Business success and apprenticeship training

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Abstract:

Whilst in applied empirical research, training in general human capital is mainly explained by structural characteristics of firms, this paper introduces business expectations as an additional explanatory factor. Business expectations are strictly time-variate and firm-specific and reflect both a firm's development in competitive markets and in the business cycle. We assume that a firm's business expectations strongly modify the cost-utility concept for firms' decisions as regards providing apprenticeship places.

When controlling for firms' structural characteristics, static econometric models support our assumption that a change in business expectations leads to an asymmetric adjustment process of firms' qualitative decisions regarding apprenticeship training. Concerning the quantitative decision as to how many apprenticeship places a firm provides we found a significant but not asymmetric response to a change in business expectations.

A dynamic approach confirms the results obtained in the static models of a symmetric quantitative adjustment process in a short-term perspective even in the absolute value. In a medium-term perspective the dynamic model supports the assumption of an asymmetric quantitative adjustment process. Uncertainty regarding business expectations tends to reduce the quantity of apprenticeship training at firm level.

Keywords:

Apprenticeship training, human capital theory, business expectations, uncertainty, asymmetric adjustment process

JEL-Codes: J24; I21; M53

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1 Introduction

Since the mid-eighties firms' provision of apprenticeship places has decreased dramatically in the old German *Länder*. Whilst in 1986 firms provided some 700,000 new apprenticeship contracts, there were only about 450,000 in 2006. This process has found its continuation in unified Germany since the early nineties. Both sectoral change and the restructuring of enterprises have been identified as the driving mechanisms behind this development. In addition to this structural change, microeconomic studies provide some evidence that firms' human capital profile, their internal on-the-job training and further training or recruitment strategies and firm-size characteristics explain firms' provision of apprenticeship places more or less stably over time (Neubäumer/Bellmann 1999; Dietrich 2000; Beckmann 2002; Euwals/Winkelmann 2004; Niederalt 2004; Dietrich/Gerner 2005).

Besides these firm-specific characteristics of business organisation, recent literature indicates some arguments that uncertainty concerning the further development of business success influences firms' future provision of new apprenticeship places (DIHK 2006; Bellmann/Hartung 2005). The aim of this paper is to introduce business expectations und uncertainty into microeconomic models explaining firms' qualitative and quantitative decisions about providing apprenticeship places. According to our considerations, firms' business expectations reflect both firms' expected performance in competitive markets and macroeconomic factors such as the expected progress of the business cycle. In this respect business expectations as a core element of firms' rational decisions are associated with uncertainty in a more general sense. A more specific concept of uncertainty, discussed in more detail in section 5, is adapting a risk concept formulated by Rothschild and Stiglitz (1970).

In the remainder of the paper, on the basis of human capital theory, explanations of firms' provision of apprenticeship places (Becker 1964; Harhoff/Kane 1997; Acemoglu/Pischke 1998; 1999a and b; Clark/Fahr 2002; Niederalt 2004) are extended by introducing business expectations as an exogenous variable. Compared with more static variables describing firms' characteristics of organisation and workforce, business expectations seem to be more variable over time. Furthermore

we adopt theoretical and empirical considerations about asymmetric processes of adjustment of firms' training decisions to changes in explanatory variables.

In the empirical section of this paper we use data from the IAB Establishment Panel. In a first analytical step, a static approach is applied to answer two questions: a) what factors motivate firms to train apprentices (qualitative decision) and b) what happens to the number of apprentices recruited by a firm when these causal factors vary over time (quantitative decision). Subsequently a dynamic approach is used to model the adjustment process for the quantitative decision. In an application we use our results to formulate assumptions about the effect of uncertainty regarding business expectations over time on a firm's quantitative and qualitative decision as to whether to provide new apprenticeship places in a given year or not.

2 Theoretical considerations

Why do firms pay for apprenticeship training (regulated by the German vocational training act, BBiG), even if apprenticeship training is an investment in general human capital? Becker already raised this question in the early sixties (see Becker 1962; 1964) and Acemoglu/Pischke (1999) and Niederalt 2004 reviewed in detail the ongoing research especially related to the German apprenticeship system.

In particular two types of training costs can be distinguished: direct and indirect costs. Direct costs are for example expenditure on firm-based training facilities or wages for apprentices. Indirect costs occur while workers spend part of their working time on training apprentices instead of on production. A net cost perspective takes into account the fact that even apprentices may be productive while being trained. Calculations by Beicht and Walden (2004) present a remarkable variation of net training costs, explained partly by firm size, industry and the type of occupation that apprentices are being trained in. Concepts motivated by net cost are closely related to assumptions derived from production-theory considerations (see Lindley 1975; Fougère/Schwerdt 2002). Also, a specific type of firm is able to gain net returns from investments in general training already during the training period.

