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Anika Jansen, Mirjam Strupler Leiser,
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Universität Zürich
IBW – Institut für Betriebswirtschaftslehre

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The effect of labor market regulations on training behavior and quality: the German labor market reform as a natural experiment

Anika Jansen*, Mirjam Strupler Leiser**, Felix Wenzelmann*& Stefan C. Wolter***⁺

*German Federal Institute for Vocational Education and Training (BiBB), Bonn

** University of Bern, Centre for Research in Economics of Education¹

*** University of Bern, CESifo & IZA

Abstract

Labor market frictions are seen in many extensions of the classical human capital theory as a prerequisite for firms financing general training. The labor market reforms in Germany at the beginning of the millennium have therefore been seen by many as a danger to the firms' willingness to support the apprenticeship training system. This paper analyzes the training strategies German firms deployed to cope with the greater labor market flexibility as a result of the labor market reform. Switzerland where no reforms had taken place serves as the counterfactual. The results show that firms successfully reduced the net-costs of training by involving apprentices in more work and reducing non-productive tasks, like practicing. Contrary to the widespread fear, this adapted training strategy resulted also in a substantial increase in work-related competencies and productivity of apprentices.

Key-words: Apprenticeship training, difference-in-differences matching estimator, cost-benefit, labor market reforms

JEL-codes: C0, I20, J50

⁺ Communicating author: Stefan Wolter, stefan.wolter@vwi.unibe.ch

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1. Introduction

The existence of large scale training systems, like the apprenticeship training system in Germany, where firms are willing to invest considerable sums up-front in the general skills of their employees has been used in the modern training literature in economics as an illustration of the importance of labor market frictions. Inversely, the absence of strict labor market regulations has been used to explain the absence of such firm behavior in Anglo-Saxon labor markets. If such is the case and apprenticeship training systems and tight labor market regulations always come as twins, then of course labor market deregulations would not be without consequences for the firms' willingness to provide training positions. Anticipating the reform agenda of the German government under Chancellor Schröder, the founding fathers of the extensions of the human capital theory beyond Becker, Acemoglu and Pischke feared exactly this, when writing: *"...naturally, in practice, increased frictions will have a number of allocative costs, such as lower employment ... [but] in any case, the implications of labor market frictions on training are worth bearing in mind when suggesting labor market reforms. For example, proposals for reducing union power and removing regulations in the German labor market, which are on the current agenda, could have unforeseen consequences regarding the German apprenticeship system, where employers pay for the general training of their workers."* (1999b, pp. 548-9).

In this paper we analyze the impact of the German labor market reforms at the beginning of the millennium on the training strategies and training quality of German firms in regard of apprenticeship training. In order to be able to assess the causal impact of the labor market deregulation we make use of the comparison with Switzerland, which has an almost identical training system but has not changed its labor market regulation during the observed period.

The findings show after the easing of the strictness of the labor market regulation, German firms have had to reduce their up-front net investment in apprentices substantially in order to limit the risk to lose the investment in a more flexible labor market. As the binding training regulations did not allow the firms to reduce their gross investment in training, they were forced to increase the productive contribution of trainees to achieve a reduction in the net-costs of training. The firms were able to substantially increase the productive contribution of trainees involving them in more skilled work, reducing at the same time the days previously used for non-productive tasks like practicing. The move from a so-called "investment-oriented" training strategy to a more "production-oriented" strategy does not go without fears that this results in an exploitation of trainees at the expense of training quality. This is why we also look into the development of training quality, which – contrary to widespread believes did not suffer from more work involvement but improve.

The paper is structured as follows: the next section offers a brief summary of the theoretical literature on the relationship between labor market frictions and the financing of general skills by firms. Section 3 describes the apprenticeship training systems in Germany and Switzerland as well as the labor market regulations. Section 4 provides information on the changes in labor market regulations that took place at the beginning of the millennium in Germany. The following two sections describe the data and the empirical strategy. Section 7 shows the empirical results and section 8 concludes.

2. Labor market regulations and training behavior

In the classical human capital theory (Becker, 1962) firms would have to pay partially for firm-specific skills and employees would have to pay entirely for general skills². The theoretical predictions are based on the assumption of competitive labor markets in which workers cannot be paid below their marginal productivity. Therefore an employer could never recoup investments in skills that are productive with many employers (general skills) by paying the trained worker below his/her marginal productivity. Based on the observation, however, that many employers do pay for general skills, extensions of the classical human capital theory tried to reconcile theory with empirical observations. Acemoglu and Pischke (1998, 1999a & b) used the observations made in Germany on the financing of apprenticeship training (Von Bardeleben et al., 1995) that showed considerable net-investments of employers in skills that are regarded as general skills to motivate their extension of the human capital theory. Acemoglu and Pischke dropped the assumption that labor markets are perfectly competitive; instead more realistically they assumed labor markets are characterized by varying degrees of frictions. These frictions lead in their model to a compressed wage structure – a pay structure in which skilled workers can be paid below their marginal product. The gap between productivity and wage increases with training, therefore, rents for firms increase with training also. As a result of this compressed wage structure, firms are able to recoup investments in training.

Labor market frictions may have several causes and labor market regulations can be just one but an important source for such frictions.³ Regulations like specific rules concerning the laying off of workers (firing costs) or limitations to temporary work (which allow employers to screen potential employees) increase the costs of bad matches. In order to avoid mismatches, firms have to invest more in the search of new recruits, therefore, bear higher hiring costs. High hiring costs make a hire and fire policy costly and therefore reduce the number of job vacancies, which also means that the probability that a training firm will be poached by a competitor is reduced. This in turn leaves the training firm a margin to pay wages below the marginal productivity and thereby recoup prior net-investments in training.

In summary, whereas labor market regulations and institutions allow firms to earn a rent on their training investment after the training period has ended, in competitive labor markets training only takes place if firms can pay trainees below productivity during the training period. In consequence, the higher the frictions in a labor market the higher the share of firms that are willing to accept net-costs of training at the end of the training period et vice versa.

