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The Retention Effect of Training – Portability, Visibility, and Credibility

Daniel Dietz and Thomas Zwick

Universität Zürich
IBW – Institut für Betriebswirtschaftslehre

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The retention effect of training – portability, visibility, and credibility[1]

Daniel Dietz[2] (University of Wuerzburg)
Thomas Zwick[3] (University of Wuerzburg and ZEW Mannheim)

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Abstract:
This paper analyses the effect of training participation on employees' retention in the training company. It for the first time empirically combines the human capital and the monopsony theory by jointly controlling for the portability, visibility, and credibility of training. Based on an extensive German linked-employer-employee data set with detailed information on training history (WeLL-ADIAB), we show that training increases employees' retention. We compare the probability to stay at the same employer between training participants and accidental training non-participants (those who could not participate in planned training on the basis of exogeneous reasons). Higher portability of general human capital contents and visibility of training induced by training certificates however reduce the retention effect of training. Retention is further reduced when training is credibly provided and certified by external institutions, the full training effect on retention is still positive, however. We are careful to control for endogeneity of training participation in retention equations, unobserved time-invariant effects, and extensive individual and employer characteristics including wage increases and general job satisfaction.

JEL-Classification: J62, J63, M51, M53

Keywords: Labor Mobility, Turnover, Employment, Training

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[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 and Boris Hirsch, Susanne Steffes, and Arne Warnke for useful comments on earlier versions of this paper.
[2] Daniel Dietz, Chair of Human Resource Management and Organisation, Department of Business Management, University of Wuerzburg, Sanderring 2, 97070 Wuerzburg, E-Mail: daniel.dietz@uni-wuerzburg.de
[3] Thomas Zwick, Chair of Human Resource Management and Organisation, Department of Business Management, University of Wuerzburg, Sanderring 2, 97070 Wuerzburg, E-Mail: thomas.zwick@uni-wuerzburg.de

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 employer – has been analysed by few empirical papers only (Manning, 2003; Brunello and De Paola, 2009). The possibility to retain trained workers is one of the key reasons for employer training investments, however (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 firms 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 elsewhere. When we look closer at the evidence on the retention effect of training, we see that most papers concentrate on the general employability of trained workers (Ridder, 1986; Card and Sullivan, 1988; Gritz, 1993; Zweimüller and Winter-Ebmer, 1996; Picchio and Van Ours, 2013) instead of the retention effect of training at the training firm.

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 also increases productivity in other firms. Therefore the labour market value as well as the desirability of trained employees is higher (Stevens, 1994; Loewenstein and Spletzer, 1999; Zweimüller and Winter-Ebmer, 2003). The monopsony theory introduces a number of labour market frictions that can explain why training firms pay trained employees a wage below their productivity without risking that they leave the firm (Acemoglu and Pischke, 1999a). Prominent examples of these market frictions are an information advantage of training firms on the ability of training participants (Acemoglu and Pischke, 1998; Autor, 2001) or on training contents (Katz and Ziderman, 1990; Chang and Wang, 1996), a compressed wage structure (Acemoglu and Pischke, 1999b; Dustmann and Schönberg, 2009), and mobility costs (Harhoff and Kane, 1997; Acemoglu and Pischke, 1999a). 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 (Becker, 1962, p.50-51; Barron et al., 1997b; Loewenstein and Spletzer, 1999, p.730). When we combine both theories, we find that firms 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 rents for the firm. As a consequence, retention of employees with portable training should be higher if training is not visible (or the certificates are not credible).

Some empirical papers on the retention effect of training only observe training as a dummy variable and therefore cannot analyse differences in training contents and market frictions (see for example Brunello and De Paola, 2009). Other papers for example distinguish either between training portability or training visibility. They use this information 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 such as information asymmetries.[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 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 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

[4] One of the few papers that jointly assess portability and visibility of training is Booth and Bryan (2005). It 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.

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 endogenous selection into training (Card, 1999; Heckman, 1999). In order to overcome this problem, we use the approach proposed by Leuven and Oosterbeck (2008): instead of comparing training participants with all training non-participants, we use as comparison 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 individual fixed effects estimation. Time-varying unobserved characteristics such as career prospects are controlled for in Diff-GMM estimations. We compare the results from between, within and GMM (instrumental) estimates and rigorously test the applicability of the different specifications.

Training frequently is accompanied by wage changes – training employers want to increase employee retention by increasing wages and sharing rents (Becker, 1962; Hashimoto, 1981). These wage increases after training might be a key factor for the retention effect of training (Benson et al., 2004; Grund and Sliwka, 2001). Nevertheless, most of the empirical retention studies have not taken wage changes after training into account. Besides Benson et al. (2004) this is therefore the first training retention analysis that includes wages changes. Another important yet usually unobserved individual characteristic that may bias the results is general job satisfaction (Brunello and De Paola, 2009). Our data set also allows us to control for this information.

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 are shown in Section 4. We present and interpret the results of the estimations and robustness checks in section 5. The paper ends with a conclusion in section 6.

