

The impact of subsidies on Apprenticeship Training

Niels Westergaard-Nielsen* and
Anders Rue Rasmussen**

May 1999

JEL classifications: J24, I28

Keywords: Apprenticeship training, subsidies

Abstract

For years, Denmark has maintained and developed its apprenticeship system which is comparable to the German system. Today, about 40% of a youth cohort get apprenticeship training. The sustainability of the system builds on the condition that demand and supply for apprentices are in a reasonable balance. In recent years there have been periods with serious mismatches between the demand for and the supply of apprenticeships in both Germany and Denmark. Subsidies and school organized apprentice courses were introduced in both countries to overcome the effect of this shortage. In this paper we have investigated the possible impact of the subsidies. A unique longitudinal data set that enables us to follow 1000 work places from 1980 to 1991 is applied. This makes it possible to control for observed and unobserved work place effects. The estimates show that the subsidies have had an impact on the supply of places in some industries while others are not affected at all. The total effect has been compared to the costs and it is found that the total costs per extra apprenticeship is about 54,000 DKK. Finally, the results are used to simulate the effects of changing the subsidies.

Acknowledgement

Financial support from the Danish National Research Foundation is gratefully acknowledged. John Bishop, Peter Capelli and Hessel Oosterbeek and other participants at the conference on "New Empirical Research on Employer Training", ILR, Cornell are thanked for comments to an earlier version of this paper. Paul Bingley and Ebbe K. Graversen, CLS, are thanked for helpful advice. An anonymous referee is also thanked.

Addresses

Centre for Labour Market and Social Research, Building 350, Universitetsparken, DK-8000 Aarhus C, Denmark. Phone: +45 8942 2350, fax: +45 8942 2365.

E-mail: nwn@cls.dk and arr@cls.dk

* CLS and Aarhus School of Business

* CLS and Den danske Bank

1. Introduction

For a long time, Denmark has had a well-organized apprenticeship system. To a large extent, the institutional arrangement is comparable with the apprenticeship system in Germany, see Blechinger and Pfeiffer (1996). The apprenticeship system has traditions that are rooted in the old guild system, it is widely accepted and serves as the most common general vocational training system of the private labour market. One of the features of the present Danish apprenticeship system (like the German system) is the dual system of vocational schools and practical training. Nowadays, an apprentice starts with one year at a vocational school. After vocational school she or he have to find an employer who is willing to employ her/him as apprentice. The schools assist in this process. Since there is almost free admission to the vocational schools and since most of the apprenticeships are provided by profit maximizing firms, the Danish (and the German) apprenticeship system has from time to time been hit by mismatch problems with respect to providing enough apprenticeships. Because the wage for apprentices is not downward flexible, there is no immediate self correcting mechanism. Instead, Denmark and Germany have both tried to create a school based training system that should substitute the practical training with a master. The involved costs were substantial partly because of the lack production and the training was in many cases also less efficient and less motivating. In Denmark, various schemes of subsidies have been tried in order to get companies to employ more apprentices. In the investigated period subsidies were given to employers for each extra apprentice they would employ.

In this paper we will analyse the impact of the actual subsidies on employers' demand for apprentices or the supply of apprentice places. We will furthermore compare the cost-efficiency of these subsidies with the costs of the school based system. We start the paper with a short description of the Danish apprenticeship system and of the subsidy schemes that have been in use in the investigated period. As the main element of the paper we have estimated a demand function for new apprentices which includes an effect of the subsidies applied. First, the demand function is estimated as a cross section model as is commonly done. Secondly, we have utilized the panel structure of data to take account of unobserved establishment heterogeneity by including a random firm effect. Finally, we have used the model to analyze the effect of the subsidy measured as how many extra apprenticeships were created because of the subsidy.

Short description of the Danish apprenticeship system

In the old days, apprenticeship training was organized as a master training with the guild controlling the quality. In the beginning of this century, this scheme was supplemented with periods of vocational school training, where the apprentices were introduced to more theoretical subjects along with new methods and materials. This has gradually become more formalized and more and more emphasis has been put on formal education.

Today, the training starts with one year of basic training at a vocational training centre. To a high extent, this training is a continuation of elementary school but with more emphasis on the practical sides, although it also contains classes in Danish, English and Mathematics. After the first introductory year, the “pupils” are expected to find themselves a company that will employ them as an apprentice; the training period has usually a duration of 2 to 3 years depending on the field. During the whole practical training period, there are a number of short periods, where the apprentice goes to a vocational school and is trained within his/her special subject. The number and length of the periods and the subject depends on the trade. Carpenters for example take training at schools for the wood industry, plumbers and auto mechanics at the metal schools, while clerical workers take computer and book keeping courses at special schools.