For our paper this allows us to formulate the hypothesis that if two countries are characterized (*ceteris paribus*) by considerable different degrees of strictness in their labor market regulations they will show differences in the observed net-costs of training at the end of the training period. Furthermore, if the strictness of labor market regulations is eased, then net-investments in training

² For a comprehensive overview of the training literature see Leuven (2005) and for its application to apprenticeship training see Wolter and Ryan (2011).

³ Geographical barriers to mobility (see Muehlemann and Wolter, 2011) or monopsony power of firms (Muehlemann et al., 2013) may be other examples of labor market frictions that have been tested in their impact on the firm's willingness to offer apprenticeship training and the financing of it.

(per trainee) are either reduced or in the case that this would not be possible (e.g. due to exogenous training regulations), the training intensity in the economy would decrease.⁴

3. One training system, different labor market regulations, different training strategies

Apprenticeship training

Apprenticeship training has a long tradition both in Germany and Switzerland. The two training systems are highly comparable in terms of training regulations, requirements for entering an apprenticeship and the amount and type of acquired skills during training. With more than half of a cohort of young adults entering the dual apprenticeship system after compulsory school in Germany and two-thirds in Switzerland, it is also the single most important educational pathway at the upper secondary level. Apprenticeship programs are labeled 'dual' because learning takes place at two different learning sites: the workplace and the vocational school. Apprentices receive formal work-related training at the training firm and additionally attend vocational school up to 2 days a week for general and occupation specific education.

Firms and apprentices sign a binding training contract for a fixed duration (2 through 4 years in Switzerland or 2 through 3.5 years in Germany) and a predetermined wage, which is a fraction of the wage of a skilled worker. By signing the contract firms commit to an occupation specific curriculum to provide apprentices with general and occupation specific skills at the workplace. Conveying formal education is costly to the firm, as it has to pay besides the apprentices' wage also for training personnel as well as material and machinery used in the training process. However, apprentices also perform tasks which would otherwise have to be performed by skilled or unskilled workers and therefore generate benefits for the training firm. Beside productive tasks, firms can also allocate non productive tasks to apprentices, such as exercises. While training regulations are quite prescriptive in terms of the content and the amount of training a firm has to provide its apprentices, the firms have considerable degrees of freedom in regard of the work allocation to apprentices.

Labor market regulations and training strategies

Contrary to the similarities in the apprenticeship systems, labor market regulations differ considerably between Germany and Switzerland. The overall labor market strictness as measured by the OECD (see Table 1) was 2.3 for Germany in the year 2000 and 1.1 for Switzerland (for a detailed description of this indicator, see Veen, 2009). When ranking the 29 OECD countries in the year 2000 according to their labor market strictness from the least (US) to the most regulated country (Turkey) Switzerland ranked number 5 and Germany number 21.

⁴ We do not look specifically into the development of firm's participation into training but the development of training places in both countries suggests that there was no reduction in the willingness of firms to offer training positions for apprentices.

In accordance with the hypothesis formulated in the previous section, an empirical analysis of the net-costs of apprenticeship training in Germany and Switzerland for the year 2000 (see Dionisius et al., 2009) showed, that for an average three-year apprenticeship a training firm in Germany had to bear net-costs, whereas a comparable training firm in Switzerland recorded a net-benefit at the end of the training period. The difference in net costs amounted to 25,000 € in the year 2000 between comparable German and Swiss firms. Using matching models Dionisius et al. (2009) showed that the main factor explaining this difference was the allocation of productive tasks to the apprentices. Swiss apprentices created more benefit for the training firm because they spent more of their time in the production process, whereas their German counterparts spent more time in non-productive exercises.⁵ Also in line with the theoretical predictions, the majority of Swiss apprentices (two thirds) left the training company within the year that followed graduation, whereas the opposite could be observed in Germany. The higher degree of employment protection causing low labor market mobility enabled German firms to recoup their investments in the post-training period, whereas their Swiss counterparts, operating in a competitive labor market, had to protect themselves against a likely loss of their investments by recouping their investments already during the training period. Muehleemann et al. (2010) analyzed in an additional paper not only the differences between the training strategies of German and Swiss firms but also the differences between training and non-training firms in both countries. According to these analyses and consistent with the formulated hypothesis, non-training firms in Switzerland mainly refrain from training because of expected high net-investments during the training period, whereas in Germany non-training firms are mainly those who despite the tighter labor market regulations do not expect substantial post-training benefits.

4. Changes in the labor market regulations in Germany

As an answer to stagnating economic growth and high unemployment rates the German government of Chancellor Schröder introduced a comprehensive economic reform, also known as the Agenda 2010 at the beginning of the first decade of this century. The reforms aimed to foster economic growth and to increase employment by taking three main measures: reducing the incidental wage costs, increasing labor market flexibility, and reforming the social welfare system. The Agenda 2010 consisted of various legislation changes bundled into four packages (Gesetze zur Reform des Arbeitsmarktes 1 to 4)⁶, which successively came into force between 2003 and 2005. These changes

⁵ There is of course the question why German training firms did not try to get a “double dividend”. The low labor market mobility allows them to earn rents on trainees after training but they could nonetheless have tried to have already a net-benefit during the training period. Although there has not been any serious research on this particular topic, the most likely explanation for the high net-costs during training (which was due to low engagement of apprentices in productive work and not higher spending on training by the firms) has to be seen as consequence of a concession to trade unions who always feared that apprentices could become cheap labor and substitute skilled workers (see Wolter and Ryan, 2011, p. 536.)

⁶ The law packages are also called Hartz 1 to 4 because they are based on the proposals of the commission “*Moderne Dienstleistungen am Arbeitsmarkt*”, which was lead by Peter Hartz.

affected a wide array of political and economic areas, such as the social welfare system, the health and pension insurance system, labor market regulations, as well as family and education policy.

