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## The German apprenticeship system

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**The German Apprenticeship System**

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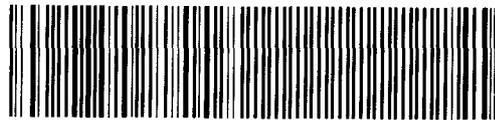
# The German Apprenticeship System

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### **Summary:**

This paper deals with the German apprenticeship training system. We first set the scene by describing the operation of the system, including the statistical picture in terms of supply and demand and costs; the relationship between the vocational training and the educational systems; the complex of regulations which companies engaging in apprenticeship training have to respect; and the relevant institutions. We then focus on the question why many companies make substantial net investments in marketable skills. Two simple ideas are developed as at least partial and complementary explanations of company behaviour. The first is that it is significantly more expensive to teach company – specific skills to externally hired workers with marketable skills. The second idea tries to capture the belief that companies have that the apprenticeship system is some sort of competition which companies have to go in for if they are to receive the best school leavers.

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# 1 The German Apprenticeship System: Introduction

The German apprenticeship system holds fascination for labor economists, since it is an example of a system in which many companies make substantial net investments in *marketable* skills. Moreover, although German companies are exhorted from time to time to provide more apprenticeship places, such exhortation is not the rule; and there is no system of sanctions or penalties for companies which do not have an apprenticeship programme: a large proportion of companies in fact do. Nor do companies cut corners with their apprentices: unions and employer associations, with input from the public authorities, bargain out the content of the company part of apprenticeship programmes, with the result that the skills are genuinely marketable; the operation of the programmes are monitored by both local chambers and by works councils within companies; and successful completion of the apprenticeship requires the passing of serious external examinations.

It is true that companies bear by no means all the costs of the apprenticeship: The apprentice accepts a very low wage for the three year duration of the training. Expertise is available at low or no cost to the company on setting up a programme and on incorporating new ideas from employer associations and the chambers, as well as from the unions. Above all, part of the training, usually a day a week, takes place in a public training school. The whole cost of this part of the training - the two parts together lead the apprenticeship system to be described as the "dual system" - is borne out of the public purse.

Nonetheless it remains the case that the contribution of companies is significant. It ranges from rather low net investments per apprentice by small *handwerk* companies to sizable net contributions by large companies. We try in this chapter to give some tentative explanations for this behaviour: Why should profit maximising companies make net investments in marketable skills? Section 2 of the chapter sets the scene by describing the operation of the system, including the statistical picture in terms of supply and demand and costs; the relationship between the vocational training and the educational systems; the complex of regulations which companies engaging in apprenticeship training have to respect; and the relevant institutions. Section 3 develops two simple ideas as at least partial and complementary explanations of company behaviour. The first is that it is significantly more expensive to teach company-specific skills to externally hired workers with marketable skills. And the second tries to capture the belief that companies have that the apprenticeship system is some sort of competition which companies have to go in for if they are to get the best school leavers.

## 2 The German Apprenticeship Training System: Institutional Regulations and a Quantitative Overview

Apprenticeship training in Germany is referred to as a dual system of vocational training. Trainees receive both school education at special vocational schools and on-the-job training at firms. Therefore, in what follows both components of the dual system are explained in some detail.<sup>1</sup>

To begin with vocational school education, each elementary school leaver (mostly

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<sup>1</sup>See Kempf (1985), Lehne (1991), and Steedman (1993) for descriptions of the German apprenticeship system.

at the age of 15 years) has to attend either a part-time compulsory vocational training school for three years or otherwise undergo a higher general or vocational school education. Teaching at a vocational training school ("Berufsschule") takes place either once a week for eight hours or in forming blocks of six or seven weeks twice a school year or as one 12 weeks bloc. The latter organization enables vocational schools to offer a broader variety of special courses. While this part-time attendance at the Berufsschule is the most common type of education there exists a variety of other forms. Among them the so-called "Basic vocational training year" ("Berufsgrundbildungsjahr") is worthwhile to mention because in West Germany in 1991/92 some 8 percent of all pupils at the Berufsschule were undergoing such a training year. The highest attention is given by the young people to a full-time school-based basic vocational training year. That means these young people are pupils at the Berufsschule for the whole week and not, as is otherwise typical for the dual system, simultaneously part-time pupils and trainees in the firm. In contrast to the part-time Berufsschule young people embarking on such a full-time school based course must have completed the compulsory period of education, i.e., the lower secondary school ("Hauptschule").

The body responsible for vocational schools is local authorities but they are supervised by the state ministry of school education. The organization of vocational schools depends mostly on the size of the local community. For villages or small towns there exists a district vocational school with departments for trade and industry, commercial business, and domestic science. For towns of greater size there are separate vocational training schools according to the divisions mentioned before.

With respect to quantitative magnitudes, Table 1 provides information on the distribution of school population and school leavers, respectively, among several types of education. The figures on school population should be viewed with care, however, since in the thirty years under consideration the number of young people changed substantially. In 1960 some 17 million people were under the age of 21, i.e., 30 percent of the whole population. The sixties experienced the baby boom resulting in 19 million people of the aforementioned age group in 1970, i.e., 32 percent of the population. After this a considerable decline of births took place, so that in 1990 the figures are 14 million persons and 22 percent, respectively. Hence, the age structure of the school population changed towards the disadvantage of youngsters. Therefore, the figures on school leavers constitute the more reliable numbers. From them a dramatic increase of school leavers with higher education certificates can be observed while the percentages of young people who complete vocational training schools of various types do not differ between 1970 and 1990.

It has been mentioned the category "vocational training system" in Table 1 includes several types, with the "Berufsschule" described before as the most important school. Other schools are, for example, the "Berufsfachschulen" and the "Fachschulen". By and large, both are vocational prep schools. The Berufsfachschulen are one-year schools with a full week teaching and aim to prepare for working life with or without previous practical experience in a profession. Attendance of a Berufsfachschule is voluntary and may replace vocational training schools. This holds also for the Fachschule with the major difference that this school is attended by young people after vocational training and experience thus offering more intensive training in certain professions in a time period between 6 months and 3 years.

Taken together, young people entering apprenticeships are not only the 15 year old graduates from the lower secondary school, but also persons who graduate from in-

Table 1: School Population and School Leavers in West Germany 1960 – 1990 (Percentages)<sup>a)</sup>

	1960	1970	1980	1990
School Population (Mio. Persons)	8.6	11.0	11.8	9.1
– Primary School (Grundschule)	36.0	36.1	23.5	27.9
– Lower Secondary School (Hauptschule)	24.7	21.5	19.3	14.0
– Upper Secondary School (Realschule/Gymnasium)	14.9	20.4	29.4	26.6
– Vocational Training System <sup>b)</sup>	22.6	18.8	22.6	10.6
School Leavers (Mio. Persons)	0.6	1.3	1.8	1.4
– Lower Secondary School Leaving Certificate				
Yes	55.2	26.8	22.2	14.6
No	17.7	10.8	6.2	3.9
– Higher Education Certificate (Abitur) <sup>c)</sup>	8.8	7.0	12.6	20.1
– Vocational School Completed	–	40.1	34.9	40.7

Notes:

a) See text for details;

b) figures include various types of vocational schools;

c) including certificate for attending “Fachhochschulen”;

Source: Institut der Deutschen Wirtschaft, Zahlen zur wirtschaftlichen Entwicklung der Bundesrepublik Deutschland 1992, table 125; calculations by the authors.

Table 2: Apprenticeship Training Positions in West Germany 1975 – 1991 (Thousands)<sup>a)</sup>

	1975/79	1980/84	1985/89	1990/91
1. Newly filled apprenticeship training positions	552	654	643	543
2. Unfilled apprenticeship training positions	24	29	49	122
3. Supply of apprenticeship training positions (rows 1 + 2)	576	683	692	665
4. Applicants not yet provided	25	36	36	13
5. Demand for apprenticeship training positions (rows 1 + 4)	577	690	679	556
6. Total apprentices	1441	1718	1717	1477 <sup>b)</sup>

Notes:

a) Averages per year reported September 30th; b) 1990.

