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Apprenticeship Training – What for? Investment in Human Capital or Substitution of Cheap Labour?

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Apprenticeship Training – What for? Investment in Human Capital or Substitution of Cheap Labour?[1]

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Apprenticeship training in Germany is generally considered to be an investment of companies into the human capital of their apprentices. This view is mainly based on the German cost benefit studies which testify training firms high net costs for their apprenticeships, but these results have not been reconfirmed by other types of data or methods. We show that motivations for apprenticeship training are not homogeneous: some firms follow an investment strategy and others follow a substitution strategy. We derive an empirical method to identify different training strategies which can be used with publicly available company data. According to our classification, we find that in Germany 18.5 percent of all companies follow a substitution strategy and 43.75 percent to follow an investment strategy; the rest is mixed or undetermined. In a second step we estimate the determinants for a substitution strategy. We find sizeable differences between sectors with different skill requirements and between firms' coverage of industrial relations.

Key Words: Apprenticeship Training, Human Capital Investments, Substitution Effects
JEL Classification: I21, J24, J63

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I INTRODUCTION

The apprenticeship system in Germany is generally considered to be a company investment in human capital. This common belief is mainly based on the results of the German cost-benefit studies of the BIBB (for latest results cf. Beicht et al. 2004), which estimated that almost all companies have sizeable net costs of apprenticeship training[2]. Since apprenticeships are unanimously considered to offer general skills these findings have motivated many researchers to study the role of market imperfections as an incentive for the training decision of companies (Franz and Soskice 1995, Acemoglu and Pischke 1998/9, Dustmann and Schönberg 2004, Kessler and Lülfelsmann 2006). Based on these theoretical discussions, the German apprenticeship system is often used as the institutional setting for empirical investigations of company sponsored general training (Harhoff and Kane 1997, Acemoglu and Pischke 1998, Dustmann and Schönberg 2004). These empirical studies implicitly assume that all German firms which train apprentices invest in human capital but none of these studies actually checks this fact. However, in addition to an investment view, Lindley (1975) already argues that there may be a second motivation for apprenticeship training, namely a production or substitution strategy. He describes apprentices as productive workers who are used as cheap substitutes for unskilled or semiskilled workers. The substitution motivation states that the productivity of apprentices (who are used as regular production workers) is higher than their training costs and that the unit labour costs of apprentices are lower than the unit labour costs of other (unskilled) employees whom they substitute.

So the first aim of our paper is to study whether the German apprenticeship system is indeed homogeneously a human capital investment of the companies. We develop an alternative method which can be used with publicly available company data to identify the two training strategies of firms. We argue that a sufficient condition to distinguish between the two training strategies is the *within firm retention rate over several years*, defined as the average proportion of apprentices staying in the company in relation to all apprenticeship graduates of a company over several years. If an engagement in apprenticeship training is supposed to be an investment in human capital that earns long term returns for the company, such earnings are clearly only possible if a sufficient number of apprentices stays in the company after they have finished their apprenticeship (see the integrated model of Acemoglu and Pischke 1999)[3]. In contrast, a substitution strategy does not require that apprenticeship graduates stay within

[2] This refers to the full cost account which is cited in scientific papers.
[3] The net cost argument defined the apprenticeship as the investment period and the return period is defined as the employment of own apprenticeship graduates.

the training company because offering apprenticeships is driven by the unit labour costs of apprentices. If apprentices are indeed used as cheap labour during their apprenticeship it can to the contrary be expected that they are too expensive after their apprenticeship, meaning that retaining apprentices is rather the exception than the rule. If we look at the long-term retention rate we find a strong clustering on both extremes of the distribution. Overall, 18.5 percent of the companies never hire their own apprenticeship graduates, while 43.75 percent of the companies hire almost all of their own apprenticeship graduates. We argue that companies which never hire their apprenticeship graduates can be clearly assigned to the substitution strategy and that companies which hire almost all of their graduates can clearly be assigned to the investment strategy. Based on this classification method we find evidence for a non negligible share of companies with a substitution strategy (around 18.5 percent of all training companies). This result is in contrast to the widely accepted stylized fact of a pure investment strategy of German firms.

In a second step, we show the reliability of our classification method by comparing it with descriptive results of the most recent BIBB cost benefit study. In a third step, we study the determinants of companies using a substitution strategy. We first find that the probability of the substitution strategy increases with lower capital equipment, with the absence of works councils and with a higher share of white collar workers as well as in smaller firms. We further find that service sector firms have a significantly higher probability to follow a substitution strategy than manufacturing firms. Finally, we found complementarities between firms' investments in apprenticeship training and firm sponsored continuing training.

The paper is structured as follows. After a short literature review (section II), important institutional settings are introduced and the within firm retention rate is defined. Then, the company training strategies are verified by a comparison with the cost-benefit studies (section III). Afterwards, we estimate determinants of a substitution training strategy (section IV) and conclude with theoretical and policy implications (section V).

II LITERATURE REVIEW

According to Beicht et al. (2004) 96 percent of the training companies incur on average net costs during the apprenticeships[4]. They conclude that the investment strategy clearly dominates while the substitution strategy can only be found on the fringes. This stylised fact has motivated many researchers to study the role of market imperfections as a source of the investment of German companies in apprenticeships that provide general skills (Franz and

[4] The cost benefit study of Beicht et al. (2004) comprises two estimations. Here, we report only the full cost approach, because this is always cited in scientific publication. Both approaches are shown in section four.

