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A Firm Level Panel Data Analysis

RESEARCH DEPARTMENT OF EMPLOYMENT AND LABOUR MARKET ISSUES

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Do Wage Subsidies Reduce Ordinary Employment? - A firm level panel data analysis

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Abstract:

Applying administrative register data information for Danish firms in 1999, 2000, and 2001, this paper investigate how the employment of wage subsidized labour affects ordinary employment at the firm level. Descriptive statistics as well as econometric estimations are presented. Descriptive analysis shows that ordinary and subsidized employment is positively correlated, i.e. employment of subsidized labour does not reduce ordinary employment. But an underlying similar movement in production levels might cause the correlation. Simple inclusion of a production level proxy in OLS estimations does not sufficiently control for the underlying correlation, but additional control for the size of the change of production indicates that subsidized labour to some extent substitutes non-subsidized labour. But the substitution depends on the applied econometric specification, i.e. a cumulative logit specification gives mixed results concerning the substitution effect.

Keywords: Firm level employment, wage subsidy schemes, substitution effects

JEL classification: J38; M51

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1. Introduction

Active labour market policy (ALMP) is used more extensively by the public authorities since the first half of the 1990s. Wage subsidy programmes targeted, for example at long-term unemployed or disabled people, are a particular type of ALMP. Wage subsidies to employers is a method of improving the earnings and employment chances of low-wage workers. By far, most of the economic evaluations of ALMP have focused on whether a given policy actually helps the *participants*. For wage subsidy programmes, however, it is equally important to ask whether a given policy reduces the labour market prospects of *workers not eligible for a subsidy*, i.e. negative effects for the ordinary labour market participants resulting from improving the labour market situation of the targeted group(s).

In this paper, we estimate whether non-subsidized employment is reduced if a (private) firm employs subsidized labour. We use a unique firm-level panel data set: For firms in Denmark during 1999-2001, we count the number of subsidized workers and relate it both to firm production and to the number of workers employed on ordinary terms.

Estimation results are mixed, especially because controlling properly for firm size is difficult. Thus, we attempt to control for firm size or growth of firm size in various ways.

Very few empirical studies at the firm level estimate the substitution between subsidized and non-subsidized labour resulting from wage subsidy programmes. The low number of such studies is in contrast to the vast amount of empirical papers on active labour market policies at the individual level.

The literature distinguishes between various substitution effects, all of which are demand side effects and can be categorised as follows:

1. Workers already employed on ordinary terms are dismissed. E.g., a person already employed on ordinary terms may be transferred to employment on terms of a wage subsidy programme. If this person would have continued on ordinary terms, had

the subsidy scheme not been available, the transfer would have been a case of substitution.

2. The firm reduces the number of new workers it will hire on ordinary terms. Again, a special case is that a firm may want to employ a particular person, whether or not subsidies are available.
3. Competition between firms is distorted if a firm that receives wage subsidies gets a competitive advantage and increases its sales at the expense of other firms.

In this paper, we study the aggregate substitution effect on current and new workers (type 1 and 2) without distinguishing between the two, but we relate the discussion of the exiting literature below to the three effects mentioned above as well as to the type of data source, which can be categorized in the following way:

a. Econometric studies at the firm level (we apply this approach).
b. Substitution directly measured by survey respondents.
c. Econometric studies at an aggregate level.
d. Econometric studies at the level of individuals.

The outline of the paper is as follows: Section 2 reviews the existing literature. In section 3 we briefly present the core of the economic motivation for wage subsidy programmes. In section 4 we give a brief description of Danish wage subsidy schemes. Sections 5 and 6 constitute the main part of the paper: section 5 describes the methodology, while econometric models are applied in section 6. Section 7 concludes.

2. Existing literature

We have found only three studies of the group a. approach. One uses register data (Kangasharju, 2005), and two use survey data (Bishop and Montgomery, 1993, and Hujer, 2002). Of these three, Bishop and Montgomery's econometric approach is closest to the one we will apply.

There are a lot of studies of the remaining approaches (b.-d.), but since they are all quite different from our study w.r.t. method and to some extent subject, we will describe this literature only by a few examples.