In general, production-motivated explanations are not sufficient to explain firms' training activities in apprenticeship training. So it is also worth noting that considerations oriented towards net cost only take into account costs and returns

occurring during the institutionally defined period of contract-based apprenticeship training. Opportunity costs or transaction costs (e.g. recruitment costs for skilled employees) may occur, however, when this type of training is completed. These types of costs are not considered here. Investment-motivated considerations (Franz/Soskice 1995; Timmermann 1998; Fougère/Schwerdt 2002) reflect the returns on training after the completion of an apprenticeship. From this viewpoint, apprenticeship training improves not only productivity during the training period but also future productivity. High mobility costs for workers, institutional barriers and low labour turnover in Germany (Harhoff/Kane 1997), asymmetric information on the ability of the apprentices and other market imperfections generate compressed wage structures and allow firms providing apprenticeship training to take a rent from employees trained within the firm compared with firms who recruit employees on the labour market (Acemoglu/Pischke 1998, 1999a, 1999b, Beckmann 2002; Clark/Fahr 2002). According to Franz/Soskice (1995) and Werwatz (1996) apprenticeship training provides additional firm-specific skills. According to assumptions on high factor specificity (Holtbrügge 2004; Williamson 1990) training firms may have additional advantages from this firm-specific human capital which is generated *en-passant* [1].

Increasing or decreasing business expectations, however, affect both the cost and the reward sides of apprenticeship training. Decreasing business expectations indicate to training firms an expected reduction in the productive contribution of apprentices to the firm. As a consequence the net costs of apprenticeship training may increase and training firms will reduce their provision of training capacities. A precondition for long-term returns on firm-based training is that firms will be able to retain apprentices after the training period. As labour demand depend on the demand for goods (Freemann 1972), the future market position must be sufficient to retain the apprentices who are currently undergoing training. When offering new apprenticeship places, firms have to make their decisions under uncertainty. So business expectations could be a relevant indicator in firms' decisions. Expanding on Acemoglu/Pischke (1999a, 1999b), a reduction in business expectations should decrease not only the probability of firms retaining their own apprentices afterwards

[1] Alternative training motives such as a reputation motive (Sadowski 1980), a stock-keeping motive especially of larger firms (Backes-Gellner 1992) or industry-specific arguments (Büchel/Neubäumer 2001) are not taken into account here.

but also the probability of using them productively during the apprenticeship training. As a consequence this will increase the expected costs of training.

With respect to the above-mentioned motives for a training decision, subsequent possible effects of short-term and long-term changes in business expectations are considered. Short-term variation in business expectations limits the opportunities for using apprentices' productivity during the training period. As a consequence, decreasing short-term business expectations increase the net costs of firm-based training in a production-motivated perspective. From an investment-motivated perspective long-term-oriented changes in business expectations will influence the assumptions on expected opportunity and transaction costs.

Supported by empirical evidence, assumptions from behavioural finance suggest that a deficit of a given amount is perceived by actors more sorely, than earnings of the same amount increase individual utility – this paradox motivates so-called loss aversion (Bank 2001; Gul 1991). Given a loss-averse behaviour, actors will renounce investments more easily with a given decrease in business expectations than they will make investments in the opposite case. In this respect, firms' training decisions should correspond with asymmetric investment or adjustment decisions. We assume that firms will reduce their training facility to a greater extent than they would intensify their training facilities in the case that business expectations improved to the same extent.

From a human-capital theory perspective, firms' training behaviour depends on enterprise-specific characteristics such as the human capital distribution of the employees, recruiting strategy, industry or firm size (Dietrich /Gerner 2005; Niederalt 2004; 2005; Dietrich 2000).

3. Econometric analysis – Part 1: static approach

3.1 Econometric strategy, data, variables and hypothesis

Analytically there are two basic management decisions – first a qualitative decision: either the firm trains apprentices or it does not, and second the quantitative decision: how many apprentices are to be trained by an individual firm (Niederalt, 2004; 2005).

To model the qualitative decision, we apply logit techniques. To use the structure of the data, we control for unobserved heterogeneity by estimating both a logit model

with random effects (see Conway, 1990; Liu/Pierce, 1994) and a logit model with fixed effects (Chamberlain, 1980). A Hausman test is employed to identify the most appropriate approach for interpretation, given the assumptions made.

The quantitative decision is modelled by using linear regressions. Again fixed effects and random effects models are calculated to control for unobserved heterogeneity (Arellano, 2003). A Hausman test supports the decision regarding the model adequacy.

The data used for the econometric analysis are derived from the IAB Establishment Panel. These data are collected annually by means of personal interviews with managers of a randomised sample of firms. In western Germany the first wave of the IAB Establishment Panel was carried out in 1993; since 1996 the sample has also covered eastern Germany. The IAB Establishment Panel is a multiply stratified sample of all German firms which have at least one employee covered by social security (Kölling, 2001). The fact that the panel is unbalanced (Bellmann et al., 2002) is ignored in our analysis[2]. The subsample used for this paper does not include firms with fewer than ten employees, as such firms would hardly be able to recruit new apprentices every year.

The endogenous variable in our logit analyses is a dummy which is zero for enterprises which do not recruit an apprentice in a given year and is one if at least one new training contract is concluded. The endogenous variable in the linear regressions is given by the rate of change of the number of new apprenticeship contracts against the previous year[3].