Soskice 1995, Acemoglu and Pischke 1998/9, Dustmann and Schönberg 2004, Kessler and Lülfelsmann 2006). Their theoretical models explain the incentive of companies to invest in apprenticeships through asymmetric information (Acemoglu and Pischke 1998), complementarity between general and specific human capital (Franz and Soskice 1995, Lülfesmann and Kessler 2006) or labour market institutions such as unions (Dustmann and Schönberg 2004). Acemoglu and Pischke (1999) integrate different theoretical models in one general framework. In contrast to the frequently modelled investment strategy, the substitution strategy is mostly intuitively introduced. The substitution strategy can be analysed by a simple microeconomic production model with two substitutable input factors (e.g. apprentices and unskilled workers) in which employment is only dependent on the relative unit labour costs (substitution of two input factors). However, Lindley (1975) studied this strategy in a more complex and formal analytical framework.

According to the theoretical discussions the German apprenticeship system is used as the institutional setting for empirical investigations of company sponsored general training (Harhoff and Kane 1997, Acemoglu and Pischke 1998, Dustmann and Schönberg 2004), but the assumption of positive net costs are not been tested. Some of these empirical studies however stress that apprenticeship training strategies are not unique across sectors and firm sizes (Soskice 1994, Franz and Soskice 1995 or Neubäumer and Bellmann 1999). For example, an increasing training incidence by firm size is explained by the presence of internal labour markets in larger firms. A first doubt on the overwhelming dominance of net cost argument in Germany occurs by the Swiss cost benefit study of Wolter et al. (2006). They find that only one half of the larger firms and one third of the smaller firms incur net costs during the apprenticeship which is somewhat surprising because of the similarity of both training systems. However, Dionisius et al. (2008) show that a part of the difference can be explained by a higher share of productive tasks allocated to apprentices in Switzerland and the differences in comparatively lower apprentice to skilled worker wages. Finally, Zwick (2007) estimates the contribution of changes in the proportion of apprentices on changes in firm performance in Germany. He found an insignificant and not a negative effect of the share of apprentices on productivity which would be expected in a pure investment strategy. He concludes that the investment and the substitution strategy may outweigh each other on average and that the cost benefit study of Beicht et al. (2004) might underestimate the substitution strategy.

However, most of the cited theoretical and empirical studies fail to discuss explicitly the retention rate of apprenticeship graduates as a necessary precondition for a return on investment. One exception is the theoretical model of Acemoglu and Pischke (1999) in which

the retention rate is seen as an important training incentive. Empirical studies on the retention rates only focus on the individual rather than on the company. These studies estimate the effect of mobility of apprenticeship graduates on wages or duration of the first job after apprenticeship (see Euwals and Winkelmann 2004 for a discussion). There are also a few studies investigating different sectoral retention rates e.g. by Schwerdt and Bender (2003) who estimate the probability of an employer changing of apprenticeship graduates and Büchel and Neubäumer (2001) who estimate the determinants of an employment in the training occupation for apprenticeship graduates. However, to the best of our knowledge there is so far no empirical analysis based on company data and studying the relation of retention rates and apprenticeship training on company level[5].

III WITHIN FIRM RETENTION RATE AS AN INDICATOR FOR FIRMS' TRAINING STRATEGIES

We argue that a sufficient condition to distinguish between the two training strategies, investment or substitution motive, is the *within firm retention rate* which is defined as the proportion of apprentices staying in the company in relation to all apprenticeship graduates of a company. If a firm's engagement in apprenticeship training is supposed to be an investment in human capital, such earnings are clearly only possible if a sufficient number of apprentices stays in the company after they have finished their apprenticeship (see the integrated model of Acemoglu and Pischke 1999)[6]. So if companies were to follow an investment strategy a minimum number of retained apprentices would be a necessary precondition because without any apprentice staying at the company positive returns on investment are not possible. In contrast, a substitution strategy does not require that apprenticeship graduates stay within the company to make it economically successful because under a substitution strategy offering apprenticeships is driven by the cheap labour costs of apprentices in comparison to their productivity during the training period. If apprentices are indeed used as cheap labour it can be expected - contrary to what was expected above - that after the apprenticeship is finished the same person is too expensive in comparison to its productivity, meaning that retaining apprentices is rather the exception than the rule. So if the retention rate is always zero this can be assumed to be a reliable indicator for a substitution strategy.

[5] The German cost benefit studies use three year average retention rate to estimate the benefits of the apprentices training, but they do not report the rates.

[6] In the investment strategy the investment period is defined as the training period and the return period is defined as the employment of own apprenticeship graduates.