2 Theoretical framework

According to Becker's traditional human capital approach, skills can be considered as enablers of individual and firm-level productivity and we should distinguish between general and firm-specific skills. Whereas training with general contents increases the productivity of train-

ees equally in all establishments, training measures imparting specific human capital enhances employees' productivity exclusively in the training establishment (Becker, 1962). As a consequence, after general training in competitive labour markets, training firms run the risk of having their trained employees poached[5] away (Bishop, 1997; Black and Lynch, 1998; Mohrenweiser et al., 2013). This threat is greatly lower if trained skills are not portable to other firms. Our first hypothesis therefore is:

> *Hypothesis 1: 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 firms. 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. This reduces the information asymmetry (Arcidiacono et al., 2010) and improves the labour market chances of trained employees. Therefore, we assume:

> *Hypothesis 2: When training content can be signalled by means of a certificate and therefore is 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. Considering various types of training certificates, trained employees rather

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

prefer an independent system of certification, which leads to a higher credibility of the training contents and, thereby, further improves their outside options (Katz and Ziderman, 1990). Often training measures are certified by external independent institutions such as chambers of commerce or chambers of crafts (Acemoglu and Pischke, 2000). Thus, we predict:

> *Hypothesis 3: When training content 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 general training contents are certified more often than rather specific training contents. 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 4: 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-ADIAB[6]. 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) Establishment Panel[7]. From these establishments, between the years 2007 and 2010 randomly

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

[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 firms with the highest and the five firms 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).

7.352 selected employees were asked in four annual waves[8] about their individual training behaviour and specific training measures during the last year(s). Only employees with jobs covered by social security contributions as well as individuals in minor employment 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 start and the end date, the duration as well as the thematic focus of their training measures. Furthermore, training participants were asked whether they received a specific training certificate, whether the training contents were portable to outside establishments, and offered and certified by external institutions (Bender et al., 2008b).

An important benefit 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, 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 (approx. 56,000 employees) was defined as the whole workforce of the 149 establishments and, therefore, the employee sample can be seen as representative (Bender et al. 2008a).

For our analysis, we use the longitudinal version of the WeLL-ADIAB data set between 2006 and 2010. Our sample comprises 5,941[9] training participants and accidental training non-participants from 149 establishments. Furthermore, note that 1,755 training non-participants

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

[9] In order to obtain comparable and convincing results, based on the sample selection of the WeLL-ADIAB data set (7.352 employees), we additionally eliminate individuals in part-time employment (1.411 employees).

have been excluded in order to obtain a homogeneous comparison group according to the Leuven and Oosterbeek (2008) approach.

Dependent variable

Brunello and De Paola (2003), 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 the 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.

In the WeLL-ADIAB data set, there are individuals with several employment spells per year measured on a day-to-day basis. These spells might be in the same establishment or in various establishments. In order to calculate the employees' retention in the period from 2006 until 2010, we define the employer at the first of January as reference point for training during the previous year. In the same manner, we accumulate further employment characteristics (e.g. working time, job status) and assign them to each employment spell. Finally, by comparing the establishment identifier in the current year and on January 1st in the next year, we determine whether an individual was still employed in the same establishment in the next calendar year[10].

Training information

In each annual wave, the respondents were asked about the last three training measures in chronological order. If 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 importance that we know which employer offered the training measure. Therefore, we eliminate all training measures that could not be clearly assigned to an employer and that have not been finished one month before the potential job change because the training information is given on a monthly basis. According to this procedure, the explanatory binary training variable d_{ijt} takes the value 1 if an individual participates in train-

[10] The calculation of the employees' retention on a daily basis is very accurate. The binary variable takes only the value of 1, if an individual was employed in the same establishment exactly 365 days after the reference point. A calculation on a yearly basis would be less exact and would often imply to measure an employee's retention, although the employee had already left the establishment a few months before.

ing offered by the training establishment *j* in the current calendar year *t,* otherwise the variable takes the value zero.

Barron et al. (1997a) and Loewenstein and Spletzer (1999) note that training definitions differ between firms and that training information provided by the employer therefore is unreliable. They propose to use the assessment by training participants as comparable and reliable information on the portability. We therefore also rely on the subjective assessment of the training participants whether their training contents can be used in other firms.[11]

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 to the outside labour market the contents and value of the training as well as employee ability (Booth and Bryan, 2005).

Credibility of training is measured by the fact that the training was provided and the certificate was issued by a third party and not the training employer itself. The training employer 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.

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 company and on training participation.

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 (Parent, 2003; Chéron et al., 2010). 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 consider individual wage changes on an annual basis.[12] To control for general wage increases in the establishment, for example due to inflation or collective bargaining contracts (Weller, 2007), 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

[11] 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*)".

[12] In other studies on the effects of training, wages cannot be taken into account at all because they are not included in the data records (Card and Sullivan, 1988; Elias, 1994; Loewenstein and Spletzer, 1999; Picchio and Van Ours, 2013; Veum, 1997; Zweimüller and Winter-Ebmer, 2003).

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 wage[13] of the employees by establishment and year. In the case of unemployment spells, the daily wage is set to zero.