In the present analysis we concentrate on the effects of the parts of the reform that targeted the labor market flexibility. Therefore, the subsequent section will only present changes that presumably have an effect on the firm's training decision and behavior. To increase the labor market flexibility protection laws for regular employment and laws on temporary employment were changed. Concerning regular employment, two major changes were introduced. First, the threshold value for the application of the employment protection regulations was raised from 5 to 10 employees per firm. Hence, all firms that are smaller than 10 employees were no longer constrained in their dismissal decisions. Second, the reasons why a person cannot be dismissed were restricted to four aspects of the employee's current situation: tenure, age, maintenance obligations, and the existence of a severe disability. All other aspects could not be held anymore against the employers firing decision.

In relation to temporary work contracts, the 2004 reform of the German act on temporary work (AÜG), which was part of the First Law for Modern Services in the Labor Market ("Hartz 1"), eased the constraints for the completion of temporary work contracts and made those types of contracts more popular. The changes provided firms with more flexibility to employ temporary workers whenever they are in need of them. As a result of the legislative changes the data from the IAB establishment panel shows that of all new work contracts, the share of temporary contracts increased by more than a third from 32% in 2001 to 45% in 2011 (Aktuell, 2012⁷).

The changes in the German employment protection are also represented in the overall OECD employment protection indicator. This indicator decreased from 2.3 in 2000 to 2.1 in 2007. In particular, the indicator for temporary employment showed a substantial decrease by 0.7 units.⁸ In contrast to the German situation, the Swiss labor market regulations did not change in this period as the constant OECD indicators reveals (Table 1).

Table 1: Strictness of employment protection

OECD Indicator of the strictness of employment protection	Germany		Switzerland	
	2000	2007	2000	2007
Overall	2.3	2.1	1.1	1.1
Regular employment	2.7	3	1.2	1.2
Temporary employment	2	1.3	1.1	1.1

Source: OECD, OECD.stat Extract, stats.oecd.org

Relaxing regulations for temporary work increases labor market mobility and therefore affects apprenticeship training by reducing the possibilities for firms to generate rents after apprenticeship training. In the absence of temporary work apprenticeship training was the only low cost screening

⁷ Source http://doku.iab.de/aktuell/2012/befristete_beschaeftigung_uebernahme.pdf (12.12.2012)

⁸ Unfortunately, we have not been able to get explanations from the OECD why the reforms undertaken by the Schröder government are not reflected in the indicator for the strictness of regular employment.

device for firms but by employing a person temporarily the firm can also learn about his or her ability and work attitudes. If the temporary worker reveals to be a good match for the firm, the firm can offer the temporary worker a fixed contract. The possibility for firms to screen future employees at low costs offers ex-apprentices new opportunities on the labor market and relieves the “Lemons” problem (see e.g. Acemoglu and Pischke, 1998) that under strict regulations prevented apprentices from leaving their training company. As the possibility to find high-ability workers on the labor market increases, firms become more willing to employ externally trained workers without knowing their actual productivity. As a consequence, training firms face a higher risk of losing apprentices after training and this in turn reduces the possibilities to realize returns on training investment and increases the pressure to train less cost-intensive.

Summing up, the German labor market reform, which reduced the strictness of temporary employment protection, increases potential labor market mobility. We therefore argue that this reform has reduced the expected rents on trainees that firms can generate after training. As a result firms who want to remain active in training had to change their training behavior in order to reduce the net costs of training. Theoretically, net costs of training can be reduced by several measures. Firms could try to cut gross costs by employing less training personnel or by reducing apprentices’ pay. However, decreasing training hours would result in a lower quality of training. Even if the firm is not willing to employ the former apprentice as a professional, reputational considerations and legal constraints limit the possibility to reduce training quality significantly. Apprentice wages, on the other hand, are determined collectively in Germany and are, therefore, not at the discretion of the firm. A more promising strategy to reduce net costs of training is to increase the benefits. Because regulations concerning the work allocations to apprentices are less strict and it is unclear whether performing productive tasks reduces or even increases the quality of training, this strategy to reduce the net-costs of training seems also most likely.

5. Data

The concept for the cost-benefit surveys used in this study was developed by the “Expert Commission on Costs and Financing of Vocational Education and Training” also known as the “Edding-Commission” in 1974. For our analysis we use four cross-section firm-level surveys, two conducted in each country at different points in time that follow the same set up. Two almost identical surveys were conducted simultaneously with reference to the year 2000 (see Beicht et al., 2004 for Germany and Schweri et al., 2003 for Switzerland). The second pair of surveys was conducted with reference to the year 2007 in Germany (Schönfeld et al., 2010) and 2009⁹ in Switzerland (see Strupler and Wolter, 2012).

⁹ It is of course unfortunate that the second pair of surveys was not conducted in exactly the same year. However, we like to argue that this does not affect the comparability of the surveys. Although only the second German survey had been conducted before the outbreak of the financial crisis, the second Swiss survey (questionnaires had been sent out in March 2010) had been conducted in a similar economic climate as in

The data comprises detailed information on costs and benefits of apprenticeship training as well as firm characteristics for German and Swiss firms. Concerning the methodology the surveys are similar and comparable in almost all aspects. Nevertheless, there are some minor differences: one concerned the question eliciting the training hours that was changed in the Swiss and the German questionnaire relative to the 2000 survey, but in different ways. As a consequence of these changes we will not be able to compare the changes over time in the gross costs of training. However, as the major difference between the two training models lies in the benefits from training (see Dionisius et al., 2009) this should not affect our analyses much. As in the previous comparative papers the analyses are restricted to three-year apprenticeship programs since longer programs are not fully comparable between the two countries¹⁰. The final sample consists of 1,471 Swiss firms and 1,738 German training firms in 2000 and 1,842 Swiss and 2,161 German training firms in 2009 and 2007 respectively.¹¹

6. Empirical strategy

To estimate the effects of the German labor market reform on training behavior we combine a difference-in-differences approach with a matching strategy, similar to Heckman et al. (1997). In contrast to a matching estimator, that compares outcomes only after the reform, the difference-in-differences estimator controls for time invariant differences in the outcomes between German and Swiss firms.

