Firms' incentives to provide apprenticeships

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Firms' incentives to provide apprenticeships –

Studies on expected short- and long-term benefits

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1. Introduction

1.1 Motivation

In Germany, vocational education is mainly organized in the form of dual apprenticeships, which combine school and work-based learning. About half of a cohort learns their vocation in an apprenticeship program (Uhly, 2015) and nearly all firms employ workers with a completed apprenticeship. Acquiring vocational skills at the workplace yields many advantages. Students gain the skills that are relevant in the labor market because training firms are able to quickly react to technological changes. The close match between acquired and required skills is not only beneficial for the apprentices themselves but also for the firms that provide these training opportunities. Moreover, the combination of practical and theoretical education can have positive effects on students' motivation and learning outcomes. Those advantages contribute to the integration of the youth in the labor market while ensuring the availability of skilled workers, which is conducive for the firms' competitiveness.

Nonetheless, this type of training relies heavily on the voluntary participation of firms because they are not forced by law to provide apprenticeships. Even though nearly all firms employ workers who completed an apprenticeship, only about a fifth of all firms provide apprenticeships.[1] Furthermore, between 2007 and 2013, firms' participation in apprenticeship training has decreased considerably. In order to prevent a further decrease it is important to understand what determines firms' willingness to provide apprenticeships and which effects different framework conditions have on potential incentives.

Many studies have investigated why some firms train and others do not. One main finding is that this decision is strongly determined by the firms' expected short-term or long-term benefits (Walden, 2007; Wolter et al., 2006). Short-term benefits arise during the training period by the apprentice's contribution to the firm's economic output. Long-term benefits arise[2] due to a wedge between the graduates' productivity and their wages after the training period.[3] In addition, social benefits could be also relevant to firms if they care about the benefits for the apprentices and the society as such. If the sum of these benefits is higher than the direct training costs, firms are willing to provide apprenticeships.

[1] The exact numbers and the respective sources will be presented in section 2.1.3 of this thesis.
[2] Other long-term training benefits exist, such as saving recruitment costs and reputation effects. These benefits are not explicitly discussed in this thesis.
[3] The theoretical background of the wedge between productivity and wages will be outlined in section 2.2.1.

However, whether those short-term and long-term training benefits materialize, depends on various conditions of the apprenticeship's training framework. The question of whether apprentices are able to contribute productively to the firm's economic output may depend on the quality of the compulsory schooling system. The question of whether firms are able to pay a wage below graduates' productivity depends on the institutional settings of the labor market as well as on the regulations of the apprenticeship system. Finally, the question of whether the potential benefits influence the eventual decision to provide apprenticeships could depend on the preferences of the individuals who make the training decision on behalf of the firm.

1.2 Aim

This thesis aims to explain firms' incentives to provide apprenticeships by analyzing several framework conditions and their relation to training benefits.[4] The theoretical starting point of this work is the assumption that firms decide to train when the current value of the expected benefits exceeds the training costs. The thesis consists of four empirical studies that deal with the following related research questions:

1. How are pre-training competencies related to apprentices' productivity at the workplace?
2. Do labor market regulations influence the expected post-training benefits and the organization of apprenticeship training?
3. Does the number of choice options in training curricula affect the supply of and demand for apprenticeships?
4. Are altruism and time preferences of decision-makers related to investments in apprenticeship training?

The relation between the different questions and their location within the conceptual framework of the thesis is illustrated in Figure 1.1. The figure is divided into three parts. The middle of the figure illustrates the potential training benefits and training costs, which have to be weighed against each other. The left side of the figure presents determinants of the training benefits and the right side shows how the assessment of the different benefits finally influence the training decision.

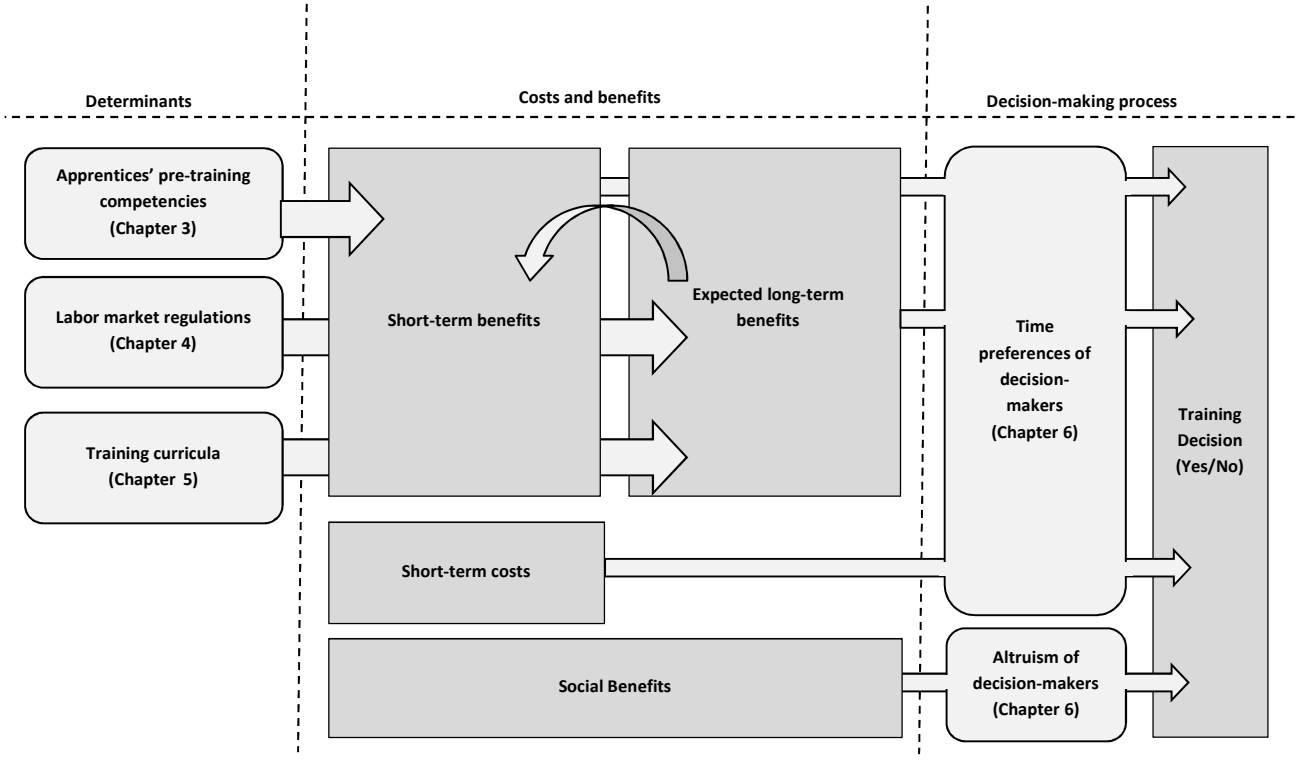
The light grey forms represent the different chapters of the thesis. The figure shows that three chapters focus on the determinants of the training benefits. These chapters discuss

[4] Depending on which type of benefit is decisive for the decision to provide apprenticeships, firms can be categorized to different training motives. See chapter 2.2 for a discussion on training motives.

different framework conditions, which either affect the short-term benefits (third chapter) or the expected long-term benefits (fourth and fifth chapter). The backward arrow illustrates that the fourth chapter further deals with the feedback effect of the expected long-term benefits on the actual short-term benefits. The sixth chapter deals with the decision-making process and is therefore represented at the right side of the figure. This chapter focuses on the functional form with which the training costs and the three different types of training benefits determine the training decision. If the short-term costs are higher than the short-term benefits, providing apprenticeships constitutes an investment, which pays off later by long term benefits. Decision-makers have to weigh the future benefits against the current investment. Therefore, decision-makers' time preferences determine in which way costs and benefits influence the training decision. Moreover, social benefits only influence the training decision if decision-makers care about the well-being of others. Therefore, decision-makers' altruism determines whether social benefits influence the training decision.

The figure also illustrates under which conditions firms are willing to make an investment in training. A firm makes a training investment when the short-term costs are higher than the short-term benefits. A firm would only be willing to train when the subjective evaluation of the expected long-term benefits or the social benefits is sufficiently high to compensate for its investment. This shows that the different training benefits are strongly interrelated and could substitute each other.

FIGURE 1.1: CONCEPTUAL FRAMEWORK OF THE THESIS



1.3 Outline

This thesis is further structured as follows. The *second* chapter presents background information on the apprenticeship system in Germany. I outline the organization of the dual apprenticeship system, its advantages and disadvantages, and shortly present the recent developments of the apprenticeship market in Germany. I go on to discuss existing literature on the question why firms have incentives to train, both in a general sense and in the context of apprenticeships in particular. Finally, I present the BIBB Cost-Benefit Surveys, which are the main data source for the empirical studies in this thesis.

In the *third* chapter, I[5] address the question on how pre-training competencies are related to the productivity of apprentices at the workplace. As the productive contributions of apprentices directly reduce firms' training investments, it is important to analyze whether these benefits are affected by apprentices' initial competencies. For this analysis, I use data from the BIBB Cost-Benefit Survey for the reference year 2007. I reduce the sample to firms with only one apprentice in the training occupation. This allows me to assign specific information about both the level of competencies and the productivity to the single apprentice in the firm. I analyze four pre-training competencies that apprentices have obtained during their prior schooling: Oral and writing, mathematical, IT, and problem-solving competencies. Even though various studies have dealt with the question how school competencies are related to productivity and wages of workers in regular employment, only few studies have investigated the relation between competencies and the productivity of apprentices during the apprenticeship training. I find that problem-solving and oral and writing competencies strongly correlate with apprentices' potential productivity. Moreover, a large difference exists between commercial and industrial/technical occupations. School competencies are more important in commercial occupations, which involve more analytical tasks and require only a very low degree of routine manual tasks.

The *fourth* chapter deals with the effect of labor market institutions as important determinants of training investments. I analyze whether labor market institutions affect the cost-benefit relation of training firms. For many firms training only becomes beneficial when they retain apprentices and recoup the costs at a later stage. It has often been claimed that frictions on the labor market are important in order to limit the mobility of workers and to ensure that graduated apprentices stay in the training firm (Acemoglu & Pischke, 1999b). Acemoglu and Pischke (1999a) presume that when frictions are reduced, the willingness of firms to train will be reduced as well. An alternative hypothesis is that firms in more competitive labor markets do not train less but instead change their training organization in such a way that training becomes more beneficial for the firm already in the short run. In order to test this hypothesis, I used data on the costs and benefits of apprenticeship training from Germany and Switzerland. In Germany, the data refer to the years 2000 and 2007,

[5] As the chapters 3, 4, and 5 are based on papers that were written with co-authors, I use the pronoun we in the chapters when taking the authors' perspective.

while in Switzerland the reference years are 2000 and 2009. I argue that the new laws[6] which came into effect between 2003 and 2005 in the course of the labor market reform Agenda 2010 and which dampened employment protection regulations, serve as a natural experiment. In order to estimate the effect of the labor market reform, I use a difference in difference approach. The development of the Swiss training costs in the same time period serves as the counterfactual in order to identify the effect of the labor market reform on the training costs. The results show that after the introduction of the labor market reform, German firms – in contrast to Swiss firms – allocated their apprentices more often to productive tasks, which led to a decrease in net training costs.

The *fifth* chapter deals with the effect of curricula changes on the training decisions of firms (and apprentices). As firms have to commit to training regulations when they provide apprenticeships, it is reasonable to assume that changes in these regulations affect the firms' cost-benefit relation. Especially for investment-oriented firms, which plan to retain their apprentices upon the completion of the training as skilled workers, it is very important that training curricula match the training needs of the firm. Building on Lazear's skill weights approach (Lazear, 2009), this chapter studies the effects of varying levels of heterogeneity in the training curriculum on supply of and demand for apprenticeship training. Modernizations of training curricula provide me with a quasi-experimental setting as these modernizations can be considered as an exogenous shock. I expect that firms will train more apprentices when they have more choice options in the training curriculum due to the higher productivity of graduates who have acquired more skills that are relevant for the firm. Moreover, due to the higher specificity of the training content, I expect that firms have a higher market power in the wage bargaining process with graduates, something that would reduce the skilled worker wage. I test this hypothesis on data on the supply of and demand for apprenticeship places in Germany in all occupations from 2004 to 2014, and find that a more heterogeneous curriculum increases both firms' supply of and students' demand for apprenticeship places.

The *sixth* chapter extends the cost-benefit framework by considering social and time preferences as further factors influencing a firm's training investments. Standard economic theory assumes that the expected long and short-term costs and benefits influence firms' training decisions. However, the question arises, whether aspects other than monetary cost-benefit considerations can also influence training investment decisions. Apart from the investment and the production motive, training out of social responsibility is a further training motive (Beicht et al., 2004). If non-monetary preferences play a role, more altruistic human resource managers should make higher investments in apprenticeships. In this chapter, I analyze the impact of altruism on both the training decision as such (extensive margin) and the amount of investments (intensive margin) and find that the degree of altruism of the decision-maker in the firm is related to a firm's investments in apprenticeships. Moreover, as for many firms training apprentices is initially associated with

[6] Gesetze zur Liberalisierung des Arbeitsmarktes im Rahmen der Agenda 2010.

net training costs, the training decision can be seen as an intertemporal trade off decision. Therefore, time preference could also play an important role. The estimation results show that firms spend indeed more in training when they have a relatively low preference towards the present.

In the *seventh* chapter, the thesis closes with a conclusion on the results of the previous chapters and the work as a whole. Some policy implications of the findings of each chapter are discussed in the valorization addendum.

2. Apprenticeships in Germany: Institutions and theoretical background

2.1 Apprenticeships in Germany

This section presents background information on the apprenticeship system in Germany.[7] I first describe how the dual apprenticeship system in Germany is organized. I will then elaborate upon the advantages and disadvantages of the dual system and upon the recent development of the apprenticeship market.

2.1.1 Organization of the apprenticeship system

The key characteristic of apprenticeship programs in Germany is the duality of the learning places. The apprentice learns both in the vocational school and at the workplace in the company. The firm is an important learning venue, in which the practical skills required for the examination are taught. The apprenticeship is set up as a training (not a working) agreement between the firm and the apprentice. The training contract, which defines the training occupation and training allowances, is concluded between the firm and the apprentice.

The tradition of this mode of learning goes back to the time of the Middle Ages when the completion of an apprenticeship was regulated by the guilds as a pre-condition to pursue a profession. Since 1969, the Vocational Training Act (Ger.: "Berufsbildungsgesetz") constitutes the legal foundation of apprenticeship training in Germany. Among other things, this act prescribes that training firms have to commit to a certain training curriculum when they want to provide an apprenticeship. Apart from the training duration, each training curriculum prescribes the set of skills and competencies that firms have to convey when training apprentices for an occupation. This contributes to the fact that the German labor market is characterized by the concept of the occupational competency (Ger.: "Beruflichkeit"), in which the bundle of the workers' competencies is largely determined by occupation-specific competencies instead of job-specific competencies. The vocational training act prescribes that all apprenticeships last between 2 and 3.5 years. Moreover, it

[7] Apprenticeships exist also in other countries as Switzerland, Austria, the Netherlands, and Denmark. I describe the German form in specific as the studies in this thesis mostly refer to the German context. However, many similarities probably can be found in apprenticeship training in the mentioned other countries.

prescribes that the apprentice spends between one and two days per week in the vocational school and three to four days at the firm.

One characteristic of the German apprenticeship system is that all relevant stakeholders are involved in the arrangement of the dual system. Employer associations, unions, and responsible representatives from the federal and state ministries jointly develop the training curricula. The final decisions upon the training curricula are made based on the consensus principle, which implies that all relevant stakeholders have to agree with the content of the new training curriculum. Besides the involvement in the development of the training curricula, employers influence the training system through the Chambers of Industry and Commerce (Ger.: "Industrie- und Handelskammer") and Chambers of Craft (Ger.: "Handwerkskammern"), which have to approve all training contracts and resolve potential conflicts between apprentices and training firms. While the chambers organize the practical examination at the end of the apprenticeships, the other stakeholders are also involved. The examination board of the final exams does not only consists of employer representatives but also of representatives of unions and vocational schools (Bundesinstitut für Berufsbildung, 2014).

The financing of dual vocational training is organized as follows: The federal states of Germany (Ger.: "Bundesländer") finance the vocational schools, at an overall cost of 2.85 billion Euros in 2014. The costs for the practical part of the apprenticeships within the firms have to be borne by the firms themselves. The BIBB Cost-Benefit Survey for the reference training year 2012/13 estimated that firms in Germany invest every year 7.7 billion Euros in apprenticeships.[8] There are no regular subsidies for firms providing apprenticeships. Only some firms receive financial support for training disadvantaged youngsters or handicapped workers. The state contributes to the system by supporting the supra-company training centers, to which firms can send their apprentices when they are not able to impart all the skills stipulated in the training curricula. The state additionally finances support programs for vocational orientation, programs for improving the match between firms and apprentices, and programs that prepare disadvantaged school graduates for apprenticeships. Additionally, the Federal Employment Agency provides subsidies to apprentices from low-income families (Müller, 2015). Even though this aspect is often neglected in the discussion on the financing of the German apprenticeship system, the apprentices personally finance the training as they accept substantial opportunity costs in the form of forgone earnings (Müller et al., 2016).

2.1.2 The advantages and disadvantages of the apprenticeship system

For young people, participating in an apprenticeship program has several advantages. They learn practical occupation-specific competencies that are relevant at the workplace. This ensures a good match between available and required competencies in the labor market.

[8] https://www.bibb.de/de/11060.php

Besides, the application-oriented learning contributes to highly motivated apprentices. Like this, apprenticeship programs are also suitable for young people who are more practically oriented and not interested in having an academic career. In fact, after the completion of a high quality apprenticeship program, graduates have higher chances to find a job, irrespective of the skills they have previously learned at school (Bertschy et al., 2009; Büchel, 2002). In this way, apprenticeship programs can have an equalizing effect on relatively poor levels of student performance.

From the government perspective, this type of education is relatively cheap because the firms incur a substantial part of the costs. The dual system plays an important role in integrating the youth into the labor market. Accordingly, in countries with a dual system, the youth unemployment rate is lower than in other countries (Quintini & Manfredi, 2009). Moreover, in contrast to full time schooling, dual training has a positive effect on the employability of graduates (Ryan, 1998). By contributing to a low youth unemployment rate and a high employability rate after graduation, the apprenticeship system relieves the national budget for social security benefits.

Also from the firms' perspective, apprenticeship programs yield substantial benefits as they serve as a strategy to safeguard the supply of skilled workers with the necessary competencies. Firms can ensure that graduates' qualifications match firms' skill requirements for two reasons: (1) they are involved in the development of the curricula which regulate the training content, (2) they provide the training themselves and, thus, can impart the skills they deem necessary as far as the curriculum allows for this. Another advantage for the firm is that vocational training has an impact on how work can be organized. Prais (1995) finds that the availability of vocationally trained workers is related to a less hierarchical production organization including less control costs.

Nonetheless, some disadvantages should be mentioned. Due to the very occupation-specific training content, the possibility to switch between occupations is rather low. Moreover, employees who have completed an apprenticeship track might have more difficulties to adapt to technological change than employees with more general education might. In this context, Hanushek et al. (2016) found that, even though vocationally trained workers enter the labor market more easily, in later career years, their employment rates are lower than those of generally trained workers. They attribute this evidence to a lower ability of vocational trained workers to adapt to technological change. However, in principle, this occupation-specificity could be cushioned by the introduction of general subjects in the training curricula of vocational schools.

Another disadvantage is the strong dependency of the system on the willingness of firms to offer apprenticeship places. If too few firms decide to offer training, young people cannot learn their desired vocation as no alternative vocational schooling system exists.[9] This does

[9] This is in contrast to the Netherlands where vocational training includes the vocational school as well as apprenticeship route.

not only produce a substantial uncertainty for youngsters who try to plan their future, but also creates a hazard for the supply of skilled workers in the economy.

2.1.3 Recent development of the apprenticeship market

In Germany, apprenticeships are popular educational programs: 53.5 % of the total workforce has been trained within the dual system (Statistisches Bundesamt, 2014) and 87.5 % of all firms employ dually trained workers.[10] That illustrates the immense importance of the firm's training engagement in Germany: one fifth of all firms train about one half of the labor force. Nonetheless, since 2007, apprenticeships have become less popular, for both school graduates and firms. Figure 2.1 shows the development of the supply[11] of and the demand for apprenticeships from 1992 until 2014.[12] Besides strong fluctuation over the years related to the business cycle[13], there is a slight negative trend. In 2014, demand for and supply of apprenticeships were lowest since 1992. The negative trend in the demand for apprenticeship places can be explained by demographic change as well as a trend towards tertiary education (Bundesministerium für Bildung und Forschung, 2015). The figure also shows that the demand for apprenticeship places (according to the new definition) has always been higher than the supply of apprenticeship places.

Since 2007, the decline in the supply of apprenticeships (intensive margin) runs parallel to the decline in the share of firms providing apprenticeships of all German firms (extensive margin). While from 2000 to 2007 the training participation rate remained relatively constant, the share of training firms decreased between 2007 and 2013 from 24.1 % to 20.7 %.[14] At the end of the year 2013[15], of about 2.1 million firms in Germany a total number of 437,721 firms offered apprenticeships. The decrease was most pronounced for micro firms with less than 10 employees (3.9 %) and small firms with less than 50 employees (3.7 %). In the group of middle-sized firms (between 100 and 250 employees) and large firms (above 250 employees) the share of training firms decreased only by 0.9 % and 1.5 %, respectively (Troltsch, 2015). The reasons for the decline in the share of training firms are manifold. Firms stated that they stopped offering training because they did not need

[10] Data source: BIBB Establishment Panel on Training and Competence Development 2013 (own calculations). The share of firms that employ dually trained workers includes firms that employ at least one worker with either an apprenticeship certificate or a master craftsman certificate as the highest qualification.

[11] According to the wording of the corresponding data set, the terms "supply" and "demand" here refer to apprenticeship places and not to the supply and demand for labor.

[12] The supply of apprenticeships is calculated by adding the open vacancies to the newly concluded training contracts. The demand for apprenticeships is obtained by taking the sum of the newly concluded training contracts and the number of students who could not start an apprenticeship. The old definition of the demand excludes those students who opted for an alternative track (returning to school, entering university, entering the labor market or any other vocational preparation scheme). The new definition, which was introduced in 2007, also includes those applicants.

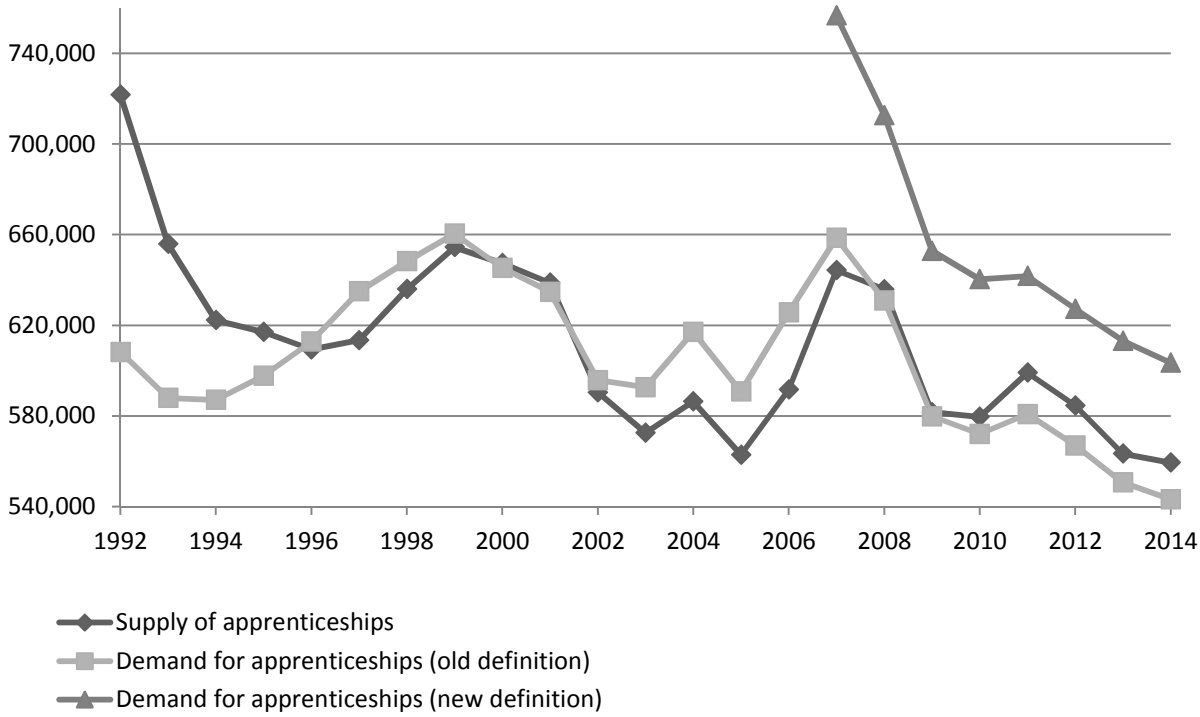
[13] For empirical evidence on the relation between the economic growth rate and the supply of apprenticeship places, see Matthes et al. (2015).

[14] See supplementary tables of the BIBB data report 2015 in the internet: https://www.bibb.de/dokumente/pdf/tab_a4_10_1-1.pdf

[15] The most recent numbers are available for the year 2013 (status January 2016).

additional skilled workers (Mohr et al., 2015). More in general, firms claim that the low number of applicants, their low qualifications, and corresponding low training maturity are reasons for their training abstinence (Gerhards & Troltsch, 2012).

FIGURE 2.1: DEVELOPMENT OF SUPPLY OF AND DEMAND FOR APPRENTICESHIP PLACES



Note: To illustrate the development over a longer time horizon the old definition for the demand for apprenticeships is also used. The new definition was only introduced in 2007. Sources: Data Report 2009 (Ulrich et al., 2009, p. 29) and supplementary tables of the Data Report 2015.[16]

The downward trend might have important implications for the future supply of skilled workers in Germany. Thus, finding reasons why firms decide to provide apprenticeship places is of utmost importance. The question why firms decide to offer apprenticeships is not only relevant in Germany. Currently, many countries attempt to involve firms in vocational education.[17] Convincing firms to participate by offering training sites is a key challenge in those attempts. Understanding the firms' incentives to train is, thus, not only interesting for the German situation, but also for other countries.

[16] The supplementary tables are only available in the internet: https://www.bibb.de/dokumente/pdf/tab_a1-2_1.pdf, retrieved 7th of January 2016.

[17] For Europe, see for example the European Alliance for Apprenticeships (EAfA): http://ec.europa.eu/social/main.jsp?catId=1147&langId=en or for the other countries of the world the internal consulting activities of the BIBB: https://www.bibb.de/dokumente/pdf/internationale_beratung_internetfassung.pdf

2.2 Firms' motives to offer apprenticeships

This section presents the theoretical background on the question why firms participate in the dual system and how the training decision relates to the cost and benefit relation.

2.2.1 Theoretical background on training incentives

The investment and the production motive are the two main training motives. Firms that train due to the production motive mainly train because they want to make use of the productive contributions of their apprentices (Lindley, 1975). Those firms profit from training already in the short run during the training period and do not need to retain the apprentices. Firms that train due to the investment motive want to safeguard the availability of skilled workers in their firm in the long term (Merrilees, 1983). For these firms, the training investment only pays off at a later stage after they have retained the apprentices.

Three other training motives exist. Firms that train with a screening motive also have a long-term perspective. These firms use the training period to observe the apprentices and retain only the best of them (Stevens, 1994b). They need to expect substantial post training benefits as their total training investments are relatively high for the restricted number of apprentices they retain. Another training motive is social responsibility. Firms train because they want to take social responsibility by giving young students a chance to integrate in the labor market (Beicht et al., 2004). Finally, firms are also motivated by upholding their reputation. Firms expect that by training apprentices they gain a better image among clients, potential employees, and suppliers (Sadowski, 1980). This positive image would eventually translate into monetary returns.

Empirical evidence shows that, in Germany, most training firms are investment oriented. Using the within-firm retention rate to identify companies' training strategies Mohrenweiser & Backes-Gellner (2010) found that only 19 % of all companies follow a "substitution strategy", i.e. the production motive, and 44 % follow an investment strategy. Using the retention rate and the net training costs as indicators, Pfeifer et al. (2010) also find that only few production-oriented firms exist in Germany. Especially in comparison to Switzerland, which has a similar apprenticeship system, German firms are more investment oriented (Dionisius et al., 2009). The training motive is strongly related to the training organization. Wenzelmann (2012) analyzes the relation between the training motive and the allocation of apprentices to productive and non-productive tasks in German firms. He shows that investment oriented firms allocate their apprentices much less often to productive tasks. The reason could be that investment oriented firms plan to retain their apprentices anyway and therefore do not mind higher short-term training costs.

As the investment motive seems to be the main motive for German training firms, it is important to understand how this motive works and why firms can recover the training costs at a later stage. Becker's (1962) human capital theory lays the theoretical foundation of the

discussion why firms offer training by differentiating between general and firm-specific human capital. General human capital can be employed in all firms, while firm-specific human capital is only of value in the training firm. He argues that under the assumption of perfect competition, firms are not willing to invest in general skills. That is because workers can leave the training firm upon completion of training and then receive a wage according to their marginal product in another firm. Accordingly, in order to retain the worker, the training firm has to pay at least a wage equal to the marginal product. In this case, however, there is no way for the training firm to recoup the costs of training. In contrast, when the skills imparted in training are firm-specific skills, the incentive situation is completely different. When skills are firm specific, the marginal product does not increase in outside firms. Thus, the training firm is able to pay a wage below the productivity and is able to obtain a rent from training. As apprenticeships in Germany are regarded as general human capital due to their standardization and certification, Becker's theory implies that firms would not be willing to invest in apprenticeships.

However, this theoretical prediction was challenged by opposing empirical evidence on firms' investments in apprenticeship training in Germany. It was shown that firms invest a substantial amount of money in apprenticeships (Bardeleben et al., 1995; Beicht et al., 2004). To reconcile theory and empirical evidence, Acemoglu & Pischke (1999a, 1999b) extended Becker's theory by questioning the assumption of perfect competition in the labor market. They argued that employees cannot easily change their workplace and therefore do not receive a wage according to their productivity. Instead, due to frictions in the labor market, wages would increase to a lower degree than the workers' productivity, which they termed as a "compressed wage structure". As a result, the training firm can pay a wage below productivity and can obtain a rent from training. A compressed wage structure can arise due to various contextual conditions as searching costs, information asymmetries, and wages floors (Acemoglu & Pischke, 1999b). One further reason is the existence of strict labor market regulations and the resulting rigidity in the labor market (Dionisius et al., 2009; Mühlemann et al., 2010).