Another factor that might influence training and retention and capture additional dimensions of otherwise unobservable individual characteristics is job satisfaction (Brunello and De Paola, 2009). We therefore control for general job satisfaction that is individual assessed and changes from year to year in our data set (Zwick, 2015).

Further individual characteristics that might influence the retention probability of employees are gender, age, and schooling level (Göggel and Zwick, 2012). Qualification might be positively 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). We capture age as cohort effects, i.e. as groups of birth years because it is closely related to experience for our employees who have few and short unemployment spells.

Since the establishment training propensity 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).

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.

[13] In order to obtain the weighted daily wage, first daily wage is multiplied with 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.

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 in period *t* is related to employment in period *t*+1. This avoids reverse causality (Dearden et al., 1997). We therefore always use training participation as determinant of retention in the training firm 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 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. 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?". 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 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 had priority[14]. 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.

In our first estimation of the retention effect of training, we use the training information d_{ijt} in an ordinary least squares estimation. In addition, we include our wage increase dummy, work satisfaction, birth year, tenure, experience, gender, and qualification in an individual information vector X_{it}. Finally, we also include an establishment characteristics vector Y_{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):

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

[14] There is some debate whether family or health reasons also can be regarded as random cancellation reasons (Görlitz, 2011). The main argument 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 these were the reasons for training non-participation and therefore we drop these cases from our sample. If we also include these cases into the group of training non-participants, our results are unchanged, however.

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. Our fixed effects model eliminates all time-fixed individual unobserved heterogeneity 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 work satisfaction, tenure, experience):

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

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 firm or the chance of the employee to get a promotion may have an impact on training participation and current retention. Therefore, in our third and preferred estimation approach, we use the Arellano-Bond difference GMM estimator (Diff GMM)[15] (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 fixed effects estimation. 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 exogenous instruments. However, the usage of exogenous instruments[16] reduces our sample size substantially[17]. 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 exogenous instrument in a robustness check only.

[15] 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).

[16] We use establishments´ expectations of skill shortages as exogenous 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 individual retention probability. Therefore, this instrument is assumed to be exogenous.

[17] 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 & Bond, 1998). However, this reduces the sample size by one observation per individual. Furthermore, it is not appropriate to use a system GMM estimation with a comparably small dataset as is the case in the current paper.

4 Findings

Descriptive statistics

Table 1 shows descriptive sample characteristics separately for training participants and accidental training non-participants.

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
Birth year				
≤ 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***
Experience				
< 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***
Tenure				
< 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
Education				
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
Work satisfaction	**82.81%**	84.14%	74.45%	-8.83***
Wage increase dummy	**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***
Training		-	-	
Training certificate	**75.22%**	-	-	
External certificate	**84.31%**	-	-	
Training with general content	**82.68%**	-	-	
Observations	**9,925**	**8,599**	**1,326**	

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 are more training measures with general and therefore portable training contents according to the training participants (82.68%).

We use the approach of Leuven and Oosterbeck (2008) 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 of training participants and all training non-participants in the original sample. In Table 1, we see socio-demographic differences between participants and accidental training non-participants in age, in professional experience, tenure, and in work satisfaction. There are no gender differences and differences in the educational background of both groups. In the context of unobservable characteristics, 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 also should be reflected by past wage differentials.[18] 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 where both groups might not have participated in training.

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. Indeed, accidental training non-participants are more similar to training participants than all training non-participants. More specifically, 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). When we replicate the impact of training on wage analysis for the small and the full sample, we obtain the same results as Leuven and Oosterbeek (2008) and Görlitz (2011): the impact

[18] By means of the linkage with administrative data, the WeLL-ADIAB data set also contains wage information previous to the reference period of the training questions for both groups.

of training participation on wages in the following year is much smaller (3.4%) when training participants are compared to accidental training non-participants than in the full sample (9.8%), compare Table A2.

Retention effect of training

In the multivariate analyses, first we test whether training increases the employees' retention when we additionally control for important individual and employer characteristics. Table 2 shows the regression output for the different estimation methods ordinary least squares, fixed effects, and diff GMM.

Table 2: Determinants of employee retention I

Dependent variable:	**Model with training dummy**		
retention next year	**OLS (1)**	**FE (2)**	**GMM (3)**
training	0.080***	0.089***	0.113***
	(0.007)	(0.011)	(0.024)
wage increase	0.031***	0.029***	0.036***
	(0.005)	(0.007)	(0.012)
female	-0.002	-	-
	(0.005)		
birth year 1952-1961	-0.011	-	-
	(0.008)		
birth year 1962-1971	-0.015*	-	-
	(0.008)		
birth year > 1972	-0.021*	-	-
	(0.012)		
tenure < 10	-0.041***	0.088***	0.176*
	(0.009)	(0.032)	(0.104)
tenure 10-20	-0.002	0.036	0.008
	(0.008)	(0.031)	(0.085)
experience < 10	-0.029**	-0.019	-0.057
	(0.011)	(0.035)	(0.065)
experience 10-20	-0.002	0.008	0.005
	(0.007)	(0.026)	(0.039)
work satisfaction	0.012***	0.010***	0.006
	(0.001)	(0.004)	(0.008)
vocational education	-0.007	-	-
	(0.012)		
university degree	-0.008	-	-
	(0.013)		
year dummies	yes	yes	yes
establishment characteristics	yes	yes	yes
R^2	0.068	0.038	-
observations	8,086	8,086	3,281
individuals	-	4,186	2,071
AR-test	-	-	0.824
Hansen-test	-	-	0.304

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.

