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The retention effect of training – portability, visibility, and credibility¹

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Abstract:

This paper analyses the effect of training participation on employees' retention in the training establishment. It empirically combines the human capital and the monopsony theory by jointly calculating the effect of portability, visibility, and credibility of training on employee retention. We use an extensive German linked employer-employee panel data set with detailed information on training history (WeLL-ADIAB). In a comparison group approach, the probability to stay at the same employer is compared between training participants and employees who could accidentally not participate at a planned training. We are careful to control for endogeneity of training participation, unobserved time-invariant effects, and extensive individual and employer characteristics. High portability of general human capital contents and visibility of training induced by training certificates both reduce the retention effect of training. Retention is further reduced when training is credibly provided and certified by external institutions. The total effect of portable, visible, and credible training on retention is still positive, however.

JEL-Classification: J62, J63, M51, M53

Keywords: Labour Mobility, Turnover, Employment, Training

¹ We use the anonymised “*Berufliche Weiterbildung als Bestandteil lebenslangen Lernens*” (“Further Training as a Part of Lifelong Learning”, WeLL) data set provided by the Research Data Centre (FDZ) of the Federal Employment Agency at the Institute for Employment Research (IAB). Data access was via guest research spells at FDZ and afterwards via controlled data remote access at FDZ. We thank Alexandra Schmucker and Stefan Bender for advice with the data preparation and interpretation as well as Benoît Dostie, Boris Hirsch, Susanne Steffes, and Arne Warnke for useful comments on earlier versions of this paper.

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1 Introduction

The empirical literature on the effects of employee training mainly concentrates on wage and productivity increases (Dearden et al., 2000). A third effect – the retention of training participants at the training establishment – has been analysed by few empirical papers only (Benson et al., 2004; Loewenstein and Spletzer, 1999; Lynch, 1991; Parent, 1999). The possibility to retain trained workers is one of the key reasons for employer training, however, because it gives the training establishments the opportunity to recoup investments in training participants (Acemoglu and Pischke, 1999a). It therefore might be a problem that training could even reduce retention if new skills are of value to other employers and training establishments risk having their trained employees hired away (Black and Lynch, 1998). An empirical assessment of the retention effect of training therefore is an important piece of evidence for the explanation of employer investments in training that increase productivity not only in the training establishment.

The few studies on the effects of training on employee retention are based on two complementary theories, the human capital theory and the monopsony theory (Manning, 2003; Leuven, 2005). Human capital theory derives differences in the impact of training on employee retention based on the distinction between general and specific human capital in a perfect labour market (Becker, 1962). Training in general human capital should lead to a lower retention effect than specific human capital because general training is portable and increases productivity also in other establishments. These outside establishments are able to outbid training establishments because they do not have to recoup training investments. Therefore, the labour market value and the outside options of employees trained in general human capital increase (Loewenstein and Spletzer, 1999; Stevens, 1994a, 1994b). An important condition for the predictions derived from the human capital theory is that there are no market frictions that reduce employee turnover. The monopsony theory introduces a number of labour market frictions that can explain why training establishments can pay employees with general human capital training a wage below their productivity without risking that they leave the establishment (Acemoglu and Pischke, 1999a; Stevens, 1994b). Prominent examples of these market frictions are an information advantage of training establishments on the ability of training participants (Acemoglu and Pischke, 1998; Autor, 2001) or on training contents (Chang and Wang, 1996; Katz and Ziderman, 1990), a compressed wage structure (Acemoglu and Pischke, 1999b; Dustmann and Schönberg, 2009), and mobility costs (Acemoglu and Pischke, 1999a; Harhoff and Kane, 1997). One important hypothesis from the monopsony literature is that visible training should have a lower retention effect than unobservable training (Acemoglu and Pischke, 1999a; 2000; Katz and Ziderman, 1990). Information asymmetries on training contents therefore might render portable human capital into non-

portable human capital (Barron et al., 1997b; Becker, 1962, p.50-51; Loewenstein and Spletzer, 1999, p.730).

When we combine both theories, we find that establishments are willing to invest in portable human capital in labour markets with information asymmetries because they can “hide” the abilities of their best training participants (Acemoglu and Pischke, 1999a). Booth and Bryan (2005) for example argue that portable training in a labour market with frictions leads to wages lower than marginal productivity during and after training, which implies the opportunity to recoup training investments for the employer. As a consequence, retention of employees with portable training should be higher if training is not visible.

Some empirical papers on the retention effect of training only observe training as a dummy variable (Mincer, 1988) and therefore cannot analyse differences in training contents and market frictions (see for example Brunello and De Paola, 2009). Other papers distinguish either between training portability or training visibility. They use the information on portability (or visibility) to test the validity of the human capital theory (or the monopsony theory). Although both theories are usually discussed in these empirical contributions, we do not find any empirical paper that jointly assesses the retention effect of different kinds of human capital and labour market frictions.⁴ For example, Acemoglu and Pischke (1998), Chang and Wang (1996), and Katz and Ziderman (1990) show that certification or visibility of training is a key determinant of the retention effect of training. These papers however do not empirically assess the validity of human capital theory on the retention effect of training. Loewenstein and Spletzer (1999) show that the retention effect of training is lower if training participants believe that training is also useful at other employers. They however do not control for labour market frictions and therefore do not assess monopsony theory. Lynch (1991) and Parent (1999) also only look at the retention effect of more or less portable training (measured by on-the-job versus off-the-job training). Benson et al. (2004) only analyse the effect of degrees obtained by training as signalling mechanism and an indicator of visibility of training on employee retention.

This paper not only distinguishes between different kinds of human capital in training but at the same time controls for information asymmetries on the training content between training establishments and other employers. It uses certifications for training measures as indicator for the visibility of training and the subjective assessment of the training participants on the

⁴ Green et al. (2000) and Sieben (2007) have information on portability and visibility – they only can look at employee search intentions instead at real employee retention, however. Manchester (2012) argues on the basis of course descriptions and majors that information asymmetry on course contents cannot be the source of higher retention of employees who enjoyed tuition reimbursements, which is interpreted as investing in employees’ general skills. Also Booth and Bryan (2005) jointly assess portability and visibility of training, however in the context of wage effects. Their paper shows that employer-financed training (that is interpreted as portable training) only has positive wage effects at the current employer. A positive wage effect is also found after a job change if training is accredited (leading to qualifications) but not when it is non-accredited.

usability of training contents at other employers as indicator for portability. In an additional step, it distinguishes between training provided and certified by external independent institutions or by the training establishment. It hereby argues that external providers give certificates a higher credibility (Katz and Ziderman, 1990). The joint empirical assessment of the human capital and the monopsony theory on the impact of training on employee retention allows us to answer a couple of interesting questions. We can assess whether one of both theories empirically dominates the other, or in other words whether the explanatory power of one theory vanishes after controlling for the other theory. It may be the case, for example that the portability of training is less important in comparison to the visibility of training because training participation per se already is an indicator for ability irrespective of the training contents. It might also be the case however that both training characteristics are orthogonal in their effect on retention and therefore do not influence the impact of each other.

We are careful to control for the usual sources of estimation bias when assessing the effects of training. One of the central empirical problems is selectivity into training with respect to unobservable drivers (Card, 1999; Heckman, 1999). In order to overcome this problem, we use an approach proposed by Leuven and Oosterbeek (2008): instead of comparing training participants with all training non-participants, we use as comparison or control group only those employees who had been selected to participate in training but had to cancel their participation on the basis of exogenous reasons. If training participants and accidental training non-participants differ with respect to relevant unobservable characteristics although their employer chose or accepted both groups for training, the training coefficients in the OLS retention equation are still biased. Time-invariant unobserved heterogeneity affecting retention and training such as ability or motivation are therefore in addition controlled for by applying a first differences estimation. Time-varying unobserved characteristics such as career prospects are controlled for in Diff-GMM estimations. We compare the results from pooled (between), longitudinal (within) and GMM (instrumental) estimates and rigorously test the applicability of the different specifications.