However, in order to reliably discriminate between companies following an investment or a substitution strategy, one additional condition has to be met. Since apprentices are always employed under fixed-term contracts (which are terminated at the end of the apprenticeship programme), apprentices themselves may decide not to stay in the company, meaning that not all apprentices are necessarily staying in the company even if a company with an investment motive would want them to stay. Instead, some of the apprentices may as well decide to leave the training firm after their apprenticeship. To account for this problem we look at the retention rate over several years to get a more reliable identification strategy for a company's training motive. We argue that if a company who invests in apprenticeship training over several years cannot attract a substantial share of their apprenticeship graduates to stay in the firm, it is requested to withdraw from apprenticeship training because otherwise it keeps having negative instead of positive returns to their investment. So even if we are not able to discriminate between contract terminations induced by the firm or by the apprentice, it still helps to single out firms following a substitution motive because a positive *within firm retention rate over several years* is a precondition for positive returns to the investment. Thus the within firm retention rate helps us to empirically distinguish between the two training strategies.

In order to do so we calculate the average yearly retention rate of apprenticeship graduates based on the waves 1996 – 2005 of the IAB Establishment Panel. This representative survey collects yearly information about the number of apprentices, graduates and stayers and a large number of general firm characteristics (see Kölling 2000). The retention rates immediately after completion of the apprenticeship is relatively stable and vary between 60 and 67 percent, corresponding to Euwals and Winkelmann (2004) or Franz and Zimmermann (2002)[7]. So in the short run only about one third of apprenticeship graduates leave the training firm.

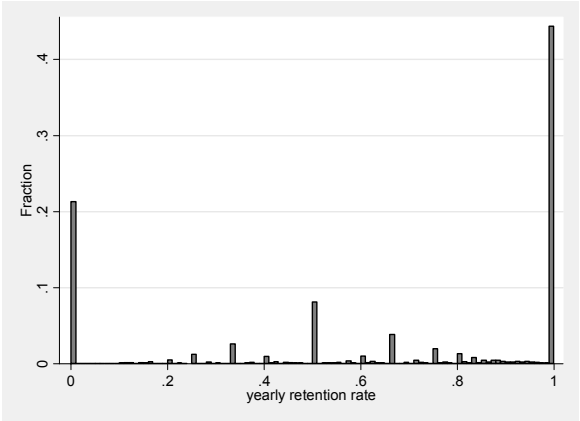
However, the yearly mean of the retention rate is a result of a strong clustering on both extremes of the retention rate distribution (see figure 1 panel A) which shows that on the left end of the distribution nearly 21 percent of all companies do not hire their own apprentices and on the right end of the distribution almost 45 percent of the companies hire all of their apprenticeship graduates. The strong clustering of the retention rate distribution is similar in every year. However, to identify the training motive of one particular company we need the retention rate of a particular firm over a minimum number of years and we name this *the within firm retention rate* and study it over several years (for all training firms for whom we

[7] The Berufsbildungsbericht as well as the study of Schwerdt and Bender (2003) use the weighted retention rates, whereby the weight is the inverse of the sample probability of the IAB Establishment Panel. The weighting result in a 10 percent lower retention rate on average.

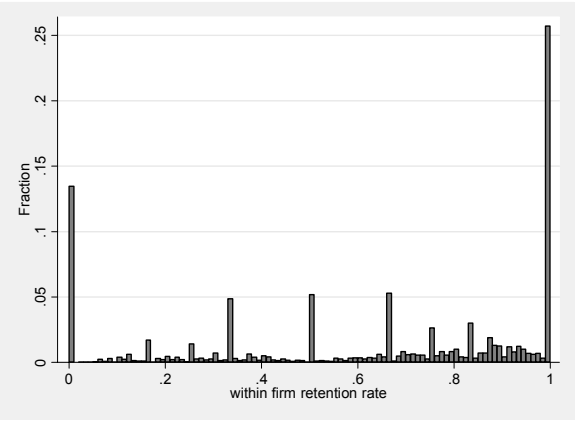
observe graduates in at least three years; see figure 1 panel B for the 2003 distribution)[8]. The distribution of the within firm retention rate over all firms shows a similarly strong clustering on both extremes of the distribution. Companies on the left end of the distribution in panel B of figure 1 never hire their own graduates over several years. At minimum, these 14 percent of all training companies can definitely not follow an investment strategy because they have no possibility of gaining returns after the investment period, i.e. after the apprenticeship termination. Thus the benefits have to be extracted during the apprenticeship period. In contrast, the companies on the right end of the distribution (25 percent) retain all their apprentices, clearly indicating that it pays to keep apprentices as skilled workers after they finish their apprenticeship.

Figure 1: The pooled cross section retention rate and the within firm retention rate of apprenticeship graduates in the year 2003.

Panel A: pooled cross section – yearly distribution



Panel B: within firm retention rate of a company



Source: IAB Establishment Panel, companies in 2003, the within firm retention rate is based on own calculation of the waves 1996 – 2005.

For a structural comparison of our results with results from earlier studies, namely Beicht et al. (2004) and Wolter et al. (2006), we use the following definition for a substitution or an investment strategy based on the distribution of within firm retentions: We define a firm to follow a substitution strategy, if the within firm retention rate is lower than 20 percent (these are firms on the far left end of the distribution in figure 1 panel B). We define a firm to follow an investment training strategy if the within firm retention rate is higher than 80 per-

[8] The retention rate distribution remains stable if we extent the minimal observation of graduates to 4 and 5 years but the number of observations naturally decreases (see appendix). This especially occurs in small firms which train only one apprentice.

cent over three years (these are the firms on the far right end in figure 1 panel B). These somewhat broader definition criteria have as another advantage that they also include companies which diverge slightly from their general retention policy due to a unexpected mismatch between the apprentices and the firm. According to this classification 18.5 percent of the companies' follow a substitution strategy and 43.75 percent follow an investment strategy[9].