The OLS estimation suggests that training participation increases the retention probability in the training establishment in the next calendar year on average by 8%. Controlling additionally for time-fixed individual unobserved heterogeneity and endogeneity, we find a retention effect of 8.9% in the Fixed Effects and of 11.3% in the Diff GMM estimation. According to this finding, 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) and Loewenstein and Spletzer (1998). Brunello and De Paola (2009) however do not find a training effect on retention. When focusing on our preferred model – the Diff GMM estimation in model 3 – we find a higher retention probability of 3.6% for individuals with a wage increase above the occupational peer group. Furthermore, we see that individuals with shorter job tenure have a higher probability to be retained (also compare Benson et al., 2004). In contrast, there is a higher retention rate for individuals with more professional experience (however, this effect is not significant). 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) (also compare Brunello and De Paola, 2009). Furthermore, in this estimation model individuals have a significantly higher retention probability, when they are satisfied with the present working conditions. The AR-test in the Diff GMM estimation indicates that there is no autocorrelation in levels. Since the Hansen-test is insignificant (p=0.304), 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 probability by 1.9% both in the OLS and in the Fixed Effects Model. Also Loewenstein & Spletzer (1999) find a significantly lower retention effects for training that is general and portable (e.g. schooling) in comparison to rather specific measures such as company training.[19]

[19] 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. Veum (1997) however does not find a retention effect of training.

Table 3: Determinants of employee retention II

Dependent variable: retention next year	**Model with general content**			**Model with training certificate**		
	OLS (1)	**FE (2)**	**GMM (3)**	**OLS (4)**	**FE (5)**	**GMM (6)**
training	0.097***	0.106***	0.130***	0.092***	0.105***	0.128***
	(0.009)	(0.015)	(0.027)	(0.008)	(0.013)	(0.027)
wage increase	0.031***	0.029***	0.036***	0.031***	0.029***	0.035***
	(0.005)	(0.007)	(0.012)	(0.005)	(0.007)	(0.012)
training * general content	**-0.019*** (0.007)**	**-0.019* (0.011)**	**-0.018 (0.015)**	-	-	-
training * certificate	-	-	-	**-0.016*** (0.006)**	**-0.020** (0.010)**	**-0.018 (0.015)**
female	-0.002	-	-	-0.002	-	-
	(0.005)			(0.005)		
birthyear 1952-1961	-0.010	-	-	-0.010	-	-
	(0.008)			(0.008)		
birthyear 1962-1971	-0.014*	-	-	-0.014*	-	-
	(0.008)			(0.008)		
birthyear > 1972	-0.021*	-	-	-0.021*	-	-
	(0.012)			(0.012)		
tenure < 10	-0.041***	0.090***	0.178*	-0.040***	0.089***	0.176*
	(0.009)	(0.032)	(0.104)	(0.009)	(0.032)	(0.104)
tenure 10-20	-0.002	0.037	0.009	-0.001	0.037	0.008
	(0.008)	(0.031)	(0.086)	(0.008)	(0.031)	(0.086)
experience < 10	-0.029***	-0.020	-0.057	-0.028**	-0.021	-0.057
	(0.011)	(0.035)	(0.065)	(0.011)	(0.035)	(0.065)
experience 10-20	-0.003	0.007	0.005	-0.002	0.008	0.006
	(0.007)	(0.026)	(0.039)	(0.007)	(0.026)	(0.039)
work satisfaction	0.012***	0.010***	0.006	0.012***	0.011***	0.006
	(0.001)	(0.004)	(0.008)	(0.001)	(0.004)	(0.008)
vocational education	-0.007	-	-	-0.007	-	-
	(0.013)			(0.012)		
university degree	-0.006	-	-	-0.008	-	-
	(0.013)			(0.013)		
year dummies	yes	yes	yes	yes	yes	yes
establishment characteristics	yes	yes	yes	yes	yes	yes
R^2	0.069	0.038	-	0.069	0.039	-
observations	8,086	8,086	3,281	8,086	8,086	3,281
individuals	-	4,186	2,071	-	4,186	2,071
AR-test	-	-	0.770	-	-	0.809
Hansen test	-	-	0.311	-	-	0.296

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.

We also find negative retention effects in the case of visible training measures (Models 4 – 6). This finding is in accordance with Benson et al (2004) who find that training participants with 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 are of the same magnitude as those of portable training. 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 the instruments are valid. We therefore find weak support for our first two hypotheses.