The curriculum for different apprenticeship training schemes are put together centrally by a board of representatives for the associations of masters, trade unions, the vocational schools and the Ministry of Education. Each trade has its own board. The quality of the training is supervised by regional bodies consisting of masters from the guild, employers' representatives, trade union representatives and teachers from the training centres.

Apprentices get a wage, which starts out at a level of about 40% of the wage of a skilled worker. This salary increases throughout the apprenticeship period, so that the average pay for apprentices is about 50% of that of adult workers. The wage level of apprentices is negotiated together with the normal wage contracts of the area.

The wide spread apprentice system has undoubtedly had a large impact on the quality and productivity of workers and on the rate of youth unemployment that is among the lowest in

the Western World in Germany, Austria, Switzerland and Denmark which are the countries maintaining the apprentice system.

Subsidies.

As described above apprenticeship training has for a long period of time been organized as a mixture of courses at vocational training schools and the more old-fashioned master training at workplace level (the so-called dual system). The wage system covers the master training periods as well as the periods of school attendance. Since 1977, there has been a subsidy for all employers who employ apprentices so that the subsidy partly covers the wage during periods of school attendance. The subsidy is designed to cover about 70% of the wage costs during school periods, and it is financed via a tax on all employers according to the number of employees irrespective of how many skilled workers they have. The education at the vocational schools is free of charge, which means that it is paid by the State. The effect of this arrangement is that to some extent the general training element is subsidized by the State and by all employers even though the employer's tax is not addressed directly to those employers who benefit most from employing skilled, trained workers.

In certain periods during the 1980s, there has been a shortage of apprenticeships for the students who finished their first year of vocational school. The reason for this shortage is that the mechanisms that determine the supply are different from the determinants of demand for apprenticeship training places, and there is no equilibrating mechanism. Thus, the number of training places is determined by the establishments based on an economic calculus of the firm where the business cycles plays a certain role together with other factors. On the other hand, the demand for apprenticeships is determined by the size of the relevant birth cohort and possibly also by the "taste" or economic conditions for manual training compared to no education or other types of education. It has been claimed (Albæk, 1988) that the shortage of training places was created by a relative increase in the wage of apprentices compared to unskilled workers. On the basis of times series, Albæk, 1988, has also claimed that already the first wave of general subsidies to school periods introduced in 1977 has resulted in higher wages for apprentices as a result of the general wage negotiations. Compared to the German apprentices the Danish apprentices have since the late 60's increased their wage share compared to adult workers. Where the share was about 20% in the 50's and 60's, it had risen to about 40% in the beginning of the 80's. The subsidy helped lowering the costs.

The increased wage level has undoubtedly contributed to the shortage of apprenticeship places that appeared in the trough of the cycle. Different subsidy schemes have been tried during the 1980s to overcome these shortage problems: From 1978, county administrations had the possibility of giving firms an hourly subsidy of 10 DKK per hour they employed an apprentice with a maximum amount of 15,000 DKK per apprentice. In 1980, the hourly rate was increased to 11 DKK per hour (about 38% of the salary per hour for apprentices) and the maximum to 16,000 DKK. But this subsidy was only used in a few cases. In 1982, the subsidy structure was changed and was now given to all firms who maintained or increased the number of apprentices.

From late 1982 to 1986 there was a Government financed subsidy of 30,000 DKK for each marginal apprentice (in 1982, this was about 18% of the salary per hour for apprentices) provided that it was a maintenance of the total number of apprentices at establishment level or that it was a net growth, in both instances compared to the average number of apprentices over the last two years. In 1984, financing the subsidy was completely levied on the employers. Each employer paid a tax according to the number of employees. For short apprenticeships, than can be found mainly within restaurants and office, the subsidy was only 18,000 DKK.

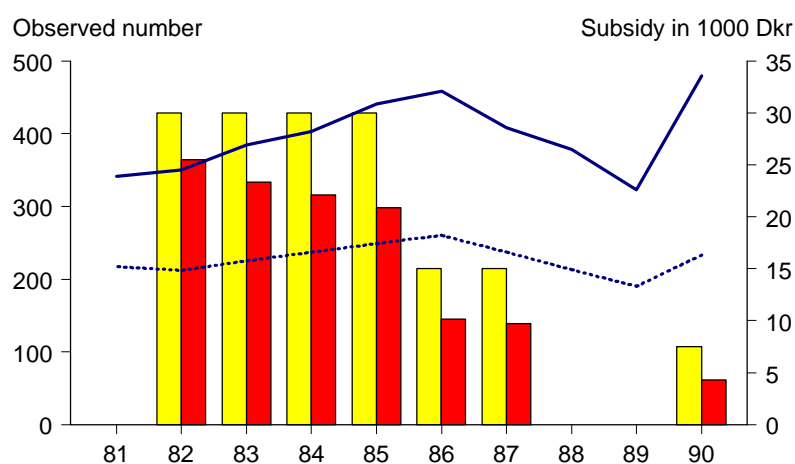
The subsidy was halved for all new apprentices from January 1, 1986 (and now made up about 8% of the salary per hour for apprentices) and was completely abolished at the end of 1987. For a short period in 1989 (September 15 to December 31) there was a smaller subsidy that varied with the length of the apprenticeship training and with the length of the periods of school attendance. This subsidy is presumed not to have had any substantial effects until the next observation point in November 1990 because it was introduced so late in the year that the employers have not yet reacted to it in November 1989. This is supported by monthly statistics on new apprenticeships.