Our aim is to estimate the effect of the labor market reform in Germany on training behavior. Therefore, we estimate an average treatment effect on the treated (ATT), where the treatment ($D(i,t)$) is the reform and the treated individuals are German firms. The effect of the treatment can be defined in a potential outcomes framework (Rubin, 1974). Let $Y^0(i,t)$ be the outcome for firm i at time $t \in (0,1)$ in absence of the treatment. $Y^1(i,t)$ represents the outcome for firm i at time t if exposed to the treatment. The fundamental identification problem is that for a particular firm i and time t , we never observe both potential outcomes simultaneously. German firms were all exposed to the reform and therefore the counterfactual outcome without reform cannot be observed. Thus, we cannot directly observe $\Delta = Y^1(i,1) - Y^0(i,1)$ but instead estimate an average treatment effect on the treated applying a difference-in-differences matching strategy and thereby use Swiss firms as the (no reform) counterfactual.

The cross-sectional data, comprising detailed information on both countries, Germany and Switzerland, in the pre and post treatment period, allow estimating difference-in-differences. The

Germany in 2007 and moreover the Swiss data had been remarkably stable in varying economic situations through the decade as is shown by comparing the 2009 data to an additional survey that had been administered in Switzerland with reference to the year 2004.

¹⁰ These longer programmes last 3.5 years in Germany and 4 years in Switzerland, respectively.

¹¹ All prices were deflated to 2000 values and the exchange rate in 2000 (1 CH = 0.64687) was used to convert Swiss Francs into Euros.

population is observed in the pre treatment ($t=0$) and post treatment ($t=1$) period. German firms are exposed to the treatment (reform), therefore German firms are denoted treated firms with $D(i,1)=1$, whereas Swiss firms are untreated $D(i,1)=0$, as they are not exposed to the reform. No firm is exposed to the treatment in the pre reform period ($t=0$), therefore $D(i,0)=0$ for all firms. The difference-in-differences estimator (Δ^{DID})¹² for repeated cross-sections is

$$\Delta^{DID} = E[Y(i, 1) - Y(i, 0)|D(i, 1) = 1] - E[Y(i, 1) - Y(i, 0)|D(i, 1) = 0] \quad (1)$$

where $E[Y(i, 1) - Y(i, 0)|D(i, 1) = 1]$ is the evolution in time for German (treated) firms ($\Delta Y(D=1)$) and $E[Y(i, 1) - Y(i, 0)|D(i, 1) = 0]$ the development for Swiss firms ($\Delta Y(D=0)$).

The crucial identifying restriction in difference-in-differences models is the common trend assumption:

$$E[Y^0(i, 1) - Y^0(i, 0)|D(i, 1) = 0] = E[Y^0(i, 1) - Y^0(i, 0)|D(i, 1) = 1] \quad (2)$$

which means that in absence of the treatment, treated and non-treated firms would have followed a parallel path. This assumption implies that economic shocks affect firms operating within the same market but in different countries equally. Given the observation that both countries have followed a remarkably similar macroeconomic growth pattern over the last decade and that their economies are heavily intertwined (Germany is by far the largest exporter to Switzerland and at the same time by far the largest destination of Swiss exports) we assume that the assumption of similar trends over time in both countries is justified.

In order to make sure that similar firms are compared, we apply a matching strategy proposed by Abadie et al. (2004). In a first step, we match to each Swiss firm in the sample 2009 a Swiss firm in 2000 with the same characteristics (X)¹³. The same strategy is applied for German firms. As a result, each firm in the post treatment period receives a (potential) outcome from the pre treatment period and, as a consequence, a within country difference over time (ΔY_i^D) can be calculated ($\Delta Y_i^D = Y(i, 1) - \hat{Y}(i, 0)$). In a second step, we estimate the difference of the within country differences ($\Delta^{DID} = \Delta Y^1 - \Delta Y^0$). Ensuring a balanced comparison group a matching strategy is – again – applied. We match to each German firm in the post treatment period one (or more) similar Swiss firms (from the post treatment period). This is equal to estimating an average treatment effect of the treated (ATT).

Let the outcome (difference in time) be denoted by :

$$\Delta Y_i = \Delta Y_i(D_i) = \begin{cases} \Delta Y_i(0) & \text{if } D_i = 0 \\ \Delta Y_i(1) & \text{if } D_i = 1 \end{cases} \quad (3)$$

¹² For details see for example Abadie (2005).

¹³ Characteristics for the within country matching are firm size, job categories, industry, region. If more than one firm in 2000 with exactly the same characteristics exists, the outcome will be averaged over these firms.

To make sure that the matching estimator identifies and consistently estimates the treatment effect of the treated, the following two assumptions have to be satisfied.

$$1. \Delta Y_i(0) | \Delta Y_i(1) \perp D_i | X = x \quad (4)$$

$$2. 0 < P(D_i = 1 | X_i) < 1 \quad (5)$$

The first assumption holds, if assignment to treatment (firms located in Germany) is independent of the outcomes conditional on covariates. Independence conditional on covariates means that there are no unobservables that affect the outcomes and the choice of residence of the firm simultaneously (unconfoundness). Although location of firms is not random, apprenticeship training is never the core business of a firm, so we can safely assume that firms choose their country location independent of factors influencing benefits and costs of apprenticeship training. Hence, the unconfoundness assumption holds. The second assumption holds when the probability of assignment is restricted between 0 and 1 (Abadie et al., 2004). This identification assumption holds as in both samples a large number of firms with similar firm's characteristics can be found.