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). The coefficients are comparable to the estimation models with separate controls, they however lose significance. Again the AR-test and the Hansen-test indicate that there is no autocorrelation in levels and that the instruments are valid. Again in all models, the retention effect of the other control variables is practically unchanged in comparison to the previous estimations. Based on these results, we see that visibility or portability do not dominate the negative retention effect measured separately. In contrast, both training characteristics seem to have a separate impact on retention and are therefore orthogonal. Furthermore, we can see that training measures with rather specific and therefore not portable contents are certified at least as often as general training measures (compare Table A3). The same applies for externally provided training measures, where the share of certification is even higher for both kinds of training contents (see Table A4). Our fourth hypothesis is therefore not supported.

According to our hypothesis three, 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 (Model 4 – 6). When individuals participate in externally provided training measures with general content, this reduces the retention probability by 4.0%. Furthermore, we find a large negative retention effect (3.6%) for training measures that are certified by external institutions. Again, visibility and portability have a distinct impact on retention and the other covariates hardly change when compared to the other estimation models. The AR-test in the Diff GMM model indicates that there is no autocorrelation in levels. Probably due to the reduced number of observations in this specification the Hansen-test is significant on the ten percent level only. We conclude that training certificates from external providers can be considered as powerful signals for training participants´ ability and the portability of training. In consequence, employees participating in 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.

Table 4: Determinants of employee retention III

dep. variable: retention next year	Model with general content and certificate			Model with general content and certificate (externally provided)		
	OLS (1)	**FE (2)**	**GMM (3)**	**OLS (4)**	**FE (5)**	**GMM (6)**
training	0.105***	0.119***	0.141***	0.121***	0.149***	0.179***
	(0.010)	(0.016)	(0.030)	(0.016)	(0.026)	(0.038)
wage increase	0.031***	0.029***	0.036***	0.040***	0.044***	0.044***
	(0.005)	(0.007)	(0.012)	(0.007)	(0.011)	(0.014)
training * general content	**-0.013****	**-0.017**	**-0.016**	**-0.030****	**-0.021**	**-0.040****
	(0.006)	**(0.011)**	**(0.014)**	**(0.012)**	**(0.019)**	**(0.019)**
training * certificate	**-0.016****	**-0.018***	**-0.017**	**-0.017***	**-0.041****	**-0.036***
	(0.007)	**(0.010)**	**(0.015)**	**(0.010)**	**(0.016)**	**(0.019)**
female	-0.002	-	-	0.002	-	-
	(0.005)			(0.008)		
birth year 1952-1961	-0.010	-	-	-0.015	-	-
	(0.008)			(0.012)		
birth year 1962-1971	-0.014*	-	-	-0.020*	-	-
	(0.008)			(0.012)		
birth year > 1972	-0.021*	-	-	-0.018	-	-
	(0.012)			(0.017)		
tenure < 10	-0.040***	0.091***	0.177*	-0.041***	0.082*	0.057
	(0.009)	(0.032)	(0.104)	(0.013)	(0.046)	(0.100)
tenure 10-20	-0.001	0.038	0.008	-0.012	0.015	-0.068
	(0.008)	(0.031)	(0.086)	(0.012)	(0.043)	(0.084)
experience < 10	-0.029**	-0.021	-0.057	-0.033**	0.001	-0.027
	(0.011)	(0.035)	(0.065)	(0.016)	(0.050)	(0.075)
experience 10-20	-0.003	0.007	0.005	-0.001	0.014	0.001
	(0.007)	(0.026)	(0.039)	(0.010)	(0.037)	(0.048)
work satisfaction	0.012***	0.011***	0.006	0.014***	0.015***	0.012
	(0.001)	(0.00)	(0.008)	(0.002)	(0.005)	(0.011)
vocational education	-0.006	-	-	0.016	-	-
	(0.012)			(0.018)		
university degree	-0.006	-	-	0.018	-	-
	(0.013)			(0.019)		
year dummies	yes	yes	yes	yes	yes	yes
establishment characteristics	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.

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 Probability Model (Table A5). The results in model 1 suggest that training

increases the probability to retain the employee in the training establishment by 12.8%. However, this positive effect is reduced by 1.2% when training contents are general and by 1.4% 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 external provided training with general content, this reduces the retention rate even by 3.3%. Furthermore, when training participants receive certificates from an external independent institution, this reduces the retention probability by 2.0%. Thus, the marginal effects in the Linear Probability Model are comparable to the results obtained in the OLS, the Fixed Effects, and the Diff GMM Model in Table 4. This also applies to the retention effects of the other covariates.

In the context of the different estimation strategies, we already discussed the possibility to use an exogenous instrument in the Diff GMM estimation as a further robustness check. In this paper, we therefore use establishments´ expectations of skill shortages as exogenous instrument. As already mentioned, expected skill shortages should lead to more training in the establishment but shouldn't affect the individual retention probability. Therefore this instrument is assumed to be exogenous. However, the required establishment information for the exogenous instrument substantially reduces the number of observations in the estimation regressions. For that reason, in the basic model of Table A6 the additional negative effects of general (-0.1%) and certified (-0.7%) training measures are rather small and no longer significant. Considering external provided training measures, again we find stronger negative effects for training measures that are portable (-2.9%) and visible (-0.8%), of which only portability is significant. Furthermore, in both models with exogenous instruments, neither the AR-test nor the Hansen-test achieve better results than in our basic model. Therefore, we prefer the basic model without exogenous instruments.