Source: Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung, Annual Report 1989/90, table 12; Institut der Deutschen Wirtschaft, Zahlen zur wirtschaftlichen Entwicklung der Bundesrepublik Deutschland, table 132.

intermediate secondary schools, upper secondary schools, and those who have already completed the vocational preschools described above. Moreover, many young men deliberately complete military service before starting an apprenticeship training. These aspects together explain why the average age for young Germans to enroll in apprenticeship training exceeds 15 years and may be as high as 19 years as is found in a study by Büchtemann, Schupp and Soloff (1993) which is based on seven waves of the German socio-economic panel (1978 – 1990).

Whatever the age of a person trying to receive an apprenticeship training position is, Table 2 is devoted to a comparison between demand for and supply of apprenticeship training within private firms and the public sector. “Demand” and “supply” are rather ambitious words because parts of them are only known if registered at the labor offices. This concerns unfilled apprenticeship positions and applicants not yet provided with an apprenticeship training positions (rows 2 and 4, respectively). Given this caveat, rows 3 and 5 denote the annually observed supply of and demand for, respectively, apprenticeship training positions (as opposed to the existing stock of positions in row 6). Taken at face value the second half of the seventies indicates an equilibrium situation on the market for apprenticeships. However, the average figures conceal imbalances, especially in 1975/76, to the disadvantage of young people searching for apprenticeships. These years were characterized by an increased demand for apprenticeship training positions stemming from the entrance of the baby boom cohort of the sixties into the labor market. On the other side, the supply of apprenticeship positions declined after 1972 due to the recession and regained the 1972 level of about 640 thousand positions in 1978/79 only. Similar observations hold for the first half of the eighties. While on average the market can be characterized as being in a slight excess demand situation,

this is only due to the excess supply in 1980/81. The consecutive years experience a considerable excess demand which peaks in 1984/85 with a lack of 37 thousand positions, i.e., about 5 percent of the demand for apprenticeships. In the second half of the eighties the situation on the market began to change dramatically. The baby boom cohort of the sixties passed through the dual system and, in addition, the demand for higher education at universities increased substantially. Hence, demand was falling and this process strengthened in the beginning of the nineties with an excess supply of 430 thousand positions in 1992 and is expected to continue in the foreseeable future.<sup>2</sup>

The coexistence between unfilled positions and unprovided applicants indicates a mismatch on this market due to regional imbalances and/or because the positions supplied do not meet the preferences for certain professions by the applicants. Moreover, unprovided applicants sometimes accept training in a profession not really desired. Therefore, not all filled apprenticeship positions are perfect matches between professions supplied and demanded.

Regional imbalances are most obviously observed between West and East Germany. While in the first half of 1993 in West Germany each applicant in terms of figure could choose between two positions supplied, in April 1993 two thirds of all East German applicants had not yet found a training position.<sup>3</sup> As of November 1993 146,000 applicants in East Germany have been offered 84,000 apprenticeship positions in the private sector in 1993. About 50,000 have found a position in West Germany and more than 5,000 youths received training in public training centers.

Table 3 is an attempt to obtain some insight as to whether a qualifications mismatch governs the market for apprenticeships. The major drawback of these figures is that they only refer to positions and applicants registered at the labor offices. Under this proviso it can be seen that supply and demand are sometimes perfectly matched at a greater scale such as for businessmen (goods and services). On the other hand, there is a considerable excess demand for apprenticeships in administrative professions and an excess supply of positions for metal manufacturers. It goes without saying that even fairly balanced markets for certain professions may be subject to a regional mismatch and vice versa.

Due to general imbalances and/or mismatch on the market for apprenticeships there are young people without training contracts. They have to attend the vocational training school nevertheless and may be employed or unemployed otherwise. Table 4 displays the evidence about the characteristics of young people without training contracts in West Germany. For example, in 1990, 1.4 percent of all young people attending the Berufsschule on a part-time basis had no training contract and 1.8 percent were unemployed. Due to the recession the latter figures were higher in 1983. Moreover, young females suffer more from not having a contract and/or being unemployed. Most of the young people without training contracts do not have a Hauptschule leaving certificate and exhibit a comparatively poor performance including disturbed or retarded social behaviour. It has been shown elsewhere that both the risk of becoming unemployed and the duration of unemployment are positively influenced by these deficits.<sup>4</sup>

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<sup>2</sup>Source: Amtliche Nachrichten der Bundesanstalt für Arbeit (ANBA), Nr. 5 (1993), p. 914. The figure refers to West Germany.

<sup>3</sup>Source: iwd - Informationsdienst des Instituts der deutschen Wirtschaft, Nr. 21 of May, 27, 1993, p. 7.

<sup>4</sup>See Franz (1982) for a detailed study on youth unemployment in West Germany.

Table 3: Professions mismatch on the market for apprenticeships in West Germany 1991/92<sup>a)</sup>

Profession	registered apprentice-ship positions	registered applicants
agriculture, live-stock breeding, fishery	2.2	2.1
metal manufacturer	19.6	14.4
electrician	6.4	8.1
textile, leather	1.8	1.6
food	6.5	2.0
construction	11.7	8.0
technical professions	1.9	5.0
businessmen for goods and services	20.9	20.9
administration	12.3	21.1
social and educational professions	4.7	7.9
human services	8.0	5.5

Notes:

a) percentages of all registered positions and applicants, respectively; not all possible professions are listed, hence column sums do not add to 100; see text for explanations.

Source: Amtliche Nachrichten der Bundesanstalt für Arbeit (ANBA), Nr. 5 (1993), p. 916.

Table 4: Young People at Vocational Schools by Employment Status in West Germany (Percentages)

	1983	1990
Total number of pupils (thousands)	1811	1469
male (thousands)	1078	825
female (thousands)	733	644
Employed with apprenticeship contract	94.4	96.9
male	95.6	97.2
female	92.6	96.4
Employed without a contract	2.3	1.4
male	1.7	1.1
female	3.3	1.7
Unemployed	3.2	1.8
male	2.7	1.8
female	4.0	1.9

Notes:

a) See text for explanations

Source: Statistisches Bundesamt, Fachserie 11, Reihe 2, 1990, p.46, 1983, p.83.

The next relevant question is which firms offer apprenticeship training positions. Supply of such a training is voluntary although firms have been urged to offer these positions by the public and their chambers in times of an excess demand for apprenticeship training positions in the seventies. In addition, a law to promote the supply of apprenticeship training positions enacted in 1976 authorized the federal government to levy a tax on firms not offering these positions if there is not an excess supply of at least 12.5 percent of demand. In fact, this tax has never been introduced although its requirements were met in the seventies. By the end of 1980, however, the aforementioned law was ruled out in general by the federal supreme court on formal legal grounds and the new law enacted afterwards did not contain such a tax.

A very important distinction is to be made between “Handwerk” and “Industrie” where the first expression refers to the small artisan and crafts sector while “Industrie” corresponds with large-scale manufacturing and service sector activities. Not only is the “Handwerk” sector the origin of the apprenticeship system which can be traced back at least until the 19th century but in addition the motives to supply apprenticeship training positions may differ from that in the industry and trade sector. In what follows this distinction should be kept in mind.

While no firm can be forced to offer training, not every firm is entitled to do so. Both the instructors and the training programs have to fulfill several requirements which are fixed in a law concerning vocational education (“Berufsbildungsgesetz” of 1969) and are supervised mostly by the chambers of crafts and of industry/trade, respectively. The qualifications of the instructors are also laid down in a decree (“Ausbilder-Eignungsverordnung”). Qualifications for an instructor can be obtained during an education as master craftsmen. These are successful apprentices who undergo a more advanced qualification and embark on courses at master craftsmen’s colleges. They have to pass exams at the chamber of crafts or industry/trade and receive the title “Meister”. The training program of the apprentices is subject to several regulations, too. There are about 400 recognized trades and occupations the contents of which are laid down in official training regulations. They specify the type, organization, and duration of training including the attendance at the part-time vocational school described before. Moreover, a detailed set of guidelines concerning the curriculum and the level of education are laid down with a tendency in the past decade to upgrade these requirements.