Using a simple matching estimator proposed by Abadie et al. (2004) we estimate the development in benefits of apprenticeship training and other related variables for German firms with and without (counterfactual) reform. The counterfactual is calculated by averaging the outcomes of similar firms¹⁴ in terms of observable characteristics in the opposite treatment group (Switzerland). For the treated group the observed outcome is its own estimate. The following approach is used to estimate the pair of potential outcomes:

$$\widehat{\Delta Y}_i(0) = \begin{cases} \Delta Y_i & \text{if } D_i = 0 \\ \frac{1}{\#\mathcal{T}_M(i)} \sum_{l \in \mathcal{T}_M(i)} \Delta Y_l & \text{if } D_i = 1 \end{cases} \quad (6)$$

$$\widehat{\Delta Y}_i(1) = \begin{cases} \frac{1}{\#\mathcal{T}_M(i)} \sum_{l \in \mathcal{T}_M(i)} \Delta Y_l & \text{if } D_i = 0 \\ \Delta Y_i & \text{if } D_i = 1 \end{cases} \quad (7)$$

where $\mathcal{T}_M(i)$ denotes the set of indices for the matches for a firm i and $\#\mathcal{T}_M(i)$ the number of elements of $\mathcal{T}_M(i)$. l represents the observations of the opposite treatment group.

Using these estimates of the potential outcomes, the matching estimator for the average treatment effect on the treated is¹⁵:

$$\Delta^{DID} = \frac{1}{N_1} \sum_{i: D_i=0} \{\Delta Y_i - \widehat{\Delta Y}_i(0)\} \quad (8)$$

¹⁴ Matching variables X are firm size, job categories and industry.

¹⁵ For more details see Abadie et al. (2004)

7. Results

Apprentices' benefit and benefit components

Our results show that the benefit apprentices generate to the firm during training increased substantially in Germany, whereas no significant change could be identified in Switzerland. The increase of benefits for an average training year was 2.000 € higher for an average German firm compared to a similar Swiss firm (Table 2). For the whole training period this sums up to more than 6,000 € and represents an increase of almost 25 percent.

The more detailed analyses show that German firms increased benefits of training by changing the allocation of tasks of apprentices whereas no substantial change in task allocation can be found for Switzerland. German firms increased the share of and the days spend in productive unskilled and skilled tasks compared to Swiss companies. These changes were all at the expense of tasks with no direct value to the firm. The difference-in-differences results reveal that the share of tasks without a direct value to the firm decreased by almost 30 percentage points in the first year of training, whereas the shares of skilled and unskilled productive tasks show an increase each of about 15 percentage points. In terms of working days these results represent an increase in unskilled and skilled tasks of 26 and 25 days, respectively, with an according reduction in days of "non-productive" practicing. For the second and third year of training it was the share of skilled tasks that increased in German firms, whereas unskilled tasks did not change relative to Swiss firms.

For the entire period of an apprenticeship the relative change was + 83 days in skilled and + 33 days in unskilled tasks for German firms compared to Swiss firms.

Apprentices' costs

Although we cannot compare all components of the gross-costs of training because of the changes in the questionnaire relating to the trainers' hours, we can nevertheless compare the development of relative wages of apprentices and skilled workers. The apprentices' wages are representing between 40-50 percent of the gross costs of apprenticeship training and Dionisius et al. (2009) had already identified them as an additional source of difference in net costs between German and Swiss firms. Table 3 shows that the difference-in-differences for wages of skilled workers in the trained occupation is not significant but real wage costs for apprentices decreased significantly both in absolute terms and relative to Switzerland in Germany.

Table 2: Average treatment effects on the treated for Switzerland, Germany and difference-in-differences estimates

Variable	ATT (ΔY^0) Switzerland		ATT (ΔY^1) Germany		ATT (Δ^{DID}) Germany-Switzerland	
	Coefficient	Std-Err	Coefficient	Std.-Err	Coefficient	Std.-Err
Benefit per year per apprentice (in €)	-499.16	324.95	1'578.34	199.43***	2'075.61	274.71***
Share of productive tasks (unskilled, 1st year)	3.02	1.59*	18.01	1.39***	14.52	1.54***
Share of productive tasks (skilled, 1st year)	-3.11	1.85*	11.22	1.40***	14.71	1.46***
Share of tasks with no direct value to firm (1st year)	0.09	1.23	-29.43	1.45***	-29.44	1.41***
Share of productive tasks (unskilled, 2nd year)	2.90	1.64*	5.31	1.21***	2.43	1.56
Share of productive tasks (skilled, 2nd year)	-2.42	1.72	16.66	1.38***	19.97	1.65***
Share of tasks with no direct value to firm (2nd year)	-0.48	4.50	-22.18	1.12***	-22.62	1.06***
Share of productive tasks (unskilled, 3rd year)	4.50	1.26***	1.48	1.25	-0.88	1.53
Share of productive tasks (skilled, 3rd year)	-4.31	1.41***	12.34	1.54***	15.97	1.83***
Share of tasks with no direct value to firm (3rd year)	-0.19	0.87	-14.12	1.05***	-15.39	1.12***
Days of productive tasks (unskilled, 1st year)	-1.15	2.72	24.95	2.18***	25.71	2.53***
Days of productive tasks (skilled, 1st year)	-8.74	3.20***	15.17	2.08***	24.61	2.23***
Days of tasks with no direct value to firm (1st year)	-2.56	2.03	-40.06	2.24***	-37.38	2.12***
Days of productive tasks (unskilled, 2nd year)	1.89	2.86	8.15	1.86***	7.27	2.38***
Days of productive tasks (skilled, 2nd year)	-6.66	2.75**	24.52	2.20***	33.68	2.88***
Days of tasks with no direct value to firm (2nd year)	-2.32	1.53	-31.01	1.79***	-29.42	1.56***
Days of productive tasks (unskilled, 3rd year)	6.34	2.06***	2.68	2.02	0.25	2.47
Days of productive tasks (skilled, 3rd year)	-7.08	2.36***	18.20	2.55***	24.66	2.95***
Days of tasks with no direct value to firm (3rd year)	0.09	1.41	-20.07	1.60***	-22.01	1.80***
Number of Observation 1st year	1308		1133		1133	
Number of Observation 2nd year	1257		1326		1326	
Number of Observation 3rd year	1237		1195		1195	
Number of Observations total	1842		2161		2161	

Note: Matching variables are firm size (exact), job categories (exact) and industry (+region for within country matching). Standard errors are robust. *p<0.1, **p<0.05, ***p<0.01.