2.2.2 Cost-benefit surveys

Empirical evidence of the training motives and the amount of investments in apprenticeship training can be obtained by conducting studies on its costs and benefits. These cost-benefit surveys have collected information on the training costs for German firms since 1980. The conceptual model on how to measure costs and benefits was developed by the Edding-Commission in 1974.[18] Since then, many studies have analyzed the resources invested in apprenticeship training (Noll et al., 1983; Bardeleben et al., 1995; Beicht et al., 2004; Schönfeld et al., 2010; Jansen et al., 2015).[19] The value for the training investments (net

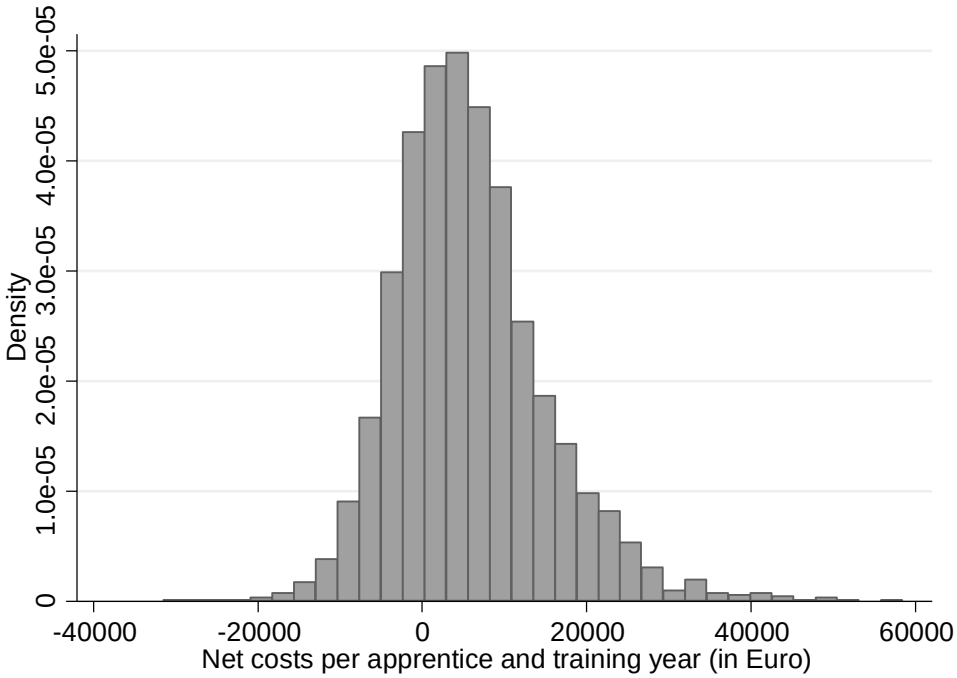
[18] See Sachverständigenkommission Kosten und Finanzierung der beruflichen Bildung (1974).

[19] Also in Switzerland, the costs and benefits of apprenticeship training have been analyzed (Schweri et al., 2003; Mühlemann et al., 2007; Strupler & Wolter, 2012).

costs) is obtained by taking the difference between the gross costs and the productive contributions of the apprentices.[20] The gross costs consist of the training allowances for the apprentices, the costs for the trainers (full time, part time, and external trainers), physical costs (costs for tools, machines, and infrastructure), and other costs (chamber fees, administrative costs, teaching material, work cloths, and external training).

Figure 2.2 shows the distribution of training investments for all German training firms. The figure illustrates that while, on average, firms have to bear net costs about 30 % of the training firms have net benefits from training. For these firms the productive contributions of the apprentices fully compensate the gross costs of training. The rest of the firms have net costs, which means that gross costs are higher than the productive contributions of the apprentices. Those firms need to benefit from training in the long term.

FIGURE 2.2: DISTRIBUTION OF INVESTMENTS IN APPRENTICESHIP TRAINING



Source: Cost-benefit survey 2012/13.

The costs-benefit surveys constitute the main database of this thesis. I will use the data from the surveys for the reference years 2000, 2007, and the reference training year 2012/13. For comparison with the situation in Switzerland, I will also make use of the Swiss cost and benefit surveys (for the reference years 2000 and 2009), which are comparable to the German surveys.

[20] In addition, funds from funding programs sponsored by the federal government or a state government, the European Social Fund (ESF) or the Federal Employment Agency are subtracted from the gross costs. However, these funds are usually rather low and can be ignored here.

In addition, I use data on the supply of and demand for apprenticeship places. This full census of all supplied and demanded apprenticeship places is obtained by combining the BIBB survey “new training contracts” with administrative data from the Federal Employment Agency.

3. Pre-training competencies and the productivity of apprentices*

3.1 Introduction

Apprenticeship training is a unique form of education because it combines company-based training with vocational schooling. While firms often bear considerable costs for trainers, apprentices' wages and training infrastructure, the productive contributions of apprentices compensate for some or all of the costs borne by the firm.[21] Schönfeld et al. (2010) find that, on average, the productive contributions of apprentices offset more than three quarter of the gross training costs. About one third of all German apprentices can fully compensate for firm expenditures on training by being involved in productive work. This means that training firms can significantly reduce their training costs when recruiting highly productive apprentices. Therefore, it is important for the firm to know which individual characteristics determine the productivity of an apprentice.

This chapter analyses the relationship between the apprentices' productivity at the workplace and the pre-training competencies that apprentices have obtained during their prior schooling. We use firm-level data that, apart from variables on productivity and wages of workers and apprentices, also contains information about apprentices' competency levels prior to the start of the training program. Reducing the sample to firms with only one apprentice in the respective training occupation transforms our data into quasi-individual data since firm-level information about productivity and competencies of apprentices is specific to the only apprentice in the firm.

In our empirical analysis, we first analyze the descriptive relationship between apprentices' productivity and their prior competencies. As we find a strong raw correlation, we further scrutinize possible reasons for this relationship and thereby differentiate between different occupational groups. We expect that pre-training competencies do not equally predict productivity in all occupations in the apprenticeship system because the strength of the relationship depends on the extent to which pre-training competencies are applicable in the respective training occupation. Commercial occupations, for example, focus more on

* *This chapter is based on the paper „Pre-training competencies and the productivity of apprentices" by Anika Jansen and Harald Pfeifer. The paper is forthcoming in: Evidenced based human resource management; special issue on personnel economics.*

[21] See Bardeleben et al. (1995); Beicht et al. (2004); Schönfeld et al. (2010) for empirical evidence on costs and benefits of apprenticeship training in Germany.

analytical and cognitive competencies, while industrial and technical occupations involve a significant number of manual skills. We thus expect pre-training competencies to have a greater impact on the productivity of apprentices in commercial occupations than on the productivity of apprentices learning industrial or technical occupations.

Our results show that pre-training competencies have different effects on workplace productivity of apprentices. Problem-solving competencies followed by oral and writing competencies are most effective in raising productivity. IT competencies have a positive but minor importance for the productivity of apprentices while mathematical competencies do not relate to productivity levels at all. As expected, we further find that the relation between competencies and productivity is strongest for commercial occupations and statistically insignificant for industrial and technical occupations.

The chapter contributes to the economic literature on apprenticeships by providing new empirical evidence for the relation between prior school competencies and the productivity of apprentices. The findings presented in this chapter are important because the attractiveness of training from a firm's point of view substantially depends on the productive contributions of apprentices. Understanding how different pre-training school competencies relate to apprentices' productivity is essential for firms that aim to minimize training costs.

The remainder of this chapter is structured as follows. Section 3.2 discusses literature and theoretical aspects of the relation between competencies and productivity. Section 3.3 describes the data source and defines the variables used in the regression models. Sections 3.4 and 3.5 provide empirical descriptive and multivariate regression results, and section 3.6 concludes.

3.2 Theory and literature

The expected short and long-term costs and benefits of training and their role in determining the training decision of firms has been discussed extensively in the literature (Becker, 1962; Acemoglu & Pischke, 1999a). In apprenticeship training, short-term benefits result from the productive work apprentices perform during the training period. Post-training benefits, on the other hand, arise if the productivity of the trained workers exceeds their wages (Acemoglu & Pischke, 1999a).[22] The training decision therefore depends substantially on both the apprentice's short and long-term productivity. For this reason, the selection of productive apprentices is crucial for a positive cost-benefit relation of training.

As applicants' potential to perform productive work differs substantially, a training firm must base its hiring decisions on observable individual characteristics that signal a high productivity. One important determinant of productivity may be the applicant's school

[22] Also other forms of post-training benefits exist, such as the saving of recruitment costs (Stevens, 1994b) or firing costs (Mühlemann et al., 2010).

achievements during secondary education. Therefore, firms put substantial weight on school knowledge, and accordingly, employers often focus on basic mathematic competencies as an important indicator for the training maturity of apprentices (Ehrenthal et al., 2005). As a result, students with high scores in mathematics have better chances of finding apprenticeships (Eberhard et al., 2005; Hupka-Brunner et al., 2011).

Most literature about the productivity impact of school competencies focuses on the productivity of skilled workers. However, we here focus on the productivity *while* still being an apprentice. To the best of our knowledge, empirical evidence regarding the impact of school competencies on apprentices' productivity at the workplace does not exist. In the economic literature, several reasons for a relation between school knowledge and productivity at the workplace are discussed.

First, early human capital theory (Becker, 1964; Mincer, 1974) claims that education has a positive *causal* effect on productivity. The skill literature goes beyond the mere measure of formal degrees and years of schooling and analyses the effects of different skills on labor market outcomes. Green (1998) shows that, in the British labor market, problem-solving and computer skills are highly valued in monetary terms. In contrast, numerical skills are not significantly associated with pay when computer skills are controlled for. Green takes a job analysis approach rather than using direct measures of skills. He interprets the reported skill requirements in respondents' jobs as their actual skills. Hanushek et al. (2015) use direct skill measures from the international PIACC data and find that numeracy, literacy and problem-solving skills are significantly associated with earnings in 22 countries. Older evidence from the International Adult Literacy Survey (IALS) also supports a positive relation between skills, i.e. functional literacy, and earnings on the labor market (Denny et al., 2003).

Second, according to signaling theory (Spence, 1973), higher school competencies would not raise productivity. Instead, they tend to be related to other characteristics of the worker, such as innate ability or motivation, which increase productivity. According to this literature, school competencies are only related to a worker's productivity, but do *not have a causal* effect. Related to signaling theory, the concept of trainability (Spence, 1973; Thurow, 1975) suggests that school competencies have the function to enable graduates to acquire the necessary job skills at work. Thus, students with high levels of school competencies will be able to acquire important job skills in a better and faster way, which makes them more productive. Trainability implies that school competencies have *a causal but indirect* effect on worker productivity. In this context, the seminal paper of Roy (1951) states that workers self-select into occupations in which they have a comparative advantage and will accordingly yield the highest earnings. Employees will only select a very difficult occupation if they possess the necessary skills to be successful in it. Therefore, if workers change their occupation, they would not necessarily acquire the respective earnings of the new occupation as they have a different endowment of skills. The empirical implications of the Roy model are opposing from the implications of signaling theory. While theoretically there might be a strong effect of skills on earnings, this cannot be detected empirically as workers

already selected themselves into those occupations in which they have the highest comparative advantage.

Nonetheless, considering the specific characteristics of apprenticeship training, some reasons exist why the theories mentioned above cannot be directly applied to the relation between competencies and the productivity of apprentices. Apprenticeship training is a non-academic educational track in which practical skills play a crucial role. Accordingly, Baron-Boldt et al. (1988) find that high school grades have a stronger influence on an apprentice's performance in the theoretical examination than on the performance in the practical examination.

Even though several studies find positive relations between high school courses or mathematics grades and the wages after entering the labor market (Altonji, 1995; Rose & Betts, 2004; Levine & Zimmerman, 2012), this effect does not necessarily have to be a direct one. Joensen and Nielsen (2009), for example, find that the relation between mathematical knowledge and labor market outcomes is partly triggered by the fact that students with more advanced mathematics courses are more likely to choose more demanding higher education tracks, which, in turn, lead to better labor market outcomes.

Moreover, the dual nature of the German apprenticeship system implies that an apprentice is both an employee and a student at the same time. To be able to contribute to the firm's output, the apprentice has to learn the professional skills from a trainer at the workplace. As a result, productivity may also depend on the training strategy and environment of the firm. Stamm et al. (2010) find that apprentices' performances in vocational training are only weakly related to their mathematical knowledge but strongly related to behavioral and company characteristics. Behavioral characteristics that predict success in vocational training include motivation, resilience, and a low susceptibility to stress. Respective firm characteristics are the recognition of the performance of the apprentices and support by their trainers. Moreover, the authors find that the effect of school competencies on training performance decreases over the training period, suggesting an equalizing effect of the training conditions. It therefore seems that good training quality can compensate for lower pre-training competencies. In line with this argumentation, Büchel (2002) only finds a small effect of school competencies on labor market success after the training period. Bertschy et al. (2009) link the performance during compulsory education to the employment situation after completing vocational training and show that the impact of competencies on labor market outcomes is only indirect. That is, students with higher competencies are more likely to choose more demanding – and therefore higher quality – apprenticeship programs, which, in turn, lead to better jobs.

Based on the existing evidence, we expect that the effect of school competencies on the productivity of apprentices is weaker than in the case of skilled workers already trained and with various educational backgrounds. Although school competencies are related to the productivity of skilled workers, the reason for this relationship is also the selection of

workers with more school knowledge into different education programs and career pathways. Moreover, the existing empirical evidence shows that the impact of school grades is confined to the theoretical aspect of the apprenticeship. While human capital theory and subsequent empirical studies imply a causal relation between education and productivity, the literature explicitly investigating apprenticeships suggests that school competencies may play a minor role for apprentices' productivity. The review of the existing studies shows that there is a gap in the literature, and therefore a need to undertake an empirical analysis of the relationship between competencies and productivity in the training place.

3.3 Data and construction of variables

The data source for our analysis is a micro data set of German firms providing training. The Federal Institute for Vocational Education and Training (BIBB) has been conducting cost-benefit studies since the early 1980's (Noll, et al., 1983; Bardeleben et al., 1995; Beicht et al., 2004). For our analysis, we use the 2007 wave of the BIBB survey, which provides information for approximately 3,000 training firms.[23] The firm-level information in the survey refers to a specific training occupation, in which the company provided training in 2007. Altogether, 51 of the most frequent training occupations in Germany are included in the study. The survey institute *infas* conducted computer assisted personal interviews (CAPI) with one or more interview partners who are responsible for the apprenticeship training in the firm. In large firms, this is often the chief instructor, while in small firms the owner is the person who is responsible for the apprenticeship. The sample of firms' addresses was drawn from the Federal Employment Office, where all firms with one or more employees subject to social security payments are registered.

Apart from supplying information about their firm structure and training organization, firms also respond to questions about the educational backgrounds of their apprentices. As many firms train more than one apprentice, firms are asked to supply averages for all apprentices being trained in the respective training occupation. In these firms, the individual-level information is not specific to the individual apprentice, and this could cause an imprecise estimation of potential effects. To obtain more accurate estimates, we reduce the sample to firms training only one apprentice. In these firms, the information about education, competencies, and productivity must be specific to the single apprentice. We therefore turn firm-level information into quasi individual-level information. To exclude non-valid data, we exclude a firm record if the respondent has not been employed in the firm at the beginning of the apprenticeship and thus could not have known the apprentice personally.

Our dependent variable is a measure of the relative productivity of the apprentice. We ask the firms to compare the productivity of their apprentice to the productivity of their average

[23] See Schönfeld et al. (2010) for detailed description and results.

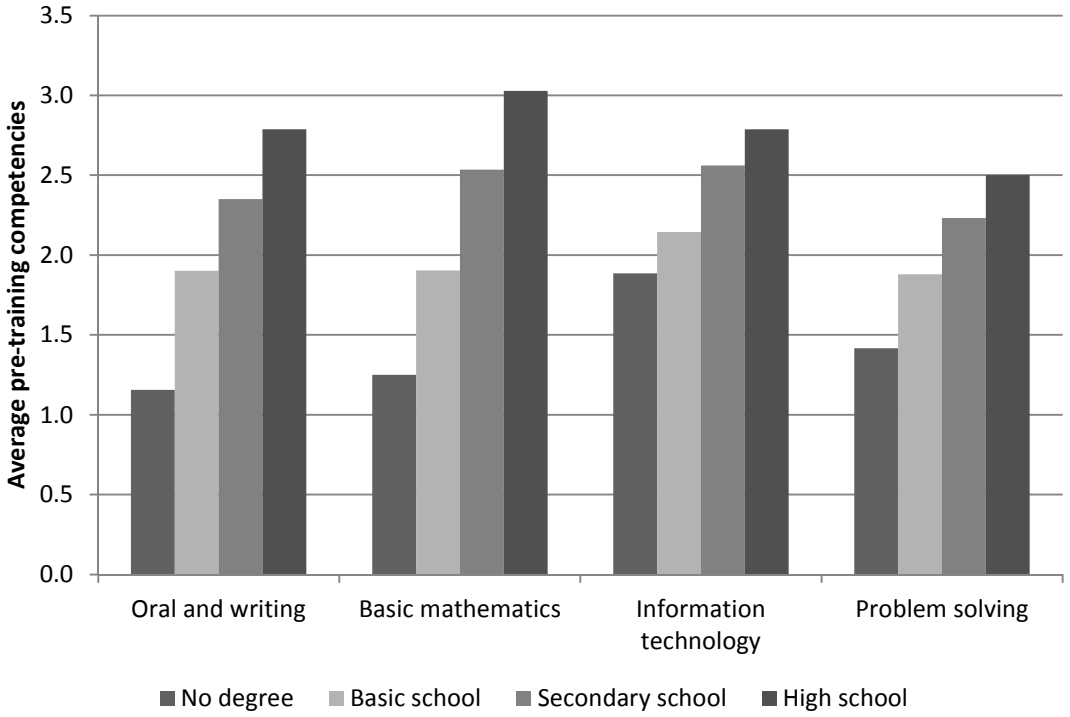
skilled worker in the respective occupation.[24] We thus presume that the apprentice is never more productive than an incumbent skilled worker. The interview partner provides a value between 0 and 100 %. Figure A3.1 in the appendix shows a density plot of the relative productivity of the apprentices in our sample. The mean value of the relative productivity is 59.4 % of the average productivity of a skilled worker with a standard deviation of 22.78 %. The main explanatory variables are the pre-training school competencies of the apprentice in the firm. We phrased the corresponding question in such a way that the respondents report the competency level of the apprentice *at the start* of the apprenticeship. The measure therefore reflects the individual level of competencies acquired over the entire educational career *prior* to the training.[25] We distinguish between four different types of competencies: 1) *oral and writing competency*, 2) *basic mathematical competency*, 3) *information technology (IT) competency* and 4) *problem-solving competency*. The level of competencies is measured on a scale from 1 (very good) to 5 (very poor). For the regression analysis, we recoded the variables in a way that 0 equals "very poor" and 4 represents a "very good" evaluation. As a result, a positive (negative) coefficient in our regression output indicates a positive (negative) relation between the dependent and the explanatory variable.

Because the measure of the school competencies – evaluated by the person responsible for training in the firm – is a subjective measure, the way in which they reflect the "real" competencies may be questionable. As information about the school leaving qualification is also in our data, we tested whether the school leaving qualification (an objective measure) is related to the subjective evaluation of the school competencies. As shown in Figure 3.1, apprentices who have obtained higher school leaving qualifications are also rated better in all four school competencies. This relation supports the objectivity of our measure.

[24] It could be that the reference group „average skilled employee" might differ from firm to firm. Therefore, we control for firm size, economic branch, and occupation. In an additional analysis (not shown in the text, but available upon request), we additionally control for the skilled worker wage. The results remain extremely robust.

[25] Translated from German, the original wording of the question is as follows: "How would you assess the pre-training school competencies of your apprentices in the selected occupation? Please tell me on a scale from 1 ("very good") to 5 ("very bad") how you would assess the pre-training school competencies of your apprentices with respect to the following areas: 1) oral and writing competency, 2) basic mathematical competency, 3) information technology (IT) competency and 4) problem-solving competency.

FIGURE 3.1: AVERAGE PRE-TRAINING COMPETENCIES BY SCHOOL LEAVING QUALIFICATION

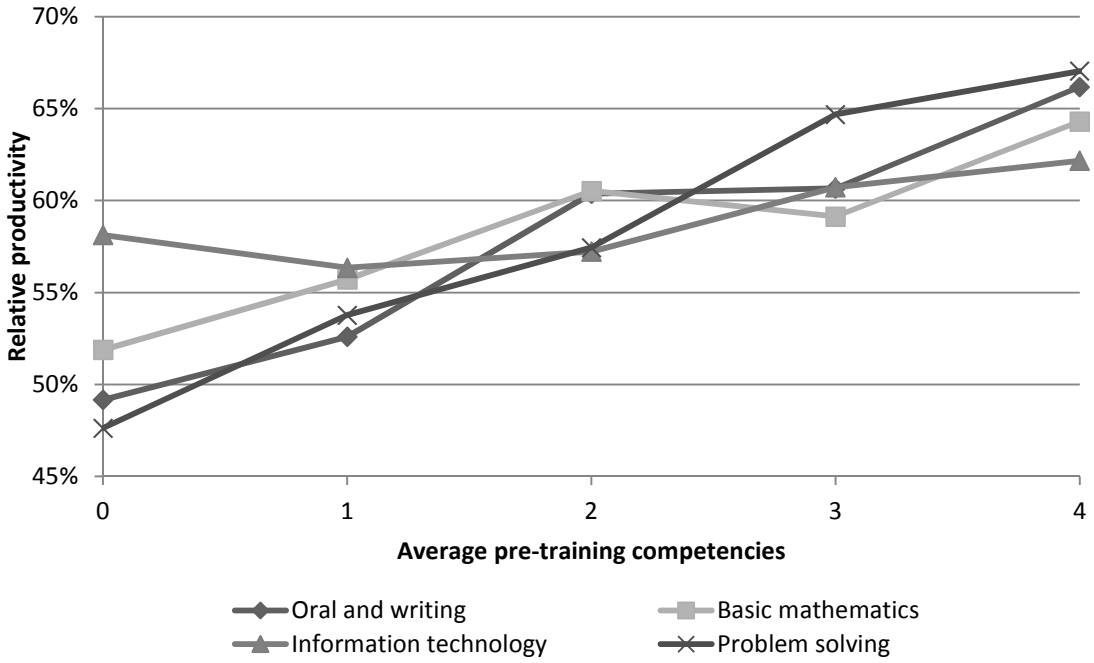


3.4 Descriptive results

Table A3.1 in the appendix provides information about the sample including all German training firms and about the sample including only those firms that train one apprentice. Although the average values of the two samples differ slightly with respect to firm size and training hours, they are remarkably similar with respect to our main variables of interest. In both samples, the average productivity of apprentices compared to skilled workers in the firm nearly reaches 60 %. Moreover, the table shows that apprentices obtain relatively high competency scores in basic mathematics and information technology, while the averages for oral and writing and problem-solving competencies are somewhat lower. The apprentices in firms with only one apprentice even receive slightly better ratings in all pre-training competencies.

To illustrate how productivity and the respective pre-training competencies are correlated, Figure 3.2 displays apprentices' mean relative productivity conditional on the level of competencies. The higher the competency level, the higher the apprentices' productivity at the workplace, which leads, ceteris paribus, to higher training benefits for firms. While all four competencies are strongly correlated with apprentices' productivity, oral and writing competencies, and problem-solving competencies show the strongest correlation with productivity.

FIGURE 3.2: CONDITIONAL MEAN VALUES OF APPRENTICES' RELATIVE PRODUCTIVITY



Notes: Source is BIBB Cost-benefit Survey 2007, restricted sample based on firms with one apprentice.

3.5 Multivariate regression analyses

3.5.1 Underlying mechanisms and explanatory variables

The strong relationship between the pre-training competencies and the apprentices' productivity demonstrated in Figure 3.2 could be caused by various mechanisms. In this section, we discuss three main mechanisms that could explain this relation and present corresponding control variables that aim to take account of these mechanisms in a multivariate regression model.

First, the most straightforward and possibly also most relevant reason is that apprentices with high levels of school competencies are more productive than apprentices with low school competencies. This higher productivity results either from a direct effect, meaning that school competencies *cause* productivity, or from an indirect effect, meaning that the effect of school competencies is channeled by a higher trainability. Likewise, it is possible that school competencies *signal* innate ability or motivation. In this chapter, we cannot disentangle these different mechanisms. However, it could be argued that, from the firms' perspective, it is important to understand the predictive value of competencies rather than to detect causality.

The *second* reason for the relation between productivity and pre-training competencies could be an assortative matching process between apprentices and firms. This mechanism implies that the allocation of school graduates to different types of training firms is not random but depends systematically on the graduate's school competencies. Highly skilled school leavers are more likely to sort themselves into very productive firms because of higher expected wages and better internal career opportunities.[26] In contrast, lower ability school leavers are more likely to start apprenticeships in companies with less attractive conditions and lower overall work productivity. As the productivity level of a worker does not only depend on personal characteristics but also on the overall productivity of the firm (for example due to spillover effects from other workers, economies of scale, the type and amount of machines), assortative matching could be responsible for the relationship between competencies and the relative productivity. Table 3.1 supports the existence of assortative matching and shows that better apprentices tend to be trained in firms with higher average apprentice wages, more employees, and more beneficial retention strategies.

TABLE 3.1: FIRM CHARACTERISTICS BY AVERAGE PRE-TRAINING COMPETENCIES

Average competence level	Apprentice wage	Firm size	Retention strategy	Frequency
0	€520.24	9.75	25.00 %	8
1	€598.32	28.10	49.21 %	126
2	€600.82	36.79	42.78 %	395
3	€624.00	54.07	51.85 %	513
4	€654.19	60.41	60.33 %	121

Notes: Source is BIBB Cost Benefit Survey 2007, restricted sample; firm size = average number of employees; retention strategy = share of firms saying they always retain apprentice.

A *third* mechanism that could reinforce the relation between apprentices' competencies and productivity is that a firm's training strategy depends on apprentices' pre-competencies. Higher competencies might lead to training strategies that are more or less beneficial for productivity. The firm could allocate an apprentice with high initial competencies to more sophisticated work tasks, which then in turn fosters the apprentice's productivity and thus has a self-reinforcing effect. Analyzing the same dataset, Wenzelmann (2012) shows that the time for which apprentices are allocated to skilled work is significantly related to the apprentices' pre-training competencies. Moreover, Mühlemann et al. (2013) find that firms use different training strategies, i.e. a different amount of instruction time, depending on the previous schooling background of the apprentices.

[26] Even though probably all school-leavers prefer firms with these attributes, school leavers with higher competency-levels have higher chances to get employed by these firms.

Although we do not claim to measure causal effects with the data at hand, we are at least able to control for two important influencing mechanisms, i.e. the assortative matching and training strategies. To control for the effect of assortative matching, we include the training occupation, firm size, and economic branch in the regression model. Academically stronger school graduates may prefer specific occupations or branches over others, and firm size controls for differences in career options after the training period. Moreover, we assume that the firm's retention strategy also plays a role in the graduate's choice of training firm. A high commitment to the retention of former apprentices leads to a higher attractiveness for apprentices. Therefore, we include a variable that identifies the retention strategy of the firm.[27]

We also take into account the possibility that the training strategy and training organization may have an additional effect on apprentice productivity, while at the same time firms might apply different training strategies depending on the apprentices' competencies. To control for the effect of different training strategies, we include additional variables in the model. For training quality, we use the total instruction time of trainers, i.e. the amount of hours an apprentice is supervised by a trainer per week. For training organization, we add variables for the apprentices' time spent with skilled and unskilled productive tasks and other learning activities.

Apart from the variables related to the two mechanisms discussed above, we add additional control variables to the model. We include the training year because respondents could have difficulties in remembering the level of competencies at the start of training. They might base their assessment on current productivity, especially when the apprenticeship started several years ago.[28] We also include the school-leaving qualification of the apprentice in the regression models. This enables us to implicitly control for the age differences between apprentices with different schooling backgrounds.

It could be argued that in different training occupations, different tasks are performed and therefore different competencies are required. Figure A3.2 in the appendix shows tasks intensities in the different occupational groups based on aggregated task measures from a large employee survey.[29] Commercial occupations require a relatively large number of analytical and interactive tasks, while industrial and technical occupations involve more manual tasks. Therefore, we divide our sample into firms that train in commercial occupations and firms that train in industrial/technical occupations. The respective

[27] A further attraction indicator is the apprentice wage. We additionally controlled for this parameter and the results remain extremely robust.

[28] A possible further selection could arise when very bad apprentices drop out of the training, and only those with good school competencies remain in the firm. If tenure and productivity were related, this could bias our results. However, analyzing the dropout rates shows that the fraction of dropouts is very small and therefore unlikely to bias our results. The average fraction of dropouts per firm and training year was about 6.5 % in the years from 2005 to 2007.

[29] The full name of the data set is BIBB/BAuA Employment Survey of the Working Population on Qualification and Working Conditions in Germany 2006. For more information on methodology see Rohrbach-Schmidt (2009).

occupations ascribed to the two groups are supplied in Table A3.2. We suspect that the productivity-enhancing influence of the different competencies varies significantly between the occupational groups. Based on the different task requirements, we expect pre-training competencies to be more relevant for commercial occupations than for industrial or technical occupations. Moreover, Roy (1951) argued that employees sort themselves into those occupations in which they have a relative advantage. As a result, comparing productivities between very different occupations does not reveal the actual effect of school competencies. Conducting analyses within relative homogenous subgroups can reduce this bias. Therefore, we run separate regressions for the two samples. As a robustness analysis, in section 3.5.3 we provide additional results using occupational task profiles instead of the dichotomy of commercial versus industrial/technical occupations.

In the following regression analysis, we run separate regressions for the competencies due to the existence of collinearity between the four competencies: the correlations between the competencies are between 0.42 and 0.66. Therefore, when all four competencies are included in one model, the standard errors of the separate types of competencies become larger and it is more difficult to disentangle the single effects.

3.5.2 Estimation results

Table 3.2 presents the regression results including the previously described control variables. In order to account for the fact that the dependent variable is left- and right-censored (the relative productivity can only take on values between 0 and 100), we use a tobit estimation model. We provide results for separate regressions with each regression containing one type of competency for commercial and industrial/technical occupations respectively.[30] We further provide regression results replacing the separate competencies with the first component obtained from a principal component analysis.[31] While this method does not provide information about the separate influences of the competencies, it tests for the general importance of school competencies on the productivity of apprentices.

Table 3.2 shows that the relation between all four competencies and the relative productivity of apprentices is stronger for commercial occupations than for industrial/technical occupations. However, even for commercial occupations, not all of the competencies are relevant for productivity. The coefficient for basic mathematics competencies stays insignificant. The coefficient for IT competencies is relatively small and only weakly significant. For problem-solving and oral and writing competencies, on the other hand, the coefficients are positive and significant at the 1-percent level. Comparing the size

[30] Including all competencies in one regression model, their coefficients are jointly significant. The F-test is highly significantly on the 1-percent level with an F statistic of 6.11.