Training frequently is accompanied by wage changes or changes in job satisfaction. Training establishments want to increase employee retention by increasing wages and sharing rents (Becker, 1962; Hashimoto, 1981). Wage increases after training therefore might be a key factor for the retention effect of training (Benson et al., 2004; Grund and Sliwka, 2001). Job satisfaction also might be positively correlated with contemporary training participation and with retention one period later (Jones et al., 2009; Brunello and De Paola, 2009). We cannot be certain however whether wage increases and (changes in) job satisfaction are pre-determined or constitute an additional indirect effect between training and retention because the variables are measured at the same time period. Therefore, we include wage increases

and job satisfaction in robustness tests in order to see whether training has the same direct impact on retention after controlling for these additional indirect effects.

The paper is organized as follows. Section 2 derives our hypotheses. Section 3 presents the data set, the estimation strategy and the variables. The sample characteristics, the results of the estimations and robustness checks are shown and discussed in Section 4. The paper ends with a conclusion in section 5.

2 Theoretical framework

According to Becker's traditional human capital approach, skills can be considered as enablers of individual and firm-level productivity. When assessing the impact of training on retention, we should distinguish between general and firm-specific skills. Whereas training with general contents increases the productivity of trainees at many employers, training measures imparting specific human capital enhances employees' productivity exclusively in the training establishment (Becker, 1962). In perfect labour markets, there is no reason to suppose any impact of specific training on the mobility of employees (Green et al., 2000). However, after general training, training establishments may run the risk of having their trained employees poached⁵ away (Bishop, 1997; Black and Lynch, 1998; Mohrenweiser et al., 2013). The poaching threat is lower if trained skills are not (completely) portable to other establishments. Moreover, employees' benefits of specific training are lost when workers leave the establishment. Therefore, employees and employers are interested in retention and specific training is unambiguously associated with lower turnover rates, at least if both sides contribute to the costs of training investments (Barron et al., 1997b; Loewenstein and Spletzer, 1999). The reduction in turnover after training therefore is taken as an indirect indicator for the degree of human capital specificity of training (Parent, 1999).

There are many additional reasons why the wage offer of external establishments is lower than the productivity at the training establishment which induces a reduction in trained employee turnover. The most important reasons are information asymmetry on the training content and on the productivity of the training participant as well as turnover costs (Green et al., 2000; Leuven, 2005). A further reduction of worker turnover after training might be induced by reciprocity: employees perceive firm-sponsored training courses as a kind action and workers reciprocate the training for example by staying with the establishment although they have attractive outside options (Batt, 2002; Sieben, 2007). As practically all training measures entail some specific training aspects that reduce turnover (Mincer, 1988), our first hypothesis on the impact of generic training on retention is:

⁵ If an establishment poaches away employees from a training establishment, then training investments are irretrievably lost. However, the poaching establishment enhances their establishments' human capital without paying anything for training (Mohrenweiser et al., 2013).

Hypothesis 1: There is a positive relationship between training and retention.

Although the theoretical predictions on differences in the effect of training heterogeneities on employee retention with respect to portability, visibility, and credibility are clear, all empirical papers so far concentrated on one specific aspect of training heterogeneity (Sieben, 2007). The main aim of this paper therefore is to combine previously separated hypotheses on the effects of heterogeneity in training on retention. It uses the prediction of human capital theory that portability of training content reduces the retention effect of training and the prediction of monopsony theory that visibility is negatively correlated with the retention effect of training. On the basis of the human capital theory, therefore our second hypothesis is:

Hypothesis 2: When the training content is general and therefore portable to outside employers, the retention effect of training is lower.

According to the theories based on labour market frictions, the retention probability depends on the visibility of training contents (Acemoglu and Pischke, 1999a; Chang and Wang, 1996). In practice, the current employer usually has information advantages concerning the exact content (for example focus and type) and the amount of the training. Training measures often are informal, heterogenous, and tailored to the needs of the training participants (Katz and Ziderman, 1990) and therefore hard to assess for outside establishments. Based on this information asymmetry, for outside establishments it is hardly possible to completely observe the contents of training. Since outside establishments are unable to judge the quantity and quality of training, they won't be willing to fully compensate the trained employees for these skills. Thus, they pay a wage below the real productivity of the trained employees (Acemoglu and Pischke, 1998; 1999a; Katz and Ziderman, 1990). The training establishment with an information advantage should therefore be able to match the outside wage offer for trained employees it would like to retain. However, often training measures end with the award of a certificate, a degree or an accreditation (Acemoglu and Pischke, 2000; Booth and Bryan, 2005). By means of certificates, trained employees are able to proof their efforts in the training measure, the training contents, and therefore their acquired skills also outside the training establishment. Certification therefore reduces the information asymmetry (Arcidiacono et al., 2010) and it is also an indicator of portability of training contents (Green et al., 2000). Certification improves the labour market chances of trained employees and we therefore assume on the basis of the monopsony theory:

Hypothesis 3: When training contents can be signalled by means of a certificate and therefore are visible, the retention effect of training is lower.

In addition to the visibility of training contents, also the credibility of certificates might play an important role for employee retention. Considering various types of training certificates, an independent certification system and certificates issued by accredited external institutions lead to a higher credibility of the training contents (Katz and Ziderman, 1990; Manchester, 2010). Therefore, contents acquired in courses certified by external independent institutions such as chambers of commerce or chambers of crafts are more credible (Acemoglu and Pischke, 2000). Thus, we predict:

Hypothesis 4: When training contents can be signalled by means of an external certificate, the retention effect of training is additionally reduced.

When assessing the relative importance of the human capital and monopsony theory for the retention effect of training, it is crucial to investigate whether portability and visibility are two separate mechanisms for the reduction in employee retention after training. For example, the explanatory power of portable training courses on retention might vanish if we additionally control for visibility of training courses. It might however also be the case that visibility and portability have an orthogonal effect on retention and therefore do not influence each other. One possible hypothesis therefore is:

Hypothesis 5: The measured effect of visibility and portability on retention respectively decreases, if we include the other dimension of training characteristics in the retention equation.

3 Data and estimation strategy

In order to analyse the retention effect of different training measures and to test our hypotheses, we use the German linked employer-employee dataset WeLL-ADIAB⁶. The dataset was developed within the project “Further Training as a Part of Lifelong Learning (WeLL)” with the purpose to gain a better understanding regarding “(...) the determinants and consequences of further training in Germany” (Bender et al., 2009, p. 638). In the project, 149 establishments were selected from the 2005 wave of the Institute of Employment Research (IAB) Es-

⁶ WeLL-ADIAB is the abbreviation for “WeLL survey data linked to administrative data on the IAB” (Schmucker et al., 2014).

tablissement Panel⁷. From these establishments, between the years 2007 and 2010, 7.352 randomly selected employees were asked in four annual waves⁸ about their individual training behaviour and specific training measures during the last year(s). Only employees with jobs covered by social security contributions were included in the sample selection. This excludes apprentices, people in internships and employees in partial retirement. The survey includes inter alia, details on the exact start and end date, the duration as well as the thematic focus of their training measures. We therefore know exactly at which establishment training took place.⁹ Furthermore, training participants were asked whether the training contents were portable to outside establishments, and offered and certified by external institutions (Bender et al., 2008b).

An important advantage of the data set is the linkage of the individual training information with administrative and survey data provided by the IAB in Nuremberg. Based on the Integrated Employment Biographies (IEB), the complete individual employment history is available. This history includes the start and end dates of employment periods, the exact daily wage in the respective periods, and further characteristics of employment (e.g. occupation, job status, working time), and unemployment spells. Besides workplace characteristics, the data set also comprises socio-demographic information such as age, sex, educational and vocational qualifications (Schmucker et al., 2014). The individual information of the employees can be linked to establishment-level information (e.g. establishment size, sector, location, wage level, and qualification structure), from the IAB Establishment Panel (Bender et al., 2008a; Spengler, 2007). Employment history and wage information have been collected for social insurance reasons by administrative institutions and therefore are highly reliable (Bender et al., 2009).