In the WeLL-ADIAB data set, the individual daily wages are censored at the social benefits contribution income threshold[20]. In the case that individuals earn daily wages higher than the appropriate income threshold, wage information therefore is not reliable. In order to ensure that the retention effect of training is not biased by censored wages, we eliminate those employees concerned and calculate a robustness check based on the restricted sample.[21] By doing so, in the basic model we find almost unchanged retention effects of training of 10.5% in the OLS estimation, of 11.6% in the Fixed Effects estimation and of 12.8% in the Diff GMM

[20] For Western Germany, the income threshold corresponds to 170.9€ per day for the year 2005, 172.6€ for 2006 and 2007, 173.7€ for 2008, 177.5 for 2009, and 180.8 for the year 2010. For Eastern Germany, the income threshold is 144.6€ for the years 2005 and 2006, 149.6€ for 2007, 147.5€ for 2008, 149.6€ for 2009, and 152.9€ for the year 2010.

[21] Only 572 individuals with 1691 observations are affected by the income threshold. This reduces the sample to 3,614 individuals

model (compare Table 4, models 1-3 with Table A7). Therefore, censored wages should not play a decisive role, when analysing the retention effect of training. This can also be seen, when we exclude the wage information from the estimation model. In this case, both the retention effect of training as well as the negative effects of portability and visibility of training remain quite robust across all methods.

By using the approach of Leuven & Oosterbeck (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 typical non-trainees in the original sample. In order to test whether the unobserved heterogeneity affects the estimation results, based on the full sample we run an additional robustness check of our basic models in Table 4 (compare Table A8). Whereas the positive retention effects of training are quite robust in all model specifications, the additional negative effects of general and certified training measures are biased. Especially the additional positive effect of general training contents in the Fixed Effects 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 external provided certificates. The distortion of the effects 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.

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 employee training history from Germany, we find that training has a significantly positive retention effect but according to human capital theory, portable training reduces the retention effect. According to monopsony theory, visibility of training also reduces the retention effect. These negative retention effects are much stronger if training is provided and certified by external training institutions. The total retention effect even of credible portable and visible training is positive, or training providers can increase their chances to keep employees even by offering training that increases productivity in other firms and leads to certificates other employers can assess. We also find that controlling for visibility reduces the retention effect of portability only minimally – this also applies vice versa. In other words, portability and visibility have a separate and distinct impact on retention.

We are careful to avoid the estimation problems usually encountered when measuring the effects of training. First, we compare training participants with accidental training non-participants – employees who had been chosen to participate in training but had to cancel it on the basis of exogeneous reasons. We have spell data for employment and training and

therefore can determine exactly which employer offered training. 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. In addition, we account for unobserved time-invariant heterogeneity in fixed effects regressions and for training endogeneity in diff GMM estimations using internal instruments. Besides the usual individual and employer characteristics that determine retention, we also include wage increases and job satisfaction as important drivers for retention as well as training participation.

In a series of robustness checks we show the impact of reducing the sample to incidental training non-participants in our reference group, taking into account wage increases, using a Probit model instead of an ordinary least square estimation or including external instruments.

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) which increases the labour market value of training participants even if training contents do not directly increase productivity in other firms and therefore visibility also decreases retention for non-portable training contents. Unfortunately, the sample sizes for these training subgroups are too small in our data set 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.

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Appendix

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

Sociodemographic Factors	Total	Training participants	Training non-participants	t-value
Female	**28.52%**	29.47%	27.57%	-3.06***
Birth year				
≤ 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***
Experience				
< 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*
Tenure				
< 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***
Education				
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***
Work satisfaction	**79.98%**	84.14%	77.34%	-12.34***
Wage increase dummy	**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***
Training				
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 the wage in the next year (Mincer equation)

dep. variable: log(daily wage) next year	**Full sample**	**Restricted sample with accidental training non-participants**
	OLS (1)	**OLS (2)**
Training	0.098***	0.034***
	(0.005)	(0.009)
Female	-0.158***	-0.126***
	(0.005)	(0.008)
Birth year 1952-1961	-0.033**	-0.031***
	(0.008)	(0.011)
Birth year 1962-1971	0.033***	0.038***
	(0.08)	(0.012)
Birth year > 1972	0.005	-0.033**
	(0.011)	(0.016)
tenure < 10	-0.002	-0.017
	(0.009)	(0.012)
tenure 10-20	0.001	-0.025**
	(0.008)	(0.012)
experience < 10	-0.383***	-0.333***
	(0.011)	(0.016)
experience 10-20	-0.250***	-0.227***
	(0.007)	(0.010)
work satisfaction	0.024***	0.016***
	(0.001)	(0.002)
vocational education	0.121***	0.075***
	(0.010)	(0.017)
university degree	0.462***	0.386***
	(0.011)	(0.018)
year dummies	yes	yes
firm characteristics	yes	yes
R^2	0.347	0.334
Observations	21,069	8,086

Dependent variable: log(daily wage) 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; *** p < 0.01; ** p < 0.05; * p < 0.1; Source: WeLL-ADIAB 2005-2010.