If we compare these results with what has been found in the cost benefit study of Beicht et al. (2004) we find that our results are structurally very similar although on a different level (see figure 2 panel A). The BiBB study distinguishes between the "full cost account", which is supposed to provide a lower bound, and the "variable cost account" which is supposed to provide an upper bound of the substitution strategy (see Beicht et al. 2004 for a discussion).

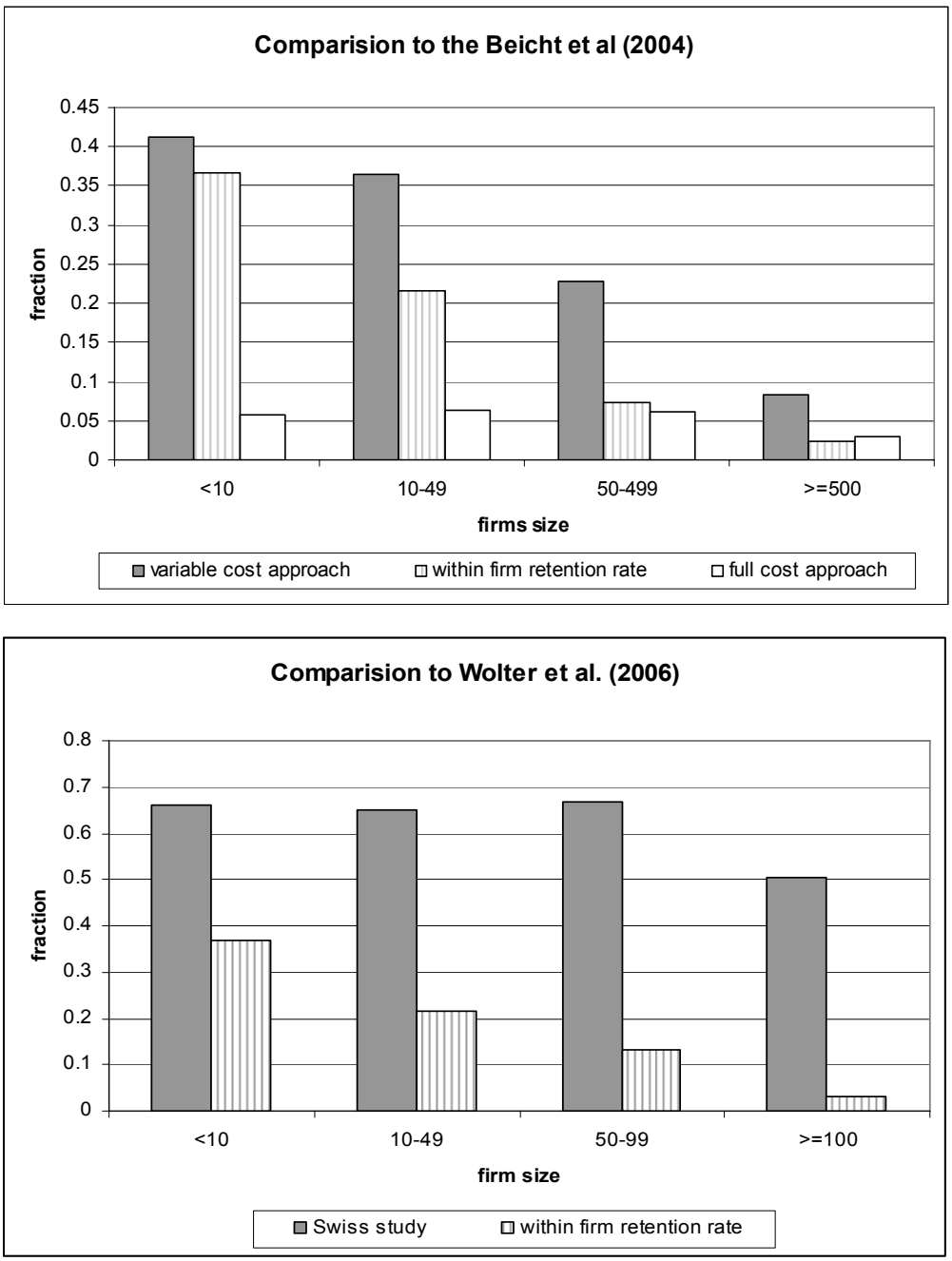
Figures 2 shows that the substitution strategy decreases by firm size according to the variable cost approach (dark bars) as well as according to our within firm retention rate classification (striped bars). In contrast, the full cost approach does not show a decreasing substitution strategy by firm size (light bars). We also find that our approach always lies between the calculated lower and upper bound of the cost benefit study, which indicates that our results provide an adequate classification despite its simple method and comparatively low data requirements. The strong firm-size related decrease in the proportion of firms with a substitution strategy can be assumed to reflect the importance of internal labour markets in larger firms which are less important or non-existent in smaller firms (Soskice 1994, Neubäumer and Bellmann 1999), differences in the occupational structure or differences in collective agreements containing an obligation to hire firm internal apprenticeship graduates.