In both models we introduce a given set of exogenous variables. The variable “short-term business expectations” uses information which is measured directly. In each panel wave since 1993 firms have been asked to answer the question: “How do you expect the business volume to develop in the current year (t), as compared with the previous year (t-1)? Is it expected to remain constant, to increase or to decrease?” In the case of change, the change in percentage points is asked for. For our analysis we make use of the given raw scores. We assume a positive correlation of the exogenous variable “change in business expectations” with both endogenous training variables. In addition a dummy variable is constructed which has the value of one if

[2] Following Nijman/Verbeek (1992) unit non response in unbalanced panels should be at random; which is the case with the IAB establishment panel (Hartmann/Kohaut 2000).
[3] $Rate_t = N_t\text{-}N_{t-1}/N_{t-1}$; with N_t = number of new apprentices in time t.

the sign of the change in business expectations is negative and this variable interacts with the business expectations. The influence of this new variable is expected to be positive[4]. This strategy enables us to identify different coefficients depending on the sign of the business expectations (descriptive statistics of the exogenous variables can be found in Tables A1 and A2 in the appendix).

A further set of exogenous variables serves mainly to control for observed heterogeneity of firms. The share of skilled employees among all employees ranges between zero and one and is an indicator of firms' demand for skilled workers. As we assume, firms recruit at least some of their skilled staff from their apprentices, the correlation between this variable and the training behaviour of the firms should be positive.

The technical state of the firm should influence the training decision in a positive way (Franz et al 2000). As there is an expected complementarity between human capital and physical capital (Filer et al., 1995), especially firms using the latest technology are limited when recruiting skilled staff on the labour market. Firms with state-of-the-art technology are coded with a value of one whereas firms using obsolete technology are coded with five.

The staff turnover rate as the share of personnel outflow as a percentage of the total number of employees has a serious impact on the investment motive of apprenticeship training. In case the investment motive is decisive for the training decision we assume a negative effect, as firms' returns from training seem to be limited. Analogously we expect the effect of staff turnover for the quantitative decision.

The share of atypical workers, such as freelancers or agency workers, in the workforce should have a negative influence because enterprises which make considerable use of these groups of workers, are expected to recruit know-how from outside. A rate of 100% is given a value of one.

[4] As e.g. Ai/Norton (2003) mentioned, the use of interaction terms in nonlinear models such as logit models causes some fundamental problems. In the given case, however, the coefficient for business expectations and the interaction term identifying a negative change should just be interpreted simultaneously. Additional effects results form the control variables. In detail a marginal reduction in business expectations will be compared to the reference situation in the representative firm; the reference situation is defined by business expectations of 0% and the representative firm by the mean vector of the remaining exogenous variables. Statistical significance of the gross effect of a negative change is to be identified by a simple Wald test; following Ai/Norton(2003) and Norton et al. (2004) the identification of the standard error using the so-called delta method (see Xu/Long 2005; Oehlert 1992) is not required.

Collective bargaining often includes negotiations about firm-based apprenticeship training. Firms which are involved in such negotiations are more likely to opt for apprenticeship training and will also recruit more apprentices.

The probability of recruiting at least one apprentice is simply correlated with firm size, measured in terms of the number of employees; however there are no precise arguments concerning the intensity of apprenticeship training.

Industry dummy variables control for the primary, manufacturing and services sectors. Compared with other sectors the manufacturing industry has a long tradition of apprenticeship training and up to now apprenticeship training has taken place there in very specific training occupations; furthermore training is less school-based and more practical in this field. Finally time dummies are included.

3.2 Results of the static analysis

The results of the logit estimates can be found in table one. The signs for significant coefficients are equal in both the random effects and the fixed effects model. A Hausman test favours the random effects model; so the interpretations are based on this model.

Whereas improvements in business expectations do not have an influence on the probability of recruiting at least one new apprentice, an influence can be seen if business expectations are decreasing. In a representative firm the probability decreases by around 0.3 percentage points if business expectations fall by one percentage point; this effect is highly significant.

Table 1 about here

The technical state of the firm and the existence of collective bargaining do have the expected positive influence on the training decision. Following the assumption of a complementary relationship between physical and human capital, the training probability increases with the technical state. What is remarkable is the fact that this probability increases if an enterprise changes from the status “there is no collective bargaining” to the status “there is collective bargaining” and vice versa – the marginal effect in the representative firm being four percentage points.

The results confirm a positive correlation between the number of employees and a firm's training activity. It is more or less plausible that the training probability increases with firm size. The relative entry cost into apprenticeship training decreases as firm size increases.

The share of skilled employees improves a firm's probability of recruiting new apprentices, and firms in the manufacturing sector are more likely to train apprentices than other firms. Firms with a high staff turnover tend to abstain from concluding new apprenticeship contracts. Finally no significant influence can be found from the share of atypical workers.

Table two displays the results of the linear regressions; a Hausman test prefers the fixed effects model. However, the signs of the significant coefficients are again the same in the two estimated models.

Table 2 about here

An improvement in the business expectations by one percentage point induces an improvement in the vocational training engagement of 0.4 percentage points – an asymmetric behaviour like in the logit models can not be found. Staff turnover has a decreasing effect. The share of atypical workers has a significant positive influence, which is not in line with our expectations. What is plausible, however, is the positive correlation between a change in the number of employees and a change in the vocational training engagement. Moreover the estimations indicate a positive influence of the share of skilled employees and the existence of collective bargaining, whereas the coefficients are supposed to be inconsistent. What is unsatisfying, however, is the weak explanatory power, both models only explain about one per cent of the variance.