Given that the selection of establishments did not occur randomly, the WeLL-ADIAB dataset cannot claim to be representative for the population of German establishments (Knerr et al. 2012). Despite this limitation, the employer-employee panel structure of the data set as well as the wide range of topics relating to training is unique for Germany. Furthermore, the basic employee sample was defined as the whole workforce of about 56,000 employees in the

⁷ Only establishments with between 50 and 1,999 employees subject to social security contributions, establishments from manufacturing or the service industry and locations in the German federal states Bavaria, Schleswig-Holstein and North Rhine-Westphalia, Mecklenburg-Western Pomerania, and Saxony were selected. By stratification of the selection criteria, 12 employer groups were formed, from which in each case the five establishments with the highest and the five establishments with the lowest overall investment expenditures were asked to participate in the WeLL project. The selection criteria have been chosen in order to guarantee that the results are not driven by specific training patterns correlated with the numbers of employees, branches or regions (Bender et al., 2008b).

⁸ The first wave contains the complete training information for the years 2006 and 2007, the second wave includes the training information for the year 2008, the third wave for 2009, and the fourth wave for 2010.

⁹ Mincer (1988) stresses the importance of information on the incidence as well as timing of training and employee turnover for the causal analysis of the retention effect of training.

selected establishments. Survey participants have not been selected by the employer but were directly approached by the social research institute conducting the survey. Therefore, the employee sample is representative for the establishments with respect to important observables (Bender et al. 2008a).

For our analysis, we use the longitudinal version of the WeLL-ADIAB data set between 2006 and 2010. In order to increase the homogeneity of our sample (7,352 employees), we eliminate 1,411 employees in part-time employment. Furthermore, note that in our main specifications, 1,623 individuals without training participation nor accidental training non-participation have been excluded to obtain a homogeneous comparison group according to the comparison group approach. Thus, our sample consists of 4,318 training participants and accidental training non-participants from 149 establishments. Further descriptive statistics are reported in part 4.

Dependent variable

Brunello and De Paola (2009), Card and Sullivan (1988), Loewenstein and Spletzer (1999), and Picchio and Van Ours (2013) measure the effect of training on employee retention as the probability to stay in employment in the next period of time. In this paper, we adopt their approach but focus on future employment in the same establishment. Therefore, our dependent binary variable r_{ijt+1} takes the value of 1 if the individual i is still employed in the current establishment j in the next calendar year ($t+1$). If the individual changes the employer or is unemployed, the variable is 0.¹⁰

In the WeLL-ADIAB data set, there are individuals with several employment spells per year measured on a day-to-day basis. These spells can be in the same establishment or in various establishments. In order to calculate the employment duration and thereby the employees' retention in the period from 2006 until 2010, we use the spell that overlaps the first of January in the previous year as reference point.¹¹ Based on the employment duration, we calculate additional employment characteristics (for example working time, job status) and assign them to each employment spell. Finally, by comparing the establishment identifier on January 1st in the current and in the next year, we determine whether an individual was still employed in the same establishment during the next calendar year.

Training information

In each annual survey wave, the respondents were asked about the timing and further characteristics of the last three training measures during the last year in chronological order. If

¹⁰ We cannot distinguish between voluntary and involuntary turnover.

¹¹ Usually all employment spells start at the first of January in each year. During the year, there are only new spells in the case of well-defined changes (for example the change of employer).

the respondents stated more training measures than requested, we delete this additional information, to ensure consistency. We also delete all training measures that have no detailed information concerning their start and end dates. Hence, we are able to assign every single training measure to the appropriate employment spell. For our research question it is of particular importance that we know which employer offered the training measure. Therefore, we eliminate all training measures that could not be clearly assigned to an establishment (300 eliminations). As the training period is given with monthly precision, we also eliminate training courses that have not been finished one month before a job change (42 eliminations). We give the explanatory binary training variable d_{ijt} the value 1 if an individual participates in training offered by the training establishment j in the current calendar year t , otherwise the variable takes the value zero.

Barron et al. (1997a), Green et al. (2000) and Loewenstein and Spletzer (1999) note that training definitions differ between establishments and that information on the portability of training provided by the employer therefore is unreliable. They propose to use the assessments by training participants because they are better comparable and more reliable. We therefore rely on the subjective assessment of the training participants whether their training contents can be used in other establishments.¹²

Besides the portability of training, we also control for the visibility of training. A certificate at the end of the training course might be viewed as a means of conveying the contents and value of the training to the outside labour market (Booth and Bryan, 2005).

Credibility is measured by the fact that the training was provided and the certificate was issued by a third party and not the training establishment itself. The training establishment might use the certificate in order to disguise the true training contents. Either it may hide general contents in order to reduce the market value of employees it would like to retain or it may exaggerate training contents attractive for other employers in order to improve labour market chances of employees it would like to get rid of. External institutions might not strategically manipulate the certification of training contents, though.

Control variables

Besides information on the training participation, a couple of further individual and establishment level characteristics may have an impact on the probability to retain employees in the training establishment and on training participation.

Individual characteristics that might influence the retention probability of employees are gender, age, and schooling level (Göggel and Zwick, 2012). Qualification might be positively

¹² The exact wording of the question is: "How easily can the obtained knowledge also be used at another employer according to your opinion" (*"Inwieweit ließen sich nach Ihrer Einschätzung die erworbenen Kenntnisse auch in einem anderen Betrieb verwenden"*).

related to training and retention (Gritz, 1993). We know that older employees and those employees with higher tenure and experience are less willing to change employers. In addition, training participation decreases with age, tenure, and experience (Picchio and Van Ours, 2013; Zwick, 2015). As an indicator for the previous employment history, we consider the years of employment in the same establishment (tenure) and the professional experience (Parent, 1999; Benson et al., 2004). Furthermore, we capture age as cohort effects (more specifically, as groups of birth years) because it is often closely related to experience.

Since the propensity of the employer to train might influence the employment prospects and the retention probability of the employees (Wagner and Zwick, 2012), we additionally take establishment size, sector, and the location of the establishment into account (Loewenstein and Spletzer, 1999).

Training frequently is accompanied or followed by wage increases and these wage increases might have a decisive impact on the decision to stay at the training employer (Chéron et al., 2010; Mincer, 1988; Parent, 2003). In contrast to previous studies, in which individual wages are observed only at one point in time (Gritz, 1993; Lynch, 1991; Parent, 2003), respectively at the beginning and at the end of the observation period (Benson et al., 2004), we can consider individual wage changes on an annual basis. To control for general wage increases in the establishment, we define an individual wage increase as an individual wage change that exceeds the average establishment-wide wage increase in the respective occupational peer group. According to this definition, our binary wage increase variable takes the value of 1, if the wage increase of individual i is higher than the average wage increase of individuals in the same occupation in the establishment j in the current calendar year t . In our data structure, wages may differ between several employment spells in one establishment and year. For the calculation of the individual wage increase, we therefore use the weighted daily wage¹³ of the employees by establishment and year. In the case of unemployment spells, the daily wage is set to zero.

Job satisfaction is another potential mechanism between training and retention (Georgellis and Lange, 2007). Job satisfaction might also capture additional dimensions of otherwise unobservable individual characteristics (Brunello and De Paola, 2009). We therefore control for yearly changes in general job satisfaction that is individually assessed in our data set (Zwick, 2015). However, as job satisfaction and wage increase are measured at the same time period as retention, both variables might be outcomes instead of controls for employee retention and therefore so-called “bad controls” in our regressions (Angrist and Pischke,

¹³ In order to obtain the weighted daily wage, first daily wage is multiplied by the number of days in the corresponding employment spell and divided by the overall duration of all employment spells by employer and year. Although it is not possible to assign the annual wage increase exactly to the start and end date of training, we are able to take into account changes in daily wages as a consequence of an employer change during the year.