[31] The principal component analysis (PCA) is used for data reduction and provides the main *eigenvectors* from the *eigen* decomposition. This method is often used in the case of multicollinearity between explanatory variables. In our case, the principal components are calculated based on the four competencies included in the survey.

of the coefficients suggests that the problem-solving competency is the more dominant of the two competency types. A one unit increase in problem-solving competency is related to an increase of 7.5 percentage points in relative productivity. Conversely, a one unit increase in oral and writing competencies is associated with an increase of nearly 4 percentage points in the relative productivity. Moreover, the first principal component of the four competencies is highly significant with a coefficient of nearly 3. This result implies that, in general, pre-training competencies are relevant for explaining apprentices' productivity at the workplace.[32]

The monetary consequences of a competency change for the training costs of firms can be simulated using the wage information provided by firms in the survey. Taking into account that the average skilled worker wage in commercial occupations is €2,236, an increase of one unit in, for example, problem-solving competencies is related to an increase in benefits of €2,015 per year and per apprentice. However, this increase is calculated under the assumption that the apprentice conducts tasks on a full-time basis at skilled worker level. A more realistic assumption (stemming from the same survey) is that apprentices in commercial occupations spend about 26 % of their time on skilled work. That means that, for an average firm, the additional productivity would increase training benefits by €524 per year. In the extreme case, when comparing an apprentice with the lowest competency level with an apprentice with the highest competency level in problem-solving competencies, the difference in productivity, and thus in training benefits, would reach €2,096 per year and per apprentice, which is 18 % of the average training benefits in commercial occupations.

The other coefficients in the model also provide some insight. The highly significant coefficient for the time spent with skilled work shows that skilled work is positively related to the productivity of the apprentices. Running the same regression without the variables "tasks at skilled worker level" and "task at unskilled worker level" yields somewhat higher coefficients for the pre-training competencies.[33] This difference indicates that part of the effect of competencies on productivity is channeled by the fact that firms vary their training strategy according to the intake quality of apprentices. Employing apprentices with high competencies is therefore not only beneficial because these apprentices have higher potential productivity, but also because they can be allocated more often to productive tasks on the skilled worker level, which in turn raises their productive contributions.

The coefficients of the different levels of school leaving qualification are not significant and thus suggest a neutral relation with the productivity of apprentices.[34] This result implies that being productive in apprenticeships requires practical skills and knowledge that is not related to school types.

[32] Even though the results may suffer from a common method bias, the ranking between the competencies should remain the same.

[33] For oral and writing competencies, the coefficient increases to 4.57 and for problem-solving competencies to 9.03. The detailed regression results are not shown in this chapter but are available upon request.

[34] This result remains robust, when running the productivity regression only on the different levels of school leaving qualifications. The results are available upon request.

The time the trainer spends with the apprentice is not a strong predictor for apprentices' productivity. In the regression for the commercial occupations trainer hours are even negatively related (10 % level) to the relative productivity. This suggests that some firms follow a compensating strategy with trainers spending more time with low-ability apprentices. Other firms might apply an efficiency strategy, which means that trainer hours are allocated especially to high-ability apprentices. The insignificant coefficients could therefore be due to heterogeneous effects, which cancel each other out.

The coefficients for the variables on firm size (not shown in the table) indicate that apprentices are more productive in larger firms, which supports our assumption that the better apprentices sort themselves into larger firms. Moreover, the productivity of the apprentices increases with each training year.

TABLE 3.2: TOBIT REGRESSION: RELATIVE PRODUCTIVITY OF APPRENTICES

	Commercial occupations					Industrial/technical occupations				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Oral and writing competencies	3.98***					0.67				
	(1.32)					(1.03)				
Mathematical competencies		1.90					-0.17			
		(1.29)					(0.99)			
IT competencies			2.07*					-0.31		
			(1.25)					(1.28)		
Problem-solving competencies				7.51***					0.82	
				(1.21)					(1.06)	
First principal component					2.96***					-0.11
					(0.78)					(0.72)
Tasks on unskilled worker level	0.07	0.07	0.05	0.02	0.04	-0.09	-0.09	-0.11	-0.09	-0.11
	(0.10)	(0.10)	(0.11)	(0.10)	(0.10)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Tasks on skilled worker level	0.49***	0.50***	0.48***	0.42***	0.45***	0.30***	0.31***	0.31***	0.30***	0.31***
	(0.08)	(0.08)	(0.09)	(0.08)	(0.08)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
Training hours by trainers	-0.12*	-0.12*	-0.13**	-0.09	-0.13*	0.04	0.04	0.06	0.04	0.06
	(0.06)	(0.06)	(0.07)	(0.06)	(0.07)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
1st year	-16.32***	-16.67***	-15.79***	-17.31***	-16.34***	-22.24***	-22.22***	-21.62***	-22.45***	-21.65***
	(3.59)	(3.60)	(3.65)	(3.33)	(3.60)	(2.86)	(2.84)	(3.30)	(2.85)	(3.32)
2nd year	-12.73***	-13.07***	-12.49***	-13.63***	-12.92***	-11.43***	-11.35***	-11.42***	-11.60***	-11.40***
	(2.85)	(2.94)	(2.93)	(2.75)	(2.87)	(2.27)	(2.27)	(2.62)	(2.26)	(2.62)
Constant	26.48*	30.58**	36.45**	27.40**	41.62***	61.34***	62.61***	63.17***	60.97***	62.49***
	(14.78)	(15.14)	(14.86)	(13.28)	(14.04)	(7.31)	(7.30)	(8.46)	(7.23)	(8.33)
Observations	566	566	553	566	553	403	403	349	403	349

Note: Standard errors in parentheses * p < 0.10, ** p < 0.05, *** p < 0.01; Source is BIBB Cost-Benefit Survey 2007, restricted sample based on firms with one apprentice. All regressions control for occupation (51), economic branch (28), firm size (5), region (2), retention strategy (3), and school leaving certification (4). The number of observations is lower for the regression on IT competencies because more firms report that those competencies are not relevant for their work or training. The reference category for the year dummies is the third training year. To compare the two occupational groups, apprentices in the fourth training year are excluded.

3.5.3 Robustness analyses

As the dataset is restricted to firms with only one apprentice, it may be argued that the observed relation between competencies and productivity is somehow limited to this specific sample and does not exist in a representative sample of all firms. As described above, the summary statistics of the sample of firms with only one apprentice do not differ much from the statistics of the full sample (see Table A3.1). Nonetheless, we further test whether our results reported in Table 3.2 remain robust when running the same regressions using the *full* sample of firms. In the full sample, the information about the competencies and the productivity are reported averages of all apprentices in the firm. The coefficients and the respective confidence intervals are displayed in Figure A3.3 in the appendix. Apart from the fact that, on average, the sizes of the competency coefficients are slightly smaller, the results remain robust. The slightly smaller size of the coefficients in the four regressions can be explained by the fact that the within-firm variation is not accounted for in the average evaluation of the apprentices' competencies.

We also test for the linearity in different levels of the competencies. We therefore create dummy variables for each of the five competency levels and include those variables in the regression instead of the respective continuous competency variable.[35] We then plot the resulting coefficients for each competency level to check whether competencies are linear, concave, or convex in their relation to productivity. Figure A3.4 in the appendix shows the result for commercial occupations. The figure suggests that, with the exception of mathematics and to some degree IT competencies, the most relevant competencies are linear in their relation to productivity.

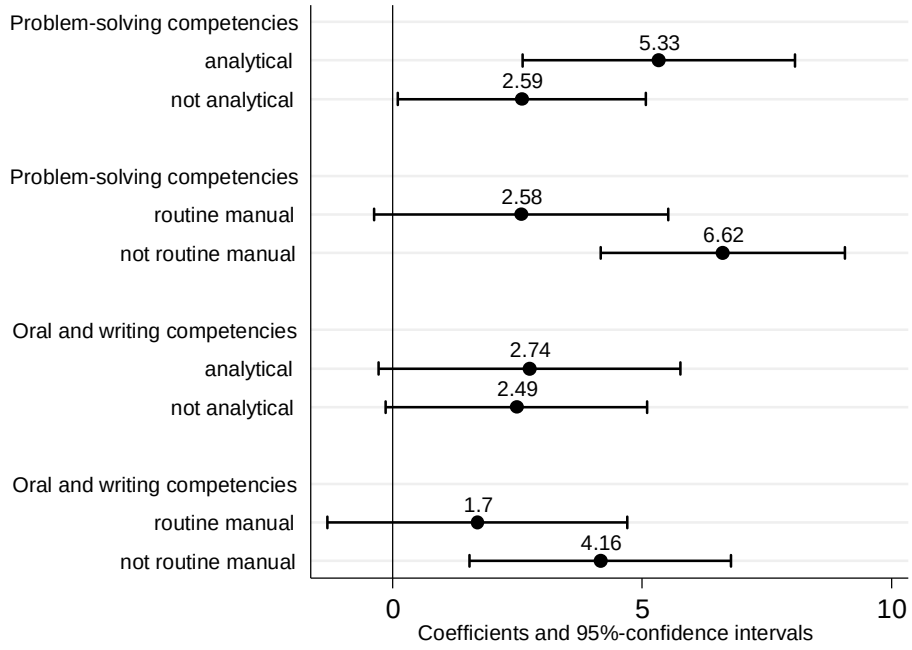
Finally, we run a regression differentiating between the task profiles of occupations instead of differentiating between commercial and industrial/technical occupations. We expect that occupations with a profound analytical task profile require a higher degree of problem-solving and oral and writing competencies than occupations without such tasks. Further, we expect problem-solving and oral and writing competencies to be less relevant for productivity in occupations extensively using routine manual tasks. To group the occupations according to their respective task structure, we use the BIBB/BAUA Employment Survey (Rohrbach-Schmidt, 2009). We create two groups for each variable – one group with a relatively low degree of analytical tasks (routine manual tasks), that is with a share of those tasks smaller or equal to the mean, and one group with a relatively high share of analytical tasks (routine manual tasks) with a value above the mean. Based on this distinction, we run separate regressions for each group of occupations.[36]

[35] The respective regression outputs are not shown in the chapter due to space limitation, but are available upon request.

[36] For twelve occupations, information on task content is not available. Therefore, the analysis is based on fewer observations.

As expected, we find that problem-solving competencies are highly significant in occupations with a high share of analytical tasks and not so in occupation with a low share of analytical tasks (see Figure 3.3). Moreover, the importance of problem-solving competencies is much lower in occupations with a high degree of routine manual tasks. In occupations in which the degree of routine manual tasks is relatively low the coefficient for problem-solving competencies is large and highly significant. The relevance of oral and writing competencies varies only with the degree of routine manual tasks in an occupation. The coefficient for oral and writing competencies is much larger in occupations with a low degree of routine manual tasks.

FIGURE 3.3: COEFFICIENTS OF COMPETENCIES FOR DIFFERENT TASK GROUPS



Note: Coefficients are obtained from a tobit regression of the relative productivity on the four pre-training competencies, respectively, and the same set of explanatory variables as in table 3.2. Source is BIBB Cost-Benefit Survey 2007. Regressions are based on firms with one apprentice. Occupations are classified as "analytical" ("routine manual"), when the share of analytical (routine manual) tasks is above the mean. Accordingly, if the share of such tasks is equal or lower than the mean the occupations are classified as "not analytical" ("not routine manual").

Overall, the latter exercise confirms our results in section 3.5.2 in that pre-training competencies may have heterogeneous relations to the productivity at the workplace, as they become more important in occupations requiring analytical tasks and less important in occupation focusing on manual skills.

3.6 Conclusion

The aim of the chapter is to shed light on the relation between pre-training competencies and the productivity of apprentices in firms providing training. We argue that competencies acquired prior to the training may be an important predictor for the productivity of apprentices at the workplace. For our analysis, we convert data from the BIBB Cost-Benefit Survey 2007, which is a firm level survey, into quasi individual-level data by reducing the sample to firms with only one apprentice in the training occupation. This allows us to assign specific information about both the level of competencies and the productivity to the single apprentice in the firm.

Our results suggest that the relation between competencies and apprentices' productivity is heterogeneous. Problem-solving competencies have a significant positive influence on productivity in commercial occupations. A one unit increase in problem-solving competencies is related to an increase in relative productivity of about 7.5 percentage points. The influence of oral and writing competencies in these occupations is with a coefficient of 4 less strong but still significant. The coefficient for IT competencies is smaller and only weakly significant. The respective coefficient for basic mathematical on the other hand is not statistically related to productivity. In the case of industrial and technical occupations, none of the competencies surveyed show a significant relation with the productivity of apprentices.

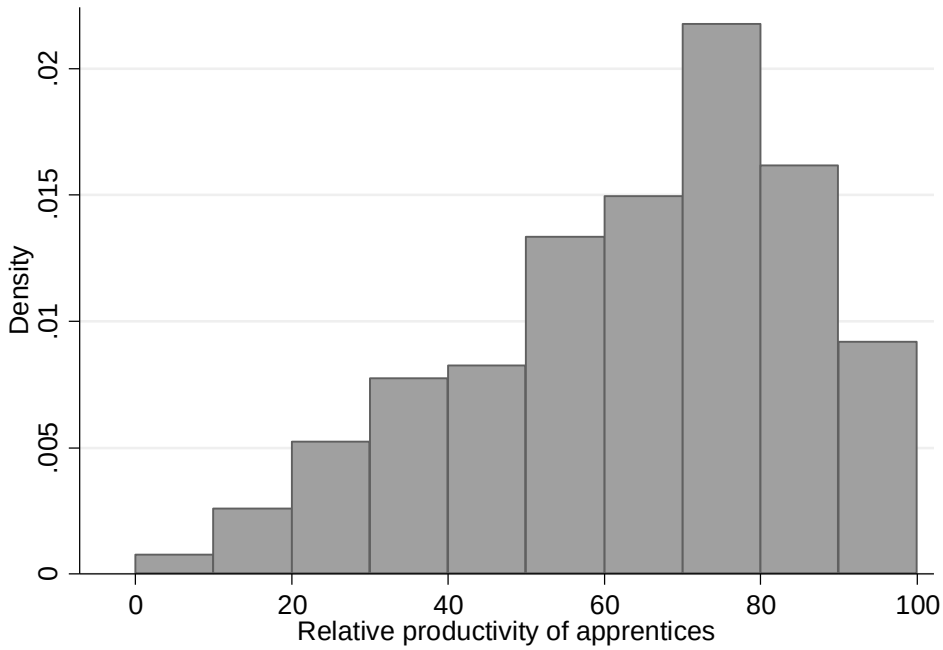
The results thus imply that pre-training competencies are more important for the productivity of commercial occupations. For industrial and technical occupations, the school competency measures are statistically insignificant. One explanation for this finding could be that school competencies play a more important role in occupations that demand relatively high levels of analytical competencies, compared to occupations in which more manual skills are needed. We provide some evidence for this presumption in the robustness section of the chapter and analyze occupations based on their task structure.

The results of our analysis are important for both firms and policy makers. Firms offering apprenticeships are interested in information about how to improve the cost-benefit relation of training. Especially in times of a decreasing number of applicants for apprenticeship places, firms cannot maintain the high requirements they have with respect to school grades. As it tends to become more difficult for firms to find apprentices, it is important for them to know which competencies predict workplace productivity and which competencies are less relevant. We show that paying special attention to the problem-solving and oral and writing competencies of apprentices is advisable because higher levels of pre-training competencies in these areas improve the benefit side of training. Higher levels of IT competencies are also important albeit to a lower extent. This particularly holds for firms training in commercial occupations. A practical implication from our analysis is that it could be useful to implement tools testing for these productivity-relevant competencies of apprenticeship applicants in the process of recruitment.

Our results are also relevant for policy makers. Although we cannot interpret our results as causal, we can still add some important empirical information to the ongoing debate regarding qualifying school graduates for the transition from compulsory education to apprenticeship training. The set of competencies necessary for successfully completing this dual track may differ from the set of competencies needed for a successful university career. Indeed, we find that pre-training competencies are especially important for apprentices in occupations that demand a high share of analytical tasks. To raise firms' training incentives in these occupations, it may be reasonable to equip potential apprentices with corresponding competencies during compulsory schooling. However, the results also imply that those who leave school with lower levels of competencies can still be very productive during training and thus may be equally "attractive" to firms that offer training in industrial or technical occupations.

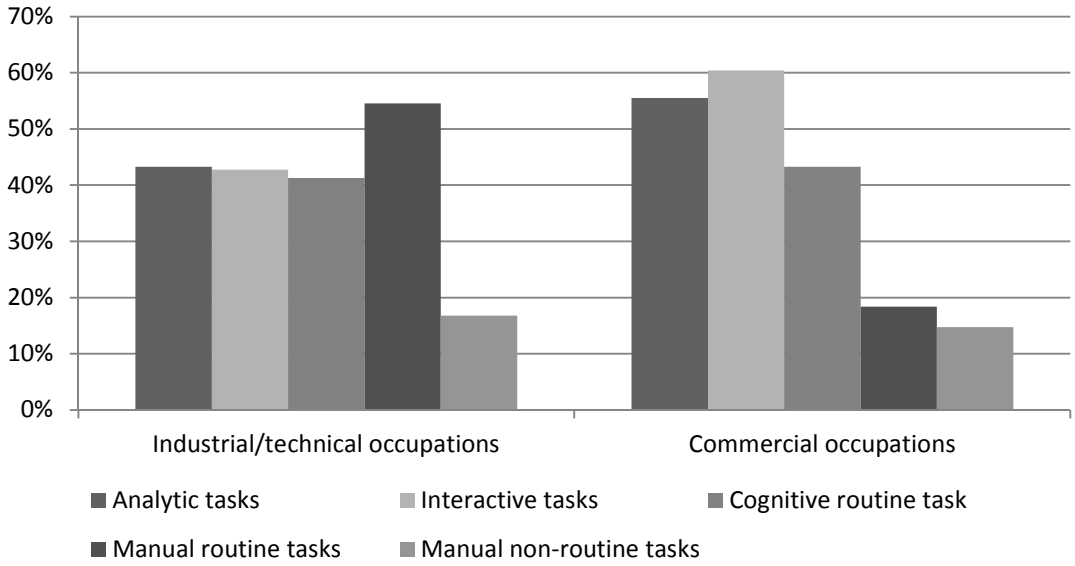
A3 Appendix

FIGURE A3.1: DISTRIBUTION OF APPRENTICES' RELATIVE PRODUCTIVITY



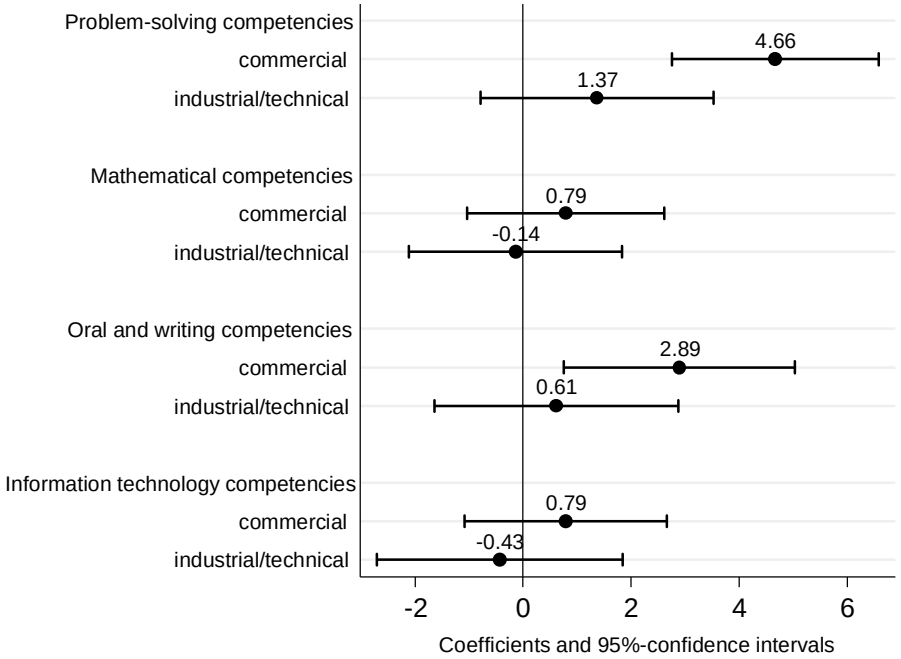
Note: Source is BIBB Cost-Benefit Survey 2007. Density plot is based on firms with one apprentice.

FIGURE A3.2: DEGREE OF TASK INTENSITIES IN DIFFERENT OCCUPATIONAL GROUPS



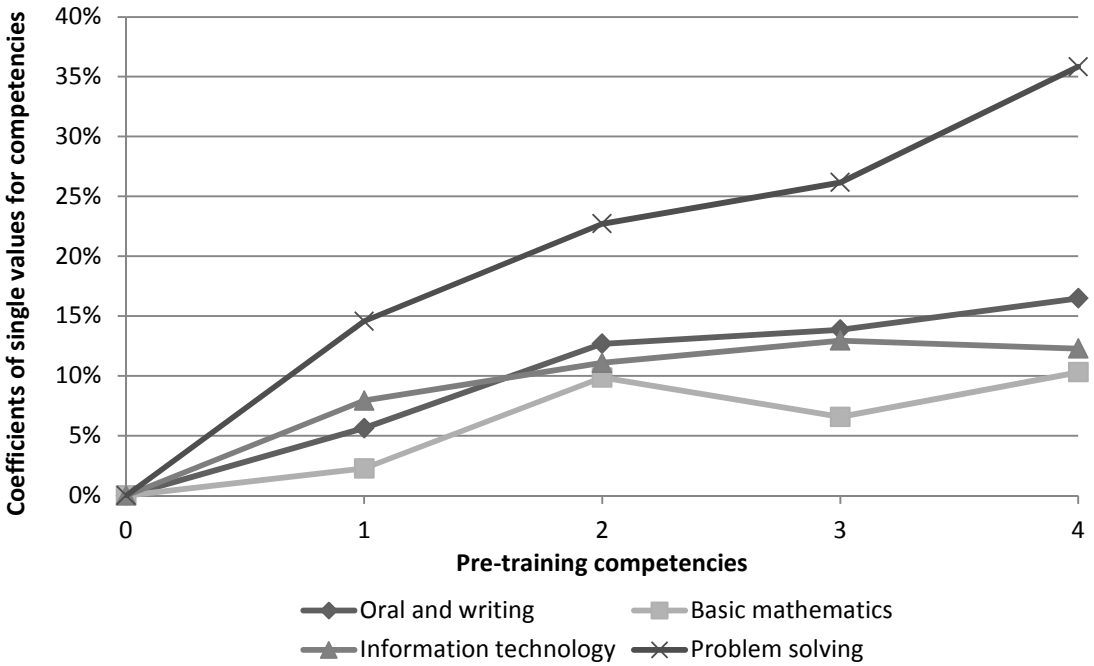
Note: Aggregated task intensities; Source is BIBB/BAuA Employment Survey of the Working Population on Qualification and Working Conditions in Germany 2006.

FIGURE A3.3: COEFFICIENTS OF COMPETENCIES FOR DIFFERENT OCCUPATIONAL GROUPS – FULL SAMPLE



Note: Coefficients are obtained from a tobit regression of the relative productivity on the four pre-training competencies, respectively, and the same set of explanatory variables as in table 3.2. Source is BIBB Cost-Benefit Survey 2007. Regressions are based on all firms.

FIGURE A3.4: COEFFICIENTS OF SINGLE VALUES FOR THE FOUR PRE-TRAINING COMPETENCIES



Note: Coefficients are obtained from a tobit regression of the relative productivity on the four pre-training competencies, respectively, included as categorical variables and the same set of explanatory variables as in table 3.2. Source is BIBB Cost-Benefit Survey 2007. Regressions are based on firms with one apprentice trained within commercial occupations.

TABLE A3.1: DESCRIPTIVE STATISTICS ON MODEL VARIABLES

Apprentice-specific variables		Firms with one apprentice	All firms in the sample
Relative productivity (0-100)		59.40	58.08
Oral expression/writing competencies (0-4)		2.31	2.19
Basic mathematical competencies (0-4)		2.46	2.31
IT competencies (0-4)		2.51	2.45
Problem-solving competencies (0-4)		2.19	2.06
Share of apprentices with	no educational degree	2%	3%
	basic school	23%	21%
	middle school	54%	54%
	high-school	21%	22%
Share of apprentices in	1st training year	21%	23%
	2nd training year	41%	40%
	3rd training year	36%	33%
	4th training year	2%	4%
Variables on training organization			
Training hours by trainers (hours per week)		20.47	16.75
Tasks on unskilled worker level (hours per month)		35.03	36.06
Tasks on skilled worker level (hours per month)		44.63	42.85
Share of firms	always retaining apprentices	45%	47%
	sometimes retaining apprentices	29%	30%
	never retaining apprentices	26%	23%
Firm variables			
Share of firms with	1-9 employees	69%	54%
	10-49 employees	25%	33%
	50-499 employees	6%	12%
	more than 499 employees	0%	6%
Share of firms in East Germany		18%	16%
Share of firms in West Germany		82%	84%
Observations		1163	2856

Note: Not shown due to space restrictions are training occupations and economic branch. Number of observations for IT knowledge is 1083 and 2631, respectively. Source: BIBB Cost-Benefit Survey 2007.

TABLE A3.2: LIST OF OCCUPATIONS BY OCCUPATIONAL FIELDS

Industrial/technical occupations	Commercial occupations
Architectural draughts person	Assistant in event managing
Baker	Assistant in office communication
Butcher	Bank clerk
Chemical laboratory technician	Clerk in public administration
Chemical technician	Industrial clerk
Cook	Information and telecommunications system support specialist
Dental technician	Insurance and financial services broker
Designer of digital and print media	Legal assistant
Electronics technician for building and infrastructure systems	Management assistant for retail services
Electronics technician for industrial engineering	Management assistant in wholesale and foreign trade
Farmer	Medical assistant
Florist	Office administrator (crafts and skilled trades)
Gardener	Office administrator (trade and industry)
Hairdresser	Qualified dental employee
Industrial mechanic	Salesperson specializing in foodstuffs
Information electronics technician	Social insurance clerk
Information technology and telecommunications system electronics technician	Specialist in the hotel business
Information technology officer	Specialist in office communication
Information technology specialist	Tax clerk
Joiner	Tourism agent
Mason	
Mechatronics fitter	
Metalworker	
Motor vehicle mechatronics technician	
Optician	
Painter and varnisher	
Plant mechanic for sanitary, heating and air conditioning systems	
Printer	
Surveying technician	
Tools mechanic	
Warehouse logistics operator	

4. Labor market deregulation and apprenticeship training: A comparison of German and Swiss employers*

4.1 Introduction

In the contemporary literature on the economics of training, the existence of extensive training systems – such as the apprenticeship system in Germany, where firms are willing to invest considerable amounts in the general skills of their employees – has been used as an illustration of the importance of labor market frictions. Conversely, the absence of strict labor market regulations has been used to explain the absence of such firm behavior in Anglo-Saxon labor markets. If apprenticeship training systems and tight labor market regulation always come in tandem, and are therefore mutually dependent, then deregulating the labor market would clearly affect firms' willingness to invest in training. Acemoglu and Pischke (1999a), pioneers in extending Becker's theory of human capital, feared exactly this when writing shortly before the adoption of the labor market reform agenda by the Schröder government in Germany:

"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." (pp. 548–549)

*This chapter is based on the paper „Labor market deregulation and apprenticeship training: A comparison of German and Swiss employers", by Anika Jansen, Mirjam Strupler-Leiser, Felix Wenzelmann, and Stefan Wolter. The paper is published in: European Journal of Industrial Relations, 21 (4), pp. 353 – 368, 2015.

In this chapter, we analyze the impact of the German labor market reforms on the behavior and strategies of German firms with respect to apprenticeship training. Identifying a strictly causal effect of the labor market reforms is not within our scope. However, we provide and test different explanations for the observed developments in the German training system. In particular, we undertake a comparison with Switzerland, a country with an almost identical training system that did not change its labor market regulations during the observation period. Our study is the first that makes use of four German and Swiss datasets at different points in time. In this way, our study extends the existing literature by reducing the reasons for changes in training behavior in Germany to country specific factors. In contrast to the predictions of Acemoglu and Pischke, the probability of training in Germany did not decrease after the government relaxed labor market rules: the share of German firms with at least one employee providing training remained at approximately 24 % between 2000 and 2007.[37] This observation is only compatible with the theoretical predictions if firms were able to change their training strategies and reduce their up-front investments in training. This makes Switzerland a most attractive comparator: first, because the Swiss labor market has traditionally been deregulated, forcing Swiss firms to train apprentices differently from their German counterparts (Mühlemann et al., 2010). Furthermore, the difference-in-differences approach allows us to rule out global changes influencing the apprenticeship training systems in both countries.

Our findings show that German firms substantially reduced their up-front *net* investments in apprentices at firm level to limit the potential loss should skilled workers leave the firm which trained them. As the binding training regulations did not allow firms to reduce their gross investments in training, they were forced to increase the productive contributions of apprentices to achieve a reduction in the net costs of training. The productive contributions of apprentices per apprentice and year increased in Germany (in contrast to Switzerland) on average by €2000 from 2000 to 2007. The firms were able to increase substantially the productive contributions of apprentices by involving them in more skilled work, while reducing the number of days that apprentices had previously used for non-productive tasks. We also consider other explanations for our results, such as the decline of union power in Germany. Although we cannot provide clear causal evidence, our results suggest that the labor market reforms rather than other developments influenced the training strategy of German firms.

The chapter is structured as follows. In section 4.2 we offer a brief summary of the theoretical literature on the relationship between labor market frictions and firm investments in general skills. In section 4.3 we describe the apprenticeship training systems

[37] The long-term trend from 1992 to 2013 indicates a decline in the supply of training places (Matthes et al., 2014). However, comparing the years 2000 and 2007, the supply of training places is remarkably similar. Moreover, the share of training firms in relation to all existing firms in these years even increased slightly from 23.7 to 24.1 %. Source: Beschäftigungsstatistik der Bundesagentur für Arbeit; reference date December 31; calculations of the Bundesinstitut für Berufsbildung (http://www.bibb.de/dokumente/pdf/ausbildungsbetriebsquote_ wirtschaftsbereiche_d_1999-2007.pdf).

in Germany and Switzerland and their labor market regulations. In section 4.4, we provide information on the changes in labor market regulation that took place in Germany from 2000, then describe the data and present our empirical strategy. After presenting our empirical results and several robustness checks as well as tests of alternative explanations, we offer a conclusion.