Kangasharju (2005) and working papers preceding it are the only studies we have found on substitution based on register data at the firm level. A part from some firm characteristics, Kangasharju has information on the amount of wage subsidies each Finnish firm receives during the period 1995-2002. He studies the effect of subsidies on the wage sum in the firm. Kangasharju's main purpose is to compare the firms which receive a subsidy with those that do not. That is, in most of the estimations he uses a 0/1-dummy rather than a continuous variable to characterize the amount of wage subsidies in a firm. Kangasharju uses difference-in-difference estimators and matching methods to compare firms that receive wage subsidies with firms that do not, and finds that wage subsidies imply a significant increase in the total wage sum. Kangasharju statistically controls for a number of firm characteristics, e.g. sales, and concludes that the wage subsidy scheme lead to an increase in employment. The results show only a small substitution effect if any. In fact, one of his estimations suggests that non-subsidized labour increases as a result of employment of subsidized labour (even after controlling for firms' sales). Kangasharju also studies distortion of competition between firms by including region and industry-specific aggregate wage subsidies in the analysis. But also here he finds no significant effects.

Bishop and Montgomery (1993) apply an approach very similar to the one we will apply to evaluate the Targeted Job Tax Credit (TJTC) program in the USA. Their data set is a survey of firms during a period of two years. Bishop and Montgomery estimate the increase in total employment as a function of the increase in subsidized labour. Simple OLS estimates suggest that total employment increases by 0.3 persons or less when the number of subsidized workers increases by 1, and hence a substitution effect on existing and new workers of at least 0.7. The possible distortion of competition works between firms and hence via the firms' sales. Since Bishop and Montgomery control for sales, the substitution effect of 0.7 does not include such distortion effects. A priori, Bishop and Montgomery expect selection effects to bias simple OLS estimates, and hence they are careful to include survey questions that could serve as instruments for participation. Two

stage least squares does not, however, give results that are as reasonable as the OLS estimates.

Hujer et al. (2002) apply a survey of firms in West Germany. They use methods similar to Kangasharju (2005) to compare firms that receive wage subsidies with firms that do not. They do not find significantly positive effects of receiving subsidies, perhaps because the number of firms that receive subsidies is low.

We will now consider literature based on surveys and direct measures of substitution (group b. above).

In surveys, a typical question to a firm manager or a participant is: "Would the work have been performed by anyone else, if wage subsidies had not been available?". Answers are presumably meant to reveal substitution effects on existing and new workers.[1] A priori, one may suspect biased answers from managers who want to give the impression that their firm lives up to the political intentions of the wage subsidy schemes, e.g. some managers might incorrectly deny any substitution between ordinary and subsidized labour. As we will see below, it is however likely that such bias is limited. Finally, surveys are useful to distinguish between whether existing or new workers are affected by subsidies, and whether it is the same person (already employed) that is employed with subsidies rather than on ordinary terms.

Calmfors et al. (2001) survey literature on the effect of ALMP in Sweden, including studies of substitution effects. The results of the estimated substitution effect vary from 1% to 84%. Calmfors et al. note that the 'closer' the participants are to regular employment, the higher the effect.

A review of private sector employment subsidies in OECD countries shows that the combined dead-weight loss and substitution effects are around 90 per cent (Martin and Grubb, 2001).

[1] In principle however we cannot preclude that answers also reflects that a firm manager intends to increase production at the expense of competing firms. But in that case, surveys do not estimate distortion of competition, because surveys do not inform about how the competitors' employment is actually affected.

For Denmark, the National Labour Market Authority (2005) conducted a survey of firms. Among private firms with subsidized labour, 52 percent say they would have employed (current or new) workers on ordinary terms if the subsidy schemes had not existed. Of these, just over half of the firms would have employed the person who received a subsidy on ordinary terms and the remaining part would have employed another person. Estimation of the effects of subsidies on current workers is a main issue in the study, since it is not allowed to dismiss non-subsidized workers as an immediate consequence of employing subsidized workers. The study finds only small effects on current workers, thus, the major part of the 52 per cent mentioned earlier relates to new workers.

Holt et al. (2003) finds that 38 percent of private firms with subsidized labour say they would have employed workers on ordinary terms had the subsidy schemes not existed. One explanation for the differences in results compared to the survey conducted by the National Labour Market Authority (2005) could be that Holt et al. studies a wider range of wage subsidy programmes.