2009, pp. 64-66). We therefore only use these variables in a robustness check in order to show whether the impact of training on retention is direct or whether it works indirectly through wage increases or higher job satisfaction.

Estimation strategy

Our main contribution to the literature is the analysis of the impact of portability, visibility, and credibility on the retention effect of training. In order to do this, we expand the training participation dummy by indicators of whether training is of general content, whether training was completed with a certificate or not, and whether the certificate was issued by an external provider or not.

In estimations of the impact of training participation on the employees' retention in the training establishment, a couple of estimation problems may occur, which might lead to biased estimators and results. First, it is important to adopt a "before-and-after" approach, i.e. training participation in period t is related to employment in period $t+1$ because this avoids reverse causality (Dearden et al., 1997). We therefore use training participation as determinant of retention in the training establishment in the next calendar year.

Besides the timing of events, we have to take into account that the selection of employees into training usually is not random, or in other words third factors such as job satisfaction, ability or tenure have an influence on training participation in t and retention in $t+1$ (Card, 1999; Heckman, 1999). There are several solutions to the endogeneity problem and we show how our results differ if we apply these solutions in turn. One solution to reduce the potential of unobserved third factors to influence the coefficients is proposed by Leuven and Oosterbeek (2008). They compare training participants only with those employees who were selected to participate in training but could not participate on the basis of exogenous reasons. The reduction in the sample to training participants and accidental training non-participants as comparison group clearly reduces the potential impact of endogeneity because all employees who have not been selected into training on the basis of unobserved characteristics are not compared to the training participants. In the WeLL data, the question to identify accidental training non-participants is: "Did you intend to participate in training courses, seminars or lectures in the last two years without realizing this plan?".¹⁴ It is crucial that the reasons for non-participation are random because otherwise selection bias could contaminate the results (Görlitz, 2011). Employees cancelling a course because of high training costs are probably not comparable to training participants, for example. Therefore, we have to take a closer look at the reasons of training cancellation. We regard the following reasons as random: the course was cancelled by the training organiser or an unexpected job

¹⁴ We include accidental training non-participants only for those years in which they had been chosen for training but did not participate.

had priority¹⁵. We use the reduced sample of training and accidental training non-participants in all main tables of the paper and compare the results obtained with the full sample in a robustness check.

Based on this comparison group approach, in our first estimation of the retention effect of training, we use the training information d_{ijt} employing an ordinary least squares estimation. In addition, we include birth year, tenure, experience, gender, and qualification in an individual information vector X_{it} . Finally, we also include an establishment characteristics vector Z_{jt} with employer size and sector, and year dummies t . The variance in our cross section specification comes from differences in training participation between employees and the regression can be written like this (with ε being an idiosyncratic error term):

$$r_{ijt+1} = c + \alpha d_{ijt} + \beta' X_{it1} + \gamma' Z_{jt} + t + \varepsilon_{it} \quad (1)$$

It might be the case however that training participants and accidental training non-participants nevertheless differ in time-variant or time-invariant characteristics related to both, training participation and retention. We therefore estimate all variables in time differences (first difference approach, FD). Our model in first time differences eliminates all time-fixed individual unobserved heterogeneity such as ability or motivation and can be written as (with Δ as indicator for differences from year to year and X_{it2} a smaller vector of the time-varying individual characteristics job satisfaction, tenure, experience)¹⁶:

$$\Delta r_{ijt+1} = c + \alpha \Delta d_{ijt} + \beta' \Delta X_{it2} + \gamma' \Delta Z_{jt} + t + \varepsilon_{it} \quad (2)$$

Even if we reduce the sample to training and accidental training non-participants and control for time-invariant unobserved heterogeneity, unobserved time-variant factors such as future employment expectations at the training establishment or the chance of the employee to get a promotion within the employer may have an impact on training participation and current retention. Therefore, in our third and preferred estimation approach, we use the Arellano-

¹⁵ There is some debate whether family or health reasons also can be regarded as random cancellation reasons (Görlitz, 2011). The main argument against this assumption is that employees with long-lasting health problems or for example employees with young children or care duties for elderly parents might routinely have to cancel training participation. Very few employees indicated that family or health was the reason for training non-participation and therefore we drop these cases from our sample. If we include them into the group of training non-participants, our results are unchanged, however.

¹⁶ Note that estimating the retention effect of training in time differences controls for the selection effect of employees into training establishments and measures the effect of training participation only (Manchester, 2012).

Bond difference GMM estimator (Diff GMM)¹⁷ (Arellano and Bond, 1991; Roodman, 2006). In the Diff GMM estimation, the lagged levels (internal instruments) of the endogenous explanatory variables are added to the estimation in first differences. By doing so, the endogenous variables are pre-determined and not correlated anymore with the error term in the initial estimation equation (Roodman, 2006).

Some authors propose to use external instruments. However, the usage of external instruments¹⁸ reduces our sample size substantially¹⁹. In addition, many papers on the effects of training argue that it is very hard to come up with a convincing instrument (Dearden et al. 1997; Leuven, 2005). We therefore show the results of the Diff GMM estimation with an external instrument in a robustness check only.

4 Findings

Descriptive statistics

Table 1 shows descriptive sample characteristics separately for training participants and accidental training non-participants. The majority of the respondents is male and is born between 1952 and 1971. Whereas most of the survey participants (79.12%) have at least a professional experience of 10 years, only 54.63% have worked with the same establishment for more than 10 years. Regarding the educational background, 3.72% have no vocational education, 68.67% completed vocational education, and 27.63% hold a university degree. Furthermore, 35.57% of the respondents receive a higher wage increase than their occupational peer group in the establishment. In 75.22% of the training measures, the employees receive training certificates, which are frequently provided by external institutions (84.31%). Furthermore, there is a relatively high share of training measures with general and therefore portable training contents, according to the training participants (82.68%).

¹⁷ More precisely, we use the one-step Arellano-Bond difference GMM estimator, which is not robust to panel-specific autocorrelation and heteroscedasticity. We therefore test for autocorrelation and use heteroscedasticity corrected standard errors. Furthermore, we apply the small-sample adjustment (Arellano and Bond, 1991).

¹⁸ We use establishments' expectations of skill shortages as external instrument. If establishments expect skill shortages, this should lead to more training in the establishment and therefore to a higher individual training probability. However, expected skill shortages should not affect the short-run individual retention probability. Therefore, this instrument is assumed to be valid.

¹⁹ In addition to the differenced equation in the Diff GMM estimation, the system GMM estimator uses the level equation to obtain a system of two equations. As the variables in levels in the second equation are instrumented with their own first differences, additional instruments can be obtained (Blundell and Bond, 1998). However, this approach reduces the sample size by one observation per individual. Furthermore, it is not appropriate to use a system GMM estimation with a comparably small data set as is the case in the current paper.