4.2 Labor market regulation and training behavior

In classical human capital theory (Becker, 1962), firms have to pay part of the cost of firm-specific skill development and employees have to pay the total cost of general skill development.[38] These 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 across a number of employers (general skills) by paying the trained worker below his/her marginal productivity. However, it has been shown that many German employers do make considerable net investments in general skills (Bardeleben et al., 1995). Acemoglu and Pischke (1998; 1999a; 1999b) therefore extended classical human capital theory in an attempt to reconcile theory with empirical observations. They dropped the assumption that labor markets are perfectly competitive; instead, and more realistically, they assumed that labor markets are characterized by varying degrees of friction. In their model, these frictions lead to a compressed wage structure, in which the gap between productivity and wage levels increases with training. Therefore, skilled workers can be paid below the marginal product of their labor and rents for firms increase through training. 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, such as employment protection legislation (increasing firing costs), may be just one but an important source of such frictions (Acemoglu & Pischke, 1999a). Regulations such as specific rules concerning the dismissal of workers or limitations on temporary work (which allow employers to screen potential employees) increase the costs of bad employer–employee matches. To avoid mismatches, firms have to invest more in the search of new recruits, and hence 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 competitor will poach a firm's apprentices is reduced. This in turn leads the training firm, at the margin, to pay wages below marginal productivity and thereby recoup prior net investments in training. Therefore, higher transaction costs induced by employment protection are one of the sources for a compressed wage structure (Acemoglu & Pischke, 1999a), which is in turn an incentive for firms to train and accept net costs in doing so.

[38] For a comprehensive overview of the training literature, see Leuven (2005), and for its application to apprenticeship training, see Wolter & Ryan (2011).

Another source of a compressed wage structure is information asymmetries between firms about the ability of the worker (Acemoglu and Pischke; 1998; 1999a; 1999b). Firms which undertake training know about the true ability of their former apprentices and can therefore retain the best apprentices. As a consequence, the average ability of former apprentices in the external labor market is lower than the average ability of those who stay. As workers cannot signal to other employers their true ability, the incumbent employer can exert a monopsony power and set wages for former apprentices below their marginal product, leading to a compressed wage structure. Therefore, in a labor market with high firing costs, apprenticeship training serves also as a screening device.

Instead of a costly apprenticeship training program, probationary periods or temporary work contracts could be used to screen future workers more efficiently. Although the screening of future workers by probationary periods is not perfect – Ichino and Riphahn (2005) and Riphahn and Thalmaier (2001) show that there is a tendency for workers to have higher absenteeism once they have secured a permanent position after the probation has ended – the possibility to test candidates during probation or with a temporary work contract should help firms to detect at least the non-productive worker before having to offer them a permanent contract. Productive workers might pretend to be motivated, but it would be hard for non-productive workers to mimic good behavior and high productivity over a long period (temporary work contracts, in contrast to probation, can last from several months up to several years). To the extent that firms can use temporary work contracts to screen future workers, the screening benefit of an apprenticeship training program loses its relevance and therefore firms would be less willing to accept net costs of such a training program for the sole purpose of screening.

In summary, while labor market regulations allow firms to earn a rent on their training investments after the training period has ended in competitive labor markets training only takes place if firms can pay apprentices below their productivity during the training period. As a consequence, the greater the frictions in a labor market, the higher the share of firms that are willing to accept the net costs of training at the end of the training period (and vice versa). This allows us to formulate the hypothesis that in two countries with considerably different degrees of strictness in their labor market regulations, (*ceteris paribus*) firms will exhibit differences in the observed investments in training at the end of the training period. Furthermore, if labor market regulations are relaxed, then net investments in training (per apprentice) are either reduced, or if this is not possible (e.g., because of externally imposed training regulations), the training intensity in the economy would decrease.

4.3 One training system, different labor market regulations, different training strategies

4.3.1 Apprenticeship training

Apprenticeship training has a long tradition in both Germany and Switzerland. The two systems are highly comparable in terms of training regulations, requirements for entering an apprenticeship and the amount and type of skills acquired. Apprenticeship programs in both countries are labelled 'dual' because learning takes place at two different learning sites: the workplace and the vocational school. Firms and apprentices sign a binding training contract for a fixed duration and at a predetermined wage, which is a fraction of the wage of a skilled worker. With more than half of a cohort of young adults entering the dual apprenticeship system after compulsory schooling in Germany and two-thirds in Switzerland, it is also the single most important educational pathway at the upper secondary level.

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 wages for apprentices and for training personnel, as well as material and machinery used in the training process (gross costs of training). However, apprentices also perform tasks that would otherwise have to be performed by skilled or unskilled workers and therefore generate benefits for the training firm (productive contributions). In addition to 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 a considerable degree of freedom regarding the work allocated to apprentices.

4.3.2 Labor market regulation and training strategies

In contrast to the similarities in the apprenticeship systems, labor market regulations differ considerably between Germany and Switzerland. Overall labor market strictness, as measured by the Organization for Economic Co-operation and Development (OECD), was 2.3 (out of a potential maximum of 6) for Germany in the year 2000 and 1.1 for Switzerland (for a detailed description of this indicator, see Venn 2009). When ranking the 29 OECD countries in the year 2000 according to their labor market strictness from the least (USA) to the most regulated country (Turkey), Switzerland ranked 5th and Germany 21st.

In accordance with the hypothesis formulated in the previous section, an empirical analysis of the net costs of apprenticeship training (gross costs minus productive contributions) in Germany and Switzerland for the year 2000 (Dionisius et al., 2009) showed that, for an average 3-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 between comparable German and Swiss firms in 2000 amounted to €25,000. 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 greater benefits for the training firm because they spent more of their time in the production process, whereas their German counterparts spent more time on non-productive exercises.[39] Also in line with theoretical predictions, the majority of Swiss apprentices (two-thirds) left the training company within 1 year of qualification, whereas exactly the opposite could be observed in Germany (one-third left the training company within 1 year). The higher degree of employment protection resulting in 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 during the training period.

In another study, Mühlemann et al. (2010) analyzed 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 hypothesis formulated, non-training firms in Switzerland generally refrain from training because of the expected high net investment costs during the training period; whereas in Germany, non-training firms are generally those that, despite the tighter labor market regulations, do not expect substantial post-training benefits.

4.4 Changes to German labor market regulations and the expected consequences

In response to stagnating economic growth and high unemployment rates, the German government of Chancellor Schröder introduced a comprehensive economic reform, also known as *Agenda 2010*, in 2003. The reforms aimed to foster economic growth and increase employment by adopting three primary measures: reducing non-wage labor costs, increasing labor market flexibility and reforming the social welfare system. *Agenda 2010* consisted of various legislative changes, which successively came into force between 2003 and 2005; among them were also the four law packages Hartz 1 to 4 (*Gesetze zur Reform des Arbeitsmarktes* 1 to 4).[40] These changes affected a wide array of political and economic areas, such as the social welfare system, the health and pension insurance system, labor market regulation and family and education policy.

[39] There is of course a question of why German training firms did not attempt to obtain a 'double dividend', i.e. a net benefit at the end of the training period as well as a rent after the training has ended. Although there has not been any study on this particular topic, the high net costs during training are probably a consequence of a concession to the public opinion. A double dividend would have been seen as a sign that apprentices were exploited and used as a cheap substitute for unskilled workers (Wolter & Ryan, 2011), which then would have had potential negative effects on the supply of new (talented) apprentices.

[40] The legislative packages are also called Hartz 1 to 4 because they are based on the proposals of the Hartz-Kommission, published in 2002 as Moderne Dienstleistungen am Arbeitsmarkt.

In the present analysis, we concentrate on the components of the reform that targeted labor market flexibility, and only present changes that could be expected to have an effect on the companies' training decisions and behavior. To increase labor market flexibility, protection for regular employment and laws on temporary employment were changed. Two major changes affected regular employment. First, the threshold at which employment protection law applied was raised from 5 to 10 employees per firm; thus, firms with fewer than 10 employees were no longer constrained in their dismissal decisions. Second, since 2004, in selection for dismissal the employer has to take account of only four clearly defined criteria: tenure, age, maintenance obligations and severe disability. Before 2004, all different aspects of the employees' current situation could enter the selection criteria, which gave employees much more possibilities to contest dismissal; thus, the employer faced a higher degree of legal uncertainty in firing decisions.

In relation to temporary work contracts, the 2004 reform of the *Arbeitnehmerüberlassungsgesetz* (AÜG), a component of Hartz 1, eased constraints on 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 Institut für Arbeitsmarkt- und Berufsforschung (IAB) establishment panel show 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 (IAB, 2012). The proportion of all contracts that were temporary increased from 5 % in 2001 to 7 % in 2007 (Hohendanner, 2014).

The changes to the German employment protection system are also represented in the overall OECD employment protection index, which decreased from 2.3 in 2000 to 2.1 in 2007. In particular, the indicator for temporary employment showed a substantial decline of 0.7 units.[41] In contrast, Swiss labor market regulation did not change during this period, as demonstrated by the constant OECD indicators (Table 4.1).

TABLE 4.1: STRICTNESS OF EMPLOYMENT PROTECTION IN GERMANY AND SWITZERLAND

OECD index	Germany		Switzerland	
	2000	2007	2000	2007
Overall	2.3	2.1	1.1	1.1
Regular employment	2.7	3.0	1.2	1.2
Temporary employment	2	1.3	1.1	1.1

Source: OECD Employment and Labor Market Statistics

The German labor market reform, which limited the strictness of protections for temporary employment, alleviated the problem of evaluating the competence of new employees and

[41] Unfortunately, we have not been able to obtain from the Organization for Economic Co-operation and Development (OECD) an explanation why the reforms undertaken by the Schröder government are not reflected in the indicator for the strictness of regular employment.

thereby reduced the expected rents that firms can extract from apprentices after training. As a result, some firms could be expected to end apprenticeship training and those remaining active in training could be expected to change their training behavior in order to reduce the net costs of training.[42] As there is no evidence for a reduction in training activity, we expect firms to reduce their up-front investment in training in response to the reduced strictness in employment protection.

Theoretically, the net costs of training can be reduced in several ways. Firms could attempt to cut gross costs by employing fewer trainers or by reducing apprentices' pay. However, decreasing training hours would result in lower training quality, and even if the firm is unwilling to employ a former apprentice as a skilled employee, reputational considerations, and legal constraints limit the possibility of significantly reducing training quality. Apprentice wages, however, are determined collectively in Germany and are therefore not completely at the firm's discretion (see Ryan et al. (2013) on this issue, comparing the German situation with Switzerland and the United Kingdom). In consequence, both potential strategies to reduce the gross costs of training are rather limited in the German context.

Therefore, a more promising strategy for reducing net training costs is to increase the benefits. Because regulations concerning the work allocated to apprentices are less strict and it is unclear whether performing productive tasks reduces or even increases the quality of training, this strategy seems more likely.

4.5 Data

The concept for the cost–benefit surveys used in this study was developed by the 1974 report of the Sachverständigenkommission Kosten und Finanzierung der beruflichen Bildung (Expert Commission on Costs and Financing of Vocational Education and Training), also known as the Edding Commission. In our analysis, we use four cross sectional firm-level surveys, two conducted in each country at different points in time, which follow the same procedure. Two nearly identical surveys were conducted simultaneously for 2000 (Beicht et al. (2004) for Germany and Schweri et al. (2003) for Switzerland). The second pair of surveys was conducted for 2007 in Germany (Schönfeld et al., 2010) and 2009 in Switzerland (Strupler & Wolter, 2012). It is unfortunate that the second pair of surveys was not conducted in exactly the same year. However, we argue that this does not affect their comparability because we expect the Swiss results to have been very similar even if the data had been collected in 2007. The Swiss cost-benefit data were remarkably stable in varying

[42] If training becomes less profitable and firms cannot influence the net costs, then this would lead to a reduction in the commitment to training provision (see also Dustmann & Schönberg, 2012), as feared by Acemoglu & Pischke (1999b). If firms with higher net costs of training leave the training market, then the changes in the net costs over time would be the result not of individual changes in the net costs but of the composition of training firms. We cannot test this directly, as we do not have a sufficiently large panel of firms that participated in both cross-sectional surveys. However, the descriptive statistics available do not indicate that the changes are the results of firms with high net costs leaving the training market.

economic circumstances throughout the decade, as shown by comparing the 2009 data to an additional survey conducted in Switzerland in 2004 (see also Mühlemann et al., 2010). All three Swiss surveys (2000, 2004, and 2009) produced very stable results and showed no significant differences in costs and benefits of apprenticeship training.[43]

The data contain detailed information on the costs and benefits of apprenticeship training and firm characteristics for German and Swiss firms. In terms of methodology, the surveys are similar and comparable in nearly all respects. Nevertheless, there are some minor differences: one related to the questions eliciting the training hours. The questions were changed in the Swiss and the German questionnaires relative to the 2000 survey, but in different ways.[44] As a consequence of these changes, we will not be able to compare changes over time in the gross costs of training. However, as the major initial difference in the net costs of training between the two countries stems from differences in the benefits from training (Dionisius et al., 2009), this should not substantially affect our analyses. As in previous comparative studies, the analyses are restricted to 3-year apprenticeship programs, as longer programs are not fully comparable across the two countries, lasting 3.5 years in Germany and 4 years in Switzerland. The final sample consists of 1471 Swiss and 1738 German training firms in 2000, and 1842 Swiss and 2161 German training firms in 2009 and 2007, respectively.

4.6 Empirical strategy

To analyze the influence of the German labor market reforms on training behavior, we combine a difference-in-differences approach with a matching strategy, similar to Heckman et al. (1998) In contrast to a matching estimator which only compares the outcomes 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 show how the German labor market reforms affected training behavior. Therefore, we estimate an average treatment effect on the treated (ATT), where the treatment is the reform and the treated firms are German firms. The fundamental identification problem is that for a particular German firm and time, we never observe both potential outcomes, with and without the reform, simultaneously. German firms were all exposed to the reform, and therefore, the counterfactual outcome in the absence of the reform cannot be observed. Thus, we cannot directly observe the effect of the reform but instead estimate an ATT by applying a difference-in-differences matching strategy and therefore use Swiss firms as the (no reform) counterfactual.

[43] Although the second German survey was conducted before the outbreak of the financial crisis, the Swiss economic climate changed little between 2007 and 2009 (according to Eurostat, the gross domestic product (GDP) index (2000 = 100) was 115.0 in 2007 and 115.2 in 2009) and the supply of and demand for apprenticeship positions are comparable in both years.

[44] For a detailed description of the changes in the German questionnaire, see Schönfeld et al. (2010).

The crucial identifying restriction in difference-in-differences models is the common trend assumption, which means that in the absence of the treatment, treated and non-treated firms would have followed a parallel path in terms of their training behavior. 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 exhibited remarkably similar macroeconomic growth patterns over the last decade[45] 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 for Swiss exports), we argue that the assumption of similar trends over time in both countries is justified. Unfortunately, there are no data available on pre-treatment trends to support this assumption. Previous surveys in Germany and Switzerland on the costs and benefits of apprenticeship training are not comparable to the surveys in 2000, because their methodology differs strongly from the later studies. For example, the previous studies did not differentiate across occupations and only covered some industries in Germany (Beicht et al., 2004).

To ensure that similar firms are compared, we apply a matching strategy proposed by Abadie et al. (2004). In a first step, we match each Swiss firm in the 2009 sample to one firm in 2000 with the same characteristics (firm size, job categories, industry, and region). If more than one firm with exactly the same characteristics exists, the outcome is averaged over these firms. 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 can be calculated. In a second step, we estimate the difference of the within-country differences. To ensure a balanced comparison group, a matching strategy is again applied: we match each German firm in the post-treatment period with one (or more) similar Swiss firms (from the post-treatment period). This is equivalent to estimating an ATT.

To ensure that the matching estimator identifies and consistently estimates the treatment effect on the treated, two assumptions have to be satisfied: 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 simultaneously affect the outcomes and the residence choice of the firm (unconfoundedness). Although the 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 locations independent of factors influencing the benefits and costs of apprenticeship training. Therefore, the unconfoundedness 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 large numbers of firms with similar firm characteristics are available in both samples.

[45] For more information, see worldbank: http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?page=2, (retrieved at 19.5.2016).

4.7 Results

4.7.1 Apprentice benefits and benefit components

Our results indicate that the benefits apprentices generate for the firm during training increased substantially in Germany, whereas no significant change could be identified in Switzerland. Table 4.2 shows the average treatment effects on the treated and the difference-in-differences estimates for several dependent variables. The increase in benefits for an average training year was more than €2000 higher for the average German firm compared to a similar[46] Swiss firm. For the entire training period, this sums to over €6000 and represents an increase of nearly 25 %.[47]

The results of a more detailed analysis (also shown in Table 4.2) indicate that German firms increased the benefits of training by changing the tasks allocated to apprentices, whereas no substantial change in task allocation can be found for Switzerland. German firms increased the shares of and the days spent 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 direct value to the firm decreased by nearly 30 percentage points in the first year of training, whereas the shares of skilled and unskilled productive tasks each increased by approximately 15 percentage points. In terms of working days, these results represent increases in unskilled and skilled tasks of 26 and 25 days, respectively, with a corresponding reduction in the number of days of 'non-productive' practice. For the second and third years of training, the share of skilled tasks 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.

The extensive use of apprentices in non-productive instead of productive work has primarily been defended by those fearing that the use of apprentices as 'cheap labor' would contradict the purposes of training and the qualification goals of apprenticeship. 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.[48] Additional analyses show that the relative productivity, compared to

[46] The matching process has mostly been exact as for 99.75 % of all firms a member of the opposite treatment group with the exact equal values could be found (the percent of exact matches is 99.75).

[47] All prices were deflated to 2000 values, and the exchange rate in 2000 (CHF 1 = €0.64687) was used to convert Swiss Francs into Euros.

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

that of an average skilled worker – as reported by the companies – increased in Germany in all training years in absolute terms and also relative to Swiss firms. In 2007/2009, relative productivity in the average German and Swiss training firms reached comparable levels.[49] The evidence presented also suggests that learning and (skilled) work are joint products and not substitutes, and that the involvement of apprentices in the production process can have a positive effect on the competencies they acquire. The positive impact of increased work exposure on the productivity of German apprentices is also credible when considering that non-productive tasks were mostly substituted by work requiring skills and not by unskilled activities.

[49] Results are available from the authors upon request.

TABLE 4.2: AVERAGE TREATMENT EFFECTS ON THE TREATED AND DIFFERENCE-IN-DIFFERENCES ESTIMATES

	ATT (ΔY^0) Switzerland		ATT (ΔY^1) Germany		ATT (Δ^{DID}) Germany-Switzerland	
Dependent Variables	Coefficient	Std.-Error	Coefficient	Std.-Error	Coefficient	Std.-Error
Benefit per year per apprentice (in €)	-499.16	324.95	1,639.93	200.54***	2,137.20	275.17 ***
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***
Number of Observations 1st year	1,308		1,133		1,133	
Number of Observations 2nd year	1,257		1,326		1,326	
Number of Observations 3rd year	1,237		1,195		1,195	
Number of Observations total	1,842		2,161		2,161	

Note: Matching variables are establishment 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.

4.7.2 Robustness checks

The most crucial assumption for our analysis is the common trend assumption. Trends in the outcomes in Germany and Switzerland are assumed to be comparable. Unfortunately, no comparable data exist for the pre-treatment periods; therefore, pre-treatment trends cannot be analyzed. As a result, this chapter cannot entirely rule out that other differences than the changes in labor market regulation explain part of our results. However, we provide some additional empirical analyses to show how and to what extent other explanations affected apprenticeship training, and to strengthen our view that deregulating the labor market affected training behavior in Germany.

Germany and Switzerland both have a considerable degree of within-country heterogeneity in economic activity. While the primary divides in Germany are East–West and North–South, in Switzerland, the differences in economic activity are more pronounced between the linguistic regions (French-, Italian- and German-speaking regions). To determine whether the difference-in-differences estimates are affected by these divisions, we run all estimations comparing only the German-speaking regions of Switzerland with the two regions (Bayern and Baden-Württemberg) in Germany that border Switzerland. Not only are the cross-border economic activities in these regions very intense, but also company activities are heavily intertwined; hence, the two areas can almost be considered a single economic area. This implies that with the exception of labor market regulations and other laws, there would not be major differences for other factors such as the business cycle or technological progress. When conducting the analyses with the reduced sample, we obtain qualitatively identical results to those obtained for the full sample, which supports the interpretation that the differences in the developments in Germany relative to Switzerland cannot have been caused by unobserved economic differences.

Germany – unlike Switzerland, where unions have always played a minor role – faced a period of declining unionization (Fitzenberger et al., 2011), which could also have affected training behavior. Weaker union bargaining power could affect apprentices' wages, as earlier research has shown that unionized firms pay higher wages for unskilled workers (and therefore most likely also for apprentices) than non-unionized firms (Dustmann & Schönberg, 2009) Moreover, firms could use de-unionization to engage apprentices more in productive work. In unionized firms, unions are likely to resist the use of apprentices for productive work, for fear that skilled and unskilled workers might be substituted by apprentices. To analyze whether de-unionization drives our results, we made several empirical checks. Some evidence against the importance of the unionization argument is already given by our reduced sample taking into account only Bayern and Baden-Württemberg. The decline in union power was much more pronounced in East Germany than in the West (Fitzenberger et al., 2011). Therefore, if de-unionization would be the reason for the increased involvement of apprentices in the production process, the increase

of training benefits would have to be considerably lower for this subsample, but this is not the case.

In a next step, we estimate the full sample with controls for collective wage agreement. If de-unionization had been the driving force for the increased engagement of apprentices in productive work, then controlling for the unionized firms should change our results significantly. The results are, however, comparable to those in Table 4.2 without such controls. Furthermore, we repeated our estimations excluding all firms with a collective wage agreement from our analysis and obtained the same results. Finally, we also ran a difference-in-differences estimation only for German firms, comparing firms with a collective agreement with firms that had never been covered. The results show that training benefits did not increase significantly more in firms without collective agreements than in firms covered by those agreements. All results are available upon request.[50]

In summary, we do not see that the de-unionization could explain the changes in the benefits for apprenticeship training for German firms over time. However, deunionization could affect the net costs by lowering gross costs of training. For methodical reasons, not all components of the gross costs of training can be compared. Nevertheless, we conducted additional analyses and compared changes in the relative wages of apprentices and skilled workers. Our results[51] show that while wages of skilled workers in the trained occupation did not change significantly in Germany relative to Switzerland, real wage costs of apprentices in Germany decreased significantly in absolute terms and relative to Switzerland. In line with the analyses of Dustmann and Schönberg (2009) it is likely that the decline in union power reduced apprentice pay and thereby contributed to a further reduction of the net costs of apprenticeship training in Germany.

4.8 Conclusion

Labor markets that have frictions rather than being competitive have played a prominent role in explaining why firms in some countries are willing to finance large up-front investments in general skills, while firms in other countries do not support such schemes. In this training literature, Germany has served as an exemplary case, demonstrating why labor market regulations (as an important source of labor market frictions) were a prerequisite for a functional large-scale apprenticeship training system. Although the case of Switzerland, where labor market regulations were considerably less strict than in Germany, indicated that it should also be possible to have an apprenticeship training system in a deregulated labor market, this did not prove that the German apprenticeship training system would not be

[50] Kriechel et al. (2014) show that, firms with work councils have higher net investments in apprenticeship training than firms without work councils have. Unfortunately, our data do not allow us to analyze the changes over time, comparing firms with and without work councils. However, the share of firms with work councils and the reduction of firms with work councils over time (from 12% in 2000 to 10% in 2007) would not be sufficiently large to explain the widespread changes in net costs in German training firms.

[51] Results are available from the authors upon request.

damaged by the deregulation of the German labor market planned and implemented by the government from 2003.

Our empirical analysis shows that German firms, realizing that post-training benefits decrease in a more flexible labor market, managed successfully to reduce their up-front investments in general skills, instead of leaving the apprenticeship training system as anticipated by the modern training literature. Firms increased the benefits of the apprenticeship training during the training period as a result of a change in the allocation of productive tasks to apprentices. The lack of experimental data and the complexity of firm's training behavior do not allow us to draw strictly causal conclusions from our difference-in-differences analysis. However, the results demonstrate that in contrast to the predictions in the literature, training participation remained high in Germany after the labor market reform.

In conclusion, this chapter 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 functional apprenticeship training system.

5. The effect of choice options in training curricula on the supply of and demand for apprenticeships*

5.1 Introduction

The dual apprenticeship system in Germany plays an important role in integrating young people into the labor market and in safeguarding a skilled workforce. More than 50% of each cohort starts an apprenticeship program each year (Uhly, 2015). As firms can freely decide whether they provide training places or not, it is important to understand the incentives and conditions under which firms are willing to supply training places. The analysis of the supply of apprenticeship places has so far focused on demographic developments, the business cycle, and alternative recruitment possibilities on the external labor market (Dietrich & Gerner, 2007; Mühlemann et al., 2009; Troltsch & Walden, 2010; Maier & Walden, 2014). However, none of these studies has related firms' supply of training places to the content of the training curriculum.

According to the German Vocational Training Act,[52] training firms have to impart a pre-determined set of skills defined in a standardized curriculum when providing training places in a recognized occupation of the dual system. While some occupations allow for specialization opportunities in their training curriculum, apprenticeship training courses for other occupations are designed as "mono-occupations", in which every firm has to teach exactly the same skills. However, due to technological and organizational developments, training curricula are sometimes modernized.[53] A modernization of the training curriculum for a particular occupation often does not only change the content of the curriculum but also changes the number of choice options training firms have. Since the 1990s, for example, a tendency towards more heterogeneity in the training curricula could be seen (Demgenski & Icks, 2003; Bretschneider & Schwarz, 2011). In this chapter, we use these exogenous changes

* *The chapter is based on the paper „The effect of choice options in training curricula on the supply of and demand for apprenticeships" by Anika Jansen, Andries de Grip, and Ben Kriechel (IZA Discussion Paper No. 9697 and ROA Research Memorandum 2016/3).*

[52] See §4(2) of German Vocational Training Act

[53] The initiative for curricula modernizations usually starts from professional associations, the central employer organization, unions, or the Federal Institute for Vocational Education and Training. The respective ministry publishes the new training curricula in the Federal Law Gazette. The Federal Institute for Vocational Education and Training provides support for firms by means of publications and counselling. For more information about the development and process of training regulations see Bundesinstitut für Berufsbildung (2014b).

in the regulatory framework of apprenticeship training to assess the impact of having choice options on firms' supply of apprenticeship places as well as on youngsters' willingness to enroll in certain occupations within the dual apprenticeship system. Observing a longer time horizon one might argue that the contents of the training curricula respond to the firms' production processes and are therefore rather endogenous in the long term. However, modernizations of training curricula involve quite an administrative effort and corresponding costs. Therefore, modernizations do not immediately respond to changes in the production process. As various stakeholders are involved in the process, the exact year a new curriculum is implemented can be seen as relatively random. Therefore, we argue that in the short run, observing a time period of about ten years, the modernizations can be considered as an exogenous shock, which decreases the gap between required and imparted skills from one training year to the other substantially.[54] A more tailor-made training content enables firms to train their apprentices in a way which is more closely aligned to what the firm really needs. This will render the apprentice more productive both during the training period and after completion of training, whereas training which is closer to the production process of the firm is less complicated to organize, something which could reduce training costs. Moreover, a more specialized curriculum increases the market power of the training firm because apprentices who have completed training can only apply their skills in fewer outside firms. As a result, firms are able to pay lower wages upon the retention of the apprentices, something which increases their incentives to provide apprenticeship places.

From the firms' perspective, the positive aspects of having more choice options seem to be undisputed. The results of a firm survey conducted on behalf of the former German Federal Ministry of Economics and Labor in 2005 (Ramboll Management, 2005) indicate that different aspects of the training curricula, such as content and structure, play a crucial role in a firm's decision on whether or not to offer apprenticeship places. Indeed, 53% of all non-training firms state that allowing for more freedom in the training organization would ease the initiation of training (Schönfeld et al., 2010).[55] Demgenski & Icks (2003) also argue that too restrictive training curricula can be a severe obstacle to providing training. They show that 54% of former training firms see the lack of specialization opportunities as a huge impediment to continue to provide apprenticeship training. Having choice options in the curriculum is therefore likely to increase firms' commitment to apprenticeship training.

Apprentices, on the other hand, do not necessarily have the same interests as the firms that offer apprenticeships. More specialized training means that apprentices who have completed training have worse chances of finding a job in other firms because their skills then only match the skill demands of fewer other firms. If apprentices are not sure whether they will be retained upon completion of training, a too specialized curriculum may not be attractive for them. However, a more specialized training can also make the apprentice more productive in the training firm as the imparted skills correspond more closely to the firms'

[54] Moreover, by including year dummies and occupation-specific time trends, we can rule out a substantial amount of potential endogeneity.

[55] This question was only asked to firms that currently do not offer training places.

skill needs in the production process. If the higher productivity is to some extent reflected in a higher wage, the introduction of more choice options for firms could also increase the attractiveness of training from the apprentice's point of view.

In this chapter, we explain the development of the supply[56] of and demand for apprenticeship places after a change in the number of choice options in the course of a modernization. Assuming that training costs do not increase, the number of firms providing apprenticeship training will increase in line with increasing post-training benefits.

Using data on the supply of and demand for apprenticeship places in Germany for 265 occupations over 11 years, we analyze the effect of curricula modernizations on training supply and demand empirically. The information about the modernization of the training curriculum is obtained by comparing the training curricula before and after modernizations. In total, 85 modernizations were analyzed. Our empirical analyses show that both supply of and demand for apprenticeships are positively affected by the introduction of more choice options in the training curriculum. This shows that leaving sufficient freedom in the training regulation improves the attractiveness of the dual system for firms as well as for apprentices.

Our study contributes to the human capital literature on training by analyzing the effect of curriculum heterogeneity on the supply of and demand for apprenticeship places. The heterogeneity of training curricula might be an important aspect of the firms' willingness to train. This issue is highly relevant for designing (new) training regulations, within existing apprenticeship systems as well as for countries that aim to introduce elements of an apprenticeship system. Taking this knowledge into account can ensure the attractiveness of the apprenticeship system both from the firms' and the students' points of view. The insights provided in this chapter can also be transferred to other centrally regulated or certified training courses.

The chapter is structured as follows. In the next section, we discuss the relevant literature that provides the theoretical background to our empirical analysis. Section 5.3 presents the hypotheses on the effect of modernizations on the supply of training places and elaborates on the relation to the demand for training places. Section 5.4 discusses the data and explains how the degree of choice options of the curricula is determined. Section 5.5 presents the empirical strategy to test the derived hypotheses and section 5.6 presents the results. Section 5.7 concludes.

[56] According to the wording of the corresponding data set, the terms "supply" and "demand" here refer to apprenticeship places and not to the supply of and demand for labor.