Altogether it can be concluded that structural determinants obviously do have a greater influence on the decision as to whether a firm should provide at least one new apprenticeship than on the extent of engagement in vocational training. Therefore changes in the German economy, especially the change from an industrial to a services economy, have probably reduced the number of firms which provide apprenticeships at all. Indications regarding a cyclical dependence are quite different in the two approaches. Thus the coefficients for the business expectations do have the expected signs, at least when they are significant. What is surprising, however, is

the fact that an improvement in business expectations does not influence the probability of opting for new training at all. The estimations indicate that the extent of engagement in training depends on improvements and also on negative developments in business expectations. Asymmetric behaviour seems to occur in the logit case only. One possible reason for this result is the fact that until now we have ignored possible dynamic aspects, which are quite plausible because reaction takes time. This consideration is the subject of the next section.

4. Econometric analysis – Part 2: dynamic approach

4.1 Econometric model, data and variables

In this section we model explicitly dynamic aspects by estimating an "autoregressive distributed lag (ADL) model" with fixed effects. In our strategy we follow Sheldon (2003) straightforwardly. It should be noted that Sheldon (2003) estimated an error correction model (EC), but due to the fact that these two approaches (ADL and EC) are structurally identical, the method to control for unobserved heterogeneity by ordinary within transformation can be applied to ADL directly[5].

If the residuals in an ADL model are independent and identically distributed (iid) and there is not a unit root in the variables, an OLS model usually leads to consistent parameter estimates (Verbeek, 2002; Beck, 2005). In particular serially correlated errors cause a serious problem in this context (Beck, 2005; Wolters, 2003; Baltagi, 1998). To avoid this problem we choose the appropriate lag structure, based on a Breusch-Godfrey test. Another problem could, however, arise from the fact that the within transformation induces another endogeneity problem in a dynamic model by construction (Greene, 2003). As our model selection is based on a Breusch-Godfrey test, the resulting inconsistency problem should be small[6].

Following Carruth/Dickerson (2003), we define a dummy variable and include an interaction term between this dummy and the exogenous and endogenous variables in our estimates (the dummy has the value of one if business expectations are negative) to model a possible asymmetry.

[5] It would also be plausible to use a vector autoregressive model with fixed effects. As the endogeneity or causality is clear, however, we preferred ADL (Hsiao, 2004; Verbeek, 2002).

[6] Another indication in this direction is the fact that the difference between the coefficients of the business expectations in t is not statistically significant in the static and the dynamic models, which will be discussed later.

Box 1 about here

Box one illustrates the model selection process in a simplified form. The application of this procedure suggests the following model:

$$y_{i,t} = \alpha_i + \Theta_1 y_{i,t-1} + \Theta_2 y_{i,t-2} + \Theta_3 \delta_{i,t} \delta_{i,t-1} \delta_{i,t-2} y_{i,t-2} + \Theta_4 y_{i,t-3} + \phi_1 x_{i,t} + \phi_2 x_{i,t-2} + \lambda_t + \varepsilon_{i,t}$$

With:

α_i : Firm-specific effect (fixed effect)

$y_{i,t}$: Rate of change of the number of new apprenticeship contracts against the previous year, firm i in year t

$x_{i,t}$: Business expectations, firm i in year t

$\delta_{i,t}$: Dummy which has the value of one if the sign of the business expectations is negative, firm i in year t

λ_t : Time-specific effect

$\varepsilon_{i,t}$: Error term

Our approach opens up the opportunity to identify differences in firms' adjustment behaviour depending on whether business expectations are good or bad for just one period or for a longer time. Moreover it is possible to see asymmetries in the adjustment behaviour of the firms. One central assumption is that a firm immediately changes its adjustment scheme if the sign of business expectations changes. What is quite interesting is the result that Wald tests do not find a significant influence of the interaction term between the dummy and the exogenous variable, which is in line with the results in the static case.

The estimates are again based on the IAB Establishment Panel. The exogenous variable is again business expectations compared with the activity a year earlier. As in the static model, the endogenous variable is the change in the number of new apprenticeship contracts compared with the previous year – we take the rate of change. Again we only take firms into account which have at least ten employees; the fact that the IAB Establishment Panel is "unbalanced" is also ignored again.

4.2 Results of the dynamic analysis

The results can be found in Table 3. As mentioned above, firms' responses to business expectations are symmetrical with respect to the direction if we look at the short run – in the case of a positive (negative) change in business expectations of one percentage point, the engagement in vocational training increases (decreases) by 0.35 percentage points. It should be mentioned that the result is really in line with those obtained in the static case, the difference is statistically insignificant. In the case that the sign of business expectations does not vary for a longer time (for at least three periods) firms choose a lower equilibrium rate of change in the negative case, although the asymmetry is not really significant (0.21 percentage points in the positive case to 0.185 in the negative case). Finally the strong quantitative correlation between the exogenous and the endogenous variables is quite interesting. This indicates a strong cyclical dependence of the supply of apprenticeships.

One possible economic explanation for the identified (weak) asymmetry could be the fact that firms, irrespective of cyclical factors, train something like a supplement amount, which isn't "touched" in the case of short-term decreases in business expectations. Such an explanation could be justified with the theory of internal labour markets (Saint-Paul, 1996; Doeringer/Piore, 1971).