Table 1: Description of differences between training participants and accidental training non-participants

Socio-demographic Factors	Total	Training participants	Accidental training non-participants	t-value
female	29.55%	29.47%	30.04%	0.43
<u>birth year</u>				
≤ 1951	9.98%	10.51%	6.70%	-4.35***
1952-61	35.14%	35.73%	31.44%	-3.08***
1962-71	32.06%	31.94%	32.84%	0.66
≥ 1972	22.81%	21.83%	29.01%	5.87***
<u>experience</u>				
< 10 years	20.88%	19.70%	28.28%	7.24***
10 – 20 years	49.86%	50.46%	46.10%	2.99***
> 20 years	29.26%	29.84%	25.63%	3.17***
<u>tenure</u>				
< 10 years	45.42%	44.19%	53.17%	6.18***
10 – 20 years	37.75%	38.79%	31.22%	-5.35***
> 20 years	16.83%	17.02%	15.61%	-1.29
<u>education</u>				
no vocational education	3.72%	3.54%	4.91%	2.42**
vocational education	68.67%	69.00%	66.51%	-1.78*
university degree	27.63%	27.47%	28.58%	0.83
job satisfaction dummy	82.81%	84.14%	74.45%	-8.83***
<u>wage increase dummy</u>	35.57%	35.97%	32.91%	-2.11**
log daily wage 2005	4.61	4.61	4.58	-1.34
log daily wage 2006	4.65	4.67	4.60	-2.28**
log daily wage 2007	4.64	4.67	4.49	-5.24***
log daily wage 2008	4.65	4.68	4.41	-6.08***
<u>training</u>		-	-	
training certificate	75.22%	-	-	
external certificate given that there is a training certificate	84.31%	-	-	
training with general content	82.68%	-	-	
observations	8,186	6,860	1,326	

We use a comparison group approach and therefore reduce the problem that training participants have been selected by unobserved third factors that may be relevant for retention. As a consequence, unobservable as well as observable characteristics of training participants and accidental training non-participants should be more similar than the characteristics of training participants and all training non-participants in the original sample. Indeed, accidental training non-participants are more similar to training participants than all training non-

participants. In Table 1, we see socio-demographic differences between participants and accidental training non-participants in age, in professional experience, tenure, and in job satisfaction. However, there are no gender differences and differences in the educational background of both groups. In the context of unobservable characteristics driving training participation, especially the educational background is very important because it is closely linked to factors such as motivation and innate ability (Görlitz, 2011). According to Pischke (2001), differences in unobservable characteristics between training participants and training non-participants are often reflected by past wage differentials.²⁰ Whereas the log daily wage of training participants and accidental training non-participants differs significantly for the years in the observation period, we cannot find significant differences for the year 2005, prior to our observation period when we cannot observe training participation of both groups.

In order to test whether our reduced sample of accidental training non-participants is better comparable to training participants than all training non-participants, we also present the descriptive statistics of the full sample in Table A1 in the appendix. Training participants have significantly higher daily wages than all training non-participants not only in the observation period, but also in the year 2005 (Table A1, $t = -7.98^{***}$). Thus, both groups already differ significantly in the full sample in the period before they were asked about their individual training behavior. Furthermore, training participants are also significantly higher educated compared to all training non-participants (Table A1). Therefore accidental training non-participants are indeed more similar to training participants with respect to decisive characteristics than all training non-participants.

Retention effect of training

In the multivariate analyses, we first test whether training increases the employees' retention when we additionally control for important individual and establishment characteristics. Table 2 shows the regression output for the different estimation methods ordinary least squares (OLS), first differences (FD), and Difference General Method of Moments (Diff GMM) using our comparison group approach.

²⁰ As administrative labour market history data are linked to the survey data, the WeLL-ADIAB also contains wage information for the time before the period covered by the training questions.

Table 2: Determinants of employee retention, training dummy

Dependent variable: retention next year	Model with training dummy		
	OLS (1)	FD (2)	Diff GMM (3)
training	0.087*** (0.007)	0.091*** (0.011)	0.118*** (0.024)
female	-0.003 (0.005)	-	-
birth year 1952-1961	-0.014* (0.008)	-	-
birth year 1962-1971	-0.018** (0.009)	-	-
birth year > 1972	-0.023** (0.012)	-	-
tenure < 10	-0.027*** (0.009)	0.292*** (0.028)	0.393*** (0.093)
tenure 10-20	0.009 (0.009)	0.207*** (0.028)	0.194** (0.077)
experience < 10	-0.033** (0.011)	-0.039 (0.036)	-0.070 (0.065)
experience 10-20	-0.007 (0.007)	-0.009 (0.027)	-0.010 (0.038)
vocational education	-0.012 (0.012)	-	-
university degree	-0.016 (0.013)	-	-
year dummies	yes	yes	yes
establishment characteristics	yes	yes	yes
R ²	0.052	0.052	-
observations	8,186	8,186	3,339
individuals	-	4,318	2,119
AR-test	-	-	0.844
Hansen-test	-	-	0.334

Dependent variable: retention probability in the next calendar year; reference category for age: birth year \leq 1951; reference category for tenure: tenure \geq 20; reference category for experience: experience \geq 20; reference category for education: no vocational education; establishment characteristics: size, sector; *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$; Source: WeLL-ADIAB 2006-2010.

The OLS estimation suggests that training participation increases the retention probability in the training establishment in the next calendar year on average by 8.7 percentage points. Controlling additionally for time-fixed individual unobserved heterogeneity and endogeneity, we find a retention effect of 9.1 percentage points in the FD and of 11.8 percentage points in the Diff GMM estimation. We therefore find support for our first hypothesis. It seems that the first two models underestimate the retention effect of training probably due to measurement errors. A positive retention effect of training is in accordance with the findings in Dearden et al. (1997), Loewenstein and Spletzer (1998), Mincer (1988), and Kampkötter and Marggraf (2015). Veum (1997) and Brunello and De Paola (2009) however do not find a training effect on retention. Haines et al. (2010) even find a negative effect of training on voluntary employee turnover in Canada. When focusing on our preferred model – the Diff GMM estimation in model 3 – we see that individuals with shorter job tenure have a higher probability to be retained (also compare Benson et al., 2004). The OLS estimation in addition indicates that

there are hardly any gender differences in the retention rate and older employees have a higher probability to stay in the current establishment (model 1), which is also found by Brunello and De Paola, 2009. The AR-test in the Diff GMM estimation indicates that there is no autocorrelation in levels. Since the Hansen-test is insignificant ($p=0.334$), we conclude that the internal instruments are valid.

Once we know that training generally increases the employees' retention in the current establishment, in the next step we investigate whether the retention effect is influenced by portability and visibility of training measures (Table 3). When the training content is portable to outside establishments, this significantly reduces the retention effect from about 10 percent to about 8 percent in the OLS and in the FD model. Also Loewenstein and Spletzer (1999) find a significantly lower retention effect for training that is general and portable (e.g. schooling) in comparison to rather specific measures such as company training.²¹

We also find a lower retention effect for visible training measures (models 4 – 6). This finding is in accordance with Benson et al. (2004) who stress that training participants receiving a degree after training are more likely to quit than without a degree. Dearden et al. (1997) also find a stronger effect of training with qualification than for training without qualification. These interaction effects of visibility are of the same magnitude as those of portability. Again, they are however not significant in the Diff GMM estimation. The retention effects of the other control variables in the different model specifications are robust to the addition of the interaction terms. Furthermore, in model 3 as well as in model 6, the AR-tests and the Hansen-tests indicate that there is no autocorrelation in levels and that the instruments are valid. We therefore find weak support for our second and third hypothesis only if we do not control for endogeneity using Diff GMM.

²¹ Green et al. (2000) find a positive correlation between transferability of training and mobility expectations of workers. Assuming that off-the-job training is rather general, Lynch (1991) and Parent (1999) find that these measures have a stronger negative retention effect than on-the-job training. Dearden et al. (1997) find a higher negative retention effect of training for employee-funded than for employer-funded training. We also find an additional positive retention effect for training at the workplace and for employer-funded training, when focusing on these measures.