5.2 Literature

While some firms train because they want to make use of the productive contributions of the apprentices, other firms decide to offer training places mainly because they want to retain the apprentices as skilled workers after the training period (Merrilees, 1983). In the former case, firms actually do not bear any training costs as the productive contributions already compensate for the training expenses. In the latter case, firms regard the training costs as an investment, which they can recoup upon the retention of the apprentices. As rational firms only decide to train when expected benefits exceed expected costs, firms need to be able to pay a wage below skilled workers' productivity in order to recoup their training costs. However, paying a wage below workers' productivity is only possible when the firm has a certain market power over its employee. Becker (1962) showed that firms have no incentives to pay for training in general human capital. If firms pay a wage below a worker's productivity after the training, the employee would leave the training firm and find a firm that offers a wage equal to his or her productivity. Firm-specific human capital, in contrast, can only be utilized in the training firm. Therefore, firms are only willing to invest in firm-specific human capital. Acemoglu & Pischke (1999b; 1999a), however, expand Becker's theory by arguing that in non-competitive labor markets under the existence of wage compression, firms are also willing to pay for general human capital. Dionisius et al. (2009) showed that Germany is such a case, where the compressed wage structure leads to substantial post-training benefits, and in the same way to a willingness to incur training costs. As most occupations are associated with net training costs (see Schönfeld et al. 2010), one can expect post training benefits for most occupations.[57]

Stevens (1994) identifies a third group of skills, which she terms as transferable skills. Although these skills can be deployed in more firms, and are thus, technically seen, general skills, the wage does not have to equal the productivity of the person who has completed training because of the low degree of competition for these skills. Occupation-specific skills are a clear example of such transferable skills. Occupation-specific human capital denotes a set of skills that are merely useful within one occupation. Wolter & Ryan (2011) explain that these occupation-specific skills create monopsony power for the training firm as they limit the number of potential outside firms where trained workers could employ their skills.[58] As a result, workers' productivity related to these occupational skills is not fully reflected in their wages. Also Bhaskar et al. (2002) argue that when employers have some market power, they may have an incentive to pay for general human capital as the skilled worker wage will be lower than their marginal product. The more market power a firm has, i.e. the fewer firms where skilled employees could move to, the more likely firms are, *ceteris paribus*, to invest in training. Smits (2007) shows that, firms would only prefer to convey occupation- or industry-specific skills if the training was not regulated otherwise. Even if workers paid for

[57] Schönfeld et al. (2010) analyzed the training costs from the 50 most important occupations.
[58] Also other sources of monopsony power can exist such as a low regional density of firms.

general skills, firms have no interest in providing workers with general training because the returns to industry-specific skills decrease with the share of general human capital.

Lazear (2009) argues that skills can be *de facto* firm specific, even if they are technically general, when the combinations of these general skills are specific to firms. He terms this concept the "skill weights approach" as each general skill has different weights in different firms. One essential outcome of the skill weights approach (SWA) is that firms that use more idiosyncratic skill weights, i.e. a combination of skills that is very different to the average combination of skills in other firms, are more willing to bear training costs as they can pay relatively lower wages after the training period. Lazear notes that the specificity of the skill combination does not necessarily mean that it is specific to one firm. It can also be related to industries, occupations, or specific jobs. Translated into occupation specific skills, this would imply that firms training in occupations in which the required skills are very idiosyncratic are more likely to bear training costs. Geel et al. (2011) test this hypothesis and indeed find that more idiosyncratic skill weights in an occupation imply higher training investments on the part of the firms. This mechanism is supported by the finding of Hofmann et al. (2011), who analyze the effect of specificity of occupations on the probability that workers change their occupation. In accordance with the concept of the skill weights approach, they find that the more specific an occupation is, the less likely it is that employees change their occupation. Analyzing the skill bundles of 80 Swiss VET occupations, also Eggenberger et al. (2015) find that workers trained in very specific occupations are less likely to change their occupation. Further, in case workers change to occupations with very different skill bundles, their wage loss is higher than if they change to rather similar occupations. Moreover, Rinawi et al. (2014) find that, after a layoff, individuals with more occupation-specific skill bundles remain unemployed for a longer time period and are less likely to find a job in a different occupation.

While these analyses focus on the mobility between different occupations, mobility within occupations to other firms is also a great threat for the training firm. The German labor market is very occupation specific and one can safely assume that, unless an unexpected change occurs, apprentices plan to stay in their occupation upon completion of training. Hall (2015) finds that in the first year after completion of training fewer than 4 % of all apprentices switch to an occupation that is not related at all to the occupation in which they have been trained. 24 % switch towards a related occupation, whereas 72 % of all apprentices stay in the occupation they have learned. For comparison, data from the BIBB Cost-Benefit Survey show that 56 % of all apprentices do not leave the training firm within the first year upon completion of training.[59] Thus, mobility of persons successfully completing training to other firms within an occupation is also of high importance. However, also within an occupation, there could be quite some variation in the production process.[60]

[59] Own calculation on the data.
[60] Even though the variation within an occupation might be lower than the variation between occupations.

Firms may have apprenticeship places for the same occupation but have different specializations. An occupation could, for example, need two main skills, but not all firms in this occupation might need these two skills to the same degree. Thus, firms training apprentices in the same occupation could also differ with respect to the weights they give to certain skills. Accordingly, Lazear's SWA can also be applied to the distribution of skill weights within an occupation. If firms could choose the training content freely, they would only train those skills that are relevant for their own production process. However, in the institutional setting of the German apprenticeship system, strict training curricula dictate the skills the firms have to provide during training.

Therefore, Lazear's skill weights approach does not fully match the settings of the German apprenticeship system. The skills, which are the main choice variables in Lazear's model, cannot be freely chosen in the case of apprenticeship training. However, in the last years, modernizations in training curricula have often given more freedom to training firms by including more choice and specialization options in the curricula, which allow the firms to train their apprentices in a way which is more closely related to their production process. In terms of the SWA, this means that firms can choose their skills more in line with what they would do if they could freely maximize their surplus. Creating more choice options in apprenticeship training also means that persons successfully completing training can apply their skills in fewer outside companies, which gives training firms more market power. This implies that firms can retain a higher share of the workers' productivity by paying lower wages, which leads to an increase in the expected long-term benefits of training for the firms. Assuming that training costs do not increase, the introduction of choice options in the training curriculum will therefore lead to more apprenticeship places.

5.3 Theory and hypothesis

In this section, we will outline the expected effect of a modernization on the supply of apprenticeship places in this occupation and briefly elaborate on the relation between modernizations and students' demand for apprenticeships.

A modernization of an occupation means that the content of its training curriculum is changed. In this case, the old training curriculum is replaced by a new one. A modernization is commenced when any of the relevant stakeholders request an adjustment of the training content to technological developments. Usually, the duration of such a procedure lasts about a year (Bundesinstitut für Berufsbildung, 2014). In most modernizations, the structure, i.e. the amount of choice options in the curricula, is also adjusted to the needs of the training firms (Table 5.1 provides an overview of the frequency of the different types of curriculum modernizations).

5.3.1 Supply of apprenticeship places

In our analyses, we will differentiate between the effect of a modernization as such, in the sense of an adjustment of the training content, and the effect of a change in the number of choice options training firms have. Firstly, we outline the hypothesis on changes of the content of the curricula irrespective of the degree of differentiation. Secondly, we discuss the effect of a change in the number of choice options. We argue that a more specific training curriculum will increase the productivity of the graduates and enable the firm to pay the skilled workers a relatively low wage after the apprenticeship.

5.3.1.1 Effect of changing the content of training curricula

A modernization of the content of the curriculum always implies an adaptation of the training curricula to technological developments. Therefore, modernizations align more closely the skills learned in the training with the skills demanded in the occupation and thus make apprenticeship training more effective. As a result, workers who successfully complete modernized apprenticeship training will *ceteris paribus* be more productive. If workers and employers equally share the returns on this additional productivity, firms have more incentives to train and workers are more likely to opt for a modernized occupation. As long as the wage increases less than graduate's productivity,[61] the return for the training firms increases. This will induce them to offer more training places. This leads to the following hypothesis:

H1: *A modernization of the training curriculum leads to a higher supply of apprenticeship places in this occupation.*

5.3.1.2 Effect of more and less heterogeneity within the curricula

Apart from the adaptation to technological development, a modernization is often associated with a change in the number of choice options in the curriculum. More choice options would then lead to more heterogeneity, while fewer choice options lead to less heterogeneity in the curriculum. The effect of heterogeneity on firms' post-training benefits can work via two mechanisms. Firstly, the degree of heterogeneity has a positive effect on the productivity of apprentices who have successfully completed training. Secondly, the

[61] For now, it can be assumed that the rent the firm retains is a constant share of a worker's productivity. Acemoglu & Pischke (1999a) also argue that for higher training incentives it is not necessary that the share of a worker's productivity that the firm retains increases. Even if the firm retains a constant share of the worker's productivity as a rent, post-training benefits are higher for more productive workers as the "firm obtains a share of this larger pie" (p.121). Later, we will relax this assumption in the way that the share of the wage in relation to the productivity decreases. Then, the effect on firm-sponsored training will be even stronger.

degree of heterogeneity has a positive effect on the firms' market power. Both mechanisms will be outlined below.

1.) Effect via the productivity of apprentices successfully completing training

In order to explain the effect of heterogeneity on the productivity of apprentices who have successfully completed training, we employ elements of the argumentation in Lazear's skill weights approach. Similarly to Lazear's skill weight model, we assume that (1) a firm i in a given occupation produces with the skills A and B, and (2) that firms employing workers with this occupation need different combinations of these two skills. The weight for skill A in firm i is denoted with λ_i, which ranges from 0 to 1. λ_i is a random variable with the density function $f(\lambda_i)$.[62] The worker's production function in firm i depends on the worker's skills A and B, and is as follows[63]:

$$Y_i = (\mathrm{A} \cdot \lambda_i)^{(1/2)} + [\mathrm{B} \cdot (1 - \lambda_i)]^{1/2} \tag{5.1}$$

Moreover, each firm has a maximum total training time for an apprentice, which has to be split between the two skills A and B. Assume that α represents the time allocation between skills A and B and lies between 0 and 1. Then, the time available for learning skill A is equal to α and the time available for skill B is equal to $1 - \alpha$. Plugging in α for A and $(1 - \alpha)$ for B , the production function could be solely written as a function of the allocation of training time to the two skills:

$$Y_i = (\alpha \cdot \lambda_i)^{(1/2)} + [(1 - \alpha) \cdot (1 - \lambda_i)]^{1/2} \tag{5.2}$$

The production function with the exponent of one half is designed in such a way that the worker is most productive if the training time for skill A (α) equals the firm's skill requirement for skill A λ_i. The higher the difference between α and λ_i, the lower the worker's productivity in firm i will be. If firms could freely maximize their surplus, they would choose α equal to λ_i.[64]

However, in contrast to Lazear's model, in German apprenticeship training time allocation α between the skills A and B is externally determined by the training curricula. As firms' training decisions depend on the expected productivity of the trained workers, this setting implies that firms' training decisions depends on the α set in the curriculum. The lower the difference between α and λ_i, the more likely it is that the firm will invest in training. As this is true for any individual firm, the supply of training places in a given occupation rise in line with lower aggregated differences between the skill requirement and the skills prescribed in the training curricula $\int_i^N \alpha - \lambda_i$, where N is the total number of firms.

[62] In the extreme case, a firm produces either with skill A (λ_i = 1) or skill B (λ_i = 0).

[63] We deviate from Lazear's production function in order to model the decreasing marginal utility of one skill.

[64] The exact specification of the formula is not pivotal for the subsequent argumentation. It should only illustrate that firms prefer a training curriculum that matches their production process.

In a mono-occupation, α is the same for all firms. If there are choice options in the training curriculum firms can choose between several α, i.e. specialization opportunities. To predict the effect of a change in the heterogeneity of the training curriculum, one needs to know in which case total productivity is highest. This depends on the amount and type of the choice options α and on the distribution of the production processes of the firms employing trained persons in the occupation: λ_i. Creating more heterogeneity in the curriculum will have a positive effect on aggregated productivity if firms' production processes are characterized by a strong specialization of skills. However, less heterogeneity could also have a positive effect on aggregated productivity, if all firms training for the same occupation have a very homogenous production process. In such a case, specialization would be counterproductive. A modernization which implies a change in the degree of heterogeneity of the curriculum usually occurs because relevant stakeholders have requested this change. One main characteristic of the German apprenticeship system is the "consensus principle" which means that all relevant stakeholders involved in the apprenticeship system have to agree to a new training curriculum (Bundesinstitut für Berufsbildung, 2014). Thus, we might expect that, when the number of choice options is changed, $\int_i^N \alpha - \lambda_i$ is smaller after a modernization than before the modernization. Under this assumption, *any* change in the degree of heterogeneity would lead to an increase in training places.

2.) Effect via firms' market power

A change in the choice options in the training curriculum has additional effects on firms' post-training benefits via a change in their market power in the labor market for skilled workers. A more specific training curriculum creates monopsony power because it reduces the outside options of trained workers in the labor market as graduates can apply their skills in fewer outside firms. A significant share of firms employing skilled workers in the same occupation will prefer to hire a skilled worker with the reversed skill combination. Outside employers can observe the chosen specialization either on the apprenticeship leaving certificate, the work certificate, or the school certificate. Therefore, apprentices are more likely to stay in the training firm if they have been trained according to a more heterogeneous curriculum. This in turn increases firms' chances to recoup training investments incurred.

Moreover, firms are able to pay a lower wage relative to skilled workers' productivity. Assuming that - in line with Lazear's argumentation - the graduate's wage within the training firm is determined by a Nash bargaining process, the wage lies exactly between the graduate's productivity and his or her expected outside option. As the expected value of the outside options decreases in line with more heterogeneity in the curricula, the training firm

is able to pay a lower wage.[65] This increases the potential return obtained from offering training, which will lead to an increase in training places.

Both because of the higher productivity of trained workers in the training firm *and* the stronger bargaining power of the firm, more possibilities to specialize in the training curriculum will lead to higher returns for the firm after the training period. Therefore, we derive the following hypothesis.

H2: *More heterogeneity in the training curriculum increases the supply of apprenticeship places in this occupation.*

With regard to the effect of less heterogeneity, we outlined two opposing effects. On the one hand, assuming that a change in the number of choice options leads to a better fit between acquired and demanded skills, less heterogeneity increases workers' productivity in the training firm.[66] This would for example be the case if firms preferred to convey all skills to an equal degree and not to specialize in one skill. On the other hand, less heterogeneity will also decrease the bargaining power of the firm, something which leads to higher wages for trained workers. Accordingly, the general positive effect on the supply of a change in the degree of choice options would (partially) be compensated by higher wages and quit rates. It is not straightforward to see which of these two mechanisms has a stronger effect in practice. Therefore, no clear hypothesis on the effect of less heterogeneity can be derived.

5.3.2 Demand for apprenticeship places

Equivalent to hypothesis 1, a modernization irrespective of the number of choice options is expected to have a positive effect on students' demand for apprenticeship places as trained apprentices will become more productive when the curriculum becomes more up to date. If the training fits better to the production process of the firm, apprentices will be more productive after completion of training, something which could increase skilled workers' wages in the firm providing training. This higher wage would make apprenticeship training in recently modernized occupations more attractive. Thus, we can derive the following hypothesis.

H3: *A modernization of the training curriculum leads to a higher demand for apprenticeship places in this occupation.*

[65] Therefore, an alternative way to test the derived hypothesis would be to calculate the wage change when apprentices who were trained in modernized occupations change their employers (see for example Fitzenberger et al., 2015; Göggel & Zwick, 2012). However, we do not have information on the wages on the level of apprenticeship occupations for the respective time span.

[66] This rests on the assumption that a change in the degree of choice options always leads to a better match between the training curriculum and a firm's needs.

A modernization which leads to more heterogeneity in the curriculum might have two opposing effects on students' demand for training places. On the one hand, more heterogeneity will lead to a better fit between the production process and the training content which will make trained workers more productive and will therefore increase their wage in the training firm. On the other hand, apprenticeship graduates will then also become more specialized and more dependent on the training firm. This would *ceteris paribus* reduce their outside options and the wage they can earn in another firm.[67] In case of a layoff, the apprentice would be more likely to suffer a wage loss. Therefore, more heterogeneity in the curriculum will reduce the graduates' bargaining power and their wage in the training firm. This makes an apprenticeship in occupations with a more heterogeneous curriculum less attractive. The effect of more heterogeneity in the training curricula on the demand for apprenticeship places could therefore go in different directions, and we cannot derive a clear hypothesis. Nonetheless, even though theoretically the effect of heterogeneity in the training curricula on the demand for apprenticeship is not clear, we will assess this relationship empirically.

With respect to the effect of a modernization leading to less heterogeneity on students' demand for apprenticeship places, both mechanisms could work in the same direction. If the lower number of choice options leads on average to a better fit between acquired and demanded skills, less heterogeneity will increase workers' productivity in the training firm. Moreover, less heterogeneity in the curriculum will improve graduates' bargaining power as they will then have more outside options. Therefore, we derive the following hypothesis.

H4: *Less heterogeneity in the training curriculum increases the demand for apprenticeship places in this occupation.*

5.4 Data

5.4.1 Supply of and demand for apprenticeship places

The data used for this analysis is based on the survey of New Training Contracts with the effective date of 30th of Sept of each training year.[68] It includes information about the number of new training contracts and the supply of and demand for training contracts. The new training contracts are collected by the Bundesinstitut für Berufsbildung (BIBB) from the responsible chambers, which have information on all new training contracts in their

[67] In this way, more heterogeneity would lead to a lower outflow of trained graduates to other firms. Unfortunately, there is no data on the outflow of apprentices successfully completing training to other firms at the occupational level.

[68] For information about the survey see: http://www.bibb.de/dokumente/pdf/naa309_BIBB-Erhebung_Zusammenfassung_201103.pdf

associated occupations. The supply of training contracts is calculated by adding the new training contracts of each year to the number of unfilled training places the firms report to the German Federal Employment Agency.[69] The demand for apprenticeship places is obtained by adding the new training contracts to the number of applicants who could not get an apprenticeship place and did not have any other alternative.[70] Thus, our database is a full census of the complete supply of and demand for apprenticeship places in Germany.[71] Information about the supply of and demand for training contracts at the occupational level has been available since 2004.

The data set comprises information on the supply of and the demand for all 330 occupations that were recognized[72] in 2014.[73] We had to gather information on the development of all occupations in order to construct a dataset with comparable occupations over time.[74] When an occupation had a different name in the past or results from a merge of different occupations, it is linked to its predecessor(s).[75] In the event that the occupation has had several predecessors, we use the sum of the supply (or demand) of training places of those predecessors and match this sum to the new occupation.[76]

We exclude very small occupations when the occupation ever comprised less than twelve apprentices in any of the years between 2004 and 2014. Moreover, we excluded eight occupations, which could not be compared over time due to a complex restructuring in the course of a modernization.[77] In this way, we obtain a panel data set of 265 different occupations over eleven years. 244 occupations existed during the whole time period from 2004 to 2014; 21 occupations were introduced at a later stage and therefore existed only during part of this period.

[69] As firms have to report each training contract to the responsible chamber, the latter are informed on all new training contracts. In principle, however, the Federal Employment Agency might not be informed by all training vacancies or searches. However, as long the share of not reported training vacancies or searches remains constant a deviation should not bias the results.

[70] The old definition of demand is used, to be able to compare the data over a longer time horizon.

[71] The data does not include the number of firms that offer apprenticeships and the number of offered apprenticeships per firm. Thus, we cannot say whether the results are a consequence of extensive or intensive changes in the apprenticeship supply. The same holds for the demand for apprenticeships.

[72] All training regulations are published under the Federal Law Gazette (Ger.: "Bundesgesetzblatt").

[73] This also excludes the possibility that occupations that were abandoned are still in the dataset.

[74] Occupations have to be comparable before and after the modernization. Occupations that were split and merged at the same time cannot be compared over time and are excluded from the analysis.

[75] In our analyses, we control for possible effects of a name change or mergers by including a name dummy as well as a dummy for mergers.

[76] As the data of the new training contracts are gathered by the chambers of industry and commerce and the chambers of craft, which sometimes incorrectly report the old name of the occupation, occupations that were not modernized in our research period also had to be matched to their predecessors.

[77] This is the case when occupations were split and the split parts were at the same time merged with other occupations.

5.4.2 Curriculum heterogeneity

5.4.2.1 Structure of the curricula

We base the categorization of the degree of heterogeneity in the curricula on the structure of the training, which is defined for each occupation in the training regulation (see (Bundesinstitut für Berufsbildung, 2014). *Mono-occupations*[78] are occupations without any specialization. Thus, the training content is identical for all firms training the same occupation. On the other hand, there are also occupations whose curricula allow for internal differentiation. Then firms can choose between training courses with special training content for different fields of activity. For example, in some occupations firms have to choose different *fields of application*. Even though the concrete competencies that have to be taught are the same, they can be imparted in different fields. In other occupations, firms can choose *priority topics*, which take company characteristics into consideration and account for not more than 6 months out of the entire training period.[79] Even more differentiation is possible in occupations with different *disciplines*. A discipline is a specialization that has to be taken in the third training year and is also tested in the final exam in contrast to the priority topics. The highest degree of differentiation within an occupation is obtained by the use of *elective qualification units*. Usually several out of many possible units have to be chosen, which leads to a high number of different possible combinations within one occupation. In these occupations, firms have most possibilities to adapt the training content to their specific skill requirements. However, *elective qualification units* vary in the time they constitute of the total training time. In some occupations, they only account for half a training year, while in other occupations they account for a full training year. Bretschneider & Schwarz (2011) provide a graphical overview of the different structures of training curricula (see Figure A5.1).

We ranked the five different training structures according to their degree of differentiation. Doing so, we take into account the number of specializations and the time these specializations take in relation to the total training time. The structure with elective qualification units, for example, allows for the highest number of possible combinations as firms can choose several out of many possible qualification units (see Figure A5.1 in the appendix). In contrast, a structure including different disciplines means that firms can choose one discipline out of usually three or four disciplines. Therefore, the disciplines are mostly ranked lower than the qualification units. However, *th*e internal differentiation is not only determined by the *number* of specializations but also by the importance these specializations have in relation to the total training content. For example, when a firm can choose between 100 specializations, but these specializations are only supposed to last for

[78] In the following, we use the terminology that is also employed in the English version of the official BIBB leaflet about training regulation (Bundesinstitut für Berufsbildung, 2014).
[79] The entire training period can last between 2 and 3 ½ years.

one week, they are likely to be not very relevant for the skill acquisition of the apprentice. Therefore, we also take into account the time these specializations take in relation to the total training time. As a result, when the elective qualification units account only for a relatively short time period (e.g., only half a year), they are ranked lower than the disciplines. According to the number and relevance of choice options, we yield the following ranking on the degree of heterogeneity for the different curricula structures from less to more heterogeneous: mono-occupations, fields of application, priority topics, elective qualification units (half a year) disciplines, and elective qualification units (full year).

5.4.2.2 Defining the change in heterogeneity

The amount of choice options, i.e. degree of heterogeneity, can only be changed in the course of a modernization. The operationalization of a modernization is straightforward as the result of a modernization is always the replacement of an old training curriculum by a new one. We allocated all modernizations into three groups: (1) modernizations creating less choice options in the curriculum, (2) modernizations that do not affect the choice options and (3) modernizations that allow for more curriculum heterogeneity.

In principle, changes in the degree of differentiation within an occupation can occur in four ways. Firstly, a curriculum could be given a different structure. For example, a change from, e.g., a mono-occupation to an occupation with disciplines is defined as a change towards more heterogeneity.[80] Secondly, the amount of possible specialization options can change within a given structure of the curriculum (e.g., a firm can choose between two instead of three possible disciplines). Thirdly, the time spent on existing specializations in the curriculum can change (elective qualification units should last one year instead of only half a year). Fourthly, when several occupations are merged into one occupation, the modernization is coded as less heterogeneity.[81] Table A5.1 and Table A5.2 in the appendix show the respective training structures before and after the modernizations in the time period analyzed differentiated for modernizations leading to less (Table A5.1) and more (Table A5.2) heterogeneity.

Table 5.1 provides an overview of how those modernizations in the different years are coded. In the period from the years 2005 to 2014, 103 modernizations were implemented, whereas six occupations were modernized twice (among those were five evaluable occupations).[82] Thus, in these years 97 occupations were modernized. For our analysis, we can make use of 85 different modernizations. Seven modernizations had to be excluded because they led to a split and a merge of several occupations at the same time, something

[80] We assume that potential additional options are also used by firms as the modernizations are initiated by the firms themselves due to changing skill requirements.

[81] We also included a separate dummy on mergers to test for potential separate effect of merged occupations. Splits of occupations are not part of our database.

[82] For occupations that were modernized in 2004, we cannot compare a pre- and post-modernization period.

which impedes a comparison between the pre- and post-treatment period.[83] One occupation was merged twice in the observed time period. In order to compare this occupation over the different years, only the second modernization was analyzed.[84] Ten modernizations were excluded because they affected very small occupations with fewer than twelve apprentices.[85] From the 85 modernized occupations, 21 became more homogenous, 26 became more heterogeneous, and 38 did not change their structure at all. As can be seen in Table 5.1, in each year at least two modernizations occurred, with peaks in the years 2005, 2006 and 2013.

The information about the modernizations is obtained from the BIBB database on occupations and their modernizations, which is available online.[86] New training regulations always come into force in the month of August in the respective year. As the new training year always starts in September, all new training contracts concluded and reported within this year have to abide by the valid curricula of the respective year. For example, when the occupation "plant mechanic" is modernized in 2004, all firms concluding and reporting a new training contract for training the "plant mechanic" in 2004 have to train according to the new regulation.

TABLE 5.1: LIST OF CURRICULUM MODERNIZATIONS BETWEEN 2005 AND 2014

Year	Modernizations	Less heterogeneity	No change in heterogeneity	More heterogeneity
2005	15	6 (3)	6	3
2006	16	4 (2)	7	5
2007	5	0 (0)	4	1
2008	2	1 (0)	0	1
2009	6	1 (1)	1	4
2010	8	1 (0)	5	2
2011	9	1 (0)	2	6
2012	5	0 (0)	3	2
2013	12	4 (3)	6	2
2014	7	3 (1)	4	0
Total	85	21 (10)	38	26

Note: The number of merged occupations leading to less heterogeneity is displayed in parentheses in the third column. Modernized occupations that were split cannot be compared over time. These occupations are not included in the analysis. Moreover, curriculum modernizations for very small occupations (with fewer than 12 apprentices) are also not included.

[83] A detailed description of the unambiguous modernization is available upon request.
[84] In the empirical analysis, this second modernization is defined as the first modernization.
[85] From all the small occupations that were modernized in the respective time span, no occupation was introduced in the analyzed time span. Therefore, there is no risk of neglecting small emerging occupations.
[86] https://www.bibb.de/de/berufeinfo.php/new_modernised_occupations_by_year

5.5 Empirical strategy

We first estimate occupational fixed-effect regressions in which we relate the supply of training places to the modernizations in the training curricula. To test the effect of changes in the degree of heterogeneity, we include two interaction terms indicating whether the modernization introduced more or less heterogeneity in the training curriculum. The occupational fixed-effect regression is therefore specified as follows:

$$S_{ot} = occ_o + \beta_1 mod_{ot} + \beta_2 het_{ot} + \beta_3 hom_{ot} + \delta_t dt + \gamma_o t_o + \varepsilon_{ot} \quad (5.3)$$

S_{ot} denotes the supply of apprenticeship places in year t and occupation o. The indicator variable occ_o denotes the dummies for the different occupation. The variable mod_{ot} is 1 if an occupation is modernized and 0 if it is not yet or has never been modernized. Thus, the parameter β_1 estimates the effect of the modernization itself. Five occupations that were modernized twice in the time period were analyzed. For these occupations, we used a second modernization dummy (not displayed in equation 5.3). To measure the effect of changes in curriculum heterogeneity, we include interaction terms indicating modernizations that allow for more heterogeneity (het_{ot}) and modernizations that lead to less heterogeneity, i.e. more homogeneity (hom_{ot}). If the modernization implied a change towards more heterogeneity, het_{ot} takes the value 1 in the years after the modernization and 0 in the years before the modernization. When there was no change in the structure of the curriculum at all or when the number of choice options was reduced, the variable het_{ot} is always equal to 0. The values for hom_{ot} are analogous. Thus, β_2 and β_3 estimate the effect of more or less heterogeneity respectively. Thus, the coefficient $\beta_1$estimates the effect of a modernization, when there was no change in the degree of heterogeneity. As controls, the following variables are included: year dummies dt and occupation-specific time trends t_o. By the inclusion of the year dummies, we can exclude year specific exogenous shocks affecting the supply of apprenticeship places, such as cohort-specific demographic changes, changes in the number of school leavers and business cycle effects. The occupation-specific time trends control for any occupation specific upwards or downwards trend in the number of apprenticeships.

Analogously, we also run a regression in which we analyze to what extent more or less heterogeneity in the curriculum introduced by the modernization affects students' demand for apprenticeship places:

$$D_{ot} = occ_o + \beta_1 mod_{ot} + \beta_2 het_{ot} + \beta_3 hom_{ot} + \delta_t dt + \gamma_o t_o + \beta_4 name_{ot} + \varepsilon_{ot} \quad (5.4)$$

This regression includes the same variables of interest and control variables as the training supply regressions. Moreover, we include an additional control variable $name_{ot}$ which

indicates whether or not the name of the occupation has been changed in the course of the modernization. Correspondingly, β_4 estimates potential changes in the attractiveness of the occupation due to a name change. Krewerth et al. (2004) show, that the name of the occupation has a significant effect on the occupational choice of young school leavers. If policy makers choose a more attractive name, a name change might be associated with an increase in students' demand for apprenticeships.

5.6 Results

5.6.1 Regression results

Table 5.2 shows the estimation results of the occupation fixed-effect regression on the supply of and demand for apprenticeships respectively. As we analyze five occupations that were modernized twice in the respective time period, we include a control dummy for the second modernization and interaction terms indicating whether or not the second modernization was associated with more (or less) heterogeneity.

The estimation results show that most of the time curriculum modernizations as such are not significantly associated with the supply of training places. Nonetheless, as the data source is a full census, the non-significant coefficients can also be interpreted meaningfully.[87] The coefficient suggests that modernizations are slightly positively associated to firms' supply of training places. Considering the first modernizations, which make up 93% of all modernizations, a modernization as such is associated to an increase of the supply of 56 training places, which corresponds to 2.5% of the average supply of training places.[88] In contrast, the five second modernizations even had a negative effect on the supply of training places with a coefficient of -183.