Table 3: Treatment effects for wages

Variable	ATT (ΔY^0) Switzerland		ATT (ΔY^1) Germany		ATT (Δ^{DID}) Germany-Switzerland	
	Coefficient	Std-Err	Coefficient	Std.-Err	Coefficient	Std.-Err
Monthly real wage of skilled workers (in €)	-27.65	39.28	-55.63	20.78***	-27.40	28.34
Yearly wage costs for apprentices (in €, 1st year)	55.82	188.70	-334.40	94.68***	-765.58	150.08***
Yearly wage costs for apprentices (in €, 2nd year)	-56.27	189.81	-516.54	114.59***	-391.39	154.51**
Yearly wage costs for apprentices (in €, 3rd year)	677.57	175.77***	-461.95	117.88***	-1181.4	183.60***
Number of Observations	1842		2161		2161	

Note: Matching variables are firm size (exact), job categories (exact) and industry (+region for within country matching). Standard errors are robust. *p<0.1, **p<0.05, ***p<0.01.

Therefore, although we cannot fully compare the impact of the reform on the gross costs of apprenticeship training, we have some evidence indicating that the reform also lowered the gross costs of apprenticeship training and that the combined effect on the net-costs of training is higher than the changes in benefits shown in the previous paragraph alone.

Apprentices' quality

As mentioned in the introduction, the extensive use of apprentices in practicing instead of productive work has been defended mainly by those fearing that the use of apprentices as “cheap labor” would be in contradiction of the training and qualification goals of apprenticeship training. Although measuring the quality of training is difficult, the relative productivity of an apprentice in skilled tasks compared to a fully trained skilled worker can be used as a valuable proxy for the quality of training.¹⁶

The relative productivity in the last year of training, compared to an average skilled worker - as reported by training companies - increased in Germany in all training years (Table 4) in absolute terms and relative to Swiss firms. In 2007/2009 the relative productivity in an average German and Swiss training firm reached comparable levels. The presented evidence also suggests that learning and (skilled) work are rather joint products and not substitutes and that the involvement of apprentices in the production process can have a positive effect on the acquired competencies of apprentices. The positive impact of more work exposure of German apprentices on their productivity

¹⁶ Employers are asked in the questionnaire to assess the productivity of apprentices relative to skilled workers for each year of the apprenticeship training. Although a subjective measure, this is certainly the only measure of quality of apprenticeship training that allows a comparison across the almost 200 different training occupations in our sample. Given the fact that German and Swiss firms are heavily intertwined in their economic activities and on average have the same technological standards, we can also safely assume that there are no structural or temporal differences in the subjective assessment of the productivity between employers in the two countries.

is also credible when considering (see Table 2) that non-productive tasks (practicing) were mostly substituted by work requiring skills and not by unskilled activities.

Table 4: Treatment effects for the relative productivity of apprentices

Variable	ATT (ΔY^0) Switzerland		ATT (ΔY^1) Germany		ATT (Δ^{DD}) Germany-Switzerland	
	Coefficient	Std.-Err	Coefficient	Std.-Err	Coefficient	Std.-Err
Relative productivity (1st year)	0.41	1.58	10.33	1.35***	6.82	1.79***
Relative productivity (2nd year)	0.59	1.44	11.36	1.23***	11.01	1.44***
Relative productivity (3rd year)	-1.77	1.24	5.33	1.34***	5.78	1.39***
Number of Observations	1842		2161		2161	

Note: Matching variables are firm size (exact), job categories (exact) and industry (+region for within country matching). Standard errors are robust. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Robustness checks

Firstly, Germany and Switzerland both have a considerable degree of heterogeneity in apprenticeship training and economic activity with the country. Whereas in Germany it is mostly the East-West and North-South divide, in Switzerland the differences are most pronounced between the language regions (Latin vs. German speaking regions). In order to test, whether the difference-in-differences estimates are affected by this, we run all estimations comparing only the German speaking regions of Switzerland with the two regions (Bavaria and Baden-Württemberg) in Germany that border Switzerland. Given the fact that the cross-border economic activities in these regions are very intense, they can be considered almost as one economic area. This implies that with the exception of labor market regulations and other laws, there would not be major differences for other factors like the business cycle or technological progress. When doing the analyses with the reduced sample we get qualitatively the same results as for the full sample, which backs up the interpretation that the differences in the developments in Germany relative to Switzerland must have been caused by the legal changes in Germany and not other unobserved economic differences.

Secondly, when looking at firm characteristics it is noteworthy that in Germany on average firms incurred net-costs at the end of the training period in 2000 irrespective of their size or sector. Therefore one would expect that the pressure to reduce the net-costs of training would have been similar across those characteristics. Taking the observation into account that especially very large firms in Germany had traditionally organized their apprenticeship training internally in specific training and practicing centers, one could assume that the scope for substitution of non-productive tasks was bigger in these firms. In accordance with this, Busemeyer et al. (2012) analyzing the changes in Germany over the same period with the same data, find, that very large firms (>500 employees) benefited the most from this change in training strategy. However, they cannot rule out the possibility that there have been unobserved changes over time that affected big and small firms differently. Comparing German and Swiss firms of the same sizes (see Table 5) we find some evidence – although the improvements in Germany are visible for all firm sizes – that the

improvement in net benefits of apprenticeship training relative to Switzerland were more pronounced for big firms compared to small firms (almost by a factor of 3).