Table A3: Share of training with general content and with training certificate

		training certificate		
		yes	no	
general training content	yes	65.15%	34.85%	100%
	no	78.46%	21.54%	100%

Table A4: Share of external provided training with general content and with external training certificate

		external training certificate		
		yes	no	
general training content	yes	79.38%	20.62%	100%
	no	85.64%	14.36%	100%

Table A5: Determinants of employee retention IV; marginal effects after Probit

	Basic Models	**Basic Models with externally provided training certificate**
	Probit (1)	**Probit (2)**
training	0.128***	0.224***
	(0.026)	(0.062)
wage increase	0.019***	0.024***
	(0.003)	(0.004)
training * general content	**-0.012****	**-0.033*****
	(0.005)	**(0.010)**
training * certificate	**-0.014*****	**-0.020*****
	(0.004)	**(0.008)**
female	-0.002	0.001
	(0.004)	(0.005)
birth year 1952-1961	-0.016*	-0.032*
	(0.009)	(0.017)
birth year 1962-1971	-0.019**	-0.037**
	(0.009)	(0.017)
birth year > 1972	-0.027*	-0.040*
	(0.014)	(0.002)
tenure < 10	-0.031***	-0.046***
	(0.009)	(0.013)
tenure 10-20	-0.009	-0.024*
	(0.008)	(0.013)
experience < 10	-0.010	-0.013
	(0.009)	(0.012)
experience 10-20	0.001	-0.001
	(0.005)	(0.007)
work satisfaction	0.006***	0.006***
	(0.001)	(0.001)
vocational education	-0.001	0.017
	(0.008)	(0.013)
university degree	-0.002	0.014
	(0.009)	(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 A6: Determinants of employee retention V; Diff GMM with exogenous instruments

dep. variable: retention next year	**Basic Models**			**Basic Models with externally provided training certificate**		
	OLS (1)	**FE (2)**	**GMM (3)**	**OLS (4)**	**FE (5)**	**GMM (6)**
training	0.105***	0.119***	0.053*	0.117***	0.149***	0.090**
	(0.010)	(0.016)	(0.029)	(0.016)	(0.026)	(0.040)
wage increase	0.031***	0.029***	0.004	0.040***	0.044***	-0.003
	(0.005)	(0.007)	(0.011)	(0.007)	(0.011)	(0.011)
training * general content	**-0.013****	**-0.017**	**-0.001**	**-0.030****	**-0.021**	**-0.029***
	(0.006)	**(0.011)**	**(0.014)**	**(0.012)**	**(0.019)**	**(0.016)**
training * certificate	**-0.016****	**-0.018***	**-0.007**	**-0.017***	**-0.041****	**-0.008**
	(0.007)	**(0.010)**	**(0.015)**	**(0.010)**	**(0.016)**	**(0.015)**
female	-0.002	-	-	0.002	-	-
	(0.005)			(0.008)		
birth year 1952-1961	-0.010	-	-	-0.015	-	-
	(0.008)			(0.012)		
birth year 1962-1971	-0.014*	-	-	-0.020*	-	-
	(0.008)			(0.012)		
birth year > 1972	-0.021*	-	-	-0.018	-	-
	(0.012)			(0.017)		
tenure < 10	-0.040***	0.091***	-0.140	-0.041***	0.082*	-0.185*
	(0.009)	(0.032)	(0.093)	(0.013)	(0.046)	(0.101)
tenure 10-20	-0.001	0.038	-0.163	-0.012	0.015	-0.196**
	(0.008)	(0.031)	(0.105)	(0.012)	(0.043)	(0.097)
experience < 10	-0.029**	-0.021	0.028	-0.033**	0.001	0.062
	(0.011)	(0.035)	(0.063)	(0.016)	(0.050)	(0.079)
experience 10-20	-0.003	0.007	0.037	-0.001	0.014	0.048
	(0.007)	(0.026)	(0.042)	(0.010)	(0.037)	(0.055)
work satisfaction	0.012***	0.011***	-0.005	0.014***	0.015***	0.011
	(0.001)	(0.00)	(0.012)	(0.002)	(0.005)	(0.016)
vocational education	-0.006	-	-	0.016	-	-
	(0.012)			(0.018)		
university degree	-0.006	-	-	0.018	-	-
	(0.013)			(0.019)		
year dummies	yes	yes	yes	yes	yes	yes
establishment characteristics	yes	yes	yes	yes	yes	yes
R^2	0.069	0.039	-	0.090	0.054	-
observations	8,086	8,086	1,810	4,682	4,682	1,087
individuals	-	4,186	1,200	-	2,626	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 A7: Determinant of employee retention V; without censored wage observations