Since the German apprenticeship system is very similar to the apprenticeship system in Switzerland we also compare our data with results of the Swiss cost-benefit study. In Figure 2 panel B the Swiss cost benefit study by Wolter et al. (2006) is compared with our within firm retention rate results[10]. According to the results of Wolter et al. the substitution training strategy is prevalent in around two third of small companies and in approximately one half of larger companies with more than 100 employees, thus the substitution strategy is more widespread in Switzerland than in Germany.

[9] If we vary the training strategy cutting points between 10/90 and 30/70 percent the summary statistics remain stable, but logical, there changes the number of companies. All following results are additionally calculated for different cut off points, which are shown in the appendix.

[10] Because of the different assignment of the firm sizes in both cost benefit studies two panels are necessary.

Figure 2: Comparison of the substitution strategy by firm size of the within firm retention rates to the cost benefit analyses of the German study (Panel A) and the Swiss study (Panel B)



The data of the German study by Beicht et al (2004) are provided by Günter Walden and the data of the Swiss study by Wolter et al (2006) are provided by Jürg Schweri, within firm retention rate is based on the IAB Establishment Panel.

IV DETERMINANTS OF A SUBSTITUTION TRAINING STRATEGY

In the following paragraph we use our classification to study what determines whether a firm follows a substitution or an investment strategy with its apprenticeship training. We estimate the determinants of the substitution strategy in the year 2003 for which we have most obser-

vations (results however remain stable if we use other years or vary the cut off points in the classification step; detailed results for alternative estimations are given in the appendix).

Table 1: Marginal Effects of a Probit Regression.

Dependent dummy variable: one = substitution strategy and zero = investment strategy.

	Coefficient	Z-Value	Coefficient	Z-Value
Share of White-Collar Worker	0.1022	1.76	0.1056	1.82
Share of Skilled Blue-Collar Worker	0.0613	1.02	0.0616	1.02
Export Share of the Revenue	-0.0008	1.17	-0.0008	1.24
Labour Turnover	0.0204	0.13	0.0221	0.15
Log(Investment)	-0.0109	3.97	-0.0107	3.88
Works Council*	-0.0560	2.17	0.0023	0.06
Collective Bargaining Contract*	0.0296	1.29	0.0623	2.25
Interaction W' Council Collective Barg.*			-0.0886	2.01
Firm Older than 5 Years*	-0.0113	0.43	-0.0128	0.49
Foreign Owned Company*	-0.0621	1.67	-0.0557	1.48
Workforce Development in the Last Year	-0.0006	1.47	-0.0006	1.45
Company Sponsored Further Training*	-0.0890	2.29	-0.0893	2.28
Located in East Germany*	0.0953	3.80	0.0987	3.94
Firm Size	-0.0002	2.60	-0.0002	2.55
Firm Size Square / 10000	0.0111	2.99	0.0107	2.94
Number of Observations	1381		1381	
Pseudo R	0.2311		0.2339	
log Likelihood	-556.7447		-554.7211	

* Dummy variable; the regression include 13 industry dummies, all service sectors are negative and mostly significant, while the manufacturing sectors are all positive (and mostly significant). Reference category: share of unskilled blue collar workers. Source: own calculations with the IAB Establishment Panel 2003 basing on classification on the waves 1996-2005.

The results of the 2003 regression analysis based on the above mentioned cut-off definition firstly show an increasing probability of a substitution strategy with a larger proportion of white-collar workers in comparison to the reference group of *unskilled* blue-collar workers[11]. This can be interpreted as a consequence of typical internal labour market characteristics. Internal labour market studies show that for blue-collar workers internal labour markets are much stronger, leading to a longer tenure and a higher probability of company sponsored general training, whereas for white collar workers internal labour markets are less strong and therefore firm sponsored general training should be lower (Janssen and Pfeiffer 2007). Internal labour markets also explain why larger firms are less likely to train with a substitution strategy: with increasing firm size the probability of internal labour markets rises and, therefore, the apprenticeships as one important port of entry into the internal labour market are

[11] Apprentices are not counted as employees.

more likely[12]. This is in line with the argument of Soskice (1994) who describes the role of internal labour markets as central for the apprenticeship system, because it helps large and medium-sized companies to retain their apprentices and it provides young people with a strong incentive to strive for an apprenticeship in those companies. Larger firms can therefore attract more able adolescents, as theoretically shown by Franz and Soskice (1995). This, together with the higher immediate retention rate (see also Euwals and Winkelmann 2004 for an individual perspective) allows larger firms to invest in more expansive training.