Table 3 about here

5. Application of the estimates

Increasing uncertainty regarding the economic future has been mentioned recently by various authors as being an influential factor for a decreasing commitment of firms to training apprentices (Bellmann/Hartung, 2005; DIHK, 2006). Within this paper increasing uncertainty is defined as an increase in the changes of the sign of business expectations, whilst the mean of the individual firms' business expectations remains constant. This definition is in line with the risk concept of Rothschild/Stiglitz (1970), which defines an increase in risk as a "mean preserving spread". Moreover, it should be mentioned that, strictly speaking, uncertainty and risk are two different

concepts, but it is usual to ignore this difference if this distinction is not the subject of the paper (Miller, 2002)[7].

Taking a look at the estimates regarding the probability of providing training, business expectations only induce firms to change from the status “new apprenticeships” to “no new apprenticeships”. Uncertainty as defined above would obviously lead to a reduction in the number of firms which provide training.

Finally both the static and the dynamic models indicate that there is no asymmetry in firms’ behaviour as regards adjustment to business expectations in the short run. Thus a negative reaction regarding engagement in vocational training, induced by poor business expectations, reduces the basis (the level of the engagement) so considerably that a subsequent symmetric positive reaction induced by good business expectations would be not strong enough to compensate for the reduction. In the long run however, the dynamic estimates give an indication that negative reactions are less sensitive, but it is clearly doubtful that it makes sense to simulate increasing uncertainty by some long-run changes in the sign of the business expectations (which means the sign does not change until the rate of change of the engagement in vocational training is in equilibrium), if it is taken into account that in the model context long term means around six years and the estimations are based on only seven years. Moreover some long-run changes in the sign of business expectations are usually not recognised as increasing uncertainty but more or less as changes in profit expectations.

Hence the conclusion seems to be justified that increasing uncertainty regarding future prospects, for example business expectations, could be a reason for the decreasing amount of apprenticeship arrangements.

6 Conclusions and further options

The econometric estimations based on the IAB Establishment Panel data provide some evidence that firms respond sensitively to changes in short-term business expectations and adapt their training behaviour correspondingly. These findings

[7] As an alternative to this purely experimental approach it would be possible to include uncertainty directly into the econometric analysis. One way to do so could be to include a dummy variable which indicates that the firm has no idea of their business expectations. Such a variable, however, has no statistical significant influence in our static analysis.

correspond with a strong interrelation between training behaviour and the business cycle.

In a short-term perspective, a decrease in business expectations affects the net cost assumptions of firms' training decisions. From a perspective oriented towards long-term investment, a decrease in business expectations affects the assumptions on future transaction and opportunity costs.

The empirical findings provide some evidence that the sectoral change from the manufacturing industry to the services industry explains some of the reduction in the supply of apprenticeship places, as the density of apprenticeship places in the manufacturing sector is higher than in the services sector.

Furthermore there is some empirical evidence that firms' departure from collective wage agreements (see Schnabel 2003) reduces both the decision to provide training and the number of training places. But more research is needed to decide whether the two decisions are interrelated or not.

As assumed, the logit model provides some empirical evidence of asymmetric behaviour of firms; these findings correspond with our assumptions on the loss-averse behaviour of firms. Again alternative hypotheses have still to be tested: the costs of entry into apprenticeship training are higher than exit costs. How does this cost asymmetry affect firms' training behaviour? It is surprising, however, that in the static model the decision to provide apprenticeship training seems to be independent of business expectations, in contrast to the decision against providing apprenticeship training.

According to our assumptions, firms' adjustment of their training capacities is positively correlated with the direction of the change in business expectations. However, there is no empirical evidence for the expected asymmetric adjustment behaviour in the static model and an inverse, but weak correlation in the dynamic model.

The empirical findings are in line with our assumptions about the correlation between increasing uncertainty regarding business expectations and the training behaviour. What needs to be done is to implement our assumptions directly in the econometric modelling.

With respect to these limitations, however, it was possible to show that our empirical results concerning the firms' fundamental training decisions (whether or not to be a training firm and the number of training places) support both our structural explanation and our assumptions on the relevance of business expectations and their change over time on these training decisions. Finally our results correspond with theoretical assumptions on uncertainty.

The formation of individual firms' business expectations by a given uncertainty over time seems, so far, to be an underestimated explanation but a relevant factor in firms' contribution to human capital formation.

References

Ai, C./Norton, E. C. (2003): Interaction Terms in Logit and Probit Models. In: Economics Letters, Vol. 80, pp. 123-129.

Acemoglu, D./Pischke, J.-S. (1998): Why Do Firms Train? Theory and Evidence. In: The Quarterly Journal of Economics, Vol. 113, pp. 79-119.

Acemoglu, D./Pischke, J.-S. (1999a): Beyond Becker: Training in Imperfect Labour Markets. In: Economic Journal, 109, 112-142.

Acemoglu, D./Pischke, J.-S. (1999b): The Structure of Wages and Investment in General Training. In: Journal of Political Economy, Vol. 107, pp. 539-572.

Arellano, M. (2003): Panel Data Econometrics. New York (Oxford University Press).

Backes-Gellner, U. 1992: Berufsbildungssysteme und die Logik betrieblicher Qualifizierungsstrategien im internationalen Vergleich. Gibt es einen Wettbewerb der Systeme? In: Boettcher, E./Herder-Dornreich, P./Schenk, K. (Hrsg.): Jahrbuch für neuere politische Ökonomie. Tübingen:245-270.

Baltagi, B. H. (1998): Econometrics. Heidelberg (Springer).