Table 3: Determinants of employee retention, inclusion of training interacted with visibility and portability

Dependent variable: retention next year	Models with general content			Models with training certificate		
	OLS (1)	FD (2)	Diff GMM (3)	OLS (4)	FD (5)	Diff GMM (6)
training	0.099*** (0.009)	0.110*** (0.015)	0.130*** (0.027)	0.100*** (0.008)	0.109*** (0.013)	0.136*** (0.028)
training * general content	-0.014** (0.007)	-0.021* (0.012)	-0.013 (0.015)	-	-	-
training * certificate	-	-	-	-0.017*** (0.006)	-0.022** (0.010)	-0.023 (0.015)
female	-0.003 (0.005)	-	-	-0.003 (0.005)	-	-
birthyear 1952-1961	-0.014 (0.008)	-	-	-0.013 (0.008)	-	-
birthyear 1962-1971	-0.018** (0.009)	-	-	-0.018** (0.009)	-	-
birthyear > 1972	-0.023** (0.012)	-	-	-0.023** (0.012)	-	-
tenure < 10	-0.026*** (0.009)	0.293*** (0.028)	0.394*** (0.093)	-0.025*** (0.009)	0.292*** (0.028)	0.392*** (0.092)
tenure 10-20	0.009 (0.008)	0.208*** (0.028)	0.194** (0.077)	0.010 (0.009)	0.207*** (0.028)	0.193** (0.077)
experience < 10	-0.033*** (0.011)	-0.039 (0.036)	-0.070 (0.065)	-0.032*** (0.011)	-0.040 (0.036)	-0.069 (0.065)
experience 10-20	-0.007 (0.007)	-0.010 (0.027)	-0.010 (0.038)	-0.007 (0.007)	-0.010 (0.027)	-0.009 (0.038)
vocational education	-0.012 (0.012)	-	-	-0.012 (0.012)	-	-
university degree	-0.014 (0.013)	-	-	-0.015 (0.013)	-	-
year dummies	yes	yes	yes	yes	yes	yes
establishment characteristics	yes	yes	yes	yes	yes	yes
R ²	0.053	0.053	-	0.053	0.053	-
observations	8,186	8,186	3,339	8,186	8,186	3,339
individuals	-	4,318	2,119	-	4,318	2,119
AR-test	-	-	0.806	-	-	0.816
Hansen test	-	-	0.338	-	-	0.324

Dependent variable: retention probability in the next calendar year; reference category for age: birth year ≤ 1951; reference category for tenure: tenure ≥ 20; reference category for experience: experience ≥ 20; reference category for education: no vocational education; establishment characteristics: size, sector; *** p < 0.01; ** p < 0.05; * p < 0.1; Source: WeLL-ADIAB 2006-2010.

In order to check whether training with general human capital content and training with certificates are not exactly the same measures, in the next step we simultaneously consider both interactions in one model (Table 4, models 1 – 3). Especially the coefficients of training with general contents are smaller and lose significance in this specification. Again, the AR-test and the Hansen-test indicate that there is no autocorrelation in levels and that the instruments are valid. Furthermore, the retention effect of the other control variables is practically unchanged in comparison to the previous estimations. Based on these results, we see that especially the visibility of training by means of a certificate, dominates the negative retention effect measured separately. Our fifth hypothesis is therefore supported.

According to our hypothesis four, the negative retention effects of general and certified training measures are stronger, when we focus exclusively on training measures provided and certified by external independent institutions (models 4 – 6). When individuals participate in externally provided training measures with general content, this reduces the retention probability by 3.9 percentage points. Furthermore, we find a large negative retention effect (3.3 percentage points) for training measures that are certified by external institutions. Visibility and portability have a distinct impact on retention and the other covariates hardly change compared to the other estimation models. The AR-test in the Diff GMM model indicates that there is no autocorrelation in levels. The instruments seem to be valid (Hansen-test). We conclude that training certificates from external providers can be considered as powerful signals for training participants' ability. In consequence, employees participating in these portable and visible measures are able to credibly prove their acquired skills to potential new employers. Individual career and earning prospects can be improved and employees have higher incentives to leave the current establishment than other training participants.

Table 4: Determinants of employee retention, joint control of visibility and portability

Dependent variable: retention next year	Models with general content and certificate			Models with general content and certificate (if certificate is externally provided)		
	OLS (1)	FD (2)	GMM (3)	OLS (4)	FD (5)	GMM (6)
training	0.108*** (0.010)	0.123*** (0.016)	0.144*** (0.030)	0.128*** (0.016)	0.143*** (0.026)	0.173*** (0.038)
training * general content	-0.011 (0.007)	-0.018 (0.012)	-0.010 (0.015)	-0.026** (0.013)	-0.018 (0.019)	-0.039** (0.019)
training * certificate	-0.015*** (0.007)	-0.020** (0.010)	-0.022 (0.015)	-0.021** (0.010)	-0.040** (0.017)	-0.033* (0.019)
female	-0.003 (0.005)	-	-	0.001 (0.008)	-	-
birth year 1952-1961	-0.013 (0.008)	-	-	-0.018 (0.008)	-	-
birth year 1962-1971	-0.018** (0.009)	-	-	-0.018** (0.009)	-	-
birth year > 1972	-0.023** (0.012)	-	-	-0.023** (0.012)	-	-
tenure < 10	-0.025*** (0.009)	0.293*** (0.028)	0.393*** (0.093)	-0.035*** (0.013)	0.302*** (0.040)	0.285*** (0.100)
tenure 10-20	0.010 (0.009)	0.208*** (0.028)	0.194** (0.077)	0.003 (0.013)	0.203*** (0.039)	0.125 (0.088)
experience < 10	-0.033*** (0.011)	-0.041 (0.036)	-0.070 (0.065)	-0.035** (0.016)	-0.002 (0.051)	-0.035 (0.074)
experience 10-20	-0.007 (0.007)	-0.010 (0.027)	-0.009 (0.038)	-0.008 (0.010)	0.006 (0.038)	-0.010 (0.046)
vocational education	-0.011 (0.012)	-	-	0.009 (0.019)	-	-
university degree	-0.014 (0.013)	-	-	0.007 (0.019)	-	-
year dummies	yes	yes	yes	yes	yes	yes
establishment charac- teristics	yes	yes	yes	yes	yes	yes
R ²	0.054	0.054	-	0.061	0.054	-
observations	8,186	8,186	3,339	4,879	4,879	1,954
individuals	-	4,318	2,119	-	2,734	1,345
AR-test	-	-	0.787	-	-	0.384
Hansen test	-	-	0.328	-	-	0.121

Dependent variable: retention probability in the next calendar year; reference category for age: birth year ≤ 1951; reference category for tenure: tenure ≥ 20; reference category for experience: experience ≥ 20; reference category for education: no vocational education; establishment characteristics: size, sector; *** p < 0.01; ** p < 0.05; * p < 0.1; Source: WeLL-ADIAB 2006-2010.

Robustness checks

In order to ensure that our results are not distorted by estimation problems or the sample selection, we run a series of robustness checks. First, as the dependent retention variable is a binary variable, for the model specifications in Table 4, we additionally calculate marginal effects in a Linear Probit model (Table A2). The results in model 1 suggest that training increases the probability to retain the employee in the training establishment by 12.8 percentage points. However, this positive effect is reduced by 1.2 percentage points when training contents are general and by 1.4 percentage points when trained employees are able to make

the contents visible to outside establishments by means of a certificate. Again, these negative effects are stronger, when we focus exclusively on externally provided training measures. When individuals participate in externally provided training with general content, this reduces the retention rate even by 3.3 percentage points. Furthermore, when training participants receive certificates from an external independent institution, this additionally reduces the retention probability by 2.0 percentage points. Thus, the marginal effects in the Linear Probit model are comparable to the results obtained in the OLS, the FD, and the Diff GMM model in Table 4. This result is also obtained for the retention effects of the other covariates.

In the context of our estimation strategies, we already discussed the possibility to use an external instrument in the Diff GMM estimation as a further robustness check. We therefore use establishments' expectations of skill shortages as exogenous instrument. Expected skill shortages should lead to more training in the establishment but shouldn't directly affect the short-run individual retention probability. Therefore, this instrument is assumed to be exogenous.²² However, the required establishment information for the external instrument substantially reduces the number of observations to 1,087. For that reason, in the basic model of Table A3 the additional negative retention effects of general (-0.1 percentage points) and certified (-0.7 percentage points) training measures are rather small and no longer significant. Again, we find stronger negative effects for training measures that are portable (-2.9 percentage points) and visible (-0.8 percentage points), of which only portability is significant. Furthermore, in both models with exogenous instruments, neither the AR-test nor the Hansen-test achieves better results than in our basic model. Therefore, we prefer the basic model without external instruments.