In 1990, the shortage problem was dealt with in a completely different manner. Now the government guaranteed apprentices that could not find a trainee job that they could be trained at a vocational school. This arrangement was financed through a tax levied on all employers. A similar model had been used in West Germany. Due to the high costs per apprentice trained and some doubts about the relevance of school attendance, subsidies for normal training were reintroduced in 1993. At that time, the subsidies were given to all new apprentices and not

only to the marginal group in order to simplify the incentive structure for employers. The intention was to make it more attractive to hire ordinary apprentices and thus compete with the use of the overly expensive vocational training schools. That worked to a large extent, but the vocational training schools are still being used and are now a place for those young people who still cannot find an ordinary apprenticeship mostly because of personal appearance, foreign origin etc. or other discriminating factors. Unfortunately, we do not yet have data for this period.

The subsidies described above are summarized together with the number of new apprentices in our sample in Figure 1. The subsidy was in 1982 about 25% of the direct wagebill.

Figure 1. The potential subsidy per marginal apprentice in real terms (black bars) and nominal terms (shaded bars) and the number of new apprenticeships (line) and plants with a new apprentice (dotted line), 1981-1990.



Note: A new apprentice is defined as an apprentice present in time t and not present in time $t-1$.

The Demand for Apprentices

The motives for employers to employ and train apprentices can be summarized in the following four divisions: First, the relative cost of employing apprentices may be sufficiently low compared to the productivity and compared to other types of labour. The produced surplus may make it profitable to employ and train apprentices. This mechanism probably depends on the production function of the company, so that some companies will choose a production function that allows more apprentices than others.

Secondly, employing apprentices secures the recruitment of the future skilled labour force. The company could, however, choose to become free rider and cover the need for skilled

workers by hiring when they have the need to and let others train them. Half of all firms actually do that. Two reasons for hiring anyway can be mentioned: Even though the apprentice training has a large element of general training there is also a certain element of specific training involved. Through the apprenticeship programme, the firm obtains this training for a relatively low price.

Thirdly, a certain flow of apprentices through the company allows the company to monitor the apprentices and to pick the best ones and offer them a career in the company. If the company has high hiring rates or high exit rates and high growth we expect it to recruit more apprentices to meet future demands for personnel. This also means that positive business cycles will have a positive effect on the recruitment of apprentices as well.

Fourthly, firms may feel an obligation to provide apprenticeships as part of a mutual responsibility for the future of the trade.

In all cases, subsidies will help increase the number of hired apprentices: It makes apprentices relatively more competitive compared to other groups, and it makes it less costly for firms to use apprentices to improve or facilitate their recruitment of new workers.

Data

The analysis in this chapter is based on a sample from IDA (Integrated Database for Labour Market Research) created by Statistics Denmark. The information comes from various administrative registers that are merged in Statistics Denmark. The specific feature of IDA is that it is possible to associate work places with the identity of all employees at a specific time of the year. Information on these individuals can then be retrieved from the administrative registers and merged. In that way it is possible to get an impression of the characteristics of the entire work force at all work places and to follow workers and work places over time. The information on employees is very comprehensive and contains data on wage rates, number of hours worked, experience, unemployment, demographic variables, education, ongoing information, region, occupation, etc. The information on work places consist of 3 digits of the industry code, (ISIC), composition of work force, total employment over the year, and region. For a more detailed description of IDA, see Leth-Sørensen (1995).

For this study, a sample of 1000 work places and all of their employees has been constructed. The 1000 work places have been chosen randomly among non-public work places with more than 5 and less than 500 employees in 1980 (due to confidentiality concerns). (Bingley and

Westergård-Nielsen, 1996 and Albæk and Sørensen, 1998 have used similar data, even though the latter have looked at the manufacturing industry at work place level.). In the subsequent years these establishments have then been followed for as long as they exist. In order to maintain the representative nature of the selection of establishments, the sample has been supplemented with a sample of new establishments according to the birth rate of new establishments. Bjørn (1992) uses also IDA data to analyze the demand for apprentices for the period 1980-87.