How training is actually managed within the firm depends, among other factors, on the size of the firm. In small firms or craft businesses training takes place on the job directly, whereas large industries have established training centres exclusively designed for training and not for producing goods to be sold on the market. In addition, smaller firms sometimes can send trainees to centers that are jointly funded by the local chambers of commerce and the Federal Ministry of Education and Science.

The overwhelming part of all apprentices, 84 percent in 1990, for example, is trained either in the industry and trade sector or in the crafts business sector. Although the industry and trade sector is training considerably more young people than the crafts business sector, this ranking is reversed if the apprentices are compared with all employees in the respective sector.

Table 5 highlights the evidence. As of 1990, the percentages differ roughly by a factor of three. The contribution of the crafts business sector is even more distinct in 1980. Although both sectors increased their supply of apprenticeship training positions as a

Table 5: Apprentices trained in crafts business and industry/trade in West Germany 1960-1990<sup>a)</sup>

	crafts business			industry and trade		
	apprenti- ces 1000	employees mill. <sup>b)</sup>	percen- tage <sup>c)</sup>	apprenti- ces 1000	employees mill. <sup>b)</sup>	percen tage <sup>c)</sup>
1960	447	3.5	12.8	743	12.6	5.9
1970	420	3.4	12.4	725	14.2	5.1
1980	702	3.4	20.6	787	14.4	5.5
1990	487	3.4	14.1	756	15.5	4.9

Notes:

- a) See text for details; b) excluding apprentices;  
c) apprentices as a percentage of figures in previous column.

Sources: Statistisches Jahrbuch für die Bundesrepublik Deutschland, various volumes; Statistisches Bundesamt, Fachserie 11, Reihe 3, 1990, S.17. Institut der Deutschen Wirtschaft, Zahlen zur wirtschaftlichen Entwicklung der Bundesrepublik Deutschland 1992, table 66; Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung, Annual Report 1992/93, table 23\*; Bundesministerium für Wirtschaft, Wirtschaft in Zahlen '92, table 4.6, calculations by the authors.

reaction to several appeals by the public, government, and their chambers to meet the excess demand for these positions, the crafts business sector, compared with its employees, undertook higher efforts so that the relation apprentices to employees amounted to one to five this year. After 1980, however, the crafts business sector reduced training to mid-seventies levels whereas the decline in the industry and trade sector was less marked.

Put differently, the above figures suggest that the crafts business sector educates young people in excess who are then employed in the industry and trade sector. Indeed, a study by Hofbauer (1977) reveals that in 1970 out of all male employees with a completed apprenticeship training roughly two thirds received their education in the crafts business sector, but only one quarter were employed there.

Table 6 breaks down employees and apprentices by major sectors in West Germany 1992. Apparently, male apprentices are concentrated in the manufacturing sector which includes crafts business while the major share of females receives their training in the service sector.

Table 6 also displays monthly earnings figures for apprentices in West Germany 1992. Although these numbers represent already aggregates over subsectors and training years (see below), they display a high variability ranging from 889 DM for females in the agricultural sector to 1175 DM for males in the public sector. The earnings differential between males and females does not mean, however, that females are paid less in the same training program. The main reason why earnings differ is that compensation is distinct in levels within those sectors by the type of the training. Females are more than proportionally trained in occupations which are paid less. One reason for these differences is that the compensations paid to the apprentices are, to a large extent, the result of negotiations between unions and employers' confederations in context with the

Table 6: Employees, Apprentices and Earnings by Sector in West Germany 1992<sup>a)</sup>

Selected Sectors	apprentices				monthly earnings (DM)			
	1000 persons		% of all employees <sup>b)</sup>		apprentices		% of earnings <sup>c)</sup>	
	male	female	male	female	male	female	male	female
Agriculture	18	9	14	13	907	889	23	28
Manufacturing (incl. crafts bussiness)	360	107	7	5	1058	1040	18	27
Construction	135	13	9	7	1160	1103	24	27
Trade and Transportation	127	125	5	5	955	896	19	26
Public Sector	40	69	2	4	1175	1155	20	23
Services	138	370	7	11	1034	961	22	32
Total <sup>c)</sup>	842	696	6	7	1070	984	20	27

Notes:

- a) Fourth quarter; see text for explanations;
- b) excluding apprentices;
- c) percentage of earnings of blue and white collar workers (weighted average);
- d) includes all sectors of the economy.

Source: Deutsches Institut für Wirtschaftsforschung (DIW), Wochenbericht Nr. 15 of April, 15th, 1993, p. 191; calculations by the authors.

Table 7: Annual Training Costs per Apprentice by Sector and Firm Size in West Germany 1985 (1000 DM)<sup>a)</sup>

Number of Employees	Industry and Trade Sector		Crafts Business Sector	
	Gross	Net	Gross	Net
1 - 4	21.3	11.9	14.4	6.2
5 - 9	20.6	12.0	15.7	7.4
10 - 19	19.9	10.7	18.1	10.1
20 - 49	21.5	12.5	18.4	10.3
50 - 99	23.4	15.4	19.0	11.9
100 - 199	25.0	16.6	-	-
200 - 499	27.6	19.3	-	-
500 - 999	26.8	18.5	-	-
1000 and more	22.4	14.3	-	-
Average	23.6	15.1	17.3	9.4

a) See text for details.

Sources: R. v. Bardeleben (1993).

wage bargaining process which in Germany is organized by industries and regions. The negotiated compensation is distinguished by year of training. For example, compensations paid 1993 for trainees in banking are 1034, 1129, and 1234 DM in the first, second, and third training year, respectively.

The aforementioned figures on compensation paid to the apprentices represent only parts of the costs of such a training the firm has to meet. Two aspects deserve attention in order to calculate these costs. First, additional costs have to be taken into account such as employers' contributions to social security, work cloths and the like. Equally important are costs of the training process itself such as establishing and operating training centers and classes for theoretical instructions. Clearly these costs arise in larger firms mainly, and to a lesser amount, if any, in the crafts business sector. Second, these gross costs have to be balanced against the revenues stemming from contributions by apprentices to value added. These profits increase with training duration and occur in firms or crafts businesses where apprentices directly work in the production process rather than in training centers. Especially, but not exclusively, the crafts business sector gains from apprentices not only because in the course of their training they produce marketable goods and services but also due to the fact that the craft business saves costs of carrying out inferior work which would occur were there no apprentices.

Table 7 attempts to give some information on gross and net training costs, respectively.

These figures display estimates for 1985 based on a 1980 survey taken by the "Bundesinstitut für Berufsbildung" (Federal Institute for Vocational Education). The gross costs include (i) the compensation paid to the trainees including employers' contributions to social security, (ii) wage costs of the staff training the apprentices, (iii) administrative and material costs. The first two types of costs represent about 50 and 40 percent, respectively, of total costs. It has to be noted that these costs can be deducted

from taxable revenues. The difference between gross and net costs are revenues produced by the apprentices. It goes without saying that especially the estimates about revenues are subject to imprecision because firms typically underestimate these revenues.

As can be seen gross costs are considerably higher in the industry and trade sector compared with the crafts business sector. On the other hand, the revenues do not differ so much; they amount to 8.4 and 7.9 thousand DM on average in each sector. Moreover, there is a tendency of gross costs to increase by firm size while a decline can be observed for revenues. As has been mentioned one reason for this development of gross costs are training centers in large firms. Their costs are, however, subject to diminishing average costs below a given firm size (500 persons, for example).