By using the approach of Leuven & Oosterbeek (2008), we restricted our sample exclusively to training participants and accidental training non-participants. As already shown in the descriptive statistics, both groups of this subsample are much more similar than training participants and all non-trainees in the original sample. In order to test whether unobserved heterogeneity between training non-participants affects the estimation results, based on the full sample we run an additional robustness check of our basic models (compare Table A4). Whereas the positive retention effects of training are quite robust in all model specifications, the additional effects of general and certified training measures differ. Especially the additional positive effect of general training contents in the FD and in the Diff GMM estimations does not make any sense. Moreover, in contrast to all previous results, we only find a significant negative effect in the case of externally provided certificates. The distortion of the ef-

²² We however do not know whether expected skill shortages do not trigger other measures besides training to reduce employee turnover (Batt, 2002, also see our discussion of shortcomings of the data set at the end of the paper).

fects may be a result of higher unobserved individual heterogeneity in the full sample. Therefore, the restriction of the comparison group to accidental training non-participants seems to be a good strategy.

In our last robustness check, we also include changes in job satisfaction and wage increases as potentially additional channels between training and retention in our preferred estimation model (Table A5). These potentially endogenous variables have the expected positive impact on retention. The training coefficient and the interaction terms with portability and visibility are somewhat smaller and less significant, the main picture is preserved, however (compare the results with Table 4). We therefore can conclude that training as well as portability and visibility have direct effects on retention and these effects are not fully mediated by job satisfaction and wage increases.

5 Conclusion

The objective of this paper is to determine the retention effect of training. On the basis of large linked employer-employee panel data with detailed information on the employees' training history, we find that training has a significantly positive retention effect. According to human capital theory, portability of training reduces the retention effect (in most specifications). According to monopsony theory, visibility of training also reduces the retention effect (in most specifications). These additional negative effects are much stronger if training is credible, i.e. it is provided and certified by external training institutions. In addition, visibility and portability have distinct and comparable negative effects on retention. The total retention effect of training after controlling for portability, visibility, and credibility however is still positive, in other words, training providers can increase their chances to keep employees even by offering training measures that increase productivity in other establishments and lead to credible certificates outside employers can easily assess.

We are careful to avoid the estimation problems usually encountered when measuring the effects of training. We use a comparison or control group approach and compare training participants with accidental training non-participants – employees who had been chosen to participate in training but had to cancel participation on the basis of exogenous reasons. We have high quality administrative spell data with daily accuracy on the labour market history of all employees included. Our measure of retention therefore indicates whether the employee stayed at the employer he or she worked for during the previous year and whether the training received during this time spell was at this employer or not. In addition, we account for unobserved time-invariant heterogeneity in first difference regressions and for endogeneity in Diff GMM estimations using internal instruments. Finally, we include a broad range of individual and establishment characteristics that determine retention. We show that our results are quite robust to changes in the estimation technique and the inclusion of additional ex-

planatory variables and external instruments. We expand the sample to include all training non-participants in our control group. We also expand our estimations by taking into account wage increases and changes in job satisfaction in order to include additional channels between training and retention.

Summing up, we are still left with the puzzle why there is a strong positive retention effect of general, visible, and credible training. A reason could be that there are additional mechanisms we cannot control for with our data set²³. Training establishments might be able to hide their most able employees because important dimensions of ability cannot be signalled on the basis of the training participation certificates (Acemoglu and Pischke, 1998; Autor, 2001; Manchester, 2010; Mohrenweiser et al., 2015). Reciprocity might also be a mechanism that increases retention of employees trained with portable and visible human capital (Kampkötter and Markgraf, 2015). It also might be the case that complementary (yet unobserved) human resources measures such as long-term incentives drive the retention effect (Green et al., 2000; Batt, 2002). Another important expansion of the paper would be to differentiate between voluntary and involuntary turnover. For example, Shaw et al. (1998) find that employers with higher training incidence also have higher discharge rates. It remains unclear whether this correlation is a consequence of a stronger focus on performance in training establishments or whether training programmes are initiated in order to counter the poor quality of the labour pool that lead to higher discharges.

Some papers propose hypotheses for further sub-samples of the data set. Loewenstein and Spletzer (1999) and Booth and Bryan (2005) for example argue that invisibility might render portable training into non-portable training. Therefore, the negative retention effect of portable training might only occur if training is visible. Spence (1973) argues that visibility of training per se leads to a reduction in retention irrespective of training portability. Visible and credible training might for example reveal the motivation to exert effort (Acemoglu and Pischke, 1998). This increases the labour market value of training participants even if training contents do not directly increase productivity in other establishments and therefore visibility also decreases retention for non-portable training contents. Unfortunately, the sample sizes for these training sub-groups are too small and therefore we have to leave these questions on the heterogeneity of different training measures to future research on the basis of larger data sets.

²³ Manchester (2012) stresses that the retention effect has to be separated into the (stronger) sorting and the pure participation effect. As we calculate the retention effect on the basis of within changes of employees, we only measure the pure participation effect.

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Appendix

Table A1: Description of differences between training participants and all training non-participants

Sociodemographic factors	Total	Training participants	Training non-participants	t-value
female	28.52%	29.47%	27.57%	-3.06***
<u>birth year</u>				
≤ 1951	12.09%	10.51%	13.91%	-7.43***
1952-61	35.52%	35.73%	33.94%	1.62*
1962-71	30.76%	31.94%	29.45%	-3.91***
≥ 1972	21.63%	21.83%	19.85%	-3.54***
<u>experience</u>				
< 10 years	20.62%	19.70%	18.40%	-2.41**
10 – 20 years	50.12%	50.46%	50.71%	0.35
> 20 years	29.27%	29.84%	30.89%	1.66*
<u>tenure</u>				
< 10 years	43.89%	44.19%	42.82%	-2.01**
10 – 20 years	37.52%	38.79%	38.14%	-0.96
> 20 years	18.59%	17.02%	19.04%	3.79***
<u>education</u>				
no vocational education	6.06%	3.54%	6.85%	10.31***
vocational education	73.41%	69.00%	75.59%	10.56***
university degree	20.53%	27.47%	17.56%	-17.24***
job satisfaction dummy	79.98%	84.14%	77.34%	-12.34***
<u>wage increase dummy</u>	34.46%	35.97%	34.49%	-2.21**
log daily wage 2005	4.52	4.62	4.46	-7.98***
log daily wage 2006	4.57	4.66	4.52	-9.22***
log daily wage 2007	4.54	4.67	4.46	-11.17***
log daily wage 2008	4.52	4.68	4.42	-11.09***
<u>training</u>				
training certificate	75.22%	-	-	-
external certificate	84.31%	-	-	-
training with general content	82.68%			
observations	22,140	8,599	13,541	

Table A2: Determinants of employee retention; marginal effects after Probit

Dependent variable: retention next year	Basic Models	Basic Models with externally provided training certificate
	Probit (1)	Probit (2)
training	0.128*** (0.026)	0.224*** (0.062)
training * general content	-0.012** (0.005)	-0.033*** (0.010)
training * certificate	-0.014*** (0.004)	-0.020*** (0.008)
female	-0.002 (0.004)	0.001 (0.005)
birth year 1952-1961	-0.016* (0.009)	-0.032* (0.017)
birth year 1962-1971	-0.019** (0.009)	-0.037** (0.017)
birth year > 1972	-0.027* (0.014)	-0.040* (0.002)
tenure < 10	-0.031*** (0.009)	-0.046*** (0.013)
tenure 10-20	-0.009 (0.008)	-0.024* (0.013)
experience < 10	-0.010 (0.009)	-0.013 (0.012)
experience 10-20	0.001 (0.005)	-0.001 (0.007)
vocational education	-0.001 (0.008)	0.017 (0.013)
university degree	-0.002 (0.009)	0.014 (0.010)
year dummies	yes	yes
establishment characteristics	yes	yes
R ²	0.180	0.190
observations	8,086	4,682
individuals	-	-
AR-test	-	-
Hansen test	-	-

Dependent variable: retention probability in the next calendar year; reference category for age: birthyear ≤ 1951; reference category for tenure: tenure ≥ 20; reference category for experience: experience ≥ 20; reference category for education: no vocational education; establishment characteristics: size, sector; *** p < 0.01; ** p < 0.05; * p < 0.1; Source: WeLL-ADIAB 2006-2010.