The sample used in this paper has been limited with respect to industry since the educational structure for apprentices is not the same in all industries. Firms belonging to farming, telecommunication, public administration and teaching institutions have therefore been removed from the sample.

The term *ongoing apprenticeship* is well defined in the educational register in Statistics Denmark. This means that the person has passed an examination after the first year of introductory vocational school, and is now under the supervision of a master and taking supplementary courses at a vocational school. All statuses are measured in a specific week in November.

Estimation of a Demand Function for Apprentices

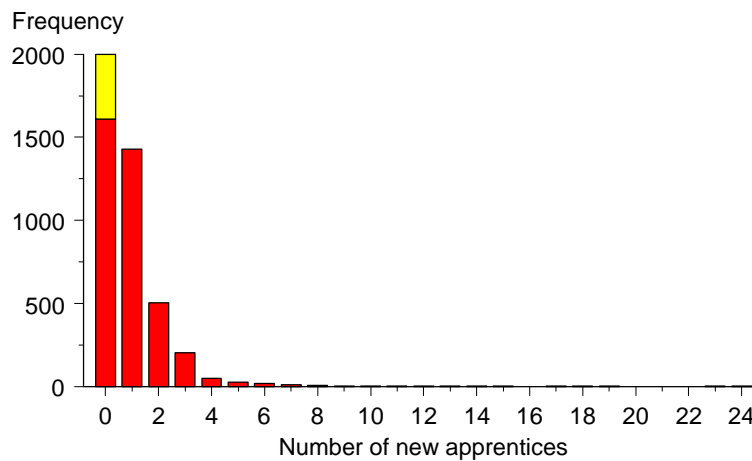
In this section, we will estimate a function describing the number of new apprentices hired. We will in particular investigate the role of subsidies along with the relative price of apprentices, the business conditions and hiring policies of the firms¹.

For the estimation we use a subsample of the data where we look only at plants that have employed apprentices during the period 1980-1991. Arguments about technology suggest that some plants may not be able to employ apprentices at all, this may be the case in industries where there is no tradition for apprentices and where there may not be any appropriate apprentice training at all. That restriction leaves us with a total of 720 plants that have all had an apprentice at some point in time.

¹ Given the marginal nature of the subsidy, the optimal behaviour of establishments is obviously quite difficult to model. In addition to this, the subsidies have been changed so many times that it is not very likely that the firms will adjust efficiently and fully to these changes. Consequently, we have estimated the true model as a reduced form equation.

The specification of the demand function depends on the nature of the dependent variable - the number of new apprentices. The definition of a new apprentice used in this paper is an apprentice who is present in time t and not present in time $t-1$. The observed frequencies of new apprentices reported in Figure 2 identify a count data process. The Poisson regression model is therefore used to estimate the demand function.²

Figure 2. Observed frequencies for number of new apprentices per workplace.



Note: The frequency of the number of new apprentices larger than 8 is very small. It is therefore not possible to spot these observations in the graph. Because the sample has been limited to firms who have employed an apprentices at least once during the observed period, we have removed a number of observations with 0 new apprentices (this is illustrated by the light bar on top of the dark bar in the graph).

For the discrete random variable Y , and observed frequencies, y_i , and regressors \mathbf{x}_i the Poisson model is given as

$$\Pr(Y = y_i) = \frac{\exp(-k_i) k_i^{y_i}}{y_i!}, \quad y_i = 0, 1, 2, \dots, \quad (1)$$

where k_i is the mean and the variance of y_i - see (3). The interpretation of k is the number of occurrences per time unit, in this case the number of new apprentices per year in firm i . A more convenient formulation of k is

² Ordered probit models have also been estimated with almost the same results.

$$\ln \lambda_i = \beta' x_i \quad (2)$$

From (2) it follows that

$$E[y_i | x_i] = \text{Var}[y_i | x_i] = \lambda_i = \exp(\beta' x_i) \quad (3)$$

A problem often encountered in the estimation of Poisson models is that the mean and the variance differ - this phenomenon is known as overdispersion³. We observe a mean of 1.02 and a variance of 2.46, but because of the two conflicting test results we have chosen not to take overdispersion into account in our estimations.