Including the interaction variables on whether the modernizations were associated with more or less heterogeneity decreases the coefficient for the first modernizations and renders the coefficient for the second modernizations even more negative and significant at the 5 % level. The coefficient for modernizations creating more heterogeneity is positive and significant at the 5 % level. This is true for both the first modernization and also for the second modernizations, whereas the coefficient of 1.057 for the second modernizations is much higher than the coefficient of 318 for the remaining 80 modernizations. However, considering the average supply of training places of 2,215, even the coefficient for the first modernization implies a substantial increase of 14 %. This shows that modernizations of the curriculum only successfully increase the supply of training places if firms receive more

[87] Usually, the significance levels indicate the probability that the estimate is true in the population. In this case, we already have administrative data from the whole population, i.e. supply of new training contracts. For a description of the dataset, please see Flemming & Granath (2011).

[88] The average supply of training places per occupation is 2,215.

opportunities to adapt the training to their needs. These results confirm hypotheses 2 and reject hypothesis 1. These results also support the theory that the effect is indeed channeled via the firm's post training benefits and not via the training costs. Training could become less costly after any modernization, but it is only the heterogeneity which leads to an increased wedge between productivity and wages.

The estimation results also show that modernizations that reduce the heterogeneity in the curriculum decrease the supply of training places by 209, which is a decrease of 9 %. We also test for a separate effect of merged occupations by including a variable indicating whether the modernization consisted of a merger of occupations (column 3). The results show that the negative effect of less heterogeneity is mainly due to modernizations that combined several occupations into one. Including this control variable, the coefficient for less heterogeneity increases and the coefficient for the merge of occupation is -336 and significant at the 10 % level.

Table 5.2 also shows the estimation results on students' demand for training places (columns 4 to 6). These results seem to be rather similar.[89] Students are more likely to apply for occupations that provide more heterogeneity in the training curriculum as the coefficient for more heterogeneity in the curricula is positive (205) and significant. Also the coefficient for the second modernizations creating more heterogeneity is positive and significant at the 1 % level. When comparing these results to the estimation results for the supply of apprenticeship places, one can see that the former coefficients are slightly smaller (at least for the first modernizations). This suggests that students' demand for apprenticeships is less sensitive to having more heterogeneity in the curriculum than the firm's supply.

Again, the modernizations as such have an insignificant effect on the demand for training places. Moreover, modernizations which lead to more homogeneous curricula are not significantly related to the demand for apprenticeship places. Thus, we have to reject hypotheses 3 and 4. The positive coefficient of more heterogeneity could suggest that more choice options always enhance the graduates' productivity.

[89] It is indeed not very surprising that the estimation results on supply and demand are closely related. Excess supply or demand is usually not large as the majority of all firms that supply apprenticeships also find apprentices and most students who would like to have an apprenticeship find one. When we regress the number of new apprenticeship contracts (i.e., matched supply and demand) on the same explanatory variables, the estimation results are indeed very similar.

TABLE 5.2: FE-REGRESSIONS: SUPPLY OF AND DEMAND FOR APPRENTICESHIPS

	Supply of apprenticeships			Demand for apprenticeships		
	(1)	(2)	(3)	(4)	(5)	(6)
Modernized (before/after)	55.68	15.55	15.48	41.49	-0.94	8.06
	(1.32)	(0.25)	(0.25)	(0.83)	(-0.01)	(0.12)
More heterogeneity		317.83**	318.62**		205.47*	204.75*
		(3.23)	(3.24)		(2.26)	(2.25)
Less heterogeneity		-209.41*	-38.24		-57.68	3.22
		(-2.01)	(-0.28)		(-0.59)	(0.03)
Merge of occupations			-335.53*			-125.60
			(-2.00)			(-0.77)
Modernized (before/after) (2nd Modernization)	-183.20	-794.78**	-794.82**	-922.74***	-1444.62***	-1446.49***
	(-1.06)	(-2.81)	(-2.81)	(-4.50)	(-5.54)	(-5.54)
More heterogeneity (2nd Modernization)		1057.13**	1085.89**		1461.85***	1458.16***
		(2.76)	(2.83)		(3.49)	(3.49)
Less heterogeneity (2nd Modernization)		939.88	939.96		1162.70	1137.38
		(1.92)	(1.92)		(1.77)	(1.73)
Constant	166445.89	155262.24	156608.42	186269.15	179077.74	179463.72
	(0.18)	(0.17)	(0.17)	(0.22)	(0.21)	(0.21)
Occupation-specific year trends	yes	yes	yes	yes	yes	yes
Occupation FE	yes	yes	yes	yes	yes	yes
Number of occupations	265	265	265	265	265	265
Observations	2843	2843	2843	2843	2843	2843
R2	0.69	0.69	0.69	0.79	0.80	0.80

Note: Occupation fixed-effects regressions. T-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Regression additionally controls for year dummies and name changes (in the demand regressions).

5.6.2 Robustness test

Only a temporary effect?

In order to test whether the effect of the modernization is particularly large in the first year after the modernization and levels off in the following years, we created a variable which is one for the immediate year after the modernization and zero in all other years. We further created two variables indicating the interaction between the first year after the modernization and the change towards more or less heterogeneity. The variables are again 1 for the year immediately after the modernization that leads to more (or less) heterogeneity and zero in all other years. We estimated the two baseline regressions for supply and demand (shown again in column 1 and 4 of Table 5.3), respectively,[90] including these control variables (see columns 2 and 5 of Table 5.3). The estimation results show that the first year after the modernization does not have an additional significant effect on firms' supply of or students' demand for apprenticeship places. Moreover, in both the supply and demand regressions, the estimation results on the effects of modernization remain robust showing that more heterogeneity in the curriculum increases both supply and demand for apprenticeship places.

Anticipation effect before the modernization

The increase in supply and demand after modernizations that increase curriculum heterogeneity could also be due to a dip in the supply and/or demand in the year before the modernization, if firms and students anticipated the modernization and postponed the training to the next year when the modernized curriculum was introduced. To test whether this could be a driver of the effects of the modernization, we also added a dummy variable for the year immediately before the modernization to the baseline regression. Again, we also construct interaction terms, which differentiate between modernizations creating more and less heterogeneity. The estimation results presented in Table 5.3 (column 3 and 6) show that the coefficients for modernization creating more heterogeneity even become larger, whereas the coefficients of the dummy variable for the last year before the modernization with more heterogeneity are also significantly positive. This suggests that firms already tend to increase their supply of apprenticeships one year before the modernization anticipating that the training curricula will be modernized and more choice options will be introduced.

[90] If we take the regression in column 3 and 6 of Table 5.2 as baseline regressions, including these control variables has similar effects.

TABLE 5.3: FE-REGRESSIONS: SUPPLY OF AND DEMAND FOR APPRENTICESHIPS (ROBUSTNESS TESTS)

	Supply of apprenticeships			Demand for apprenticeships		
	(1)	(2)	(3)	(4)	(5)	(6)
Modernized (before/after)	15.55	21.00	-0.16	-1.09	-26.52	-61.47
	(0.25)	(0.29)	(-0.00)	(-0.02)	(-0.35)	(-0.69)
More heterogeneity	317.83**	322.40**	646.90***	209.72*	209.49*	537.94***
	(3.23)	(2.80)	(4.56)	(2.31)	(1.97)	(4.11)
Less heterogeneity	-209.41*	-225.64	-275.84	-61.32	-46.25	51.29
	(-2.01)	(-1.81)	(-1.79)	(-0.63)	(-0.40)	(0.36)
Modernized (before/after) (2nd Modernization)	-794.78**	-796.32**	-742.99**	-1443.87***	-1439.88***	-1389.40***
	(-2.81)	(-2.81)	(-2.63)	(-5.53)	(-5.51)	(-5.34)
More heterogeneity (2nd Modernization)	1057.13**	1058.78**	1046.41**	1647.41***	1631.73***	1613.30***
	(2.76)	(2.75)	(2.73)	(4.66)	(4.60)	(4.57)
Less heterogeneity (2nd Modernization)	939.88	944.61	898.21	1559.68***	1541.68***	1499.63***
	(1.92)	(1.92)	(1.84)	(3.45)	(3.41)	(3.33)
First year after modernization		-10.16	-6.19		47.19	54.07
		(-0.14)	(-0.08)		(0.70)	(0.80)
First after modernization with more heterogeneity		-9.05	-80.90		1.57	-71.08
		(-0.08)	(-0.72)		(0.02)	(-0.68)
First after modernization with less heterogeneity		29.31	34.48		-28.64	-45.85
		(0.24)	(0.28)		(-0.25)	(-0.40)
Last year before modernization			-30.50			-53.47
			(-0.39)			(-0.75)
Last year before modernization with more heterogeneity			459.38***			466.84***
			(3.79)			(4.17)
Last year before modernization with less heterogeneity			-73.59			142.31
			(-0.55)			(1.15)
Constant	155,262	155,514	157,810	179,003	176,230	177,376
	(0.17)	(0.17)	(0.17)	(0.21)	(0.20)	(0.21)
Number of occupations	265	265	265	265	265	265
Observations	2843	2843	2843	2843	2843	2843
R2	0.69	0.69	0.69	0.80	0.80	0.80

Note: Occupation fixed-effects regressions controlling for anticipation and short-term effects. Regression controls for year dummies, name changes, and occupation-specific year trends. T-statistics are in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

5.7 Conclusion

In this chapter, we analyzed the effect of heterogeneity within training curricula on the supply of and demand for apprenticeship training places. We make use of the modernizations of training curricula to find the effect of creating more or less heterogeneity in the contents of a training curriculum. We find that more heterogeneity in a training curriculum increases both supply and demand for training places in the occupation.

Modernizations of training curricula can be considered as exogenous changes of the institutional training framework when observing a relatively short time span of, e.g., ten years. However, one might argue that choice options could be introduced in the same year of other unobserved changes that might affect the supply of or demand for apprenticeship places. Such changes could refer to the business cycle or the demographic situation. However, by including year dummies and occupation-specific time trends, we can rule out a substantial amount of potential endogeneity. Moreover, the exact year of the modernized regulation can be seen as relatively random as occupations are not regularly modernized.

Our estimation results show that introducing more heterogeneity in a training curriculum increases the number of apprenticeship places offered by firms as well as students' demand for these places. This suggests that having a curriculum that fits more closely to the requirements of a firm's production process is necessary to ensure the attractiveness of the dual system both for the firm and the apprentice. A modernization, which improves the match between the content of the curriculum and firms' training needs, makes apprenticeship training more effective and graduated apprentices more productive. As the production processes of firms are often quite diverse, it is recommendable to allow for sufficient choice options in the training curriculum when a modernization is implemented. Firms are willing to offer more training places when they can expect higher post-training benefits from their apprentices. Moreover, more specific curricula also increase the market power of firms, something which enables them to pay wages that are below workers' productivity.

However, we find that the beneficial effect of more heterogeneity in the training curricula for the firms does not lead to a decrease in potential students' demand for apprenticeships. Instead, we find that a more heterogeneous curriculum also increases students' demand for apprenticeship places. This might be explained by a positive net effect of heterogeneity on skilled worker wages when they acquire more skills that they can apply in their job instead of skills they could not use in the firm where they are employed.[91]

While a sufficient number of choice options is important for the attractiveness of a curriculum for both firms and apprentices, it might also be important to ensure certain standardization, because too much heterogeneity will give graduated apprentices very few

[91] The available data does not allow us to estimate the effect of heterogeneity on skilled worker wages.

chances outside their training firm. Also for firms, some standardization of the contents of the training curriculum could have positive effects. When firms search for workers on the external labor market, they will benefit from a higher number of apprenticeship graduates that could potentially work in their firm. In contrast, having too much heterogeneity would restrict the possibilities to recruit skilled workers from other firms. The number of suitable skilled workers would then fully depend on the firm's own engagement in apprenticeship training. Our findings show that the modernizations that increased heterogeneity in the curricula of apprenticeship training in Germany retained sufficient standardization to prevent these potential adverse effects.

A5 Appendix

TABLE A5.1: LIST OF MODERNIZATIONS LEADING TO LESS HETEROGENEITY

Year	Occupation	Number and type of choice options		
		Before modernization	After modernization	Merger
2005	Building materials tester	Disciplines (1 out of 3)	Priority topics (1 out of 3)	No
	Industrial ceramist, decorative engineering	Disciplines (2 out of 2)	Mono-occupation	No
	Textile production mechanic	12 predecessor occupations	Mono-occupation	Yes
	Textile product finisher	2 predecessor occupations	Mono-occupation	Yes
	Saddler	4 predecessor occupations	Disciplines (1 out of 3)	Yes
	Tourism services management clerk	Disciplines (1 out of 2) + fields of application (1 out of 3)	Fields of application (1 out of 3)	No
2006	Port boatman	2 predecessor occupations	Mono-occupation	Yes
	Wood mechanic	Disciplines (1 out of 6)	Disciplines (1 out of 2)	No
	Media agent for digital and print media	Priority topics (1 out of 2)	Mono-occupation	No
	Builder of stoves and air heating systems	2 predecessor occupations	Mono-occupation	Yes
2008	Protection and safety specialist	Fields of application (1 out of 4)	Mono-occupation	No
2009	Technical model-maker	2 predecessor occupations	Disciplines (1 out of 3)	Yes
2010	Paper technologist	Disciplines (1 out of 2) 52 weeks	Elective qualification units (2 out of 12) 26 weeks	No
2011	Screen print media technologist	Elective qualification units (2 out of 5) + (2 out of 8) + (1 out of 7) (44 weeks)	Elective qualification units (2 out of 11) + (1 out of 7) (52 weeks)	No

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Year	Occupation	Number and type of choice options		
		Before modernization	After modernization	Merger
2013	Skilled metal worker	11 predecessor occupations	Disciplines (1 out of 4)	Yes
	Aircraft electronics technician	Fields of application (1 out of 5)	Fields of application (1 out of 4)	No
	Motor vehicle mechatronics technician	2 predecessor occupations	Priority topics (1 out of 5)	Yes
	Designer of digital and print media	4 predecessor occupations	Disciplines (1 out of 3)	Yes
2014	Office Manager	3 predecessor occupations	Elective qualification units (2 from 10)	Yes
	Technologist in confectionery goods	Disciplines (1 out of 3)	Fields of application (1 out of 5)	No
	Motor vehicle body and vehicle construction mechanic	Disciplines (1 out of 3)	Disciplines (1 out of 2)	No

TABLE A5.2: LIST OF MODERNIZATIONS LEADING TO MORE HETEROGENEITY

Year	Occupation	Number and type of choice options	
		Before modernization	After modernization
2005	Butcher	Disciplines (1 out of 3)	Elective qualification units (2 out of 6)
	Surface coater	Mono-occupation (3 alternatives)	Mono-occupation (4 alternatives)
	Animal caretaker	Mono-occupation	Discipline (1 out of 5)
2006	Salesperson specializing in foodstuffs	Priority topics (1 out of 2)	Priority topics (1 out of 3)
	Property agent	Mono-occupation	Elective qualification units (2 out of 5)
	Insurance and financial services broker	Mono-occupation with elective modules (2 out of 3 modules)	Disciplines (1 out of 2)
	Media designer for images and sound	Mono-occupation	Fields of application (1 out of 10)
	Mechanic in plastics and rubber processing	Mono-occupation with 4 priority topics	Mono-occupation with 6 priority topics
2007	Management assistant for retail services	Elective qualification units (1 out of 4) + (4 out of 7)	Elective qualification units (1 out of 4) + (4 out of 8)
2008	Hairdresser	Mono-occupation	Elective qualification units (1 out of 5)
2009	Mining technologist	Mono-occupation	Disciplines (1 out of 2)
	Photographer	Mono-occupation	Priority topics (1 out of 4)
	Industrial ceramist	Disciplines (1 out of 3)	Elective qualification units (1 out of 6)
	Specialist retail assistant for the music branch	Mono-occupation	Elective qualification units (1 out of 3)
2010	Precision machinist	Priority topics (1 out of 3)	Priority topics (1 out of 4)
	Equine manager	Priority topics (1 out of 4)	Disciplines (1 out of 5)

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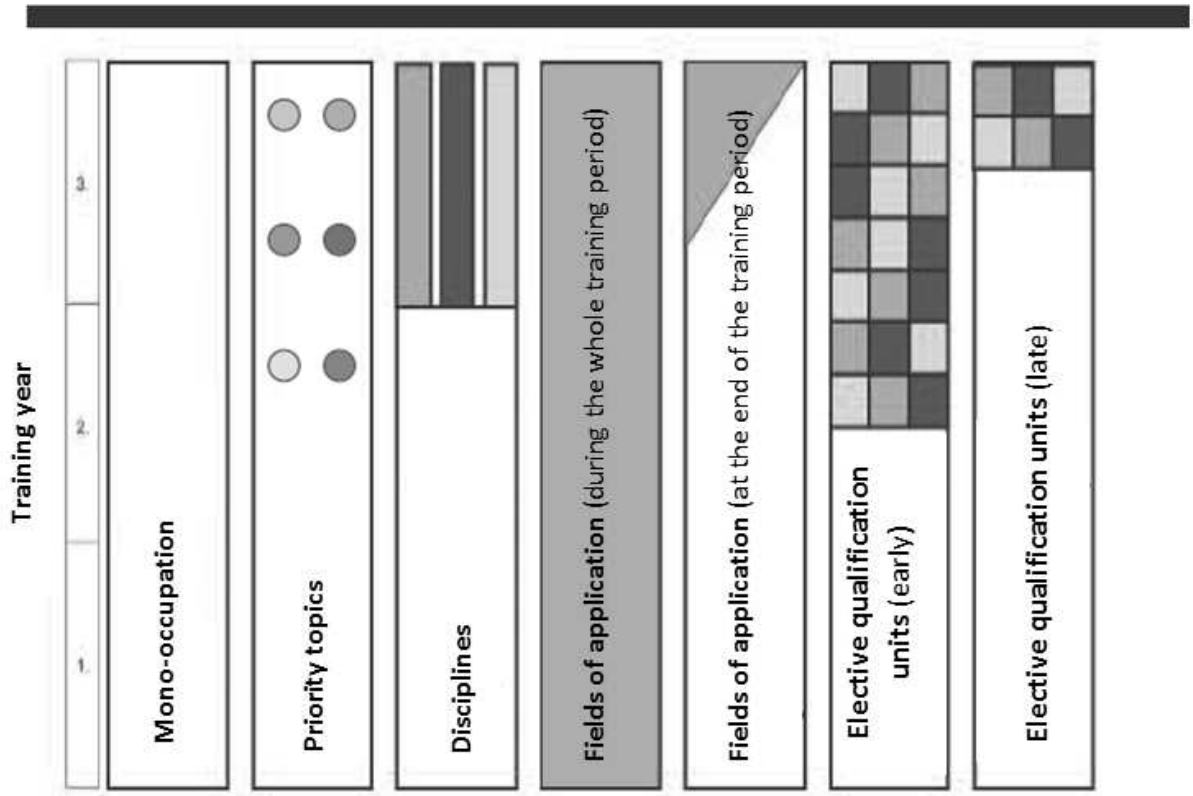
Year	Occupation	Number and type of choice options	
		Before modernization	After modernization
2011	Boat builder	Mono-occupation	Disciplines (1 out of 2)
	Bookbinder	Disciplines (1 out of 3)	Elective qualification units (2 out of 9) + (1 out of 2)
	Bookseller	Priority topics (1 out of 3)	Elective qualification units (1 out of 3)
	Print media technologist	Disciplines (1 out of 4)	Elective qualification units (2 out of 21 + 1 out of 13)
	Packaging materials technologist	Elective qualification units (2 out of 8)	Elective qualification units (2 out of 4) + (2 out of 6)
	Tourism services management clerk	Fields of application (1 out of 3)	Elective qualification units (1 out of 3)
2012	Luminous advertisement maker	Mono-occupation	Priority topics (1 out of 2)
	Mechanic in plastics and rubber processing	Priority topics (1 out of 6)	Disciplines (1 out of 7)
2013	Orthopedic technician	Mono-occupation	Priority topics (1 out of 3)
	Materials tester	Mono-occupation	Disciplines (1 out of 4)

FIGURE A5.1: OVERVIEW OF CURRICULA STRUCTURES



Note: Translated from Bretschneider & Schwarz (2011)

6. Are altruism and time preferences of decision-makers related to investments in apprenticeship training?*

6.1 Introduction

The dual training system in Germany has an important role in facilitating the introduction of young people to the labor market and in safeguarding the availability of skilled workers. In overall terms, 53.5 % of the workforce has been trained within the dual system (Statistisches Bundesamt, 2014) and 87.5 % of all firms employ such workers.[92] Nonetheless, the rate of training firms has declined in recent years. In 2014, only about 20 % of all firms in Germany decided to offer apprenticeship training. For the functioning of the dual vocational system, a participation of sufficient firms by providing apprenticeship places is pivotal. In order to increase or at least stabilize the number of firms providing training, the driving forces behind the training decisions have to be understood. For this reason, various attempts have been made to explain the firm's decision to provide apprenticeship places.

Firms decide to provide training when the expected benefits exceed the expected costs (e.g., Becker, 1962; Acemoglu & Pischke, 1998). Benefits can either accrue in the short term during the training period itself in the form of productive contributions of apprentices or in the long term upon retention of the apprentices in the form of a wedge between the retained apprentices' productivity and their wages. Accordingly, two main economic motives prevail.[93] Some firms train because of the so-called production motive (see Lindley (1975) for a first discussion of this motive), which means that they use their apprentices as a cheap substitute for unskilled and semi-skilled labor. Those firms usually do not retain their apprentices and already benefit from training in the short run, i.e. they do not have to incur any net costs for training apprentices. Mohrenweiser & Backes-Gellner (2010) find that about 19% of all firms in Germany are production oriented. Other firms train because of the investment motive. Those firms mostly retain their apprentices and can recoup the costs

* *The chapter is based on the paper „Is investing in apprentices related to decision-makers' altruism and their high time preference" by Anika Jansen (ROA Research Memorandum 2016/2).*

[92] This share includes firms that employ at least one worker with either an apprenticeship certificate or a master craftsman certificate as the highest qualification (Data source: BIBB Establishment Panel on Training and Competence Development 2013; own calculations).

[93] Other motives that were analyzed were the screening motive (Franz & Zimmermann, 2002; Stevens, 1994b) and the reputation motive (Sadowski, 1980). A good overview of the training literature is provided in Wolter & Ryan (2011).

that they have incurred at a later stage (see Merrilees, 1983). Therefore, those firms are willing to make substantial initial investments.

A further explanation for firms' training engagement is that firms train because of social responsibility. Some firms might not only be profit maximizing but instead also benefit from an increased utility of third parties. This motive has often been mentioned (Beicht et al., 2004; Schönfeld et al., 2010), but never explicitly analyzed. Another explanation for the differential in firms' training engagement might be related to the different importance they put on the long-term benefits.

In this chapter, I analyze whether firms' training decisions may be influenced by the economic preferences of the decision-makers within the firm. As with any other firm decision, the decision whether or not to train apprentices is eventually taken by an individual, i.e. the firm owner or manager. While in recent economic literature the influence of individual economic preferences on employees' and consumers' decisions has become broadly accepted, the literature on the influence of individual preferences on management decisions is rather scarce (e.g., Armstrong & Huck, 2010; Certo et al., 2008). Also in the training literature, the influence of individual preferences on the firms' training strategy has not been analyzed. However, with respect to firms' training decisions, the influence of especially two important individual preferences is likely:

Firstly, training apprentices involves a clear time dimension. Cost and benefit surveys of the provision of apprenticeships have shown that training apprentices is costly for most firms (Schönfeld et al., 2010). In the long-term, however, when firms retain apprentices after the completion of the training period, the investments pay off due to numerous advantages of internally trained workers in contrast to externally trained workers. A low preference for the present of the decision-makers should hence be a prerequisite for making these long-term investments. In contrast, if decision-makers highly reward current benefits, they are likely to refrain from taking on apprentices and are instead more likely to search for workers on the external labor market who have already been trained. Moreover, decision-makers who have a high time preference might tend to ignore their future need for skilled workers. The decision-maker's time preference could thus play an important role in taking decisions on training investments.

Secondly, providing training positions is not only beneficial for the firm itself but also creates huge monetary and non-monetary benefits for the apprentices and society as such.[94] If decision-makers in firms also take into account the expected impact on apprentices and society, the cost-benefit relation could alter, and they might decide to train even if training is not beneficial for the firm in purely monetary terms. Therefore, another important economic preference that could influence firms' training decisions is altruism.

[94] For a discussion on the advantages of the apprenticeship system, see section 2.1.2.

The two preferences are also chosen because of their relevance in the political discussions on the approaches to incentivize firms to train, in which it is implicitly assumed that firms training behavior is also influenced by social and time preferences. Firms are – especially by unions – often accused of shortsightedness in their training strategy (Ulrich, 2004). Hence, prominent approaches to convince firms to train apprentices are directed towards raising the awareness for the future need of skilled labor.[95] However, it is not clear whether these approaches are really targeted in the right direction. This would only be the case if it was really short-sightedness rather than cost-benefit considerations that prevent firms from engaging in training. Analyzing the influence of time preference on the firms training investment provides us with initial evidence of whether this condition is fulfilled. Moreover, in the political discussion and throughout this strand of literature, it is often mentioned that firms have a social responsibility to train apprentices (Busemeyer, 2009). For that reason, campaigns to convince firms to train emphasize the social benefits for young school graduates and for the economy as a whole.[96] However, the actual influence of social preferences on firms' training policies has never been explicitly analyzed. Do firms really take into account the utility they create for others in their training decision? If this were the case, altruistic decision-makers should be more willing to invest in training. This chapter fills these research gaps by analyzing these two important economic preferences and their relation to the investments in apprentices.

The analyses are based on the German BIBB Cost-Benefit Survey 2012/13, which includes firm information, such as the training decisions and the training costs, as well as information on the economic preferences of the individuals who are responsible for the firm's decision to provide apprenticeships.

The contribution of the chapter to the literature is twofold. *Firstly*, the chapter adds to the literature on the determinants of training investments and training decisions by introducing a further explanation for the variation in training costs and training engagement. *Secondly*, the chapter adds to the behavioral economics literature on social and time preferences, which has mainly focused on individuals in their role of consumers or workers. In contrast, literature on the effect of economic preferences on managerial decisions is scarce and tends to exist in the field of market interactions, with regard to collusive, vengeful, and imitative behavior (Armstrong & Huck, 2010). This chapter complements this literature by analyzing the effects of two relevant economic preferences on two important management decisions, i.e. the decision to train and the amount of investments in apprentice training.

[95] The training pact (2010 – 2014) signed by the Federal Government and the central associations of the private sector aims to provide more in-company training. One measure that originates from this pact was to set up an information campaign that aimed to increase the awareness for the future skilled workers (http://www.praktisch-unschlagbar.de/content/ueber-die-iobb-179.php). One further measure arising from the new training pact signed in December 2014 is the "Week of apprenticeships", also aiming to increase firms (and students) awareness of the future training benefits (http://www.arbeitsagentur.de/web/content/DE/Veroeffentlichungen/Weisungen/Unternehmen/Detail/index.htm?dfContentId=L6019022DSTBAI712091).

[96] See for example the Alliance for Initial and Further Training, which was established in 2014.

The chapter is organized as follows. The next section presents the theory and derives the respective hypotheses. The third section of this chapter introduces the database and the operationalization of the main independent variables, and section 6.4 presents the empirical strategy. Section 6.5 presents the regression results and some robustness checks. Section 6.6 concludes.

6.2 Theory and hypotheses

6.2.1 Theoretical framework: costs and benefit of training

According to economic theories of investment in human capital, the expected costs and benefits of training determine whether a firm provides training to its employees or not. Two forms of benefits are possible – short and long-term benefits. Short-term benefits can accrue because apprentices contribute productively to the economic output of the firm. In about 30% of all German firms providing training, these short-term benefits are so high that training pays off during the training period itself (see Figure 2.2 in chapter 2). The remaining firms rely on the long-term benefits. The long-term benefits essentially accrue due to the gap between workers' productivity and their wages (Becker, 1962; Acemoglu & Pischke, 1998). This is for example due to the provision of firm-specific skills which make internally trained workers more productive in the long term. Moreover, theory predicts that, due to a certain degree of market power, firms are able to pay their internally trained workers a wage below their productivity (Bhaskar et al., 2002 and for reviews see Leuven, 2005; Wolter & Ryan, 2011). Moreover, by providing apprenticeships firms become more independent from the external labor market and can circumvent production losses and save high recruitment costs (Stevens, 1994b). For Germany, Walden (2007) and Mühlemann et al. (2010) find that the probability to train depends substantially on those long-term benefits. Differences in short-term training costs nearly do not have any influence on the training decision.[97]

Economic preferences fit into this costs benefit framework in the following way. Firstly, the time preference determines the strength to which the long-term benefits influence the current training decision. Secondly, via altruism the increased benefits of apprentices and society can enter the firms' utility function. As economic preferences refer to an individual, the cost-benefit framework is extended by acknowledging that it is not the firm as an abstract entity which makes the training decision, but instead a person who is in charge of the training decision within the firm.

The influence of economic preferences on individual behavior is extensively documented in various studies in the field of behavioral economics (e.g., Camerer et al., 2004; Fehr &

[97] This is not everywhere the case. In Switzerland for example, short-term training costs have a strong influence on the training decision. Comparing the actual and the hypothetical training costs of non-training firms in Switzerland Mühlemann et al. (2005) and Wolter et al. (2006) have shown that cost-benefit considerations have a significant influence on the decision to train apprentices.

Schmidt, 2006). Also in the field of educational choices, the literature has shown that economic preferences have an important effect. Fouarge et al. (2013) have shown that the workers' willingness to participate in continuous training also depends on their future orientation. Regarding firm behavior, less evidence on the influence of economic preferences exists. Nonetheless, some studies indicate that also managers acting on behalf of their firms can make decisions that depart from rational behavior and the profit maximizing paradigm (Armstrong & Huck, 2010; Certo et al., 2008). In the following, I will present two main economic preferences and explain why especially time preferences and altruism are expected to influence the training decision and training investment.

6.2.2 Time preference – training apprentices as an intertemporal investment decision

Several studies have found that training apprentices in Germany is not self-supporting in the short run (see e.g., Schönfeld et al., 2010). On average, firms have to invest in training apprentices during the contract duration of an apprenticeship. For more than 70% of all firms, training apprentices is an investment which pays off only in the future by retaining the apprentices upon their qualification. Even for the remaining 30% of firms, for which training pays off in the course of the training program, i.e. in the second or third year,[98] an initial investment upon the start of the program is necessary. Thus, training apprentices always requires an upfront investment, which pays off at a later stage.