Bank, M. (2003): Dispositionstheorie: Eine Theorie zur Erklärung von Kauf- und Verkaufsentscheidungen von Investoren in risikobehafteten Assetmärkten. http://www.uibk.ac.at/c/c4/c409/kerschbamer/w04/BBLP-Bank.pdf.

Beck, N. (2005): Time Series Cross-Section Data – Dynamics – Continuous. http://www.nyu.edu/classes/nbeck/q2/morning.short.pdf

Becker, G. S. (1962): Investment in Human Capital: A Theoretical Analysis. In: Journal of Political Economy, Vol. 70, pp. 9-49.

Becker, G.S. (1964): Human Capital. A Theoretical and Empirical Analysis, with Special Reference to Education. New York, London (NBER).

Beckmann, M (2002): Firm-sponsored Apprenticeship Training in Germany. Empirical Evidence from Establishment Data. In: Labour: Review of Labour Economics and Industrial Relations Vol. 16 (2), pp.287-310.

Beicht, U./Walden, G. (2004): Empirische Ergebnisse zum Nutzen der betrieblichen Berufsausbildung: Ein Vergleich zwischen technischen und anderen Berufen. http://www.bmbf.de/pub/sdi_02_04.pdf.

Bellmann, L./Hartung, S. (2005): Betriebliche Ausbildung: Zu wenig Stellen und doch sind nicht alle besetzt. IAB-Kurzbericht Nr. 27.

Bellmann, L./Kohaut, S./Lahner, M. (2002): Das IAB Betriebspanel – Ansatz und Analysepotenziale. In: Kleinhenz, G. (ed.): IAB-Kompendium Arbeitsmarkt- und Berufsforschung. Nürnberg, pp. 13-20.

Büchel, F./Neubäumer, R. (2001): Ausbildungsinadäquate Beschäftigung als Folge branchenspezifischer Ausbildungsstrategien. In: Mitteilungen aus der Arbeitsmarkt- und Berufsforschung, Vol. 34, pp. 269-285.

Carruth, A. A./Dickerson, A. P. (2003): An Asymmetric Error Correction Model of UK Consumer Spending. In: Applied Economics, Vol. 35, pp. 619-630.

Chamberlain, G. (1980): Panel Data. In: Griliches, Z./Intriligator, M. D. (ed.): Handbook of Econometrics, Vol. 2, Amsterdam (North-Holland).

Clark, D./Fahr, R. (2002):Transferability, Mobility and Youth Training in Germany and Britain: A Simple Theoretical Analysis. In: Konjunkturpolitik Vol. 48 (3-4), 235-255.

Conway, M. R. (1990): A random effects model for binary data. In: Biometrics, Vol. 46, pp. 317-328.

Dietrich, H (2000): Betriebliches Ausbildungsverhalten im Kontext der betrieblichen Ausbildungsstruktur. In: George, R./Struck, O. (eds.): Generationenaustausch im Unternehmen. München/Meiningen: pp. 159-176.

Dietrich, H./Gerner, H.-D. (2005): Theorie im Praxistest: Warum Betriebe in die Ausbildung investieren. In: IAB Forum, Vol. 2, pp. 56-61.

DIHK (2006): Impulse für mehr Ausbildung – Die Sicht der Unternehmen – Ergebnisse einer Online-Befragung von 7500 Unternehmen. http://www.ausbildung-plus.de/allgemein/news/00469/index.html.

Doeringer, P. B./Piore, M. J. (1971): Internal Labor Markets. Lexington.

Euwals, R./Winkelmann, R. (2004): Why Do Firms Train? Empirical Evidence on the First Labour Market Outcomes of Graduated Apprentices. In: International Journal of Manpower, Vol. 25 (5), 447-463.

Filer, R. K./Hamermesh, D./Rees, A. (1996$^{6\ Ed.}$): The Economics of Work and Pay. New York.

Fougère, D./Schwerdt, W. (2002): Are Apprentices Productive?. In: Konjunkturpolitik Vol. 48 (3-4), 317-346.

Franz, W./Soskice, D. 1995: The German Apprentice System. In: Buttler, F./Franz, W./Schettkat, R./Soskice, D. (eds.): Institutional Frameworks and Labour Market Performance. London, New York: pp. 208-234.

Franz, W./Steiner, V./Zimmermann, V. (2000): Die betriebliche Ausbildungsbereitschaft im technologischen und demographischen Wandel. Baden-Baden (Nomos).

Freeman, R. B. (1972): Labor Economics. New Jersey.

Greene, W. H. (2003): Econometric Analysis. Upper Saddle River (Pearson Education).

Gul, F. (1991): A Theory of Disappointment Aversion. In: Econometrica, Vol. 59, pp. 667-686.

Harhoff, D./Kane, T. (1997): Is the German Apprenticeship System a Panacea for the U.S. Labor Market?. In: Population Economics Vol. 10, pp. 171-196.

Hartmann, J./Kohaut, S. (2000): Analysen zu Ausfällen (Unit-Nonresponse) im IAB-Betriebspanel. In: Mitteilungen aus der Arbeitsmarkt- und Berufsforschung, Vol. 33**,** 609-618.

Holtbrügge, D. (2004): Personalmanagement. Berlin (Springer).

Hsiao, C. (2004): Analysis of Panel Data. Cambridge (University Press).