Furthermore, we can utilize the panel structure of our sample and estimate a random effect Poisson model. This allows for plant specific effects denoted u_i

$$\ln \lambda_i = \beta' x_i + u_i \quad (4)$$

Table 1 reports the estimated parameters from a Poisson regression where the number of new apprentices is regressed on plant and industry level variables. *NSKILL* is the number of skilled workers at the plant. *SIZE* is the number of primary jobholders at the establishment in November⁴. *ENTRYRATE* is the ratio of new hires of all other workers than apprentices to the average number of primary jobholders in time t and $t-1$. Similarly, *EXITRATE* is the ratio of leavers to the average number of primary jobholders in time t and $t-1$. These variables are supposed to reflect the impact of business cycles for the plant as well as for the industry on the demand for apprentices. *WAGERATIO* is the average wage of ongoing apprentices in plant i divided with the average wage of the skilled workers in plant i . If the number of apprentices or the number of skilled workers in plant i is zero then the wage rates are replaced by industry mean values. *SUBSIDY* is the deflated subsidy (see Figure 1) in DKK 1000. Since we do not have complete information on which apprenticeships only get the low subsidy we have treated all subsidies in the same way. Effects due to industry dummy variables are included to allow

3 ³For a more detailed description of overdispersion and how to test for overdispersion see Cameron and Trivedi (1990). We have tested for overdispersion and the two possible tests give different results.

4 ⁴Primary job holder means that the persons with multiple jobs have their most important (highest earnings) employment in this establishment in November.

for different levels of apprentice hiring in different industries - manufacturing is used as the basic industry.

See the appendix for detailed descriptive statistics of the explanatory variables.

The Poisson estimates in Table 1 show that the number of apprentices is positively related to the number of skilled workers and the size of the plant. The wage ratio has a negative sign indicating that the demand for new apprentices is negatively correlated with their relative wage. The subsidy is found to have a highly significant positive effect, the higher the subsidy the higher the demand for apprentices. Both measures of labour turnover rates are significant but with opposite signs - the entry rate has a positive effect and visa versa with the exit rate. Work places with a high number of hires employ more apprentices, while work places with many leavers are demanding less apprentices. The entry rate dominates, however, so that establishments with a higher net growth also employ more new apprentices, so that there is an asymmetric upward bias in the employment of new apprentices. Construction, trade and restaurant are found to have a higher demand for apprentices than manufacturing, office and other industries. Bjørn (1992) was not able to estimate an effect of the subsidy, because he had fewer years. With OLS he obtained estimates for the other variables of the same magnitudes as in Table 1.

Table 1. Poisson regression of the number of new apprenticeships, 1981-1990.

	Poisson		Random effect	
	Parameter estimate	Standard error	Parameter estimate	Standard error
INTERCEPT	-0.4499	0.0622	-0.6140	0.0839
SIZE	0.0040	0.0003	0.0041	0.0006
NSKILL	0.0098	0.0009	0.0081	0.0024
WAGERATIO	-0.3760	0.1256	-0.1949	0.1327
RESTAURANT	0.4302	0.0436	0.4071	0.0805
CONSTRUCTION	0.0914	0.0534	0.0603	0.0950
TRADE	0.2210	0.0545	0.1905	0.1002
OTHER	-0.1980	0.0894	-0.2999	0.2149
OFFICE	-0.2285	0.0696	-0.2148	0.0762
SUBSIDY	0.0060	0.0016	0.0061	0.0017
ENTRYRATE	0.7274	0.0710	0.8121	0.0944
EXITRATE	-0.4677	0.0807	-0.3357	0.0957
N	3882		3882	

Note: Coefficients in **bold** are significant at a 5% level. The reported standard errors for the random effect regression are consistent even if the residuals across groups are not identically distributed or the correlations within the groups are not as hypothesized by the random effect estimator. Subsidy is measured in a unit of DKK 30,000.

Estimating with a random work place effect and thus controlling for unobserved work place effects changes the significance of a few of the parameters but it does not change the signs. The most important change is undoubtedly that the wage ratio here is found to be insignificant indicating that on the plant level the relative apprentice wage does not influence the demand, possibly because wage ratios vary with the work place ID or because unobserved plant specific elements dominate the wage differentials.

In order to investigate how stable these effects are across industries we have run the Poisson regressions separately for each industry. Results are shown in Table 5.

Table 2. Poisson Regressions for each Industry

	Manufacturing	Office	Other	Restaurant	Trade	Construction
INTERCEP	-0.3384 [0.1218]	-1.1049 [0.2449]	-0.4443 [0.2840]	0.0008 [0.1048]	-0.4219 [0.1681]	-0.6567 [0.1536]
NSKILL	0.0127 [0.0014]	0.0044 [0.0030]	0.0457 [0.0111]	0.0012 [0.0018]	0.0155 [0.0075]	0.0395 [0.0061]
WAGERATIO	-0.2127 [0.2581]	-0.3541 [0.5033]	-0.1172 [0.6465]	-0.5710 [0.2122]	-0.3316 [0.3790]	0.0330 [0.3067]
SUBSIDY	0.0070 [0.0033]	0.0200 [0.0066]	0.0118 [0.0088]	0.0004 [0.0028]	0.0122 [0.0043]	-0.0001 [0.0044]
ENTRYRATE	0.2991 [0.1502]	0.7786 [0.3120]	0.9497 [0.3552]	0.9335 [0.1322]	1.2170 [0.1815]	0.7230 [0.2064]
EXITRATE	-0.5625 [0.1814]	-0.0045 [0.3380]	-0.8803 [0.4534]	-0.3976 [0.1375]	-1.0618 [0.2769]	-0.3572 [0.1987]
SIZE	0.0027 [0.0005]	0.0057 [0.0006]	-0.0081 [0.0024]	0.0063 [0.0005]	0.0053 [0.0010]	-0.0069 [0.0043]
No. obs	970	424	178	1054	581	675
Log L	-1163.88	-396.40	-205.81	-1442.11	-719.96	-744.47