In order to assess whether the investment is worthwhile, the future training benefits have to be estimated and discounted to obtain their present value (see chapter 7.2 in Borjas, 2008).[99] In a firm potentially interested in providing training, this is the task of the manager or the owner. A decision-maker in a potential training firm only decides to train if the present value of the long-term benefits is at least as high as the immediate training investments.[100] The condition is formulated in the following equation.

$$Inv_i \leq \frac{1}{1+\delta_i} \cdot Long\ term\ benefits_i \tag{6.1}$$

The training investments are indicated by Inv_i. δ denotes the individual time preference. Equivalent to the discount rate, a high value of δ indicates a high preference towards the present and vice versa.[101] Accordingly, the present value of the long-term benefits is

[98] Data from the BIBB Cost-Benefit Survey 2012/13 show that apprentices' productive contributions increase during the training program. At the beginning, apprentices are less productive and receive more training. At the end of the training period, they are more competent and can be better allocated to productive tasks. As a result, the training costs decrease during the training period.

[99] The influences of individual time preferences that depart from the interest rate are (only) recognized in the human capital literature when it comes to workers' individual training or educational decision (see chapter 7.4 on human capital in Borjas, 2008).

[100] Accordingly, it can be expected that for all training firms in the data set, the present value of the future benefits are at least as high as the training investments.

[101] Most research analyzing intertemporal trade-off decisions attempt to determine a specific discount function, which describes the changes of the discount factor depending on the size of the reward and on the

obtained by multiplying the long-term benefits by $\frac{1}{1+\delta_i}$. When the preference towards the present is high, the present value of the long-term benefits is low and vice versa. Assuming constant training costs and constant long-term benefits, a low value of future benefits renders the training decision less attractive. Therefore, the higher the preference for the present of the decision-maker, the lower the probability to provide apprenticeship places will be, as long as everything else is equal. This leads to the following hypothesis.

H1: *A higher preference towards the present is negatively related to the probability to offer apprenticeship places.*

Equation 6.1 also illustrates that firms would train in the presence of high training costs if the preference towards the present is low. In contrast, firms are less willing to make investments in training, when, due to high time preferences the present value of future benefits is low. Thus, assuming constant long-term benefits, firms with high preference towards the present should be willing to accept lower training investments and vice versa.

Moreover, in case the decision-maker can influence the training organization, the effect of the time preference could be channeled via an additional mechanism. To some degree the decision-makers can influence the training cost by determining the trainer hours and the time the apprentices are allocated to productive tasks. A higher quality apprenticeship with many teaching and learning hours is probably associated with higher training costs. At the same time, a high quality apprenticeship will probably increase the productivity of the apprentice at the end of or after the training program. Accordingly, especially if firms want to retain their apprentices, they should have a long-term interest in training them well. A shortsighted decision-maker might focus only on the short-term training costs and might organize the training accordingly. Thus, there are two reasons for a relation between time preferences and the training investments. The first reason refers to the presumption that decision-makers with low preferences for the present *accept* higher *exogenous* training costs. The second reason refers to the presumption that trainers *actively organize* training in a different way depending on their time preferences. The resulting hypothesis is the following.

H2: *A higher preference towards the present is associated to lower investments in apprenticeships.*

It is likely that this relation is especially pronounced for firms with high training investments, as firms that have low costs or even do not have to incur any net costs for training would

time when the reward will be handed over (see e.g., Benhabib et al., 2010). The scope of this chapter is much simpler in the way that it just looks at the intertemporal trade off irrespective of the size and the timing of the reward.

benefit from training anyway and do not have to rely at all or to a lower extent on potential future benefits. Thus, the discount factor with which future benefits have to be weighted should play a minor role for firms with low training costs.

6.2.3 Altruism – training apprentices as a social action

For young school leavers in Germany who do not aim for a university career, starting an apprenticeship program is the main track to receive a formal vocational qualification at the intermediate level.[102] In 2013, 54.5 % of the relevant age cohort started an apprenticeship (Uhly, 2015). For these youngsters, apprenticeship programs give access to the labor market and ensure their integration in society. Therefore, firms' participation in the dual system of apprenticeship training is pivotal for the integration of young people in the labor market. In Germany, youth unemployment rates are relatively low, which is often attributed to the dual system. Thus, training does not only yield benefits for the firm but is also socially beneficial. Smits & Zwick (2004) present evidence that German firms providing training are indeed very conscious of the positive impact of training on society and are also aware of their social responsibility.

However, even though the recent development shows that fewer school graduates opt for an apprenticeship, the number of firms that is willing to provide training places is still not high enough for all school leavers that apply for an apprenticeship place (Matthes et al., 2015). The excess demand for apprenticeship places even enhances the importance of firms' engagement in the dual training system. Appeals towards their social responsibility should convince firms to provide training places. Busemeyer (2009) maintains that those appeals can be successful. He argues that especially in the 1980s, firms increased the supply of training places and trained in excess of their needs because they responded to appeals of the chambers of industry and commerce and employer associations. The author concludes that firms are often not aware of the exact costs of apprenticeship training, which leaves leeway for social considerations and the acceptance of social responsibility. In this context, Maier and Walden (2014) found that before the nineties firms' supply of apprenticeship places reacted to students' demand for apprenticeship places, which they interpret as a sign that appeals to community spirit were effective in this time period.[103] Indeed, according to the BIBB Cost-Benefit Surveys, many training companies state that social responsibility is an important reason to participate in the training system (Beicht et al., 2004; Schönfeld et al., 2010). Also a recent qualitative study by the BIBB showed that training firms tend to name social responsibility as a reason to train apprentices much more often than non-training firms (Foraus, 2015).

If social responsibility is a reason to train apprentices, the mechanism must work via the person or a group of persons within the firm who is in charge of this decision. This can be the

[102] Only very few occupations are taught in a vocational school setting.

[103] However, they also find that after the nineties the strength of this relation has decreased. They deduce that therefore also the effectiveness of appeals to the community spirit has declined.

firm owner, manager or a group of managers. In order that the manager opts for training *because* of social responsibility, two prerequisites must be fulfilled. *Firstly*, the individual in charge of this decision must be aware of the positive social impact of the training decision. *Secondly*, the individual must care enough about the benefits of other, potentially unknown, people in order to act accordingly. That means decision-makers must be to some degree altruistic.[104] Altruism means that the act of giving enhances the givers' utility even though they do not receive anything in return (Becker, 1974; Andreoni, 1989), either because the actor enjoys giving or because he cares about the recipient. Fehr & Schmidt (2006) define altruism as "[…] a form of unconditional kindness", an act which is not "[…] a response to a favor received".

In the field of private individual decisions, the impact of social preferences on behavior is extensively analyzed. It is widely accepted that not only material self-interest motivates decision-makers, but also the well-being of others. Carpenter & Myers (2007), for instance, found that more altruistic people are more likely to volunteer. However, in the field of management decision, especially with regard to the training decision, empirical evidence on the influence of altruism is scarce.

An altruistic decision-maker takes the external utility he produces into account in his training decision. This means that the decision-maker's utility will be enhanced by providing apprenticeship places from which youngsters can benefit. Then, the utility obtained by enhancing others' well-being can partly compensate for the training costs. Therefore, a higher degree of altruism is ceteris paribus associated with a higher probability of providing apprenticeships places, which is formulated in the following hypothesis.

H3: *The degree of altruism is positively related to the probability of providing apprenticeship places.*

The relation between training investments and altruism can be illustrated by including the utility of other persons in the decision-makers' utility function. With each training place, the firm is creating a constant external positive utility. When the decision-maker is altruistic, he would only decide to train if the training costs are equal or smaller than the long-term benefits plus the external utility. The degree of altruism of each decision-maker determines to what extent the external utility enters the decision-maker's utility function and is given by the parameter α_i, which is bound between 0 and 1.

$$Inv_i \leq Long\ term\ benefits_i + \alpha_i \cdot External\ utility \tag{6.2}$$

[104] Apart from altruism, other forms of social preferences like fairness and reciprocity exist (Fehr & Schmidt, 2006). In general, social preferences describe the idea that individuals do not only care about their own pay off but also care about others' payoff. In the context of the firms' training decision, where firms usually do not know the apprentice before the start of the training program, it is reasonable to expect that altruism is the most relevant form of social preferences.

If the altruism parameter α_i is equal to zero, the decision-maker's utility from training is entirely determined by the long-term training benefits minus the training costs, which means that observed investments must be equal or lower than the long-term benefits. If the altruism parameter is larger than zero, decision-makers can obtain a positive net utility from training apprentices, even if the long-term benefits are lower than the training investments. This argumentation implies the following hypothesis.

H4: *The degree of altruism is positively related to the amount of investments in apprenticeships.*

6.3 Data and operationalization

The analysis in this chapter is based on the most recent BIBB Cost-Benefit Survey 2012/13 collected by the Federal Institute for Vocational Education and Training (BIBB). The survey measures the costs and benefits of apprenticeship training from the firms' perspective. The sample was drawn from the administrative firm register of the Federal Employment Agency, which contains all German firms that are subject to social security contribution. Therefore, the data are representative for all German firms with at least one employee. The data set include a total of 3,032 training and 913 non-training firms. In the data analysis based on all firms, sampling weights are used to account for the fact that training firms are overrepresented.

The field work of the survey was conducted by infas (Institute for Applied Social Sciences) between September 2013 and April 2014. The interviews were designed as computer assisted personal interviews (CAPI). The interviewee was always the person responsible for training in the firm. In 1,477 cases, the owners of the firm were interviewed. The remaining interviewees were employees of the firm, mostly managers of human resources or training departments.

The dependent variables of the analyses are the firm's decisions to train apprentices and the firm's investments in apprenticeships. The training decision indicates whether a firm has been training an apprentice at the effective date of 30.9.2012. The firm's training investments are given by the net costs of apprenticeship training. The net costs are the difference between the gross training costs and the productive contributions of the apprentices during their training. The gross costs consist of the wages of apprentices, the costs for training personnel, machines and infrastructure, and other costs. The net costs always refer to one apprentice and one training year. For a detailed description of the training costs see (Schönfeld et al., 2010).

The main independent variables of interest are the economic preferences of the decision-maker in the firm. All other questions in the survey refer to the firm in general and not specifically to the person interviewed. As the questions on the economic preferences refer

to the individual and not to the firm, they were only asked in interviews with one respondent, which was the case in most of the interviews. In only 276 out of all 3,945 interviews, more than one respondent took part in the interview. Moreover, the individual questions were only addressed to respondents who were involved in the decision whether and how many apprentices are trained. That can either mean that respondents make the training decisions alone or together with other colleagues. Only 256 interviewees were not involved in the training decision at all and were therefore excluded from the analysis.

To measure the degree of altruism of the respondents, we included a hypothetical choice question in the BIBB Cost-Benefit Survey 2012/13. Throughout this survey, we did not have the possibility to conduct experiments, which are usually employed to measure altruism.[105] However, trying to be as close as possible to existing measures of altruism, in which decision-makers have to allocate real resources, we employed a question that is based on the idea of the dictator game. In experimental economics, the dictator game is usually employed to elicit altruism. In this game, the subject receives a fixed amount of money and can then decide to give some share of this amount to another participant of the game. The amount spent to the other subject is used as an indicator for altruism (see e.g., Carpenter & Myers, 2010). Our survey question is based on the idea of this game. The exact wording of the question is taken from a module of suggested survey questions for key economic preferences, which also have been experimentally validated (see (Falk et al., 2013). The question asks the respondents how much of an amount of €1,000 they had just won they would donate to charity:

Q1: *"Imagine you have won €1,000 in a prize competition. How much of this amount would you, in your current situation, donate to charity?"*

The answer of the respondents denotes their altruistic inclination. The higher the value reported, the higher is their degree of altruism. Falk et al. (2013) have shown that the hypothetical donation correlates significantly with the respective experimental measure[106] with a correlation coefficient of 0.298. Another study uses an index of this measure combined with another altruism measure[107] and found that this index also correlates strongly with real pro social behavior including donating, volunteering time, helping strangers, or sending money or goods to other people in need (Falk et al., 2015).

[105] Murphy & Ackermann (2012) provide a review of existing measurement methods for social preferences focusing on preferences for allocation of recourses. Questionnaires regarding verbally expressed altruistic attitudes are not considered in their review as they believe that the better approach to measure social preference is to have people making decisions with real consequences. This is probably correct, but in practice was not feasible as we had to rely on a measure we could readily include in an already existing survey.

[106] The respective experimental measure was a dictator game in which subjects could spend a share of an endowment of 300 points to a charity organization (see Falk et al., 2013).

[107] The index is calculated by weighing responses to two survey items (the donation decision used in this chapter and a qualitative altruism question) using the weights obtained from an experimental validation procedure. The altruism question used in this chapter has a weight of 0.54.

Also time preferences are usually measured in experiments instead of surveys.[108] When measured in surveys, the concept of time preferences has been captured by either asking questions on the degree of impatience or on future orientation. Vischer (2012) measures impatience by asking respondents about how impatient they are in general and shows that his measure of impatience correlates with actual behavior.[109] Fouarge et al. (2013) measure future orientation by using a scale containing 12 different items related to future orientation. In his meta survey of studies on non-standard preferences, DellaVigna (2009) conceptually equates time preferences with self-control problems. In this study, I use a self-assessment question, which is also taken from Falk et al. (2013). The answer to the following question serves as an indicator for the preference towards the present.

Q2: *"To which degree does the following statement apply to you? I tend to postpone things even though it would be better to get them done right away."*

The respondent can indicate his answer on a scale from 0 (does not apply at all) to 10 (applies completely). The higher the answer of the respondent, i.e. the higher the tendency to postpone things, the higher is his or her preference for the present.

Figure A6.1 and Figure A6.2 in the appendix show the distributions of the two main independent variables - altruism and time preference -, respectively. The figures show that even though both distributions are left skewed, the respondents used the whole range of response possibilities. Table A6.2 shows the descriptive statistics of main variables of interest. The average investment in training, i.e. the net costs, per apprentice and per year in the analyzed data is €5,657 and range from -€31,000 to €58,000. Moreover, respondents state that they are willing to give on average €185 to charity. The standard deviation lies at 247. To describe their tendency to postpone things, respondents indicate on a scale from 1 to 10 on average a 2.85, with a standard deviation of 2.61.

6.4 Empirical strategy

To test the derived hypotheses empirically, first a probit regression is conducted which relates decision-makers' altruism and time preferences to whether the respective firm is a training firm or not. Equations 6.1 and 6.2 from the hypothesis section show that the willingness to train and/or incur costs for apprenticeship training is strongly related to the expected long-term benefits and thus illustrate the necessity to control for variables that

[108] Wang et al. (2011) measure time preference by letting the respondents answer an intertemporal choice question.

[109] See also Vischer et al. (2013) for a review of this question.

indicate firms' possibility to make long-term benefits.[110] The estimated regression is as follows.

$$Train\ (yes/no)_i = \ \beta_1 Altruism_i \ + \ \beta_2 Present_i \ + \ \beta_3 LTB_i + \ \varepsilon_i \tag{6.3}$$

$Train\ (yes/no)_i$ is a binary variable, which is one if the firm is a training firm and zero if the firm does not provide training. The variable $Altruism_i$ represents the degree of altruism of the decision-maker within the firm i, and $Present_i$ represents the degree of preference towards the present of the decision-maker within firm i. The long-term benefits are denoted by LTB and are measured by a variety of variables.

The second regression is an OLS regression based only on those firms that train and relates altruism and time preferences to the amount the firm invests in apprenticeship training Inv_i.

$$Inv_i = \ \beta'_1 Altruism_i \ + \ \beta'_2 Present_i \ + \ \beta'_3 LTB_i + \ \varepsilon'_i \tag{6.4}$$

In the following, I present the variables that are intended to capture the long-term benefits for the OLS regression with the training investments as the dependent variable. The probit regression includes the same set of variables except those that specifically refer to firms providing training. In our data set, we can only observe the training investments as the long-term benefits are difficult to monetize. Therefore, I control for a number of variables that capture the firms' potential to accrue long-term benefits.

The long-term benefits depend substantially on the firms' alternative recruitment possibilities on the external labor market. If it is relatively difficult for firms to find skilled workers in the relevant occupation on the external labor market, training their own apprentices becomes more beneficial and firms are more willing to invest in apprenticeship training. The possibilities to recruit new workers depend on the external labor market conditions. This variation is captured by a number of variables. Firstly, I add a variable that subjectively assesses the availability of skilled workers on the external labor market. Other control variables that indicate the variation in labor market conditions are economic sector, firm size, and region (Ger.: "Bundesländer"). The potential for long-term benefits are also expected to vary substantially between different occupations. Therefore, I further control for occupations. Moreover, the conditions on the product market could also have an effect on the firms' incentives to train.[111] Therefore, I add a variable on whether the firm is subject to high pressure of competition. I also control for the retention strategy of the firm, which indicates whether a firm is rather production or investment oriented. Usually, investment-

[110] The coefficient would be biased if the potential for long-term benefits was related to the characteristics of the decision-makers.

[111] The theoretical hypotheses on the direction of this effect are mixed. Gersbach and Schmutzler (2006) argue that if product differentiation is low and competition is high, firms train less because workers can easily switch to another firm and the firms' market power decreases. Bassanini and Brunello (2007) acknowledge this effect, but also argue that more training reduces the unit costs and like this the price, which in turn has a positive effect on the demand. The effect of the price on the demand is stronger in competitive product market. Then more competition on the product market could also lead to more firm sponsored training.

oriented firms expect much higher post training benefits than production-oriented firms and are therefore also willing to incur higher training costs. Further control variables for long-term benefits are the actual retention rate, share of apprentices that are still in the training firm after three years, and the existence of a works council.

As the answers of the respondents might depend on their income due to the decreasing marginal utility of income, I control for the respondents' income possibility. As we do not have information on the individual income of the respondent in our data set, I use the average wage of a manager within the firm as a proxy for the respondent's income. I further control for the number of apprentices as this variable is usually a strong determinant of average training costs due to the existence of economies of scale.

In principle the control variables should be the same for the probit regression. However, in the probit regression I have to exclude those variables that are only relevant for training firms, such as training occupation, retention strategy, actual retention rate, share of apprentices that are still in the training firm after three years, and number of apprentices.

6.5 Results

In the following, firstly, some descriptive results on the relation between altruism (preference towards the present) and the training decision and investments are presented. Subsequently, I present the regression results with the variables previously described. I first discuss the results from the probit regression, referring to the probability to train (extensive margin), and then turn to the OLS regression, referring to the amount of investments in apprenticeship training (intensive margin).

6.5.1 Descriptive results

The black line in Figure 6.1 shows the descriptive relation between the degree of altruism of the decision-makers and the training participation rate, i.e. the number of firms providing apprenticeship places in relation to all firms. In specific terms, it shows the average training participation rate for different quartiles of the altruism distribution. The figure illustrates that the relation between the degree of altruism and the training probability is small but continuous because with each quartile of altruism, the training participation increases. The lowest quartile lies at zero, meaning that 25 % of all respondents stated they would not donate any money of the €1,000 they had just won to charity. In this group the training participation rate lies at 19 %. The next quartile includes decision-makers who would donate more than 0 but not more than €100 to charity. In this group, 21 % of the firms provide apprenticeship places. In the third quartile, 23 % of all companies decide to train. In the highest quartile, which comprises decision-makers who would donate more than €300, the training participation rate is 25 %.

Figure 6.1 also shows the average investment in apprenticeship training for the different quartiles of the altruism distribution. Again, the training investments increase with each quartile steadily. While firms with decision-makers in the lowest quartile of the altruism distribution spend about €5,000 per year on their apprentices, firms with the most altruistic decision-makers spend more than €6,000 on training an apprentice. Although the relationship is not very strong, it is steadily increasing.

FIGURE 6.1: TRAINING INVESTMENTS AND -PROBABILITY BY ALTRUISM

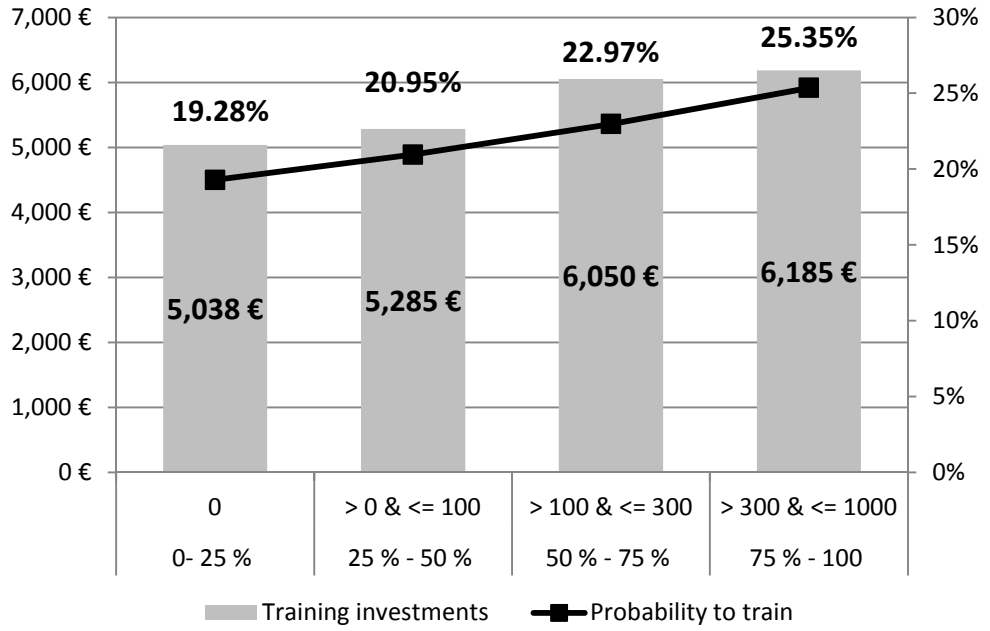
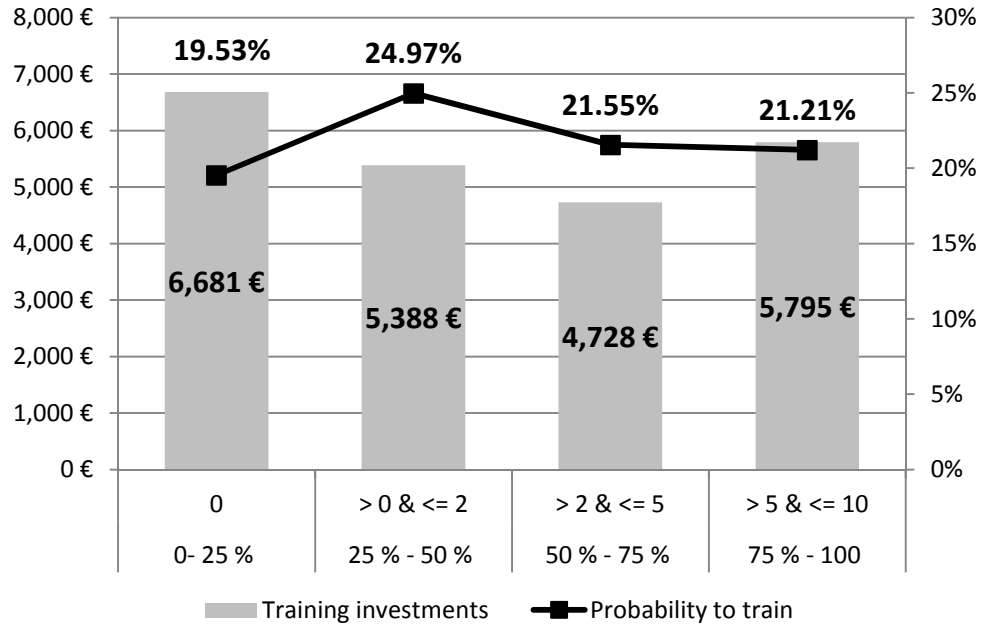


Figure 6.2 shows the relationship between the preference towards the present and the training participation rate. In contrast to the altruism variable, this relation is not very pronounced. The lowest quartile comprises those decision-makers whose response to the question whether they tend to postpone things was that this statement does not apply to them at all. In this quartile, the training participation rate lies at 20 %. In the second quartile are those persons that marked either a one or a two on the scale from 0 to 10. Here, the training participation lies at 25 %. Interviewees who indicated a value between three and five belong to the third quartile and those who marked a value above five to the fourth quartile. In those quartiles, the training participation decreases again and lies at 22 % (third) and 21 % (forth), respectively. The relation between the preference towards the present and the actual amount of training investments is more pronounced. From the first to the third quartile, the training investments decrease constantly, from about €6,700 to €4,700. Only in the highest quartile are training investments relatively high again with a value of nearly €5,800.

FIGURE 6.2: TRAINING INVESTMENTS AND -PROBABILITY BY TIME PREFERENCES



6.5.2 Regression results

Table 6.1 presents the relation between economic preferences and the likelihood of providing training places. The table shows the results of a probit regression[112] displaying the beta coefficients (BC) and the marginal effects (ME). All independent variables that are displayed in Table 6.1 are standardized so that they have a standard deviation of one and a mean of zero. This allows a better comparison between the different independent variables. In addition to the variables shown in the table, controls for economic branch (19), firm size (4), and region (16 Bundesländer) are included.

Table 6.1 shows that the coefficient of altruism is significantly (10 % level) related to the probability of offering apprenticeship places. An increase of one standard deviation of altruism on average increases the likelihood to provide training places by 2 percentage points. Time preferences, on the other hand, are not significantly related to the firm's training decision. The coefficient is very small and not significant.

The coefficient of works councils is significant at the 5 % level. Having a works council in the firm increases the probability to train by 3.6 percentage points. The availability of skilled workers on the labor market is significant on the 10 % level. The better the availability of skilled labor on the external labor market, the less likely is a firm to train. The effect size is comparable to the size of the altruism coefficient. The variable indicating the degree of product market competition and the respondents' wage are not significant.

[112] The same model was run using a logit regression. The results remain very similar.

TABLE 6.1: PROBIT REGRESSION: DECISION TO PROVIDE APPRENTICESHIPS (YES/NO)

	Probit: BC	Probit: ME
	(1)	(2)
Altruism	0.0741*	0.0205*
	(0.04)	(0.01)
Time preference	0.0264	0.0073
	(0.05)	(0.01)
Respondents' wage	-0.0840	-0.0232
	(0.06)	(0.02)
Availability of workers	-0.0807*	-0.0223*
	(0.05)	(0.01)
Works council	0.1349**	0.0373**
	(0.06)	(0.02)
Product market competition	-0.0658	-0.0182
	(0.05)	(0.01)
Constant	-0.4457	
	(0.37)	
Log likelihood	-1388	
Pseudo R^2	0.13	
Observations	2983	2983

Note: All independent variables are standardized, standard deviation in parenthesis, *** p<0.01, ** p<0.05, * p<0.1; Source: BIBB Cost-Benefit Survey. Controls for economic branch (19), firm size (4) and Bundesländer (16) are included. BC = Beta coefficient and ME = Marginal effects.

Table 6.2 shows the relation between the economic preferences and the training investments based on all firms that train apprentices. The coefficients that are presented in the table are standardized beta coefficients. Apart from the variables displayed in the table, the models include controls for economic branch (19), firm size (4), Bundesländer (16), and occupation (211). In all models, the training investments, measured by the net costs, are the dependent variable. The different columns show the estimation results with different set of control variables.

Table 6.2 shows that the coefficient for altruism remains remarkably robust for all kinds of models, even though it slightly decreases with the introduction of additional control variables. While in the first model with only few control variables it lies at 0.06, the coefficient in the last model, which includes the complete set of control variables, lies at 0.05. Through all combinations, the coefficient is significant. The number of observations varies between the models as not all firms have answered all the questions. The most conservative estimation as displayed in column 5 suggests that an increase of one standard deviation in altruism is related to an increase of 0.05 standard deviations of training investments.

In contrast to the altruism coefficient, the coefficient for preference towards the present even becomes stronger after the introduction of additional control variables. The coefficient obtained from the estimation of column 5 shows that an increase of one standard deviation of preferences towards the present is related to a decrease of 0.085 standard deviations of training investments.

The other variables also yield interesting results. The number of apprentices is always negatively related to the training investments, which is due to the existence of economies of scale in the training engagement. Moreover, the respondent's wage is significantly positively related to the training investment. Furthermore, firms with a works council spend significantly more on training than firms without a work council. The effect size is about 0.1 standard deviations. This is not surprising as Kriechel et al. (2014) also have found a significant effect of works councils on training investments with a similar data set.

Most variables indicating potential long-term benefits are also related to the training costs. The retention strategy seems to be important for the willingness to invest in training. Those firms that only sometimes retain their apprentices have significantly lower training costs compared to those who always retain their apprentices. Nonetheless, as soon as the control variables for retention rate and tenure are added, this effect becomes insignificant. In this vein, the variables retention rate and tenure of graduated apprentices are significant at the five % level in explaining the training investments. Only the availability of skilled workers on the labor market is not related to the training investments.

The results show that on average firms that can expect more long-term benefits are indeed more willing to incur net costs. However, also after controlling for those long-term benefits, the coefficients for altruism and preferences towards the present remain significant in explaining the firms' willingness to invest in training. That shows that the economic preferences of the decision-makers have an additional effect on the training investments.

TABLE 6.2: OLS REGRESSION: INVESTMENTS IN APPRENTICESHIPS

	Investments in apprenticeships				
	(1)	(2)	(3)	(4)	(5)
Altruism	0.060***	0.057***	0.053***	0.055***	0.050**
	(0.66)	(0.65)	(0.65)	(0.68)	(0.75)
Time preference	-0.044**	-0.048**	-0.046**	-0.041*	-0.085***
	(72.32)	(71.84)	(71.54)	(74.15)	(85.55)
Number of apprentices	-0.046**	-0.047**	-0.047**	-0.047**	-0.045*
	(19.55)	(19.41)	(19.32)	(19.53)	(18.77)
Respondents' wage		0.130***	0.127***	0.125***	0.111***
		(0.09)	(0.09)	(0.10)	(0.11)
Work council			0.115***	0.113***	0.104***
			(656.35)	(676.50)	(696.08)
Availability of workers				0.009	0.002
				(167.22)	(189.28)
Retention strategy (Ref.: Always)				0.000	0.000
				(.)	(.)
Sometimes				-0.049**	-0.004
				(426.96)	(480.33)
Only in exceptional cases				-0.023	0.029
				(559.90)	(695.25)
Product market competition				0.011	0.017
				(419.29)	(481.88)
Retention rate					0.066**
					(542.86)
Still in firm after three years					0.056**
					(5.75)
Constant					
	(12729.62)	(12640.11)	(12586.38)	(12716.92)	(15476.25)
Observations	2449	2449	2449	2366	1884
R2	0.222	0.233	0.240	0.247	0.303

Note: Dependent variable refers to investments in apprenticeships per one apprentice in €. Standardized beta coefficients are displayed; standard errors in parentheses; * p < 0.10, ** p < 0.05, *** p < 0.01; Controls for economic branch (19), firm size (4), Bundesland (16), occupation (211) included in all models.