In other words, due to a possible underestimation of the revenues in the "Handwerk" sector there is reason to argue that the net costs of training may be small if not negative. This makes it clear that firms may take on apprentices for fundamentally different reasons. In addition to possible net benefits in the "Handwerk" sector there is anecdotal evidence that especially in small towns and villages the small craft or artisan employers and the parents of applicants for an apprenticeship training know each other for some time for reasons such as belonging to the same social circles. Hence, in addition to a possible pressure from the chamber there might exist some personal network motivating training in the "Handwerk" sector more or less absent in the industry and trade sector.

On average of all sectors net training costs amounted to 12,348 DM in 1985. One way to give an impression of the order of magnitude is to compare this figure with the wage costs of a worker who has successfully completed such a training. In 1985 such a male worker ("Facharbeiter") in the industry had a monthly income of about 3000 DM. That means that gross wage costs relevant for the employer's decision amount to some 5300 DM per month. Given annual training costs per employee of 15 thousand DM and a training period of three years, an apprentice costs approximately 8 to 9 months of a Facharbeiter's income.

### **3 Analysis of the Apprenticeship System: Why do Companies Train Apprentices?**

The discussion of the German apprenticeship system in the first section of this chapter poses for the economist the classic question raised most clearly by Becker. "Why should a company pay for the training of a young person in marketable skills?" As is well known, Becker's argument was that a company would make no contribution to training in marketable skills because, once the person had acquired the skills, he or she would have to be paid the market wage; in which case it would be more profitable for the company to hire in someone who had been trained elsewhere, since the company would pay the same wage and avoid the costs of training.

In despite of Becker's argument, we pointed out in the previous section, first that many German companies train apprentices (Table 6); second, that companies appear to pay substantial net amounts to cover the cost of the training (Table 7); third, that the successful completion of an apprenticeship leads to a marketable certificate of skills in the relevant occupation; fourth, there is no financial or other contractual bonding and the young person is at liberty, on completion of the apprenticeship, to leave the company in which they were apprenticed and seek employment elsewhere; indeed, this is common for those trained in the craft sector; and finally, while institutional pressure on

companies to take apprentices has not been unknown, nor is it the rule - as is attested by the excess supply of apprenticeship places in West Germany in recent years (Table 2, row 2).

There is no accepted explanation of why German companies appear prepared to pay to train apprentices in marketable skills. In what follows, we make two assumptions: that German companies are behaving rationally to maximise profits; and that they are not subjected to any direct form of institutional, social or political pressure in their choices. Clearly, these assumptions should not be taken as literally true in all cases; but they provide for a sharper analysis and one which is more useful in an internationally comparative context.

We focus in this theoretical section on the facts which most clearly challenge Becker's argument that companies do not invest in training their employees in general skills, by looking at large and medium-large companies the great majority of whom train apprentices. The arguments suggested here probably apply less well to smaller companies. Indeed there is a case in analysing the German apprenticeship system for distinguishing at least broadly between larger and smaller companies. A case can be made that the method of training cost calculation greatly exaggerates the net cost to small companies Soskice (1993). In looking at larger companies in this paper, however, the net cost of training to the company is taken at its face value. Why then do larger companies train? The next two subsections are devoted to two complementary explanations of why it may be profitable for larger companies to invest in apprentices.

### **3.1 Large companies: specific skills and the apprenticeship calculation**

Company-specific skills cannot be easily measured, but there are several reasons for believing that they are of considerable importance in German companies. First, a large body of case study evidence shows that work organisation in German companies involves skilled employees (who are not necessarily the majority of the workforce) in jobs with considerable responsibility both individually and in groups, with knowledge of the company's products and technology, reorganisation of production processes, as well as skills in working with company engineers; this is not confined to manufacturing and appears also to be true of banks. Second, as indirect evidence of company specific skills, German tenure lengths are exceptionally long on average.

Company specific skills, on the usual assumptions, do not affect the Becker argument. The intuition is straightforward: since the company bears the costs of investing in company-specific skills and gains the return from them (net of a wage premium to discourage quitting), the company should be indifferent between investing in skilled workers hired from the external market and investing in skilled workers trained as apprentices in the company. But the assumptions necessary for this argument to work are sharper than often realised. In particular, *if (i) the costs to the company of investing in specific costs by training apprentices are significantly lower than the costs of training externally hired skilled workers, and if (ii) the benefits of specific skills are significantly large, it may pay the company to train apprentices rather than hire skilled workers externally.* Both the usual Becker argument and the reasons why it does not hold under these conditions will be demonstrated in a slightly more formal way in a moment. Before that, we suggest why these conditions may hold in larger German companies and why intuitively this makes it profitable for companies to train apprentices.

There are good reasons to believe that both conditions may hold in many larger

German companies today. The first condition is that it is less costly to train company-specific skills to apprentices than to train them to externally hired skilled workers. There are two reasons why this is so:

(a) Most obviously, the wage cost of an apprentice is lower than that of a skilled worker. As we showed in the first section, an apprentice is paid about one third of the pay of a skilled worker.

(b) Although the apprenticeship programme which a company runs must meet a number of externally imposed requirements (see Section 2), these relate to minimum standards. Larger companies (and advanced companies generally) train their apprentices well beyond minimum standards, in order for them to have the general skills needed in the company. They can develop programmes which embed the general training within company requirements, practices, machines and so on. Thus the specific skills can be taught at very low (or zero) marginal cost within the apprenticeship. By contrast, the cost of training an externally hired worker, such as the training time taken by a supervisor, is an additional cost.

The second condition relates to the relative importance of specific skills, and more specifically the need to acquire them before marketable skills can be effectively used in a particular company. With the type of modern patterns of work organisation which seem increasingly widespread in Germany, the requirements of a skilled worker have changed radically. By contrast to the traditional craftsman or to a tradesman in a Fordist company who had a set of standardised skills which they could use in many different environments, the modern skilled employee plays a complex interactive role in production, maintenance, organisation of new processes, and so on. Our contention is that, with modern work processes, a newly hired skilled employee will need to acquire company specific skills before he can effectively utilise his marketable skills. Marketable skills and company specific skills are in fact complementary.

Thus, oversimplified, if a given quantity of company specific skills can be taught more cheaply at the apprenticeship stage than subsequently, and if some company specific skills are necessary for the use of marketable skills, then for some combination of low relative costs and high company specific skill requirement it may be profitable to train apprentices rather than hire externally. In the simple example which follows, the conditions are derived for this to be true.

Assume a one-period model, in which the output of a skilled worker,  $y$ , is given by Model 1:

$$y = s_c^\alpha s_m \quad (1)$$

where  $s_c$  is company specific skills, with  $0 \leq s_c \leq 1$ ;  $s_m$  is marketable skills, with  $s_m = 0$  or  $1$ ;  $\alpha$  measures the importance of company specific skills, with  $0 \leq \alpha \leq 1$ :  $\alpha = 0$  implies company specific skills have no effect on the productivity of marketable skills. Total output is the sum of the output of individual workers, all of whom in the example have to have marketable skills, i.e.  $s_m = 1$ , for their output to be positive. So we only consider workers with marketable skills, either (just) ex-apprentices or those hired externally at the start of the period. All workers are paid the same wage,  $w_m$ , irrespective of their company specific skills; (marginal premia for company specific skills change the conclusions marginally).

The model abstracts from a multi-period analysis by assuming that the company's previous expenditures on training an apprentice is equivalent to paying a lump sum,  $c_a$ ,

at the start of the period. It is assumed that the cost of training in company specific skills to the full, that is to  $s_c = 1$ , is included in  $c_a$ . It is also assumed that apprentices who are offered employment at the company will accept the offer; this can be justified if necessary by marginal premia above  $w_m$ .