Note: Coefficients in **bold** are significant at a 5% level. Standard errors in brackets.

As expected the results appear to be less significant when splitting the observations into industry groups. The signs are, however, consistent across industries. It is remarkable that the coefficient to *entry rate* is significantly positive with a size around 1 for all industries except

manufacturing, where it is quite small. This result is again only to some degree counteracted by the exit rate, though the negative coefficient from the exit rates is dominating for manufacturing.

Subsidy is found to have a significantly positive effect in *manufacturing*, *office* and *trade* and is insignificant in the other industries. As in the industry pooled regression reported above plant size and the number of skilled workers have a positive effect on the number of apprentices.

All in all we can conclude that the variables concerning the size of the work place, the number of skilled workers and entry rate (of all other workers) into to workplace are very important determinants of the demand for new apprentices. This gives support for the hypothesis that firms demand apprentices because of concern for their future workforce and for the screening hypothesis. The hypothesis of cheap labour can only find support in the restaurant industry. Here the demand elasticity is found to be -0.6 , indicating that a 10% increase in the wage for apprentices compared to skilled labour is followed by a reduction in the demand for apprentices of 6%. The reason is undoubtedly that substitution with other types of labour are very easy in the restaurant industry. Moreover, the skill ratio does not have any significant impact here either.

In the first column of Table 3 we have reported the expected number of new apprentices per year at each employer in the sample using the estimated coefficients of Table 2 and the level of subsidies in 1983-86, see Figure 1. The largest expected number of apprentices is found for *Restaurants* trailed by *Manufacturing* and *Trade* and the smallest for *Construction* and *Other*. To investigate the *effects of changes of the subsidy* we have subsequently predicted what would have happened if the subsidy had been eliminated as one extreme and what would have happened if the actual subsidy had been increased with 50% as the other extreme. If the subsidy is eliminated the expected number of apprentices drop from an average of 1.02 to 0.95 which is -7%. For 1983 we can calculate the demand elasticity for a 3 year apprenticeship including the subsidy to about -0.34 assuming that the total wage cost for a 3 year apprenticeship including the subsidy is 139,000 DKK and the total subsidy also in real prices is

32,328 DKK. The change in the number of apprentices is largest for Offices with -23%⁵, Trade with -17% and Manufacturing with about -8%. The effect of eliminating the subsidy is either very small or insignificant for the other industries.

Similarly, it is found that an increase in the subsidy of 50% would result in an overall increase in the number of apprentices of about 5%. The largest increase in the number of apprentices is found for Offices where the effect is an increase of 22% in the number of apprentices compared to 12% for Manufacturing and Trade and non-significant or small reactions for the other industries. Thus, the analysis has shown that the impact of the subsidy is limited to Offices, Manufacturing and Trade, whereas Construction, Restaurants and Other industries do employ the number of apprentices they are used to irrespective of the subsidy system.

Table 3. Predicted average number of apprentices per employer for different levels of subsidy looking at all the years.

	Average number of apprentices with actual subsidy	Elimination of the subsidy	No. of observations
Manufacturing	1.03	0.94	970
Office	0.67	0.52	424
Other	0.83	0.72	178
Construction	0.85	0.85	675
Restaurant	1.31	1.31	1054
Trade	0.98	0.84	581
All	1.02	0.95	3882

From the above we can infer that the actual profile of subsidies described in Figure 1 has increased the number of apprentices with 7% compared to a situation without any subsidy. 7% is similar to 276 more apprentices in the sample over the whole period.