Kölling, A. (2001): Ein „Schalter“ für die Forschung – Daten des IAB-Betriebspanels stehen externen Forschern seit 1999 zur Verfügung. In: IAB Werkstattbericht Number 9.

Lindley R.M. (1975): The Demand for Apprentice Recruits by the Engineering Industry: 1951-1971. In: Scottish Journal of Political Economy, Vol. 22, Number 1, pp.1-24.

Liu, Q./Pierce, D. A. (1994): A Note on Gauss-Hermite Quadrature. In: Biometrika, Vol. 81, pp. 624-629.

Miller, R. M. (2002): Experimental Economics – How We Can Build Better Financial Markets. New Jersey.

Neubäumer, R./Bellmann, L. (1999): Ausbildungsintensität und Ausbildungsbeteiligung von Betrieben. Theoretische Erklärungen und empirische Ergebnisse auf der Basis des IAB Betriebspanels 1997. In: Beer, D./Frick, B./Neubäumer, R./Sesselmeier, W. (eds.): Die wirtschaftlichen Folgen von Aus- und Weiterbildung. München/Mehring (Hampp):9-41.

Niederalt, M. (2004): Zur ökonomischen Analyse betrieblicher Lehrstellenangebote in der Bundesrepublik Deutschland. Frankfurt/Main (Lang).

Niederalt, M. (2005): Bestimmungsgründe des betrieblichen Ausbildungsverhaltens in Deutschland. In: Lehrstuhl für Arbeitsmarkt- und Regionalpolitik, Friedrich-Alexander Universität Erlangen-Nürnberg, Diskussionspapier, Number 36.

Nijman, T./Verbeek, M. (1992): Nonresponse in Panel Data: The Impact on Estimates of a Life Cycle Consumption Function. In: Journal of Applied Econometrics, Vol. 7, 243-257.

Norton, E. C./Wang, H./Ai, C. (2004): Computing Interaction Effects and Standard Errors in Logit and Probit Models. In: Stata Journal, Vol. 4, pp. 154-167.

Oehlert, G. W. (1992): A Note on the Delta Method. In: The American Statistican, Vol. 46, pp. 27-29.

Rothschild, M./Stiglitz, J. E. (1970): Increasing Risk: A Definition. In: Journal of Economic Theory, Vol. 2, pp. 225-243.

Sadowski, D. 1980: Berufliche Bildung und betriebliches Bildungsbudget. Stuttgart (Poeschel).

Saint-Paul, G. (1996): Dual Labor Markets – A Macroeconomic Perspective. Cambridge/London (MIT).

Schnabel, C. (2003): Tarifpolitik unter Reformdruck. Gütersloh (Bertelsmann).

Sheldon, G. (2003): Die Auswirkung der Ausländerbeschäftigung auf die Löhne und das Wirtschaftswachstum in der Schweiz. http://www.wwz.unibas.ch/fai/pages/arbeitspapiere/auslaenderbeschaeftigung.pdf.

Timmermann, D. 1998: Nutzen aus der Sicht der Wissenschaft. In: Bundesinstitut für Berufsbildung (ed.): Nutzen der beruflichen Bildung. Bielefeld: Bertelsmann, pp. 75-92.

Verbeek, M. (2002): A Guide to Modern Econometrics. Chichester (Wiley).

Werwatz, A. (1996) How Firm-Specific is German Apprenticeship Training? Discussion paper 96-12, Humbold-Universität Berlin.

Williamson, O. E. (1990): Die ökonomischen Institutionen des Kapitalismus. Tübingen (Mohr).

Wolters, J. (2003): Neuere Entwicklungen in der ökonometrischen Analyse aggregierter Zeitreihen. In: Franz, W./Ramser, H.J./Stadler, M. (eds.): Empirische Wirtschaftsforschung – Methoden und Anwendungen. Tübingen (Ottobeuren).

Xu, J./Long, S. (2005): Using the Delta Method to Construct Confidence Intervals for Predicted Probabilities, Rates, and Discrete Changes. Indiana University, Bloomington (Mimeo).

Appendix

A 1
Descriptive statistics for the logit model with random effects

Variable	Mean	Standard Error
Business expectations	1.19	16.12
Difference between the coefficient of negative to positive business expectations (interaction term)	-2.62	6.63
Share of skilled employees	0.71	0.30
Technical state of firm	2.11	-
Staff turnover rate	0.03	0.05
Rate of atypical workers	0.03	0.06
Collective bargaining	0.76	-
Agricultural, mining etc. sector	0.05	-
Manufacturing sector	0.51	-
Services sector	0.44	-
Number of employees	434.43	1288.29
Dummy, Di,t=1, if firm i has at least one new apprenticeship contract in t	0.71	-
Number of observations	19,141	

A 2
Descriptive statistics for the linear regression model with fixed effects

Variable	Mean	Standard Error
Business expectations	1.24	12.22
Difference between the coefficient of negative to positive business Expectations (interaction term)	-2.33	6.01
Share of skilled employees	0.71	0.71
Technical state of firm	2.09	-
Staff turnover rate	0.03	0.05
Rate of atypical workers	0.03	0.05
Collective bargaining	0.80	-
Agricultural, mining etc. sector	0.05	-
Manufacturing sector (base category)	0.53	-
Services sector	0.42	-
Number of employees	566.85	1503.20
Rate of change of the number of new apprenticeship contracts against the previous year	-0.01	1.14
Number of Observations	13,546	

