483	0.028 ***
Expect. about employment growth: increase (d)	0.169	0.375	0.201	0.400	-0.032 ***
Expect. about employment growth: decrease (d)	0.102	0.302	0.099	0.299	0.003
Expect. about employment growth: unsure (d)	0.069	0.253	0.068	0.251	0.001
Expect. about business volume dev.: equal (d)	0.483	0.500	0.459	0.498	0.024 ***
Expect. about business volume dev.: increased (d)	0.263	0.440	0.286	0.452	-0.023 ***
Expect. about business volume dev.: decreased (d)	0.175	0.380	0.182	0.386	-0.006
Expect. about business volume dev.: don't know (d)	0.072	0.259	0.067	0.250	0.005
Workers leaving the firm (d)	0.692	0.462	0.742	0.437	-0.051 ***
Current vacancies (d)	0.361	0.480	0.471	0.499	-0.110 ***
Temporary workers (d)	0.282	0.450	0.305	0.460	-0.023 ***
Apprentices (share)	0.084	0.100	0.095	0.115	-0.012 ***
Unskilled workers (share)	0.154	0.207	0.154	0.215	0.001
Fixed-term workers (share)	0.064	0.117	0.072	0.123	-0.008 ***
West Germany (d)	0.712	0.453	0.521	0.500	0.191 ***
Craft sector (d)	0.243	0.003	0.290	0.005	-0.048 ***

Note: Asterisks indicate significance levels: *** p<0.01, ** p<0.05, * p<0.1. Firm size refers to the number of employees excluding apprentices. Further notes see Table A1.

Data source: IAB Establishment Panel, 2008-2014. Own calculations.

Table A3: Sensitivity of results

	Full sample (as in Table 4, column 1b) indicator (0/1) (1)	intensity [0,1] (2)	w/ lagged indicator (0/1) (3a)	w/o lagged indicator (0/1) (3b)	Period: 2011-2014 indicator (0/1) (4)
Panel I: Retention of apprenticeship graduates					
Unfilled apprentice	0.0015	0.0086	0.0004	0.0005	0.001
pos. (0/1) or [0,1]	(0.0014)	(0.0089)	(0.0025)	(0.0025)	(0.0013)
	[0.287]	[0.3367]	[0.8634]	[0.8508]	[0.4185]
Unfilled apprentice			-0.0004		
pos. in t-1 (0/1)			(0.0013)		
			[0.7762]		
Number of obs.	18,843	18,843	14,341	14,341	10,233
Number of firms	6,932	6,932	5,476	5,476	4,968
Panel II: Conversion of fixed-term contracts (into permanent contracts)					
Unfilled apprentice	0.0010	0.0054	0.0005	0.0005	0.0000
pos. (0/1) or [0,1]	(0.0011)	(0.0061)	(0.0008)	(0.0008)	(0.0011)
	[0.3698]	[0.3749]	[0.5332]	[0.5671]	[0.9792]
Unfilled apprentice			0.0003		
pos. in t-1 (0/1)			(0.0009)		
			[0.7734]		
Number of obs.	26,435	26,435	18,251	18,251	14,456
Number of firms	9,372	9,372	6,702	6,702	6,721
Panel III: Further training					
Unfilled apprentice	-0.0217	-0.0927	-0.0165	-0.0185	-0.0258
pos. (0/1) or [0,1]	(0.0088)	(0.1088)	(0.0106)	(0.0112)	(0.0127)
	[0.0131]	[0.3942]	[0.1195]	[0.1003]	[0.0415]
Unfilled apprentice			0.0161		
pos. in t-1 (0/1)]			(0.0119)		
			[0.1741]		
Number of obs.	25,645	25,645	17,652	17,652	14,007
Number of firms	9,219	9,219	6,586	6,586	6,593
Panel IV: Hires of unskilled workers					
Unfilled apprentice	0.0039	0.0174	0.003	0.0033	0.0074
pos. (0/1) or [0,1]	(0.0019)	(0.017)	(0.0014)	(0.0014)	(0.0032)
	[0.0344]	[0.3051]	[0.0289]	[0.0189]	[0.0213]
Unfilled apprentice			-0.0027		
pos. in t-1 (0/1)			(0.0016)		
			[0.0896]		
Number of obs.	25,926	25,926	17,916	17,916	14,276
Number of firms	9,298	9,298	6,660	6,660	6,687
Panel V: Hires of skilled workers					
Unfilled apprentice	0.0017	0.0007	0.0013	0.001	0.0005
pos. (0/1) or [0,1]	(0.0016)	(0.004)	(0.0017)	(0.0017)	(0.0022)
	[0.2877]	[0.8638]	[0.4697]	[0.5668]	[0.8208]
Unfilled apprentice			0.0022		
pos. in t-1 (0/1)			(0.0023)		
			[0.3353]		
Number of obs.	26,037	26,037	18,111	18,111	14,329
Number of firms	9,272	9,272	6,682	6,682	6,697
Panel VI: Offered apprentice positions					
Unfilled apprentice	0.0173	-0.578	0.0219	0.0222	0.0001
pos. (0/1) or [0,1]	(0.0132)	(0.059)	(0.0209)	(0.0203)	(0.0054)
	[0.1899]	[0.000]	[0.2954]	[0.2733]	[0.9826]
Unfilled apprentice			-0.0029		
pos. in t-1 (0/1)			(0.0236)		
			[0.9029]		
Number of obs.	19,263	19,263	12,886	12,886	9,097
Number of firms	7,038	7,038	4,962	4,962	4,798