It is assumed that the "cost" of company-specific training for employees hired externally is not financial, but is reflected in the length of time taken before they acquire any given level of company specific skills. In particular it is assumed that in order to acquire specific skills  $s_c$ , they must work unproductively for some proportion of the period,  $\mu \cdot s_c$ . Thus being fully trained in company specific skills, and so having a productivity of 1, would require that in the first  $\mu\%$  of the period the externally hired skilled worker was occupied unproductively in training; to acquire skills of  $s_c < 1$  implies they have zero productivity for the first  $\mu \cdot s_c\%$  of the period. Thus the net profit to the company from an externally hired worker is

$$s_c \cdot (1 - \mu \cdot s_c) - w_m \quad (2)$$

Now consider the company's optimisation problem: If the company hires skilled workers externally, it will choose to train them in company-specific skills to the cost-minimising level, say  $s_c^*$ ; and it will then choose between training apprentices (i.e. paying  $c_a$ ) to have workers with  $s_c = s_m = 1$ , and external hires with the optimal training in company specific skills,  $s_c^*$ .

The optimal level of  $s_c$ ,  $s_c^*$ , for an externally hired worker is that which maximises

$$s_c^\alpha - \mu \cdot s_c^{\alpha+1} - w_m \quad (3)$$

subject to  $s_c \leq 1$ . This implies an interior solution, and

$$s_c^* = \frac{\alpha}{\mu(1 + \alpha)} \quad s_c^* < 1 \quad (4)$$

$$s_c^* = 1 \quad \mu \leq \frac{\alpha}{1 + \alpha} \quad (5)$$

when it is optimal to train the hired worker fully in company specific skills. The intuition here is that  $\alpha/s_c$  is proportional to the marginal benefit to the company from extra company specific skills and  $\mu(1 + \alpha)$  is proportional to the marginal cost of training external hires in specific skills. Roughly  $\alpha$  can be thought of as the relative importance of specific skills (relative to marketable skills), and  $\mu$  as the relative cost of training external hires in specific skills (relative to the zero cost of training apprentices in them). As  $\alpha$  rises relative to  $\mu$ , it pays the company to increase investment in specific skills; for high enough  $\alpha$  relative to  $\mu$ , the company will invest fully in specific skills; (note  $\alpha/(1 + \alpha)$  increases in  $\alpha$ ).

To decide on apprentices versus external hires, the company compares the net profit per apprentice and per external hire. The simplest case is where  $\mu \leq \alpha/(1 + \alpha)$ , so that external hires are fully trained in specific skills: then the condition for training apprentices is:

$$1 - c_a - w_m \geq 1 - \mu - w_m \quad \rightarrow \quad c_a \leq \mu \quad (6)$$

where the LHS is the net profit per apprentice and the RHS the net profit per external hire, with in both cases  $s_c = s_m = 1$ . The simple condition here is that the net cost of

the apprenticeship be less than  $\mu$ , which can be interpreted as the value added lost in specific training (since the value added of an ex-apprentice is 1, and  $\mu$  is the percentage of the period required to train the external hire fully in specific skills). We come back to this condition below.

In the general case, define the maximum profit function per external hire as  $\pi_h^*(\alpha, \mu)$ , given by substituting Equation 4 into Equation 5; and call the constant profit per apprentice,  $\pi_a^*$ . The condition for training apprentices is then:

$$\pi_a^* \equiv 1 - c_a - w_m \geq \left( \frac{\alpha}{\mu} \right)^\alpha \cdot (1 + \alpha)^{(1+\alpha)} - w_m \equiv \pi_h^*(\alpha, \mu) \quad (7)$$

Totally differentiating  $\pi_h^* = \pi_a^*$  gives:

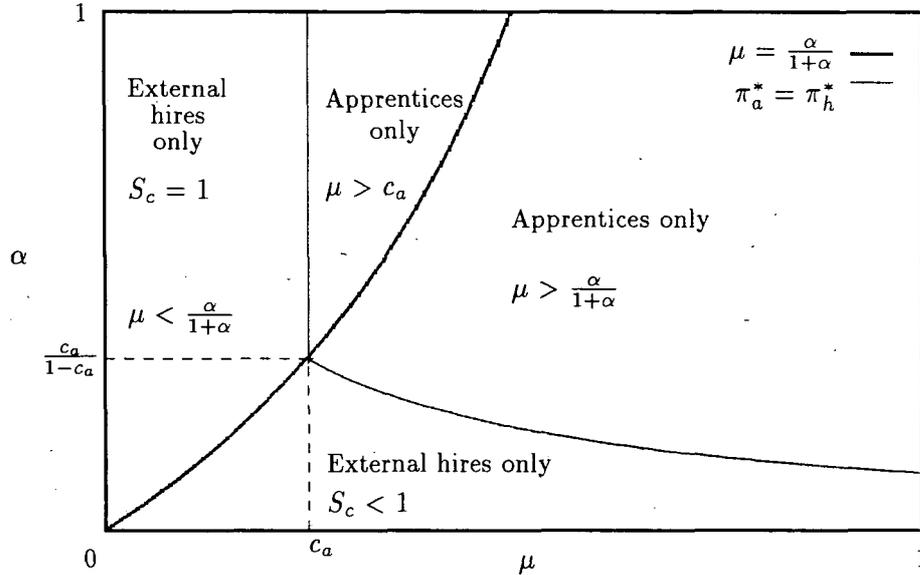
$$\frac{d\alpha}{d\mu} = \frac{\frac{\alpha}{\mu}}{\ln \frac{\alpha}{\mu(1+\alpha)}} < 0 \quad (8)$$

which is negative since  $\alpha/(\mu \cdot [1 + \alpha]) < 1$  along the interior solution. These results can now be put together to show precisely (Figure 3.1), under what conditions on  $\alpha$  and  $\mu$  it will pay to train apprentices rather than hire. Above  $\mu = \alpha/(1 + \alpha)$ , external hires will be fully trained in specific skills if hired; above this line, apprentices will be trained in the region to the right of  $\mu = c_a$ , this being the condition in Equation 6 above. It clearly pays to train apprentices in the region to the right  $\mu = c_a$ , since  $\alpha$  is constant and  $\mu$  is increasing.  $\pi_a^* = \pi_h^*$  is defined for the area to the right of the  $\mu = \alpha/(1 + \alpha)$  line, where there is an internal solution to the specific training of external hires (if they are hired). It starts from the intersection of  $c_a$  and  $\mu = \alpha/(1 + \alpha)$ , where therefore  $\alpha = c_a/(1 - c_a)$ ; Equation 8 shows that it is downwards sloping; it cuts  $\mu = 1$  at some positive value of  $\alpha$ , since at  $\alpha = 0$  it pays to hire externally and do no training in specific skills independent of the value of  $\mu$ . Thus what we have shown is that if the cost of training, measured by  $\mu$  is small enough and the significance of company specific skills is important enough for the effective use of marketable skill, measured by  $\alpha$ , it will pay to train apprentices rather than hire already trained employees from the external market. The argument, it is true relies on the apprentices accepting offers to stay in the company, but the company can pay them a small premium making it worth their while to do so, without the argument being affected.

What are the empirical supports of this approach? We made it clear at the start of this section that there is a genuine puzzle about why the larger German companies make the net investments they do in apprenticeships, and that this argument (and the next) are experimental. It is very difficult to imagine getting the type of statistical evidence which would pin down the importance of the argument by giving some idea about the relative magnitudes of  $\alpha$  and  $\mu$  in relation to  $c_a$ . In its absence, we rely on case studies and broad orders of magnitude.

The case studies of German industrial sociologists (Kern, Schumann, Streeck, Sengenberger) are not of course directly concerned with the value of  $\alpha$ . But there is some agreement that work organisation in German industry in the 1980s requires that skilled workers have both general skills and have complex teamwork, organisation and technology/product skills specific to a particular company. General skills by themselves are not of much value, until these complementary skills have been acquired. If these studies are taken literally, then the sort of crude model used here is not too far off the mark,

Figure 1: Costs and Benefits of Company Specific Skills



and the associated value of  $\alpha$  is high. Let it be assumed at any rate that  $\alpha$  is at a level (the metric will be discussed shortly) above the  $c_a/(1 - c_a)$  level.