Table 1
Coefficients of the logit models (1993-2003)
Dependent variable:
Dummy, $D_{i,t}$=1, if plant i has at least one new apprenticeship contract in t

Variable	Coefficient	
	random effects	**fixed effects**
Business expectations	-2.63×10^{-3} (0.13)	4.58×10^{-3} (0.90)
Difference between the coefficient of negative to positive business expectations (interaction term)	0.03*** (0.00)	0.01* (0.08)
Share of skilled employees	0.82*** (0.00)	-0.26 (0.12)
Technical state of firm	-0.17*** (0.00)	-0.14** (0.02)
Staff turnover rate	-2.21*** (0.00)	-0.77 (0.25)
Share of atypical workers	-0.15 (0.72)	0.24 (0.71)
Collective bargaining	0.40*** (0.00)	0.23* (0.07)
Primary sector	-0.49*** (0.00)	-0.21 (0.76)
Services sector	-0.48*** (0.00)	-0.06 (0.86)
Number of employees	3.32×10^{-3}*** (0.00)	2.67×10^{-3}*** (0.00)
Time dummies	***	***
$\chi^2(15)$	1273.67	168.41
Number of observations	19,141	4,625

***) Significant at the 1% level
**) Significant at the 5% level
*) Significant at the 10% level
p-values in parentheses
Source: Own calculations based on the IAB Establishment Panel (1993-2003)

Table 2
Coefficients of the linear regressions (1993-2003)
Dependent variable:
Rate of change of the number of new apprenticeship contracts against the previous year [8]

Variable	Coefficient	
	random effects	**fixed effects**
Business expectations	0.25** (0.02)	0.40** (0.01)
Difference between the coefficient of negative to positive business expectations (interaction term)	0.26 (0.22)	-0.16 (0.61)
Share of skilled employees	0.08** (0.05)	0.02 (0.79)
Technical state of firm	-0.01 (0.62)	0.02 (0.48)
Staff turnover rate	-0.40* (0.12)	-0.65* (0.01)
Share of atypical workers	0.31 (0.05)	0.87** (0.08)
Collective bargaining	0.10*** (0.00)	0.03 (0.61)
Primary sector	0.04 (0.46)	-010 (0.77)
Services sector	0.01 (0.72)	-0.08 (0.58)
Number of employees	2.96×10^{-5}*** (0.00)	1.04×10^{-4}** (0.05)
Time dummies	***	***
R^2	0.01	0.01
Number of observations	13,546	13,546

***) Significant at the 1% level
**) Significant at the 5% level
*) Significant at the 10% level
p-values in parentheses
Source: Own calculations based on the IAB Establishment Panel (1993-2003)

[8] It is worth noting that a model was also calculated explicitly with rates of change for every variable. The result of the business expectations remains stable however. On the whole the significance level for the control variables suffers in this case – only the number of employees (the rate of change of the number of employees) remains significant. Moreover there is also no asymmetric behaviour when we exclude all control variables.

Table 3
Coefficients of the ADL model
Dependent variable:
Rate of change of the number of new apprenticeship contracts against the previous year (rate of change of the new contracts)

Variable	Coefficient
Rate of change of the new contracts in (t-1)	-0.47*** (0.00)
Rate of change of the new contracts in (t-2)	-0.21*** (0.00)
Interaction term of the rate of change with the dummy which is one if the sign of the business expectations in (t), (t-1) and (t-2) is negative	-0.14* (0.09)
Rate of change of the new contracts in (t-3)	-.0.05*** (0.00)
Business expectations in (t)	0.35*** (0.00)
Business expectations in (t-2)	-0.01 (0.92)
Time dummies	***
R^2	0.20
Number of observations	5,376

***) Significant at the 1% level
**) Significant at the 5% level
*) Significant at the 10% level
p-values in parentheses

Comment: The test statistic, based on a Breusch-Godfrey test, is 0.27, the critical value (10% level) $\chi^2(3) = 0{,}58$.

Source: Own calculations based on the IAB Establishment Panel (1993-2003)

Box 1
Simplified illustration of the model-selecting process

1) First Step: ADL(3.3) model without asymmetric behaviour – selection is based on a Breusch-Godfrey test

2) Second Step: Introducing interaction terms of the endogenous and the exogenous variables with the dummy, which has the value of one if business expectations have a negative sign

$$\delta_{i,t}x_{i,t},\quad \delta_{i,t}\delta_{i,t-1}x_{i,t-1},\quad \delta_{i,t}\delta_{i,t-1}\delta_{i,t-2}x_{i,t-2},\quad \delta_{i,t}\delta_{i,t-1}\delta_{i,t-2}\delta_{i,t-3}x_{i,t-3}$$
$$\delta_{i,t}\delta_{i,t-1}y_{i,t-1},\quad \delta_{i,t}\delta_{i,t-1}\delta_{i,t-2}y_{i,t-2},\quad \delta_{i,t}\delta_{i,t-1}\delta_{i,t-2}\delta_{i,t-3}y_{i,t-3}$$

3) Third Step: Wald tests to exclude regressors (to take into account considerations regarding efficiency)

4) Fourth Step: Breusch-Godfrey test