Thirdly, we find that service sector firms are significantly more likely to follow a substitution strategy than manufacturing firms. This corresponds with a lower importance of internal labour markets in service sector firms (Janssen und Pfeiffer 2007) and that these firms require more general skills (Smits and Zwick 2004). This can theoretically be explained by the skill weights approach of Lazear (2004) who shows that more general bundles of skills lead to a higher probability of an external job offer (see also Backes-Gellner et al. 2008). This causes a higher mobility of apprenticeship graduates in the service sector as a result of their more general combination of skills.[13] Basing on the skill weights approach, Backes-Gellner and Mure (2008) show that a higher mobility of apprenticeship graduates correspond with a more general combination of skills. Therefore, service sector firms are more likely requested to ensure cost neutral apprenticeship training and their apprentices have to be more productive during the apprenticeship than apprentices in other sectors where the combination of acquired skills is more specific. Evidence for a higher productivity of service sector apprentices is provided by Mohrenweiser and Zwick (2008) based on six years social security panel data study. They find a higher productivity of apprentices in commercial and trade occupations in comparison to manufacturing apprentices. Thus, if the service sector becomes more important in the future, this could result in an increasing importance of the substitution strategy if nothing else changes. According to this, Müller and Schweri (2007) show that sectoral changes explain a part of the declining training incidence of Swiss companies.

Fourthly, we find that a firm's coverage by a collective bargaining agreement results in a higher (but insignificant) probability of a substitution strategy whilst a firm with a works council have a significant lower probability of a substitution strategy. This is in line with the argument that works councils raise company sponsored training expenditures using their co-determination rights on social matters especially the skill development (Müller-Jentsch 1995).

[12] We modelled a continuous concave function of the firm size, but the maximum lies outside the observed firm size distribution.

[13] This paper analyses the mobility based on the companies view. Similar results of sectoral different mobility on an individual perspective are shown by Schwerdt and Bender (2003) or Franz and Zimmermann (2002).

These co-determination rights may be used to negotiate with the business management about an obligatory employment contract of apprenticeship graduates and this leads therefore to a declining probability of the substitution strategy. This describes theoretically the voice function of employee representation which is widely associated with works councils operating on the company level whereas collective bargaining takes place mostly on the industry level and it is carried out by trade unions (collective bargaining agreement). The wage bargaining can be associated with the union muscle and can be interpreted as a binding minimum wage (Kaufman 2004). The influence of minimum wages on companies training expenditures is mixed in theoretical and empirical studies (see Kaufman 2004 for a survey). Indeed, the interaction between works councils and collective bargaining is pronounced as the important link to understand the German system of industrial relation because works councils are more beneficial if the company is covered by a collective bargaining contract meaning that the distributional conflicts are delegated to the industry level (Hübler and Jirjahn 2003). Interestingly, an interaction term (works council and collective bargaining) enforces the pure collective bargaining effect which results now in a significant higher probability of the substitution strategy. This can be interpreted that if a company faces a binding minimum wage (here especial for unskilled workers) but not a works council it uses apprentices as substitutes for unskilled workers. Otherwise, the works council itself has no effect on the training strategy as long as the company is not covered by a collective bargaining agreement which means that the distributional conflicts are not delegated to the industry level. Indeed, the coverage of a works council and a collective bargaining contract decrease the probability of a substitution strategy (interaction effect). Here, the distributional conflicts are negotiated on the industry level and the works council may now use the co-determination rights to negotiate a job offer for apprenticeship graduates and this changes the role of apprentices within a company fundamentally. These findings support the argument of Hübler and Jirjahn (2003), who state that the interaction between works councils and collective bargaining is as fundamental as the firm size in explaining the German system of industrial relations.

Moreover, a higher capital equipment per employee leads to a lower probability of a substitution strategy indicating complementarities between physical and human capital (Franz and Soskice 1995, Acemoglu and Pischke 1999). Another interesting result is that a higher export share which is a common measure for a firms' competitiveness does not lead to a lower probability of a substitution strategy. This indicates that a stronger competitive environment is obviously not an obstacle for training investments. Interestingly, foreign owned firms are also not more likely to follow a substitution strategy. Although, foreign owned firms

have a lower probability to train apprentices, those firms obviously do not train to substitute unskilled workers with low wage apprentices. Finally, the negative relation between investment in further training and a substitution training strategy indicates complementarities between initial and further training expenditures. Additionally, we have controlled for changes in labour demand by taking into account the workforce development in the last year, to make sure that hiring of a company's own apprenticeship graduates is not a pure question of a rising labour demand.

V CONCLUSION

Apprenticeship training in Germany is typically seen as an investment of companies into the human capital of their apprentices in most theoretical and empirical studies over the last decades. This view is based on the German cost benefit studies which provide evidence for substantial net costs for firms training apprentices. However, this assumption has not been reconfirmed by other types of data or methods so far. We show that apprenticeship training does not follow one homogeneous strategy. Rather, some firms follow an investment strategy and others follow a substitution strategy. We suggest an empirical method based on a detailed analysis of retention rates to distinguish between firms which train for investment reasons and firms which are driven by a substitution strategy. According to our classification, we find 18.5 percent of all companies to follow a substitution strategy and 43.75 percent to follow an investment strategy; the rest is mixed or undetermined. We also find that our classification method is in line with structural features of the available cost benefit studies; the within firm retention rate distribution is located between the full and the variable cost account estimates of Beicht et al. (2004).

In a second step we estimate which firm characteristics determine a substitution strategy. We find that the probability of a firm following a substitution strategy increases with lower capital equipment, with the absence of works council and with a higher share of white collar workers as well as in smaller companies. We further find that service sector firms have a significantly higher probability to follow a substitution strategy than manufacturing firms and we find complementarities between firms' investments in initial training and firm sponsored continuing training.