Table 5: Treatment effects for the net benefit per apprentice and firm size

		ATT (ΔY^0)		ATT (ΔY^1)		ATT (Δ^{DID})	
		Switzerland		Germany		Germany-Switzerland	
Variable	Employees	Coefficient	Std-Err	Coefficient	Std.-Err	Coefficient	Std.-Err
	1-9	133.81	402.72	1'373.99	252.02***	1'311.21	322.47***
Benefit per year per apprentice (in €)	10-49	-826.60	612.17	1'743.26	375.21***	2'308.30	600.52***
	50-99	56.14	974.64	3'080.27	720.43***	2'991.58	732.67***
	100+	-624.59	762.64	1'486.75	919.51	3'384.56	615.99***

Note: Matching variables are job categories (exact) and industry (+region for within country matching). Standard errors are robust. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

8. Conclusion

Labor markets with frictions instead of competitive ones have played a prominent role explaining why firms in some countries were willing to finance huge up-front investments in general skills, while firms in other countries were not supporting such schemes. Germany has been used in this training literature as an exemplary case why labor market regulations (as an important source for labor market frictions) were a prerequisite for a functioning large-scale apprenticeship training system. Although the case of Switzerland, where labor market regulations were considerably less strict than in Germany was a hint that it should be possible to have an apprenticeship training system also operating in an environment of a deregulated labor market, this was no proof that the apprenticeship training system would not be damaged by the deregulation of the German labor market planned and implemented by the German government at the beginning of the millennium.

In summary our empirical analyzes shows that German firms, realizing that post-training benefits decrease in a more flexible labor market, managed successfully to reduce their up-front investment in general skills. Firms reduced their net costs of training by increasing the benefit of the apprenticeship training during the training period as a result of a change in the allocation of productive tasks to apprentices. More interestingly than the fact that the system was flexible enough to allow firms to change their training strategies in the light of changing framework conditions is the finding that the more pronounced involvement of apprentices did not harm the quality of training. Quite the contrary, the use of apprentices to substitute skilled workers has apparently led to better work-skills acquisition than the previous strategy of letting apprentices learn in non-work-related practicing.

In conclusion, this paper shows that labor market regulations and frictions are indeed a prerequisite for net-investments in general skills by firms as stipulated by the modern training literature but that a net-investment is not a precondition for a functioning apprenticeship training system.

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Appendix

Table 6: Descriptive statistics Switzerland

Switzerland	2000			2009		
Variable	Mean	Std-Er	Obs.	Mean	Std-Er	Obs.
Benefit per year per apprentice (in €)	18'927.48	149.25	1'471	18'878.75	107.78	1'842
Relative productivity (1st year)	35.00	0.68	1'006	36.15	0.63	1'308
Relative productivity (2nd year)	54.04	0.61	927	55.81	0.53	1'257
Relative productivity (3rd year)	74.57	0.60	886	74.21	0.50	1'237
Monthly wage of skilled workers in trained occupation (in €)	3'217.98	19.37	1'471	3'245.10	15.03	1'842
Yearly wage costs for apprentices (in €, 1st year)	5'888.49	68.56	1'006	6'264.22	71.03	1'308
Yearly wage costs for apprentices (in €, 2nd year)	7'773.05	81.75	927	8'048.46	72.48	1'257
Yearly wage costs for apprentices (in €, 3rd year)	10'172.17	90.76	886	11'088.44	89.79	1'237
Share of productive tasks (unskilled, 1st year)	50.43	0.66	1'006	52.99	0.59	1'308
Share of productive tasks (skilled, 1st year)	28.23	0.66	1'006	25.79	0.56	1'308
Share of tasks with no direct value to firm (1st year)	21.33	0.60	1'006	21.23	0.49	1'308
Share of productive tasks (unskilled, 2nd year)	39.40	0.59	927	41.60	0.53	1'257
Share of productive tasks (skilled, 2nd year)	45.43	0.64	927	43.09	0.55	1'257
Share of tasks with no direct value to firm (2nd year)	15.17	0.40	927	15.31	0.37	1'257
Share of productive tasks (unskilled, 3rd year)	28.22	0.60	886	31.46	0.54	1'237
Share of productive tasks (skilled, 3rd year)	58.47	0.66	886	53.73	0.60	1'237
Share of tasks with no direct value to firm (3rd year)	13.31	0.37	886	14.80	0.37	1'237
Days at workplace (1st year)	156.24	0.82	1'006	145.42	0.74	1'308
Days at workplace (2nd year)	155.73	0.72	927	148.52	0.61	1'257
Days at workplace (3rd year)	155.16	0.70	886	156.09	0.59	1'237
Days of productive tasks (unskilled, 1st year)	78.71	1.11	1'006	77.84	0.97	1'304
Days of productive tasks (skilled, 1st year)	44.65	1.10	1'006	37.27	0.84	1'308
Days of tasks with no direct value to firm (1st year)	32.89	0.94	1'006	30.56	0.71	1'308
Days of productive tasks (unskilled, 2nd year)	61.55	0.98	927	62.24	0.86	1'257
Days of productive tasks (skilled, 2nd year)	70.59	1.05	927	63.83	0.87	1'257
Days of tasks with no direct value to firm (2nd year)	23.59	0.64	927	22.53	0.56	1'257
Days of productive tasks (unskilled, 3rd year)	43.66	0.95	886	48.80	0.85	1'237
Days of productive tasks (skilled, 3rd year)	91.02	1.13	886	83.95	1.01	1'237
Days of tasks with no direct value to firm (3rd year)	20.48	0.56	886	23.34	0.59	1'237
Firm size	Mean		Obs.	Mean		Obs.
1-5 employees	0.35		1'471	0.23		1'842
6-10 employees	0.25		1'471	0.24		1'842
11-25 employees	0.19		1'471	0.18		1'842
26-50 employees	0.10		1'471	0.14		1'842
51-100 employees	0.05		1'471	0.10		1'842
101-250 employees	0.03		1'471	0.08		1'842