In an additional analysis, I check whether the effect of altruism on training investment could have a positive side effect on training quality. One variable which could be seen as an input-based measure for training quality is the amount of trainer hours that are allocated to each apprentice in an average week. Column 2 in Table A6.3 in the appendix shows the same regression as in Table 6.2, albeit with the total trainer hours as the dependent variable. The coefficient for altruism is highly significant and twice as high as in the investment regression. Moreover, column 3 shows that as soon as the trainer hours are included as a control variable in the investment regression, the altruism coefficient becomes insignificant (column 1 presents the baseline regression to compare the results). This shows that the effect of altruism on the net training costs is mainly channeled by the trainer hours. As trainer hours can be seen as an input-based measure for training quality, this analysis shows that more altruistic decision-makers are not only willing to invest more in training but are also more likely to provide a higher training quality. This is line with evidence from Smits (2006) who analyses the relation between the quality of apprenticeship training and the training motives. She finds that when firms are more investment oriented they provide higher quality apprenticeships. This effect can be only observed for the altruism variable. The preferences towards the present do not seem to be related to the trainer hours.

6.5.3 Robustness checks

As a robustness check, I test whether the relation between economic preferences and the training investments is more pronounced for firms that are more investment oriented. This should be the case as a production-oriented firm would benefit from training anyway, irrespective of whether they obtain an additional utility from being altruistic. I differentiate the firms into three groups – those that are production oriented, those firms that are investment oriented, and those firms that follow a mixed strategy. The allocation into investment or production oriented is conducted according to a question which asks firms whether or not they plan to retain their apprentices after the training period. They can either answer “never”, “sometimes”, or “always”. Firms that always (never) retain their apprentices are categorized as investment (production) oriented. Firms that answer that they sometimes retain their apprentices follow a mix of the two strategies.

Differentiating for the training motive reduces the observation for each regression. As a result, the inclusion of occupation dummies is no longer possible. Instead, I include dummy variables that refer to different occupational characteristics as type of occupation[113], training sector, and length of training program.

The results show that time preferences are only significant when firms are clearly investment oriented. When firms are either mixed or production oriented, the variable is no longer significant. This is expected as firms that are production oriented do not plan to retain their apprentices anyway and thus do not need to rely on the future benefits. The strength

[113] The categories are commercial, clerical, and industrial.

with which they weigh the future benefits should hence not influence their decision. A similar picture can be seen with regard to altruism. Here, both investment-oriented firms and those which follow a mixed strategy are influenced by their degree of altruism. For production-oriented firms, the relation is basically zero.

TABLE 6.3: OLS REGRESSION: INVESTMENTS IN APPRENTICESHIPS - BY TRAINING MOTIVE

	Baseline	Investment oriented	Mix	Production oriented
	(1)	(2)	(3)	(4)
Altruism	0.045**	0.056**	0.096***	-0.009
	(0.65)	(0.86)	(1.12)	(2.43)
Time preference	-0.052**	-0.103***	-0.053	0.055
	(71.64)	(101.12)	(120.86)	(219.96)
Number of apprentices	-0.049**	-0.057**	-0.050	-0.148**
	(19.89)	(19.77)	(97.13)	(257.43)
Respondents' wage	0.136***	0.106***	0.168***	0.192***
	(0.09)	(0.14)	(0.18)	(0.24)
Works council	0.131***	0.177***	0.185***	-0.002
	(652.79)	(799.79)	(1361.54)	(2429.71)
Availability of workers	-0.011	0.041	-0.124***	0.015
	(155.47)	(215.35)	(271.90)	(522.09)
Product market competition	0.020	0.045	-0.037	0.056
	(393.94)	(583.19)	(619.24)	(1237.77)
Constant	*			*
	(2112.82)	(4249.90)	(3516.95)	(5836.15)
Observations	2375	1342	700	324
R^2	0.100	0.141	0.216	0.267

Note: Dependent variable refers to investments in apprenticeships per one apprentice in €. Values of the dependent variable refer to annual investments in one apprentice in €. Standardized beta coefficients are displayed; standard errors in parentheses; * p < 0.10, ** p < 0.05, *** p < 0.01; Controls for economic branch(19), firm size (4), Bundesland (16), occupational type (commercial, clerical, or industrial), length of training program (4), and training sector (6) included.

6.6 Conclusion

The aim of the chapter is to illustrate the relationship between two important economic preferences of decision-makers, i.e. altruism and time preferences, and the training behavior of the firms they have to manage. To rule out a potential selection of decision-makers to more investment oriented firms, I control for a number of firm specific variables that capture the potential for long-term benefits.

I showed that altruistic decision-makers are more likely to provide training places than non-altruistic decision-makers. Moreover, altruism is related to the amount of investment in apprenticeship training. This suggests that training decisions in firms are not exclusively motivated by the firms' own material self-interest. Instead, decision-makers who are more altruistic seem to take into account the positive effects of offering training places on society and individuals. A positive side effect of altruism is the effect on training quality. In firms with more altruistic decision-makers, apprentices are supervised by trainers for more hours.

Moreover, I showed that the time preference is very strongly associated to the firm's training investments. Decision-makers that have a stronger preference for the future are more willing to accept higher training costs because they are aware of the long-term benefits of training.

The chapter has two important contributions. *Firstly*, it goes beyond the cost-benefit literature by introducing altruism and time preferences as additional determinants of firms' training decisions and investments. Even though it has been often mentioned by the firms themselves that training apprentices is also seen as service they provide to the apprentices and the society as such, the actual relation of social considerations and the firms' training behavior has never been empirically analyzed.

Secondly, it adds to the behavioral economics literature by presenting empirical evidence on the impact of preferences of vital decision-makers within firms on firms' training investments. This suggests that economic preferences are not only relevant in private consumer and labor market choices but can also influence the decision of firms. In this chapter, I have shown that two relevant economic preferences have a substantial impact on such an important decision as investing in the dual apprenticeship system in Germany.

The results suggest that appeals to social responsibility and the awareness of the future need for skilled workers can have an effect on firm decisions to invest in training. The requirement for those sorts of campaigns to work is that firms care about the utility or well-being of others. If firms did not take into account the benefits of others at all, all campaigns raising the awareness of the social benefits of training would be in vain. The results suggest, however, that more altruistic decision-makers are also more likely to invest in training, which means that their decisions are indeed influenced by social considerations. Thus, the requirement for policies that are targeted at increasing the awareness of social benefits of training can be effective is given. Effective campaigns could then also have a positive side effect on training quality. Moreover, policy campaigns that address the future need for skilled workers, which have been and are currently used to increase firms' provision in apprenticeship training, are especially relevant for firms employing decision-makers with a high preference for the future.

Nonetheless, it has to be taken into account that the impact of preferences is much stronger on the actual training investments than on the decision to provide apprenticeship places at all. This result is intuitive as starting to train apprentices requires even higher up-front investments, when the firm did not train before at all. Trainers with a training license have to be employed, machines, tools, and learning materials have to be purchased, internal training strategies and organizations have to be developed, etc. Once the training infrastructure is set up, the decision to accept slightly higher training costs is relatively "easy". Thus, the amount of training investments is more sensitive to variations in the economic preferences of the decision-makers than in the probability to be a training firm or not. Moreover, the actual training costs are not only set exogenously. Instead, in practice decision-makers may

have some scope to influence the training costs, for example by providing apprentices with more trainer hours than usual. Thus, more altruistic decision-makers or decision-makers with a higher preference towards the present could also actively decide to increase the training costs if they know that this will also increase the training quality. This additional influence of economic preferences on the training investments can further explain the stronger and more pronounced coefficients in the investment regressions in contrast to the training probability regression. Even though the variation in altruism of decision-makers is significantly associated to the training probability, the small size of this coefficient suggests that other arguments, such as purely monetary cost-benefit considerations, are additionally necessary to convince firms to start to train when they have not done that so far.

A6 Appendix

TABLE A6.1: DESCRIPTIVE STATISTICS ON INTERVIEW PARTNER

	Interviewees' involvement in training decision			
Position	Alone	With others	No involvement in decision	Total
Non-training firm	437	346	73	856
	51.05%	40.42%	8.53%	100%
Training firm	1,158	1,460	183	2,801
	41.34%	52.12%	6.53%	100%
Total	1,595	1,806	256	3,657
	43.61%	49.38%	7%	100%

Note: Numbers refer to the sample and are not weighted.

TABLE A6.2: DESCRIPTIVE STATISTICS OF MAIN VARIABLES OF INTEREST

	N	Mean	Std. Dev.	Minimum	Maximum
Training investments	3,032	€5,657	€8,648	-€31,490	€58,466
Altruism	3,210	184.84	246.80	0	1,000
Time preference	3,348	2.85	2.61	0	10

TABLE A6.3: OLS REGRESSION: TRAINING INVESTMENTS AND TOTAL TRAINER HOURS

	Training investments (1)	Trainer hours (2)	Training investments (3)
Altruism	0.050**	0.106***	-0.000
	(0.75)	(0.00)	(0.66)
Time preference	-0.085***	-0.021	-0.075***
	(85.55)	(0.15)	(75.42)
Number of apprentices	-0.045*	-0.057**	-0.017
	(18.77)	(0.03)	(16.58)
Respondents' wage	0.111***	-0.063**	0.141***
	(0.11)	(0.00)	(0.09)
Works council	0.104***	-0.004	0.106***
	(696.08)	(1.19)	(613.55)
Availability of workers	0.002	-0.066**	0.034
	(189.28)	(0.32)	(167.15)
Retention strategy (Ref.: always)	0.000	0.000	0.000
	(.)	(.)	(.)
Sometimes	-0.004	-0.014	0.003
	(480.33)	(0.82)	(423.41)
Only in exceptional cases	0.029	-0.061**	0.058**
	(695.25)	(1.19)	(613.54)
Product market competition	0.017	-0.036	0.034
	(481.88)	(0.82)	(424.99)
Retention rate	0.066**	0.095***	0.021
	(542.86)	(0.93)	(480.28)
Still in firm after three years	0.056**	0.050*	0.032
	(5.75)	(0.01)	(5.08)
Trainer hours			0.474***
			(12.69)
Constant		*	
	(15476.25)	(26.45)	(13655.16)
Observations	1884	1884	1884
R^2	0.303	0.306	0.459

Note: Standardized beta coefficients are displayed; standard errors in parentheses; * p < 0.10, ** p < 0.05, *** p < 0.01; Controls for economic branch (19), firm size (4), Bundesland (16), and occupation (211) included.

FIGURE A6.1: DISTRIBUTION OF ALTRUISM – HYPOTHETICAL DONATION

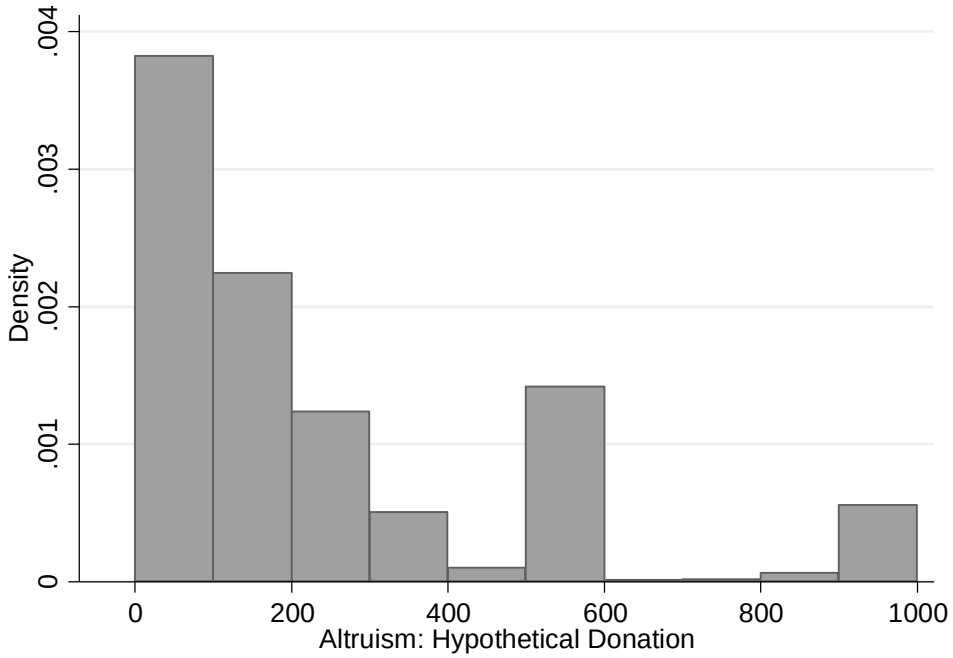
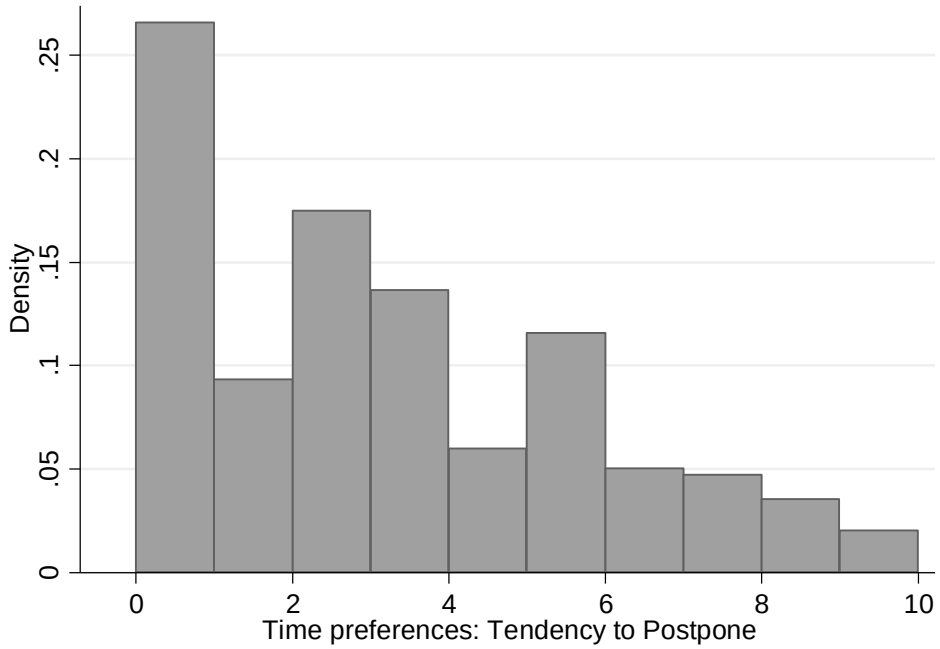


FIGURE A6.2: DISTRIBUTION OF TIME PREFERENCE – TENDENCY TO POSTPONE



7. Conclusion

7.1 Summary of main findings

The contribution of firms is pivotal for the functioning of the dual system of apprenticeship training. Therefore, firm's incentive to train apprentices is an important field of research. Various studies have shown that the decision to train depends on the expected costs and benefits. Two major training benefits are short-term benefits in the form of productive contributions of apprentices and the long-term benefits in the form of a wedge between productivity and wages. It remained to be analyzed what in turn determines these benefits. In this thesis, I have analyzed a variety of framework conditions that act as such determinants.

In the *third* chapter, I investigated how school competencies of apprentices influence the short-term benefits of training. As the productive contributions of apprentices directly reduce firms' training investments, it is crucial to analyze whether these benefits are affected by apprentices' initial competencies. The analysis is based on data from the BIBB Cost-Benefit-Survey for the year 2007. I analyze four pre-training competencies that apprentices have obtained during their prior schooling: Oral and writing competencies, mathematical knowledge, IT competencies, and problem-solving competencies. The estimation results show that especially problem-solving competencies and oral and writing competencies lead to a higher productivity of apprentices at the workplace. Mathematical knowledge and IT competencies are of minor importance. The analysis also shows that apprentices with better school competencies are allocated more often to tasks on a skilled worker level. This additionally increases the short-term benefits of training in the form of productive contributions. These findings have valuable implications for the recruitment process of firms when selecting apprentices. Further, the results suggest that a good compulsory schooling system could alleviate the economic burden of the private sector in financing the apprenticeship system by equipping the apprentices with the necessary skills.

The *fourth* chapter addresses the effect of labor market institutions on the amount of training investments. In particular, it addresses the effect of the laws[114] which came into effect between 2003 and 2005 in the course of the labor market reform Agenda 2010 and which dampened employment protection regulations. I used data on the costs and benefits of apprenticeship training from Germany and Switzerland. Switzerland, where no such reforms occurred, serves as the counterfactual. In Germany, the data refer to the years 2000

[114] Gesetze zur Liberalisierung des Arbeitsmarktes im Rahmen der Agenda 2010.

and 2007, while in Switzerland the data refer to the years 2000 and 2009. The results show that after the introduction of the labor market reform, German firms – in contrast to Swiss firms – allocated their apprentices more often to productive tasks, which led to a decrease in net training costs. Many extensions of classical human capital theory regard labor market rigidities as a prerequisite for firms to invest in general training. From this perspective, the German labor market reforms should have reduced their willingness to support the apprenticeship training system. The findings of this chapter show that weaker labor market regulations will not necessarily lower the willingness of firms to train if firms are able to make their training more beneficial in the short term by allocating apprentices more often to productive tasks. The results further show that the increase in the apprentices' working time is not at the expense of deterioration in training quality.

Also the *fifth* chapter addresses the long-term benefits by arguing that their realization is affected by the design of the training curricula. The empirical approach to test this hypothesis is rather indirect as I observe the supply of apprenticeship places in a given occupation. I argue that the higher the potential for short and long-term benefits in a given occupation, the higher is ceteris paribus also the number of supplied apprenticeship places in this occupation. Building on Lazear's skill weights approach (Lazear, 2009), I study the effect of modernizations, which change the number of choice options in training curricula, on the supply of and demand for apprenticeship places in Germany in all occupations from 2004 to 2014. The modernizations provide me with a quasi-experimental setting as these modernizations can be seen as a relatively exogenous shock. I argue that firms will train more apprentices when they have more choice options in the training curriculum because of the higher productivity of graduates who have acquired more skills that are relevant for the firm and firms' higher market power in the wage bargaining process with graduates. I find that a more heterogeneous curriculum increases both firms' supply of and students' demand for apprenticeship places.

Benefits of apprenticeship training do not only accrue to the firms themselves but are also realized by the apprentices and society as such. If decision-makers of firms are altruistic, which means that external benefits are incorporated in their utility function, these external benefits can be internalized and constitute benefits for the firms. Likewise, the fact that most firms first invest in their apprentices shows that training activities involve an intertemporal trade off decision. Therefore, the *sixth* chapter extends the cost-benefit framework by considering social and time preferences as factors influencing a firm's training investments. The analysis is based on the BIBB Cost-Benefit Survey for the reference training year 2012/13, which contains questions on the economic preferences of the decision-makers. The results show that firms are more likely to train when they employ altruistic decision-makers. I also find that the amount of training investments is highest in firms that employ decision-makers who are not only altruistic but also have a high preference for the future.

7.2 Integration

The thesis adds to the existing literature by analyzing various determinants of training benefits and by examining how those potential training benefits eventually influence the training decision. While all four chapters analyze different aspects of the apprenticeship framework conditions they all aim to describe the complex incentive structure in which firms are placed. The thesis shows how different aspects of costs and benefits are related and how benefits can partially substitute each other. For example, a firm that is aware of the potential long-term benefits of apprenticeship training might be willing to incur much higher short-term training costs. To gain a comprehensive picture, it is important to look at the several types of benefits and how these are related to the decision to provide and invest in apprenticeships. The results of all four empirical studies confirm that cost-benefit considerations are indeed important for firms' training decisions.

Even though apprenticeship framework conditions affect the ability to realize different training benefits, the firm itself also has an important influence on the training benefits by arranging their training organization accordingly. For example, chapter four shows that firms adjust their training organization, when the possibility to make long-term benefits diminishes. Chapter six shows that in firms with more altruistic decision-makers, trainers spend more hours per week supervising and training the apprentices. Chapter three gives another example of how the firm can affect the benefits of training: apprentices with better school competencies are not only more productive because they reach the same productivity level as a skilled worker more easily, but also because the firm can allocate them more often to productive work.

Although the thesis mainly focuses on the firm's perspective, the work could also reveal some insights that concern the interests of the apprentices. On the one hand, the thesis has partly tackled the issue of training quality. Chapter three shows that allocating apprentices more often to productive work on the skilled worker level might have a positive effect on training quality. Chapter six demonstrates that altruistic decision-makers are more likely to provide a higher training quality by providing apprentices with more trainer hours. On the other hand, the thesis has considered the interest of apprentices regarding the amount of choice options firms have in the training curriculum. Accordingly, chapter five shows that if firms have more choice options in the training curriculum this can also be beneficial for apprentices. These additional analyses show that even though firms and apprentices can partially have conflicting interests, a careful setting of the framework conditions can yield benefits for both parties.

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Valorization Addendum

Apprenticeship training programs are socially beneficial as they serve to integrate the youth into the labor market and ensure the availability of skilled workers. Therefore, studying firms' incentives to provide apprenticeships is highly relevant. Without neither any laws forcing firms to train nor any public subsidies for providing apprenticeships, the framework conditions have to ensure that providing apprenticeships is attractive for firms. The thesis investigates several highly relevant contextual conditions and shows which factors are conducive to a high engagement of firms in the dual system.

Overall, policy-makers could be considered the core target group for the findings of this thesis, as they are the ones who set the conditions and institutions, which in turn affect firms' training decisions. These conditions and institutions can be directly linked to the apprenticeship system, such as policy campaigns convincing firms to train or the development of training curricula. Nonetheless, also for related policy areas like the system of compulsory general education or the regulation of the labor market, it is important to understand potential side effects on firms' training engagement. Furthermore, firms can also benefit from the results of this thesis. Training firms may use of the results when organizing the process of recruiting apprentices. Non-training firms may use of the results when considering whether training could be a beneficial venture for them.

The insights given are relevant for countries with existing apprenticeships systems such as Germany, Switzerland, Austria, the Netherlands, and Denmark. Additionally, these insights are helpful for countries with school based systems of vocational education that want to introduce elements of duality, such as internships, in their educational systems and face the challenge of convincing firms to participate in the vocational education process. In the following, the policy relevant implications of the four empirical studies presented in this thesis are listed separately for each chapter.

Policy implications of chapter 3

"Firms should focus on oral and writing as well as problem-solving competencies in their recruitment decisions."

Chapter 3 investigates the relation between pre-training competencies and the productivity of apprentices. It focuses on oral and writing competencies, basic mathematics, IT, and problem-solving competencies, which have been acquired in the complete educational career prior to the start of the apprenticeship. Controlling for assortative matching and productivity enhancing firm effects, the analysis shows that especially oral and writing and problem-solving competencies and, to a lower degree, IT competencies are essential predictors for the productivity at the workplace.

This finding is especially relevant for firms, which have difficulties to recruit apprentices. Particularly in times of a relatively low demand for apprenticeship places, firms cannot simply choose the applicant who is best in all potential criteria. Instead, firms need to focus in the recruitment decision on characteristics that predict apprentices' potential productivity. Apprentices with high pre-training competencies also contribute more to the firms' economic output than apprentices with low pre-training competencies do because they conduct productive tasks more often. As the productive contributions of apprentices make up for 70 % of the total gross costs of training, a high productivity of apprentices can reduce the training costs substantially. As a result, it can be worthwhile for firms to employ assessment centers that test, e.g., for applicants' problem-solving competencies.

"For firms training occupations with a low share of analytical tasks and a high share of routine manual tasks, it can be worthwhile to use short internships to screen the applicants instead of relying only on school competencies."

A differentiation between occupational groups shows that the strong relation between pre-training school competencies and the productivity at the workplace can only be observed for commercial occupations and not for industrial/technical occupations. An additional differentiation between the different tasks shows that, e.g., problem-solving competencies are only imperative in occupations that involve a high share of analytical tasks and a low share of routine manual tasks. Thus, firms that train for occupations with a rather high share of routine manual tasks and a low share of analytical tasks should not focus too much on school competencies. Instead, these firms can better use short trial periods or internships in order to observe the applicants' practical skills before offering them an apprenticeship contract.

"Compulsory schooling should equip students with the necessary competencies to acquire vocational skills."

Even though we cannot claim clear causal evidence for the impact of pre-training competencies, the analysis suggests that on average school competencies are crucial for the productivity of apprentices. Better prepared school graduates are probably more productive in an apprenticeship, thereby making apprenticeship training more profitable from the firms' perspective. This relationship can be triggered by various mechanisms. Firstly, competencies could be directly relevant for the conducted tasks at the workplace. Secondly, having general skills can enable students to learn occupation-specific skills with less effort. Thirdly, productive apprentices are assigned more often to productive work tasks.

Thus, the quality of compulsory education seems to be pivotal for the employability of apprentices. If the educational system prepares the school graduates well for the work in an apprenticeship program, it can alleviate the economic burden the firm would have to carry otherwise. From a policy point of view, the results suggest that equipping young students with the right set of competencies might increase the attractiveness of offering apprenticeships.

Policy implications of chapter 4

"Labor market deregulations do not have to be detrimental to firms' incentives to provide apprenticeships."

Another essential framework condition relates to the employment protection regulation within the labor market. Various extensions of human capital theory regard labor market rigidities as a prerequisite for firms to invest in general training. The regulations of the labor market have an effect on the mobility of workers and therefore also recently trained workers. As training is only beneficial for the firm, if trained workers stay sufficiently long at the firm, firms operating in labor markets with a high degree of mobility will have lower incentives to invest in training. Chapter 4 challenges this view and shows that labor market regulations are not a pre-condition for the functioning of the apprenticeship system by analyzing the example of the German labor market reforms. If firms are able to increase the productive contributions of apprentices, providing apprenticeships can be attractive for firms even if they operate in a flexible labor market with a high mobility of recently graduated apprentices. The fourth chapter demonstrates that German firms did not abandon the training system; instead, they changed their training strategies after the implementation of the labor market reforms. German firms reduced the net costs of training by involving apprentices in more work and reducing non-productive tasks.

"Curricula should leave sufficient freedom for firms to allocate the apprentices to productive work."

The central idea in this chapter highlights the importance of apprentices' productive contributions for the engagement in apprenticeship training in in more competitive labor markets. The analysis has shown that the allocation of apprentices to productive work is not detrimental to the quality of the apprenticeship, especially when apprentices carry out work at the skilled worker level. Instead, learning and working can take place at the same time and should be seen as joint products.

Thus, the regulations of the training system should ensure that training firms have enough possibilities to allocate their apprentices to productive work tasks. On the one hand, this means that training regulations should provide sufficient freedom for firms to organize their training. This can be achieved, for example, by including choice options in the training curricula, thereby allowing firms to adapt the training according to their need. On the other hand, this means that the regulatory framework should ensure that apprentices spend enough time in the firm. For example, an increase of the days per week at the vocational schools could be counterproductive. Furthermore, a decrease in training duration could also limit firms' possibilities to benefits from apprenticeship training already during the training period. The allocation of apprentices to productive work usually increases with each training year as the apprentices have acquired more occupation-specific competencies in the course of the apprenticeship program. Accordingly, for some occupations a decrease in the training duration could decrease total training benefits for the firm, which will make it less attractive to train apprentices.

Policy implications of chapter 5

"Training regulations should include choice options in order to remain attractive for both the firms that supply apprenticeships and students that demand apprenticeships."

Chapter 5 showed that firms are more likely to supply apprenticeships when training curricula include choice options. On the one hand, this is due to the higher productivity of graduates who have acquired more skills that are relevant for the training firm. On the other hand, this is due to the firms' higher market power in the wage bargaining process with graduates. Moreover, this enables firms to train closer to the production process and to allocate apprentices more often to productive work. This insight is especially useful for curricula developers, who determine the amount of choice options within the curricula. The results further show that students also prefer curricula with more choice options and that the beneficial effects of choice options for firms do not come at the expense of a lower demand for apprenticeship places.

Nonetheless, the results should not be interpreted as a recommendation to increase the number of choice options without any limit. The results refer to the modernizations that were implemented between 2004 and 2014 and accordingly refer to the variation in the number of choice options that actually existed. Whether an expansion in the number of choice options beyond what has been implemented has beneficial effects on supply and demand cannot be answered with the data at hand.

Indeed, policy-makers may face a tradeoff situation. Even though more flexibility leads to higher attractiveness for firms, certain standardization is also important to ensure a sufficient mobility of graduated apprentices. Too much heterogeneity could overly restrict the apprentices' chances outside their training firms. Also for firms certain standardization could have beneficial effects, as this would ensure the availability of a sufficient number of skilled workers on the external labor market. This allows staffing flexibility in unforeseen situations, e.g., when additional skilled workers are needed. Nonetheless, the findings of the fifth chapter show that the implemented modernizations increasing the curricula heterogeneity retained sufficient standardization to prevent these potential adverse effects.

Policy implications of chapter 6

"Appeals that aim to increase the firms' investment in apprenticeship training and target the community spirit of firms can be successful."

The sixth chapter investigates the relationship between economic preferences of those who decide on a firm's training investments and the training policy of the firm. Decision-makers who are more altruistic and have a higher preference towards the future invest more in apprenticeship training. The evidence for the impact of altruism suggests that decision-makers take into account the enhanced subjective well-being of others. This increases the likelihood that appeals to firms' social responsibility have an effect on firms' training decisions because the requirement for such a campaign to work is that decision-makers in potential training firms care about the well-being of others. Another advantage of these kinds of campaigns would be that the higher training investments due to altruism are also related to higher training quality. In the long run higher training investments and higher training quality could lead to higher wages and a lower probability of getting unemployed (Pfeifer et al., 2012).

However, the impact of preferences is much stronger on a firm's training investments than on the decision to provide apprenticeship places at all. Thus, the effect of campaigns targeting altruism will probably be most effective for firms that already provide apprenticeships, while firms that do not provide training will need additional monetary incentives to start to train.

"Appeals that aim to increase firms' investments in apprenticeship training and target the awareness of the future need for skilled workers can be successful."

The sixth chapter also shows that time preferences are a significant predictor of training investments. Firms that employ decision-makers with a high preference towards the future are more likely to accept higher training investments because they value future benefits sufficiently high. Policy campaigns that address the future need for skilled workers are probably most effective to increase training investments in these firms.

Moreover, the results in this chapter also have important implications for the recruitment of human resource managers who decide on a firm's training investments. As a firm usually has a longer time horizon than their employees, it could be beneficial for the firm to employ decision-makers with high preferences towards the future as this will better align the decision-maker's preference with the firm's interest.

Curriculum Vitae

Anika Jansen studied at the University of Cologne, where she obtained her Bachelor degree in Economics in 2010. She graduated from the MSc program in International Economic Studies (track Behavioral Economics) from Maastricht University in 2012. She joined the German Federal Institute for Vocational Education and Training in March 2012. At the same time she started her PhD affiliated at the Research Centre for Education and the Labour Market (ROA) at Maastricht University. Her research focuses on the firms' cost and benefits of providing apprenticeship places, with a special focus on the firms' incentives to train under different institutional and regulatory frameworks.

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