Now consider  $\mu$  in relation to  $c_a$ . We know of no case studies in which large companies have been asked how long is required for an externally hired skilled worker to become reasonably effective as a skilled worker in the company. This may be in part because, as was pointed out in the first section, larger companies tend to hire in workers who have done an apprenticeship in the handwork sector as semi-skilled and not as skilled workers. An experienced researcher in the area of training and productivity case studies suggested that somewhere between one and two years might be an appropriate period in machinery building companies.

How is this to be converted into a measure of  $\mu$ , and how is  $c_a$  to be measured?  $\mu$  purports to measure the cost of training in specific skills when  $s_c^* = 1$ ; it measures the proportion of the period the new worker is unproductive multiplied by average productivity (1 in the model). So an appropriate measure of  $\mu$  is the number of unproductive months times the value added per worker; and that then needs to be compared with the net cost to the company of training an apprentice. We showed in section 1 that the net cost of an apprentice to a company in 1985, was of the order of magnitude of 50,000DM (15,000DM p.a. for just above 3 years).

How very roughly does this compare to the cost of training an external hire in specific skills? If on average a newly hired skilled worker takes one and a half years to become effective, and if it assumed the worker improves productivity on a straight line basis, then the worker is on average unproductive for 9 months. As we pointed out in section 1, 9 months labour costs to a company of a skilled worker at 5300DM per month in 1985, roughly 50,000DM, comes to the same order of magnitude as the net cost of an apprentice. There are, in addition two reasons for thinking that average labour costs may underestimate relevant average value added: First, the new hire may need

machinery to train on, so that capital costs per worker (or some percentage of them) should be included. Second, the company is likely to face a non-perfectly elastic demand curve, given that it is likely to be producing a differentiated product. The calculation also takes no account of the amount of time taken by other skilled employees to train a new worker, nor of a supervisor's time.

It seems to us therefore that, at least in principle, the interplay of general and company-specific skills and the relative cheapness of teaching specific skills simultaneously with general skills to apprentices may alter the balance of calculations away from Becker's conclusion. The numbers which we have put forward are only informed guesswork. But even if they are considerably awry, they suggest that this is an important argument which needs further empirical work.

### **3.2 Large companies: competing to get the best school-leavers via apprenticeships**

The previous argument, on the role of company specific skills, suggests at least that the apprenticeship versus external hire calculation may be quite finely balanced. In this subsection, we put forward a complementary argument which reinforces the case for training apprentices. Our starting point is a belief which seems widely held by companies in justifying their involvement in the apprenticeship system. This sees it as a sort of competition among companies to get the "best" schoolleavers as apprentices and hence subsequently as skilled workers. If a company does not take apprentices, they will end up with a less effective skilled workforce than they could have done with apprentices.

In a world of full information, this proposition is incorrect: Assume that skilled workers (those who have successfully completed an apprenticeship) have different levels of effectiveness, and that a worker of any given level can identify their effectiveness to companies, then there will be market wages for different levels of effectiveness. In that case the Becker result will hold, since it will pay companies to hire the desired workforce from the external labour market and thus avoid the cost of apprenticeships.

A necessary condition for an argument along these lines to hold is therefore that there is asymmetric information. We set out here a simple model of how the acquisition of private information by the training company about capacities of apprentices during the apprenticeship produces results similar to the justification sketched out above. That is to say, that participation in the apprenticeship system enables companies to get effective skilled workers, which they would not be able to do otherwise.

We hope to justify in a very simple model the behaviour of large German companies and apprentices as an equilibrium, and one which complements the argument of the last subsection on specific skills: In the simple model here, use is made of the inside information which companies get during the three and a half year apprenticeship of the quality (reliability, responsibility, effectiveness etc) of the apprentices they are training, information which apprentices cannot communicate to other companies: Specifically it is assumed that apprentices come in two "types" of effectiveness, "good" ones and "lemons". We show there is an equilibrium in which all companies train apprentices and offer contracts at the end of the apprenticeship to "good" apprentices, but not to "lemons"; these contracts are accepted by the "good" apprentices. If a company tried to hire an apprentice trained elsewhere, there would be a high probability that the hire would be a "lemon": therefore companies train their own apprentices; and "good"

apprentices (even if they would prefer to work elsewhere) accept the contracts offered by their own companies, because other companies have no vacancies.

The decisions of German companies to “make or buy” their skilled workforces are of course far more complex in reality than the model presented here. But even in this simple model, the high training equilibrium result relies on key institutional rules and understandings which govern apprenticeships, wage-setting and employment security in Germany. It is not just, therefore, the asymmetric information condition outlined in the last paragraph which leads Becker’s results not to hold: it is the combination of that condition and the restrictive wage-setting and employment security rules. Without these rules, in fact, asymmetric information does not prevent Becker’s result from holding; and without asymmetric information, the wage-setting and employment security rules are insufficient. This seems an interesting case therefore in which two problematic conditions produce a good result: inside information and restrictive labour market rules produce a better outcome than full information and deregulated labour markets. What are the important restrictive rules and understandings?

- (1) Apprenticeships cannot be terminated by the employer after a brief probationary period. The probationary period is either 1 or 3 months, and the apprenticeship is normally 3.5 years. (Termination can only take place for grossly improper conduct or for force majeure, e.g. company closure). Apprentices are however in practice allowed to leave.
- (2) It is extremely costly for a company to dismiss a skilled worker if the works council is opposed to the dismissal.
- (3) Roughly speaking, companies cannot pay less to a newly hired skilled worker for a particular category of job than to its existing employees in that category.
- (4) Companies are quite at liberty to hire skilled workers from other companies. But again roughly speaking, companies cannot use pay and conditions as a means of attracting workers from a similar “level” of company. This is a consequence of several factors: first, basic wages are regulated by industry agreements; second, although actual wage rates are (depending on the size and skilled labour composition of a company) above the basic rates, both employer associations and industry unions are concerned about preventing significant wage drift; finally works councils (representing existing skilled employees and with a strong interest in their retraining) would make it difficult for companies to pay newly hired workers above the odds.

Model 2: With these rules in mind, a simple model can be constructed. Companies are identical, and they produce output according to constant returns using skilled labour as the only input. Again the fiction of a one-period model is adopted, and the same assumptions apply except that there are no specific skills, (they are brought in at the end to reinforce the conclusions of the model). The model can be thought of as a game between a large number of companies and a larger number of apprentices. Although it is constructed in one period, the timing form of the game is as follows:

- (C1) Companies move first and choose the number of apprentices they will take; they know the proportion of lemons among any given number of apprentices but any individual company only discovers the identity of the lemons among its apprentices after the apprentices have been taken on and trained by the company.

(Training takes no time in the model, but requires the company to pay  $c_a$ .) At the same time companies choose the number of external hires they will make, and the number and identity of apprentices who will get offered jobs. All companies make these moves simultaneously, so no company knows what another company has done. If companies choose not to take on apprentices, the game ends with zero training and zero output (since skilled workers are needed to produce output); so this can be taken as a low-skill outcome.

(A2) The second move is made by apprentices again before any production has taken place. Each apprentice knows at this move whether or not he or she has been offered "post-apprenticeship" employment in the company which trained them; they also know what the common probability of an external job offer is (but not whether they individually have a better or worse chance to get one, since other companies cannot distinguish lemons from good apprentices).

The alternatives facing the company in C1 are set out first; but its optimal decision depends on the contingent choices which post-apprentices make in the second move A2. Thus having discussed the parameters of the company's decision, the move of the apprentice is brought in in order to see the equilibria in the model.