Our findings are theoretically important because they challenge the assumption that German firms are generally faced with substantial net training costs. Companies with a substitution strategy employ apprentices because of their lower unit labour costs and, thus, they react strongly to relative wages of apprentices. Their decisions may be in sharp contrast to the

decisions taken by firms training apprentices according to an investment strategy because the latter care more about future returns and training quality rather than lowering apprenticeship wages. Thus we conclude that a sound analysis of apprenticeship training and its determinants firstly needs to distinguish firms training according to an investment or a substitution strategy.

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APPENDIX:

Figure A1. Within firm retention rate distribution of apprenticeship graduates by minimum observations increase:

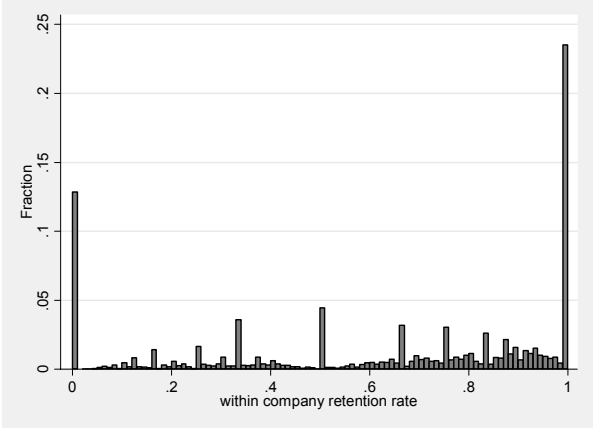
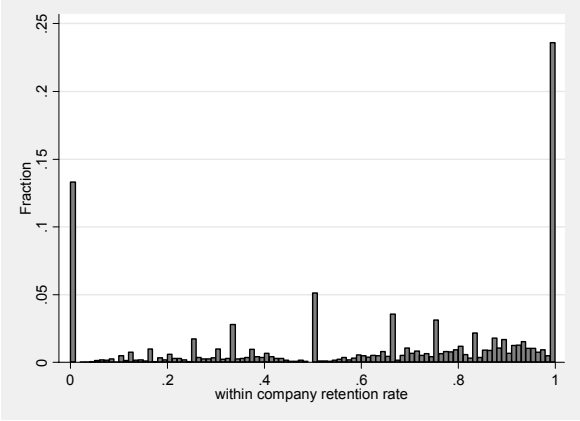
Minimum Observation: 4	Minimum Observation: 5
	

Table A1: Descriptive statistics, all classified companies in 2003.

	Number of Obs.	Mean	Standard Deviation	Mini-mum	Maxi-mum
Proportion of Substitution strategy firms	1381	0.2180	0.4130	0	1
Share of White-Collar Worker	1381	0.4396	0.2887	0	1
Share of Skilled Blue-Collar Worker	1381	0.3972	0.2900	0	1
Export Share of the Revenue	1381	17.72	25.38	0	100
Labour Turnover	1381	0.0243	0.0540	0	0.8913
Log(Investment)	1381	6.5993	3.4971	0	14.72
Works Council*	1381	0.6329	0.4822	0	1
Collective Bargaining Contract*	1381	0.6807	0.4664	0	1
W' Council and Collective B' Contract*	1381	0.5228	0.4997	0	1
Firm Older than 5 Years*	1381	0.1470	0.3542	0	1
Foreign Owned Company*	1381	0.1122	0.3158	0	1
Workforce Development in the Last Year	1381	-4.47	48.24	-701	445
Company Sponsored Further Training*	1381	0.9283	0.2581	0	1
Located in East Germany*	1381	0.3526	0.4780	0	1
Firm Size	1381	380.27	1069.58	1	19443

Table A2: Descriptive statistics, substitution strategy companies in 2003.

	Number of Obs.	Mean	Standard Deviation	Mini-mum	Maxi-mum
Share of White-Collar Worker	301	0.5069	0.3286	0	1
Share of Skilled Blue-Collar Worker	301	0.3798	0.3274	0	1
Export Share of the Revenue	301	5.08	15.43	0	100
Labour Turnover	301	0.0326	0.0695	0	0.5714
Log(Investment)	301	4.9015	3.8318	0	12.44
Works Council*	301	0.3721	0.4842	0	1
Collective Bargaining Contract*	301	0.5914	0.4924	0	1
W' Council and Collective B' Contract*	301	0.2857	0.4525	0	1
Firm Older than 5 Years*	301	0.2226	0.4167	0	1
Foreign Owned Company*	301	0.0332	0.1795	0	1
Workforce Development in the Last Year	301	-4.12	53.67	-701	350
Company Sponsored Further Training*	301	0.8372	0.3698	0	1
Located in East Germany*	301	0.5183	0.5005	0	1
Firm Size	301	123.39	764.44	1	13080

Table A3: Descriptive statistics, investment strategy companies in 2003.