>250 employees	0.02	1'471	0.04	1'842
Job categories	Mean	Obs.	Mean	Obs.
Nature	0.04	1'471	0.06	1'842
Food, restaurant and hotel, home economy	0.16	1'471	0.16	1'842
Textile, clothing, hygiene	0.06	1'471	0.03	1'842
Construction	0.17	1'471	0.16	1'842
Manufacturing, craft (technical), IT	0.05	1'471	0.05	1'842
Trade, public administration	0.43	1'471	0.41	1'842
Education, health, social work	0.08	1'471	0.12	1'842
Media, art, social sciences	0.01	1'471	0.01	1'842
Industry	Mean	Obs.	Mean	Obs.
Manufacturing	0.07	1'471	0.06	1'842
Energy, water supply	0.00	1'471	0.01	1'842
Construction	0.17	1'471	0.15	1'842
Trade, automotive industry	0.25	1'471	0.25	1'842
Restaurant and hotel	0.07	1'471	0.07	1'842
Transport and communication	0.03	1'471	0.03	1'842
Credit and insurance	0.04	1'471	0.03	1'842
Real estate, IT, R&D, Services	0.08	1'471	0.11	1'842
Public administration, national security	0.08	1'471	0.05	1'842
Education	0.02	1'471	0.02	1'842
Health and welfare	0.11	1'471	0.16	1'842
Other public or personal services	0.07	1'471	0.06	1'842

Table 7: Descriptive statistics Germany

Germany	2000			2007		
Variable	Mean	Std-Er	Obs.	Mean	Std-Er	Obs.
Benefit per year per apprentice (in €)	7'922.93	95.17	1'738	9'862.77	98.32	2'161
Relative productivity (1st year)	30.07	0.47	1'032	41.64	0.60	1'133
Relative productivity (2nd year)	46.40	0.54	1'115	57.84	0.52	1'326
Relative productivity (3rd year)	68.38	0.70	1'005	72.62	0.54	1'195
Monthly wage of skilled workers in trained occupation (in €)	2'003.57	11.41	1'738	1'969.30	13.59	2'161
Yearly wage costs for apprentices (in €, 1st year)	7'245.14	60.99	1'032	7'154.60	57.84	1'133
Yearly wage costs for apprentices (in €, 2nd year)	8'257.22	64.21	1'115	7'903.04	60.42	1'326
Yearly wage costs for apprentices (in €, 3rd year)	9'238.85	75.85	1'005	9'061.34	65.54	1'195
Share of productive tasks (unskilled, 1st year)	29.83	0.59	1'032	48.51	0.67	1'133
Share of productive tasks (skilled, 1st year)	13.16	0.49	1'032	26.43	0.62	1'133
Share of tasks with no direct value to firm (1st year)	57.22	0.73	1'032	25.06	0.58	1'133
Share of productive tasks (unskilled, 2nd year)	31.25	0.53	1'115	36.89	0.58	1'326
Share of productive tasks (skilled, 2nd year)	25.72	0.58	1'115	42.45	0.62	1'326
Share of tasks with no direct value to firm (2nd year)	43.30	0.59	1'115	20.66	0.44	1'326
Share of productive tasks (unskilled, 3rd year)	27.23	0.56	1'005	29.11	0.60	1'195
Share of productive tasks (skilled, 3rd year)	41.66	0.72	1'005	53.66	0.69	1'195
Share of tasks with no direct value to firm (3rd year)	31.47	0.57	1'005	17.22	0.42	1'195
Days at workplace (1st year)	133.90	1.01	1'032	137.94	1.05	1'133
Days at workplace (2nd year)	137.81	0.97	1'115	142.68	0.93	1'326
Days at workplace (3rd year)	142.34	1.00	1'005	144.93	1.00	1'195
Days of productive tasks (unskilled, 1st year)	39.88	0.85	1'032	66.61	1.08	1'133
Days of productive tasks (skilled, 1st year)	17.91	0.71	1'032	36.73	0.92	1'133
Days of tasks with no direct value to firm (1st year)	76.41	1.15	1'032	34.60	0.86	1'133
Days of productive tasks (unskilled, 2nd year)	42.94	0.78	1'115	52.49	0.91	1'326
Days of productive tasks (skilled, 2nd year)	35.49	0.86	1'115	60.94	1.01	1'326
Days of tasks with no direct value to firm (2nd year)	59.74	0.95	1'115	29.25	0.66	1'326
Days of productive tasks (unskilled, 3rd year)	38.77	0.88	1'005	42.39	0.95	1'195
Days of productive tasks (skilled, 3rd year)	60.00	1.16	1'005	78.27	1.17	1'195
Days of tasks with no direct value to firm (3rd year)	44.11	0.85	1'005	24.28	0.61	1'195
Firm size	Mean		Obs.	Mean		Obs.
1-5 employees	0.34		1'738	0.29		2'161
6-10 employees	0.26		1'738	0.30		2'161
11-25 employees	0.16		1'738	0.19		2'161
26-50 employees	0.12		1'738	0.10		2'161
51-100 employees	0.05		1'738	0.05		2'161
101-250 employees	0.04		1'738	0.04		2'161
>250 employees	0.03		1'738	0.03		2'161
Job categories	Mean		Obs.	Mean		Obs.
Nature	0.05		1'738	0.04		2'161
Food, restaurant and hotel, home economy	0.12		1'738	0.13		2'161
Textile, clothing, hygiene	0.04		1'738	0.02		2'161
Construction	0.15		1'738	0.15		2'161
Manufacturing, craft (technical), IT	0.10		1'738	0.09		2'161

Trade, public administration	0.38	1'738	0.43	2'161
Education, health, social work	0.14	1'738	0.13	2'161
Media, art, social sciences	0.02	1'738	0.02	2'161
Industry	Mean	Obs.	Mean	Obs.
Manufacturing	0.19	1'738	0.13	2'161
Energy, water supply	0.00	1'738	0.00	2'161
Construction	0.11	1'738	0.17	2'161
Trade, automotive industry	0.19	1'738	0.17	2'161
Restaurant and hotel	0.05	1'738	0.06	2'161
Transport and communication	0.02	1'738	0.03	2'161
Credit and insurance	0.02	1'738	0.02	2'161
Real estate, IT, R&D, Services	0.12	1'738	0.16	2'161
Public administration, national security	0.02	1'738	0.02	2'161
Education	0.00	1'738	0.01	2'161
Health and welfare	0.12	1'738	0.15	2'161
Other public or personal services	0.16	1'738	0.07	2'161