dep. variable: retention next year	**Basic Models**			**Basic Models with externally provided training certificate**		
	OLS (1)	**FE (2)**	**GMM (3)**	**OLS (4)**	**FE (5)**	**GMM (6)**
training	0.105***	0.116***	0.128***	0.120***	0.147***	0.155***
	(0.010)	(0.018)	(0.032)	(0.017)	(0.029)	(0.043)
wage increase	0.034***	0.026***	0.026**	0.042***	0.038***	0.036***
	(0.005)	(0.008)	(0.011)	(0.008)	(0.012)	(0.014)
training * general content	**-0.014***	**-0.012**	**0.002**	**-0.025***	**-0.011**	**-0.015**
	(0.007)	**(0.012)**	**(0.018)**	**(0.013)**	**(0.021)**	**(0.018)**
training * certificate	**-0.011***	**-0.005**	**-0.006**	**-0.014**	**-0.032***	**-0.029**
	(0.006)	**(0.011)**	**(0.014)**	**(0.012)**	**(0.019)**	**(0.023)**
female	-0.004	-	-	0.001	-	-
	(0.006)			(0.008)		
birth year 1952-1961	-0.005	-	-	-0.009	-	-
	(0.010)			(0.015)		
birth year 1962-1971	-0.010	-	-	-0.019	-	-
	(0.010)			(0.015)		
birth year > 1972	-0.013	-	-	-0.008	-	-
	(0.013)			(0.019)		
tenure < 10	-0.043***	0.081**	0.150	-0.056***	0.059	0.012
	(0.010)	(0.036)	(0.117)	(0.015)	(0.052)	(0.119)
tenure 10-20	-0.005	0.019	-0.007	-0.013	-0.027	-0.112
	(0.010)	(0.033)	(0.097)	(0.014)	(0.048)	(0.101)
experience < 10	-0.032**	0.011	-0.048	-0.041**	0.082	0.032
	(0.013)	(0.042)	(0.085)	(0.018)	(0.062)	(0.104)
experience 10-20	-0.003	0.023	-0.006	-0.003	0.040	-0.001
	(0.007)	(0.032)	(0.059)	(0.012)	(0.045)	(0.075)
work satisfaction	0.012***	0.010**	0.007	0.014***	0.012*	0.007
	(0.001)	(0.004)	(0.008)	(0.002)	(0.006)	(0.011)
vocational education	-0.006	-	-	0.018	-	-
	(0.013)			(0.020)		
university degree	-0.005	-	-	0.023	-	-
	(0.014)			(0.021)		
year dummies	yes	yes	yes	yes	yes	yes
establishment characteristics	yes	yes	yes	yes	yes	yes
R^2	0.076	0.046	-	0.091	0.061	-
observations	6,395	6,395	2,442	3,619	3,723	1,358
individuals	-	3,614	1,583	-	2,162	958
AR-test	-	-	0.934	-	-	0.666
Hansen test	-	-	0.125	-	-	0.069

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 A8: Determinants of employee retention VI; full sample

dep. variable: retention next year	Basic Models			Basic Models with externally provided training		
	OLS (1)	FE (2)	GMM (3)	OLS (4)	FE (5)	GMM (6)
training	0.092***	0.076***	0.074***	0.110***	0.102***	0.117***
	(0.010)	(0.011)	(0.013)	(0.017)	(0.020)	(0.020)
wage increase	0.043***	0.037***	0.043***	0.048***	0.042***	0.044***
	(0.004)	(0.005)	(0.006)	(0.005)	(0.006)	(0.007)
training * general content	**-0.010**	**0.006**	**0.017**	**-0.022**	**0.011**	**0.001**
	(0.009)	**(0.011)**	**(0.012)**	**(0.015)**	**(0.018)**	**(0.015)**
training * certificate	**-0.010**	**-0.006**	**0.004**	**-0.016**	**-0.026***	**-0.019**
	(0.007)	**(0.009)**	**(0.011)**	**(0.012)**	**(0.015)**	**(0.016)**
female	0.008*	-	-	0.011**	-	-
	(0.005)			(0.005)		
birth year 1952-1961	-0.008	-	-	-0.007	-	-
	(0.006)			(0.007)		
birth year 1962-1971	-0.007	-	-	-0.007	-	-
	(0.007)			(0.008)		
birth year > 1972	-0.032***	-	-	-0.033***	-	-
	(0.010)			(0.011)		
tenure < 10	-0.071***	0.170***	0.314***	-0.082***	0.180***	0.240***
	(0.007)	(0.020)	(0.051)	(0.009)	(0.023)	(0.048)
tenure 10-20	0.011	0.046**	0.008	0.008	0.034	-0.033
	(0.007)	(0.018)	(0.037)	(0.008)	(0.021)	(0.039)
experience < 10	-0.058***	-0.065	-0.106	-0.064***	-0.051*	-0.097**
	(0.010)	(0.025)	(0.041)	(0.011)	(0.030)	(0.042)
experience 10-20	-0.021***	-0.008	-0.001	-0.023***	-0.006	-0.013
	(0.006)	(0.018)	(0.023)	(0.007)	(0.021)	(0.023)
work satisfaction	0.012***	0.009	0.006	0.013***	0.008	0.003
	(0.001)	(0.002)	(0.005)	(0.001)	(0.003)	(0.005)
vocational education	0.002	-	-	0.009	-	-
	(0.009)			(0.010)		
university degree	-0.002	-	-	0.003	-	-
	(0.010)			(0.011)		
year	yes	yes	yes	yes	yes	yes
establishment characteristics	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.