In general, the relatively high substitution effect found in survey studies may indicate that firm managers do not bias their responses much to appear in accordance with the political intensions of the subsidy programmes.

A number of studies use data that are aggregated across regions or countries (group c. above). The regional variation in the use of wage subsidy programs, or more generally ALMP, is related to employment growth. The studies measure the substitution of existing and new workers, but not the distortion of competition between firms, because competitive effects on individual firms are aggregated out – at least if regions do not compete with each other. Compared to a firm-level approach, intra-regional variation in data is of course neglected with aggregate data. On the other hand, one may believe regional variation in the use of wage subsidy programmes to be exogenous. Calmfors et al. (2001) also survey this strand of literature (for Swedish regions). These studies find substitution effects of approximately 60 per cent, i.e. somewhat higher than average effects from the survey approach. Edin et al. (1998) studies youth wage subsidy programmes' 'crowding out' of general youth employment, and finds significant but small effects using

aggregated data from Swedish municipalities. It is obviously possible that the programme crowds out workers from other age groups.

Finally, we turn to the econometric literature on the effects on individual participants of wage subsidy programmes (group d. above). From some of these studies substitution effects can be inferred, because the studies compare the employment effects of the program on treated workers (the subsidized) to a specific control group (the non-subsidized). The control group may include unemployed people not eligible for the treatment (the subsidy). A program with a negative effect on the control group may indicate a substitution effect on new workers, and on the particular control group, i.e. it may be that unemployed persons not eligible for a wage subsidy face a relatively low chance of getting a job because employers' demand is directed towards subsidized unemployed. Blundell et al. (2001) studies a programme – though not a subsidy programme – applying the treatment/control group approach, but finds no substitution effects.[2]

3. Wage subsidy schemes: a theoretically ideal policy with practical problems

Ideally, wage subsidies have many virtues compared to other types of government support for people facing difficulties in the labour market, but an ideal scheme may, however, be difficult to carry out in practice. In this section we briefly try to explain the theoretical virtues of wage subsidy schemes and how practical problems, e.g. too high levels of wage subsidies, may distort the labour market.

3.1. An ideal wage subsidy scheme

Two features characterize an ideal wage subsidy scheme. First, the subsidy, b_i, to person i covers the difference between the potential wage that person i is able to earn and a

[2] Similarly, Katz (1996) studies the effect on targeted group of a wage subsidy programme. However, his study may also indicate that the non-targeted control group is affected by the wage subsidy programme, and thus this kind of effect on the control group could be interpreted as a substitution effect.

minimum income level determined by the policy maker, $y^{\min}$ (e.g. per month). If the labour market works well, we know from standard arguments that the employer will end up paying a wage for the service of worker i that equals the value of the person's contribution to production. We denote the value of the contribution to production q_i (e.g. per month). Hence the ideal wage subsidy in a well functioning labour market is

$$b_i = \begin{cases} y^{\min} - q_i & \text{for } q_i < y^{\min} \\ 0 & \text{otherwise} \end{cases}$$

Second, a purpose of many wage subsidy programmes is to increase participants' productivity, e.g. through pure learning-by-doing, but in some cases the subsidized worker receives education, extra instruction from colleagues, or the worker may imply extra costs for the employer in some other way. The employer may therefore receive a subsidy, e_i, to cover these costs, c_i, of improving productivity.

The subsidy scheme therefore combines concern for distribution with efficiency, since people with low productivity to begin with, will be able to supply their labour and have an income above what their initially low level of productivity would generate.

3.2. Practical problems

In practise, it is obviously very difficult for the ALMP-authority to estimate the productive value of a worker, q_i, and thus to estimate the appropriate wage subsidy, b_i. Similarly, it is difficult to determine the benefit, e_i, and to ensure that the employer actually carries the costs, c_i.

In table 3.1, the cost and benefits of employment of a subsidized worker is described for the employer and the employee. We assume that b_i is formally paid to the worker, and e_i to the employer. The ideas below are simple and static, and thus we assume that i.e. education efforts, e, lead to an increase in productivity and thus wage in a later period. We do not take workers' possible disutility of working into account.