Companies can either use their own ex-apprentices (of number  $A$ ) or hire in skilled workers from the external market ( $H$ ), to produce output. The new hires may be lemons,  $H_l$ , or effective workers,  $H_{nl}$ . The productivity of an effective worker is  $s_m = 1$ , and the productivity of a lemon is  $\beta$ . The proportion of lemons in the population is  $\gamma$ , and they are assumed to be distributed evenly over training companies. Of a company's  $A$  apprentices, it does not offer employment to those who are lemons. This is because the productivity  $\beta$  of a lemon is assumed to be below the market wage,  $w_m$ . The company offers employment to all non-lemon apprentices; but some percentage of non-lemon apprentices,  $q$ , will choose to quit at the end of the apprenticeship: the quit rate  $q$  is an endogenous variable to be chosen by the apprentices in a Nash equilibrium. The output of a company is thus:

$$y = (1 - q) \cdot (1 - \gamma) \cdot A + H_{NL} + \beta H_L \quad (9)$$

The company maximises profits, subject to some output constraint (i.e. it is demand constrained), with unit output being sold at price of 1. The company's choice variables are  $(A, H)$ : it has to choose the number of apprentices and the number of external hires of skilled workers, the choice of apprentices being made before it knows which ones are lemons. Given the constant returns nature of the model, the relevant choice is simply whether it will use apprentices or whether it will hire in skilled workers or whether it is indifferent. Which of those three choices depends on the unit profitability of apprenticeships,  $\pi_a$ , and on the unit profitability of new hires,  $\pi_h$ .

If (i):  $\pi_a > \pi_h$ , then the company only uses apprentices.

If (ii):  $\pi_a < \pi_h$ , then the company only uses external hires.

if (iii):  $\pi_a = \pi_h$ , then the company is indifferent between external hires and apprentices.

We define  $\pi_a$  and  $\pi_h$  in turn:

$$\pi_a = (1 - q) \cdot (1 - \gamma) \cdot (1 - w_m) - c_a \quad (10)$$

$$\pi_h = p_L(\beta - w_m) + (1 - p_L) \cdot (1 - w_m) \quad (11)$$

The unit profit from training an apprentice is the profit  $(1 - w_m)$  from an apprentice who is employed by the company, reduced by the probability of lemons multiplied by the probability of quits, and less the cost of the apprenticeship  $c_a$ . The unit profit from an external hire is the profit  $(1 - w_m)$  from the hire of a non-lemon, multiplied by the probability of a non-lemon  $(1 - p_L)$  less the loss from a lemon multiplied by the probability of a lemon  $p_L$ .

The probability of hiring a lemon is not exogenously given, since it depends on the percentage of non-lemons who quit after an apprenticeship and seek work in other companies:

$$p_L = \frac{\gamma}{\gamma + q \cdot (1 - \gamma)} \quad (12)$$

Thus before the company can make a choice between apprenticeships and external hiring, it must forecast the strategy which apprentices will adopt (assuming it has apprentices) towards quitting.

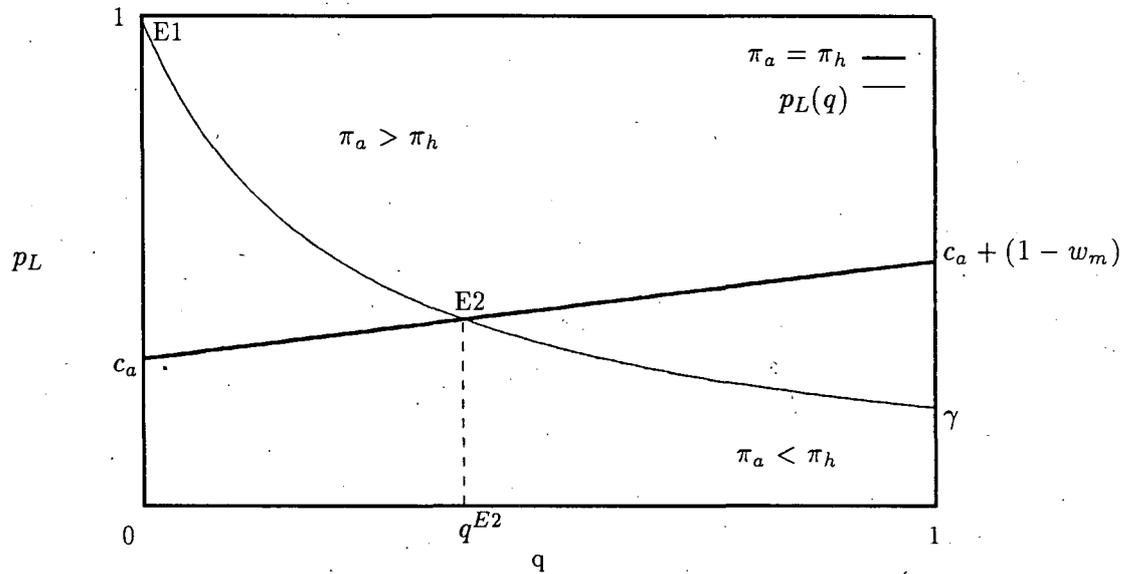
Turn therefore to the apprentice's decision. The "good" apprentice, on receiving an employment offer by the company which trained him or her, has to choose either to accept the offer or to take a chance on getting a job offer externally, i.e. to quit; (the "lemon" gets no offer and is forced to seek employment elsewhere). It is simplest to assume the apprentice chooses a mixed strategy, where the choice of  $q$  means that the apprentice seeks offers elsewhere with probability  $q$  and accepts the training company's offer with probability  $1 - q$ .

Apprentice preferences: It is assumed that there is on average some desire by apprentices to quit and look for employment elsewhere even if they have been offered employment where they have been trained. But it is also assumed that they are highly risk averse and they will only quit if they are sure of getting employment elsewhere. This is expressed by assuming that if the probability ( $p_\Phi$ ) of an external job offer is unity ( $p_\Phi = 1$ ), then good apprentices will prefer the highest  $q < q^*$ , consistent with  $p_\Phi = 1$ . Thus  $q^*$  represents this desire to quit:  $q^*$  is in practice likely to be quite small, but here it will be assumed that  $q^* = 1$ . This latter is not meant as a realistic assumption, but merely to show that even if apprentices are potentially footloose they will not in fact necessarily choose to leave.

There are two equilibria in this model, both of which involve companies training apprentices. In the first equilibrium, companies meet all their employment needs by apprenticeships; in the second some are also met by external hiring. The first equilibrium is the one sketched out earlier in providing the intuition behind the argument: Companies meet all their employment requirements by training, so they make no external hires; apprentices do not quit since they see the probability of a job offer outside is zero.

The first equilibrium corresponds to the following conditions. (a) Companies choose only to train: This requires  $\pi_a > \pi_h$ . The latter condition is satisfied so long as  $q = 0$ , as can be seen by comparing the RHS of Equations 10 and 11. The RHS of  $\pi_h$  is negative, since  $q = 0$  implies  $p_L = 1$ ; the RHS of  $\pi_a$  is assumed positive with  $q = 0$ . (b) Given that companies have hired enough apprentices to need no external hires, and that this is known to apprentices, they will choose not to quit since  $p_\Phi = 0$ .

Figure 2: Lemons Equilibria



It may be useful to represent this equilibrium graphically, see Figure 3.2. The perceived probability of hiring a lemon,  $p_L$ , is shown on the vertical axis; and the quit rate of qualified apprentices,  $q$ , is on the horizontal. The graph is divided into two areas by the line  $\pi_a = \pi_h$ ; the equation of this line in terms of  $p_L$  and  $q$  is given by:

$$p_L = c_a + (1 - w_m) \cdot (\gamma + q \cdot (1 - \gamma)) \quad (13)$$

Above this line apprentices are more profitable than external hires, and below the reverse. Along the upwards sloping line, companies are indifferent between keeping apprentices and external hires: the "indifference" line slopes up because an increase in  $p_L$ , the probability of a lemon, makes it less attractive to hire external workers, and therefore must be balanced by an increased quit rate which reduces the attraction of apprentices.