We can now try to estimate the total costs of the actual subsidy over the investigated period and within the sample of creating 7% more places for apprentices. Applying the rules for calculating the actual subsidies on the observed distribution of apprentices we find that subsidies have been paid to 192 apprenticeships in 1985 based on 2/3 of the sample while 195

⁵ The duration of an apprenticeship within Office and Trade is shorter (2 years) and the subsidy is 60% of the full subsidy. Correcting for this the demand elasticity for Office and Trade is about -.8, or nominally much higher than within Manufacturing.

were not eligible, see Table 4 and the note. The total number of eligible apprenticeships for the total sample is $3/2 \cdot 192$ employed at the sampled firms and the total costs are therefore about $3/2 \cdot 2.63$ million DKK. This is about 3.9 million DKK. For the whole period it is $3/2 \cdot 10$ million DKK or 15 million DKK. Each new apprenticeship created by the subsidy has therefore an average cost of about 54,000 DKK. It is interesting that a system was introduced in 1990 that provided school based training for those otherwise qualified who could not find an apprenticeship. This arrangement was considered to be immensely expensive with costs of more than 150,000 DKK per year and per apprentice covering school costs and wage to the apprentices, i.e. at least $2 \cdot 150,000$ per apprentice. The differences between the two systems of subsidies is however, that the school based apprentice teaching does not create any value added. So even with a substantial dead weight loss it is preferable to use a subsidy compared to the school based system since the subsidize system on average is about 6 times more cost efficient.

Table 4. The potential subsidies at the plant level 1983-1990 and the estimated cost within the sample.

	1983	1984	1985	1986	1987	1988	1989	1990
0	191	188	195	208	240	247	268	221
1	65	72	78	87	74	57	42	72
2	19	31	32	31	28	17	10	13
3	3	9	15	10	3	11	1	10
4 or more	2	3	1	4	1	4	0	3
Estimated cost in mio	2.0762	2.5442	2.6341	1.3424	1.0285	0	0	0.4202

Note: Number of observations = 2566. It is not possible to get information about the other 1316 observations in the sample because these are lefthand censored and the calculations have to be based on observations of at least 3 consecutive years.

In Table 5 we have finally looked at the predicted number of apprentices in different years and with different sizes of the subsidy. The second column shows that the business cycles actually do matter for the total number of new apprentices. Thus, it shows that the number of apprenticeships would have increased more in 1990 without a subsidy than with the full subsidy in 1985 because of a better demand situation. Finally, the table shows what would have happened in specific years if we had either eliminated the subsidy or increased it with 50%. For 1985 it is seen that an elimination would have meant a decline in the number of apprentices of about 12%. On the other hand, a 50% increase in the subsidy would only mean

a 6.8% increase in the impact. Similarly, it is found that an elimination in 1987, where the subsidy was only 50% of the level in 1985, would have had a much smaller impact.

Table 5. Predicted average number of apprentices per employer for different levels of subsidy looking at specific years.

	No. of observations	Average number of apprentices with actual subsidy	Elimination of the subsidy	50% increase of the subsidy
1985	388	1.0819	0.9553	1.1513
1987	412	0.9680	0.9137	0.9964
1990	372	1.1624	1.1331	1.1773

Finally, it is worth mentioning that the efficiency of the subsidy could have been improved by only giving subsidies to industries where there was a significant impact. These industries are Trade, Office and Manufacturing according to the results of Table 2.

Conclusion

The main findings of this paper are that the demand for apprentices at the work place level is positively related to the net and gross entry rate of employees, the number of skilled workers and the size of the plant. Furthermore, we find that demand is positively related to the size of the subsidy used to promote more apprenticeships. A high exit rate of other employees means that the plant is less likely to employ apprentices. A higher relative wage for apprentices compared to workers in general also means a lower demand. However, this latter result is only found to be significant for one single industry, restaurants.

Comparing the magnitudes of the different factors we find that the entry rate of employees clearly dominates the other factors. This means that a good business cycle is second to none in creating more apprenticeships. Since the negative impact of higher exit rates is relatively small it is more easily offset by offering subsidies. The analysis also shows that the key variables have a varying impact on different industries. Thus, it is found that a relatively high (or low) wage rate for apprentices within restaurants compared to other worker groups have a significant negative impact on the demand. This effect is not found in other industries. Similarly, it is found that the subsidy only has an impact on manufacturing, offices and trade. The entry rate is found to be significantly positive for all industries with a varying impact. The

main conclusion is therefore that the main determining factor for the demand for apprentices is the rate of actual hirings of other groups of personnel and to a lesser degree the job separations of a given firm. The size of the subsidy and the relative wage are of second order to these. This means that the motive to demand apprentices for most industries is related to the future workforce of the work place. The cheap labor argument only applies to restaurants, while the subsidy had the highest impact for the office-area and a minor impact for manufacturing and trade.

Furthermore, we have simulated the effect of the actual subsidy used in the 1980s and compared that to the counterfactual where there were no subsidy at all. The effect of the actual subsidy was that the total demand for apprentices was 7% larger than it would have been without a subsidy. Secondly, it is found that each newly created apprenticeship has cost about DKK 54,000. This appears to be cheap compared to the alternative of school based apprenticeships, that in Denmark had a price tag of at least DKK 300,000 per apprentice. However, a higher efficiency could have been obtained if the subsidy had been limited to a few industries.