	Number of Obs.	Mean	Standard Deviation	Mini-mum	Maxi-mum
Share of White-Collar Worker	1080	0.4209	0.2738	0	1
Share of Skilled Blue-Collar Worker	1080	0.4020	0.2786	0	1
Export Share of the Revenue	1080	21.24	26.47	0	100
Labour Turnover	1080	0.0220	0.0485	0	0.8913
Log(Investment)	1080	7.0725	3.2451	0	14.72
Works Council*	1080	0.7056	0.4560	0	1
Collective Bargaining Contract*	1080	0.7056	0.4560	0	1
W' Council and Collective B' Contract*	1080	0.5889	0.4923	0	1
Firm Older than 5 Years*	1080	0.1259	0.3319	0	1
Foreign Owned Company*	1080	0.1343	0.3411	0	1
Workforce Development in the Last Year	1080	-4.57	46.64	-323	445
Company Sponsored Further Training*	1080	0.9537	0.2102	0	1
Located in East Germany*	1080	0.3065	0.4612	0	1
Firm Size	1080	451.87	1130.10	2	19443

Table A4: Marginal Effects of Probit Regression in different years, with the same cut off point 20/80, the 2003 regression is reported in the text.

Dependent dummy variable: one = substitution strategy and zero = investment strategy.

	2001: 20/80		2003: 20/80		2005: 20/80	
	Coef.	Z	Coef.	Z	Coef.	Z
Share of White-Collar Worker	0.1420	2.51	0.1056	1.82	0.0974	1.45
Share of Skilled Blue-Collar Worker	0.1296	2.28	0.0616	1.02	0.0574	0.84
Export Share of the Revenue	-0.0018	2.24	-0.0008	1.24	-0.0009	1.35
Labour Turnover	-0.0155	0.11	0.0221	0.15	0.0614	0.37
Log(Investment)	-0.0118	3.52	-0.0107	3.88	-0.0102	3.52
Works Council*	-0.0217	0.57	0.0023	0.06	-0.0193	0.53
Collective Bargaining Contract*	0.0577	2.13	0.0623	2.25	0.0601	2.20
Interaction W' Council Collective B' Contract*	-0.0998	2.16	-0.0886	2.01	-0.0677	1.49
Firm Older than 5 Years*	-0.0245	0.87	-0.0128	0.49	-0.0094	0.35
Foreign Owned Company*	-0.0337	0.86	-0.0557	1.48	-0.0576	1.50
Workforce Development in the Last Year	-0.0002	1.01	-0.0006	1.45	0.0004	1.15
Company Sponsored Further Training*	-0.0847	2.43	-0.0893	2.28	-0.0326	0.87
Located in East Germany*	0.0738	2.90	0.0987	3.94	0.0767	2.94
Firm Size /10	-0.0002	0.46	-0.002	2.55	-0.003	3.70
Firm Size Square / 10000	0.00005	0.48	0.00011	2.94	0.0021	4.06
Number of Observations		1372		1381		1065
Pseudo R		0.2019		0.2339		0.2546
log Likelihood		-554.0939		-554.7211		-418.9715

* Dummy variable; including 13 industry dummies, all service sectors are negative and mostly significant, while the manufacturing sectors are all positive (and mostly significant). Reference category: share of unskilled blue collar workers. Source: IAB Establishment Panel 2003 basing on classification on the waves 1996-2005, own calculations.

Table A5: Marginal Effects of Probit Regression with different cut off points in 2003, the 20/80 regression is reported in the text.

Dependent dummy variable: one = substitution strategy and zero = investment strategy.

	2003: 15/85		2003: 20/80		2003: 25/75	
	Coefficient	Z	Coefficient	Z	Coefficient	Z
Share of White Collar Worker	0.0606	1.45	0.1056	1.82	0.0867	1.56
Share of Skilled Blue Collar Worker	0.0049	0.11	0.0616	1.02	0.0323	0.56
Export Share of the Revenue	-0.0005	1.01	-0.0008	1.24	-0.0007	1.17
Labour Turnover	-0.0053	0.05	0.0221	0.15	0.0485	0.33
Log(Investment)	-0.0080	3.88	-0.0107	3.88	-0.0108	4.15
Works Council*	0.0267	1.06	0.0023	0.06	0.0103	0.31
Collective Bargaining Contract*	0.0438	2.26	0.0623	2.25	0.0478	1.77
Interaction W' Council Collective B' Contract*	-0.0584	1.78	-0.0886	2.01	-0.0843	2.04
Firm Older than 5 Years*	-0.0070	0.38	-0.0128	0.49	-0.0140	0.55
Foreign Owned Company*	-0.0428	1.53	-0.0557	1.48	-0.0450	1.24
Workforce Development in the Last Year	-0.0001	0.18	-0.0006	1.45	-0.0006	1.58
Company Sponsored Further Training*	-0.0499	1.71	-0.0893	2.28	-0.1112	2.87
Located in East Germany*	0.0817	4.16	0.0987	3.94	0.0960	4.02
Firm Size	-0.0003	3.50	-0.0002	2.55	-0.0002	2.84
Firm Size Square / 10000	0.0014	3.52	0.0011	2.94	0.0013	3.24
Number of Observations		1122		1381		1549
Pseudo R		0.2782		0.2339		0.2251
log Likelihood		-402.8253		-554.7211		-644.2081

* Dummy variable; including 13 industry dummies, all service sectors are negative and mostly significant, while the manufacturing sectors are all positive (and mostly significant). Reference category: share of unskilled blue collar workers. Source: IAB Establishment Panel 2003 basing on classification on the waves 1996-2005, own calculations.