The downwards sloping line shows how the probability of a lemon declines as ex-apprentices become more inclined to quit. If no ex-apprentices choose to quit, the probability of hiring a lemon is unity; if on the other hand there is a 100% chance that an ex-apprentice will quit the probability that an external hire will turn out to be a lemon is  $\gamma$ , the percentage of lemons in the population.

The first equilibrium is at E1. Here companies offer employment to all good apprentices, and apprentices know that the probability of employment elsewhere is zero. Hence they accept the offers, even if they would prefer to leave. The second equilibrium is at E2. In this equilibrium, employers are indifferent between offering apprentices employment and hiring externally. Therefore the strategy of announcing that they will offer external hires corresponding to filling quits of  $q^{E2}$  is at least as good as any other strategy. However, this second equilibrium is a weak one, since any other percentage would be equally good. For this reason the first equilibrium can be taken as the equilibrium of interest.

*Models 1 and 2.* These two models can be put together usefully as follows. In model 2, the preferences of apprentices can be made more plausible by assuming that there is some percentage of apprentices who will always quit at the end of the apprenticeship (for demographic reasons, etc.). Call that percentage  $q^{**}$ . Clearly E1 is no longer an equilibrium if apprentices choose a mixed strategy quit rate of at least  $q^{**}$ , and no equilibrium exist with  $q < q^{**}$ . Is there an equilibrium analogous to E1 but with  $q = q^{**}$  rather than  $q = 0$ ? The answer to this is positive iff  $q^{**} < q^{E2}$ .

If  $q^{**} < q^{E2}$ , then it pays companies to fill as much of their needs as possible by offering employment to its own apprentices, and by hiring externally to fill those who have quit. It does not pay companies to train apprentices if a larger percentage than  $q^{E2}$  quit, since then  $\pi_a < \pi_h$ . Moreover it does not pay apprentices to adopt a mixed strategy greater than  $q^{**}$ , since they will be unable to get employment with probability 1.

The critical question then is whether or not  $q^{**} < q^{E2}$ . Model 1 can now be brought into play. In model 1, the cost of the acquisition of specific skills by externally hired workers with marketable skills makes external hiring *cet.par.* less attractive than employing one's own ex-apprentices. If the cost of acquisition of company specific skills is imported into model 2, Equation 11 requires modification since the productivity of external hires is zero for a fraction  $\mu$  of the period. This in turn changes the upwards sloping "indifference" Equation 13, which becomes:

$$p_L = \frac{c_a + (1 - w_m) \cdot (\gamma + q \cdot (1 - \gamma)) - \mu}{(1 - \mu)} \quad (14)$$

This inclusion of specific skills does not alter the downwards sloping  $p_L$  schedule, so a change in  $\mu$  has the effect of the indifference line up or down the lemon probability curve. As it does so,  $q^{EL}$  is reduced or increased. Partially differentiating  $p_L$  by  $\mu$  along the indifference line implies:

$$\frac{\delta p_L}{\delta \mu} = \frac{(1 - p_L)}{(1 - \mu)} \quad (15)$$

Thus it can be seen that the inclusion of the company specific skills argument pushes the indifference line down and hence increases  $q^{EL}$ . This in turn implies that the room for  $q^{**}$  is that much greater.

Hence the two arguments which have been made in this section reinforce each other. Our claim is that both arguments capture important elements of the current German scene and both modify Becker's assumptions in such ways as to reverse his conclusions in these cases. Where first it is both the case that specific skills are complementary to general skills and that specific skills can be taught more cheaply at the apprenticeship stage than later; and second that the apprenticeship stage enables training companies to screen out lemons: then (depending on the parameters) companies may have incentives to make investments in training apprentices in marketable skills. Unfortunately current data make it difficult to test these hypotheses econometrically: It is difficult to measure specific skills and the cost of teaching them. And it is equally difficult to measure the efficiency of externally hired skilled employees.

## 4 Conclusion

This chapter has focussed on the apprenticeship system in what might very loosely be called the advanced sector of the German economy, namely medium to large companies

in the industrial and commercial sector. Leaving aside the liberal professions, agriculture and public services, roughly 60% of apprenticeships are now in this area. The remaining 40% are in the craft or handwerk sector (see Table 5). Although the formal structure of apprenticeships in the two sectors is (more or less) the same, we noted in the second section that there are major differences in the actual patterns of operation. Having suggested in the last section two complementary models to explain why profit-maximising industrial and commercial companies make significant net investments in apprenticeships, let us briefly recall the main differences between this and the craft sector. First, the retention rate of post-apprentices in craft sector companies is relatively low: Those who do not stay move in large numbers to semi-skilled work in large industrial companies, where semi-skilled workers often earn more than skilled workers in the craft sector; large companies appear to value the organisational skills they acquired during their craft apprenticeship and often they do not use the technical skills they learnt, e.g. as a baker. Second, the existing studies of the net costs of training apprentices in the crafts sector suggest they are low (Table 7), and it seems likely that a proper shadow price procedure would establish that they were insignificant or negative. In addition to these differences, the conditions which drove the two models of the last section - namely, substantial company-specific skills and considerable asymmetric information about the quality of apprentices - are much less likely to be of relevance in the craft sector. Thus a full model of the German apprenticeship system would distinguish between the two sectors, with the craft sector acting as a training school for future semi-skilled workers in the other sector in addition to its own skill requirements.

In focusing on why companies in the industrial and commercial sectors make significant net investments in apprenticeship training, our goal is to try and understand which assumptions of Becker's argument are inapplicable in the German context. Our maintained assumption throughout is that these companies are profit-maximising and that their investment choices do not reflect political or social pressures. A more complete approach than that in this chapter might want to explore this assumption more fully. It may be appropriate in the conclusion to suggest in what direction such an exploration could most fruitfully go. Let us start by reiterating that there is no strong set of institutional sanctions against companies which do not train apprentices; moreover there is an active labour market in skilled workers, and there is nothing to prevent a company which does not train using that market. There may from time to time be political pressures on companies to increase the number of apprenticeship places, but this typically relates to exceptional circumstances and does not supply the general motivation to train.

The more interesting direction to go in, as briefly referred to in Section 2, is that of personal, family and social networks. In small communities, an employer depends in many ways on the goodwill of the local community for the smooth running of the business. Thus taking local apprentices may be an important way of maintaining local goodwill; and the community, and its political representatives, may see the giving of goodwill, for instance in the form of political cooperation in a whole range of activities, as a worthwhile means of ensuring that young people in the community have local apprenticeships available. Certainly, both small and medium sized companies have long-term attachments to particular small towns in Germany. In general, the reasoning may be less conscious: it may approximate the anthropological model of "gift-exchange," which of course can be seen in game theory terms as an example of the Folk theorem.

The main thrust of the chapter, however, is to show that (leaving all political, so-

cial and institutional pressures aside) it can pay profit-maximising companies to engage in net investments in training in marketable skills under certain assumptions. the alternative but complementary sets of assumptions are: (1) That the cost of training apprentices in company-specific skills is much lower than the cost of training externally-hired workers in the same company-specific skills; and that company-specific skills are needed to make transferable skills productive. (2) That the company gains considerable information about the quality of an apprentice during the apprenticeship, which the apprentice cannot signal to other companies.

In both cases, it seems likely that the German labour market institutional environment explains why these conditions are important in encouraging costly apprenticeship training. The type of autonomous work organisation of skilled manual employees which generates the need for combined specific and general skills (as implied in (1)) is clearly helped by a highly cooperative trade union system and an effective system of internal employee representation via works councils. And the wage-setting system and the rules governing apprenticeship security play a key role in the argument relating to (2). Thus, there is a contrast between the German and American systems, which explains why some degree of greater institutionalisation in the former is important in getting companies to invest in apprenticeship training.

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