After 1993 it was decided that the subsidy should be given according to the total number of apprenticeships irrespectively of the number employed in the past. Thus, large firms got a subsidy for all of their apprentices contrary to the situation up to 1993. The subsidy scheme was almost abandoned after 1996. Subsidies are now only given to employers who employ apprentices who cannot find a regular apprenticeship and who are placed via the apprentice schools. In the future and when the registers make it possible it would be highly interesting to compare the efficiency of the two different subsidy systems.

References

- Albæk, K. & B. Sørensen, 1995. Worker Flows and Job Flows in Danish Manufacturing, 1980-91. *Working Paper*, Dep of Economics, University of Copenhagen
- Bingley, P. & N. Westergård-Nielsen, 1996. Worker and Plant Wages: Estimates from a Multi-Level Model. *CLS Working Paper, 96-10*, Centre for Labour Market and Social Research, University of Aarhus and the Aarhus School of Business.
- Bjørn, N.H., 1992. Virksomhedernes elevafterspørgsel - en analyse på virksomhedsniveau. *CLS Working Paper 92-3* and in "Rapport fra udvalget vedrørende alternativer til praktikpladskompenserende undervisning", Ministry of Education, Copenhagen.

Blechinger, D. & F. Pfeiffer, 1996. Technological Change and Skill Obsolence: The Case of German Apprenticeship Training. *ZEW Discussion Paper No. 96-15*

Cameron, A. & P. Trivedi, 1990. Regression based tests for overdispersion in the Poisson model, *Journal of Econometrics*, 46, pp. 347-364.

Leth-Sørensen, S., 1995. The IDA Database: A Longitudinal Database of Establishments and their Employees. *Statistics Denmark Working Paper 95:5*

Soskice, D., 1994. Reconciling Markets and Institutions: The German Apprenticeship System. In: Lynch, L.(ed.) *Training and the Private Sector*, University of Chicago Press, Chicago.

Appendix

A1. Wage ratio by industry and year

	Manufacturing	Restaurant	Construction	Trade	Other	Office
1981	0.35	0.42	0.36	0.35	0.37	0.31
1982	0.33	0.41	0.41	0.35	0.44	0.35
1983	0.35	0.41	0.39	0.36	0.43	0.37
1984	0.38	0.41	0.34	0.33	0.39	0.35
1985	0.36	0.41	0.35	0.36	0.31	0.40
1986	0.35	0.44	0.33	0.33	0.38	0.43
1987	0.36	0.43	0.32	0.34	0.31	0.43
1988	0.36	0.39	0.30	0.32	0.34	0.38
1989	0.34	0.41	0.40	0.30	0.27	0.37
1990	0.40	0.41	0.38	0.34	0.38	0.41

A2. Average number of skilled workers by industry and year

	Manufacturing	Restaurant	Construction	Trade	Other	Office
1981	12.34	4.33	8.37	1.95	7.76	0.20
1982	12.18	4.65	8.35	3.30	9.19	0.64
1983	12.03	4.35	9.52	2.77	9.93	1.15
1984	13.43	3.49	10.30	2.77	9.31	3.52
1985	14.54	3.83	11.45	3.02	10.33	3.42
1986	12.47	4.94	11.60	3.63	10.19	1.09
1987	11.94	4.58	11.81	3.79	7.05	0.51
1988	12.69	3.79	11.98	3.77	6.95	1.80
1989	13.86	3.64	9.66	3.65	9.79	2.93
1990	13.56	6.93	10.41	4.26	12.25	1.45

A3. Average plant size by industry and year

	Manufacturing	Restaurant	Construction	Trade	Other	Office
1981	35.56	21.62	13.62	27.89	36.47	22.09
1982	38.24	24.17	12.47	34.45	41.13	28.91
1983	37.24	22.90	13.34	34.36	51.00	31.53
1984	41.60	19.48	16.02	34.98	39.38	40.71
1985	44.62	21.01	17.03	34.79	35.44	37.37

1986	39.42	24.78	18.81	33.98	41.76	29.09
1987	37.69	25.24	18.39	36.08	31.30	33.76
1988	38.49	24.20	18.81	37.40	38.95	39.71
1989	40.72	27.46	16.66	37.43	61.21	52.66
1990	42.57	30.85	17.31	40.47	67.65	48.77

A4. Average number of new apprentices by industry and year

	Manufacturing	Restaurant	Construction	Trade	Other	Office
1981	92	121	53	43	11	21
1982	94	105	53	63	11	24
1983	93	139	56	56	20	20
1984	107	116	55	70	10	45
1985	121	117	58	64	18	63
1986	100	145	77	73	28	35
1987	98	146	60	69	15	20
1988	111	128	61	46	9	23
1989	78	138	45	37	7	18
1990	103	228	57	52	20	19