Table A3: Determinants of employee retention; Diff GMM with external instruments

Dependent variable: retention next year	Basic Model	Model with externally provided training certificate
	GMM (1)	GMM (2)
training	0.053* (0.029)	0.090** (0.040)
training * general content	-0.001 (0.014)	-0.029* (0.016)
training * certificate	-0.007 (0.015)	-0.008 (0.015)
female	-	-
birth year 1952-1961	-	-
birth year 1962-1971	-	-
birth year > 1972	-	-
tenure < 10	-0.140 (0.093)	-0.185* (0.101)
tenure 10-20	-0.163 (0.105)	-0.196** (0.097)
experience < 10	0.028 (0.063)	0.062 (0.079)
experience 10-20	0.037 (0.042)	0.048 (0.055)
vocational education	-	-
university degree	-	-
year dummies	yes	yes
establishment characteristics	yes	yes
R ²	-	-
observations	1,810	1,087
individuals	1,200	790
AR-test	0.092	0.531
Hansen test	0.265	0.059

Dependent variable: retention probability in the next calendar year; reference category for age: birthyear ≤ 1951 ; reference category for tenure: tenure ≥ 20 ; reference category for experience: experience ≥ 20 ; reference category for education: no vocational education; establishment characteristics: size, sector; exogenous instruments: expected skill shortages; *** p < 0.01; ** p < 0.05; * p < 0.1; Source: WeLL-ADIAB 2006-2010.

Table A4: Determinants of employee retention; full sample

Dependent variable: retention next year	Basic Models			Basic Models with externally provided training		
	OLS (1)	FD (2)	GMM (3)	OLS (4)	FD (5)	GMM (6)
training	0.092*** (0.010)	0.076*** (0.011)	0.074*** (0.013)	0.110*** (0.017)	0.102*** (0.020)	0.117*** (0.020)
wage increase	0.043*** (0.004)	0.037*** (0.005)	0.043*** (0.006)	0.048*** (0.005)	0.042*** (0.006)	0.044*** (0.007)
training * general content	-0.010 (0.009)	0.006 (0.011)	0.017 (0.012)	-0.022 (0.015)	0.011 (0.018)	0.001 (0.015)
training * certificate	-0.010 (0.007)	-0.006 (0.009)	0.004 (0.011)	-0.016 (0.012)	-0.026* (0.015)	-0.019 (0.016)
female	0.008* (0.005)	-	-	0.011** (0.005)	-	-
birth year 1952-1961	-0.008 (0.006)	-	-	-0.007 (0.007)	-	-
birth year 1962-1971	-0.007 (0.007)	-	-	-0.007 (0.008)	-	-
birth year > 1972	-0.032*** (0.010)	-	-	-0.033*** (0.011)	-	-
tenure < 10	-0.071*** (0.007)	0.170*** (0.020)	0.314*** (0.051)	-0.082*** (0.009)	0.180*** (0.023)	0.240*** (0.048)
tenure 10-20	0.011 (0.007)	0.046** (0.018)	0.008 (0.037)	0.008 (0.008)	0.034 (0.021)	-0.033 (0.039)
experience < 10	-0.058*** (0.010)	-0.065 (0.025)	-0.106 (0.041)	-0.064*** (0.011)	-0.051* (0.030)	-0.097** (0.042)
experience 10-20	-0.021*** (0.006)	-0.008 (0.018)	-0.001 (0.023)	-0.023*** (0.007)	-0.006 (0.021)	-0.013 (0.023)
job satisfaction	0.012*** (0.001)	0.009 (0.002)	0.006 (0.005)	0.013*** (0.001)	0.008 (0.003)	0.003 (0.005)
vocational education	0.002 (0.009)	-	-	0.009 (0.010)	-	-
university degree	-0.002 (0.010)	-	-	0.003 (0.011)	-	-
year dummies	yes	yes	yes	yes	yes	yes
establishment charac- teristics	yes	yes	yes	yes	yes	yes
R ²	0.095	0.063	-	0.103	0.066	-
observations	17,177	17,177	11,722	13,958	13,958	8,127
individuals	-	5,941	5,378	-	5,703	4,363
AR-test	-	-	0.067	-	-	0.000
Hansen test	-	-	0.617	-	-	0.046

Dependent variable: retention probability in the next calendar year; reference category for age: birth year ≤ 1951; reference category for tenure: tenure ≥ 20; reference category for experience: experience ≥ 20; reference category for education: no vocational education; establishment characteristics: size, sector; *** p < 0.01; ** p < 0.05; * p < 0.1; Source: WeLL-ADIAB 2006-2010.

Table A5: Determinants of employee retention (consideration of wage increase and satisfaction)

Dependent variable: retention next year	Models with general content and certificate			Models with general content and certificate (externally provided)		
	OLS (1)	FD (2)	GMM (3)	OLS (4)	FD (5)	GMM (6)
training	0.105*** (0.010)	0.119*** (0.016)	0.141*** (0.030)	0.121*** (0.016)	0.149*** (0.026)	0.179*** (0.038)
wage increase	0.031*** (0.005)	0.029*** (0.007)	0.036*** (0.012)	0.040*** (0.007)	0.044*** (0.011)	0.044*** (0.014)
training * general content	-0.013** (0.006)	-0.017 (0.011)	-0.016 (0.014)	-0.030** (0.012)	-0.021 (0.019)	-0.040** (0.019)
training * certificate	-0.016** (0.007)	-0.018* (0.010)	-0.017 (0.015)	-0.017* (0.010)	-0.041** (0.016)	-0.036* (0.019)
female	-0.002 (0.005)	-	-	0.002 (0.008)	-	-
birth year 1952-1961	-0.010 (0.008)	-	-	-0.015 (0.012)	-	-
birth year 1962-1971	-0.014* (0.008)	-	-	-0.020* (0.012)	-	-
birth year > 1972	-0.021* (0.012)	-	-	-0.018 (0.017)	-	-
tenure < 10	-0.040*** (0.009)	0.091*** (0.032)	0.177* (0.104)	-0.041*** (0.013)	0.082* (0.046)	0.057 (0.100)
tenure 10-20	-0.001 (0.008)	0.038 (0.031)	0.008 (0.086)	-0.012 (0.012)	0.015 (0.043)	-0.068 (0.084)
experience < 10	-0.029** (0.011)	-0.021 (0.035)	-0.057 (0.065)	-0.033** (0.016)	0.001 (0.050)	-0.027 (0.075)
experience 10-20	-0.003 (0.007)	0.007 (0.026)	0.005 (0.039)	-0.001 (0.010)	0.014 (0.037)	0.001 (0.048)
job satisfaction	0.012*** (0.001)	0.011*** (0.00)	0.006 (0.008)	0.014*** (0.002)	0.015*** (0.005)	0.012 (0.011)
vocational education	-0.006 (0.012)	-	-	0.016 (0.018)	-	-
university degree	-0.006 (0.013)	-	-	0.018 (0.019)	-	-
year dummies	yes	yes	yes	yes	yes	yes
establishment charac- teristics	yes	yes	yes	yes	yes	yes
R ²	0.069	0.039	-	0.090	0.054	-
observations	8,086	8,086	3,281	4,682	4,682	1,915
individuals	-	4,186	2,071	-	2,626	1,312
AR-test	-	-	0.763	-	-	0.352
Hansen test	-	-	0.303	-	-	0.075

Dependent variable: retention probability in the next calendar year; reference category for age: birth year ≤ 1951; reference category for tenure: tenure ≥ 20; reference category for experience: experience ≥ 20; reference category for education: no vocational education; establishment characteristics: size, sector; *** p < 0.01; ** p < 0.05; * p < 0.1; Source: WeLL-ADIAB 2006-2010.