Note: Fixed effects regression with clustered robust standard errors in parentheses (cluster: firm) and p-values in squared brackets for the period 2008-2014. Column 2 uses the share of unfilled apprentice positions measured relative to all employees in the previous year as control variable for the unfilled apprentice positions. Column 3a controls additionally for an indicator for unfilled apprentice positions in the previous period. Column 3b shows the main specification for the restricted sample as in column 3a. All regressions include control variables as in Table 4, column 1b. Further notes see Table 4.

Data source: IAB Establishment Panel, 2008-2014. Own calculations.

In der Diskussionspapierreihe sind kürzlich erschienen:

Recently published Discussion Papers:

99	Hinz, T.	Personnel policy adjustments when apprentice positions are unfilled: Evidence from German establishment data	09/2016
98	Lechmann, D., Wunder, C.	The dynamics of solo self-employment: persistence and transition to employership	05/2016
97	Hirsch, B., Jahn, E. J., Oberfichtner, M.	The urban wage premium in imperfect labour markets	01/2016
96	Hirsch, B., Lechmann, D., Schnabel, C.	Coming to work while sick: An economic theory of presenteeism with an application to German data	04/2015
95	Schnabel, C.	United, yet apart? A note on persistent labour market differences between western and eastern Germany	03/2015
94	Hirsch, B., Oberfichtner M., Schnabel, C.	The levelling effect of product market competition on gender wage discrimination	07/2014
93	Konietzko, T.	Der Einfluss von Arbeitslosigkeit der Ehemänner auf die Zeitallokation von Paaren	07/2014
92	Hirsch, B., Merkl, C., Mueller, S., Schnabel, C.	Centralized vs. Decentralized Wage Formation: The Role of Firms' Production Technology	06/2014
91	Bossler, M., Oberfichtner, M.	The employment effect of deregulating shopping hours: Evidence from German retailing	02/2014
90	Fackler, D.	Establishment survival in East and West Germany: A comparative analysis	01/2014
89	Hirsch, B., Jahn, E. J., Schnabel, C.	The cyclical behaviour of employers' monopsony power and workers' wages	12/2013

Eine aktualisierte Liste der Diskussionspapiere findet sich auf der Homepage:
http://www.arbeitsmarkt.wiso.uni-erlangen.de/

An updated list of discussion papers can be found at the homepage:
http://www.arbeitsmarkt.wiso.uni-erlangen.de/