Table 3.1. Subsidy related costs and benefits for employer and employee

	Employer	Employee
Cost	$w_i + c_i$	$y^{\min}$, if the alternative to a job is a 'passive' benefit equal to $y^{\min}$
Benefit	$q_i + e_i$	$w_i + b_i$

Now suppose the public benefits, b_i and/or e_i, are too "generous". Table 3.2 describes the possible advantages of this case for the employer and employee respectively.

Table 3.2. Subsidy related gains from excessive benefits

	Employer gets the advantage of the excessive subsidy	Employee gets the advantage of the excessive subsidy
b_i is too high, $b_i > y^{\min} - q_i$ (Assume $e_i = c_i$)	***Case A*** $w_i = y^{\min} - b_i < b_i + q_i - b_i = q_i$	***Case B*** $w_i = q_i$ $w_i + b_i > w_i + y^{\min} - q_i = y^{\min}$
e_i is too high $e_i > c_i$ (Assume $b_i = y^{\min} - q_i$)	***Case C*** $w_i = q_i$ $q_i + e_i - c_i > q_i = w_i$	***Case D*** $w_i = q_i + e_i - c_i$ and $w_i + b_i = w_i + y^{\min} - q_i = q_i + e_i - c_i + y^{\min} - q_i > y^{\min}$
Consequence	The employer will hire as much subsidized labour as possible	The subsidized worker has a relatively large incentive to supply labour

If b_i is too high, but the worker receives $y^{\min}$, the employer will gain from the large subsidy by paying less than the value of the worker's production ($w_i < q_i$, case A) implying high demand for subsidized workers. The demand for subsidized labour may however lead to an increase in the wage rate, w_i, so that the subsidized workers may eventually also gain from the large b_i by having a total income above the minimum ($w_i + b_i > y^{\min}$, case B).

Cases C and D, where the education subsidy to employers are higher than the education costs, are parallel to A and B. In case C, the employer gets $e_i - c_i$ as a 'premium' for hiring a subsidized worker, which leads to high demand for subsidized workers. Higher demand may again lead to a higher wage rate and a gain for the subsidized worker (Case D).

3.3. Substitution

In section 2 we described various substitution effects between subsidized and non-subsidized labour. If subsidy rates are correctly set, e.g. $b = y^{\min} - q$ and $e = c$, we should not expect to see competition between firms with subsidized labour and other firms being distorted. We should however expect to find that employment of subsidized labour leads to less employment of non-subsidized labour (substitution effects on current and new workers). For example, if a subsidized worker produces half as much as a non-subsidized worker, we would expect a firm to be indifferent between hiring two subsidized workers or one non-subsidized worker.

4. Wage subsidy schemes in Denmark

In section 3 we saw how wage subsidies, productivity and wage rates were related from a standard theoretical point of view. In this section, we briefly describe the most important wage subsidy schemes in Denmark with respect to the same variables and with respect to the legal rules concerning substitution. [3]

Many wage subsidies are related to the 'ordinary wage rate', which in practice presumably means the minimum of normally paid wages. But there are no minimum wage-laws in Denmark. Wages are negotiated between workers' unions and employers' organizations. Thus, in stead, we use the term 'agreed minimum wage' rather than 'minimum wage', and we ignore that the agreed minimum wage varies across industries and occupations.

[3] From 2003 (after the estimation period we consider), rules have been simplified. Information about the schemes are found in the relevant law texts "Lov om en aktiv arbejdsmarkedspolitik" (*Law about an active labour market policy*), and "Lov om en aktiv socialpolitik" (*Law about an active social policy*) and on the homepage of the ministry of employment www.bm.dk. Useful information can also be found on the homepage of the National Labour Market Authority www.ams.dk. From 2003 "Lov om en aktiv beskæftigelsesindsats" (Law about an active employment effort) replaced parts of the other two laws. All these texts are in Danish.

The local labour market authorities arrange contacts between the unemployed and the firm. For some subsidy schemes, the local workers' union representatives approve work conditions, wage rates etc.

Flex job: (Fleksjob). The programme is designed for people with limited work capacity who, in absence of the program, might have applied for disability benefit. The wage subsidy is 1/2 or 2/3 of the agreed minimum wage. The wage rate actually paid to the worker is allowed to be higher than the agreed minimum wage. There is no time limit on the job, but each work contract is reconsidered regularly by the authorities. There are no rules requiring that a Flex job-worker cannot substitute non subsidized workers.

Relief job: (Skånejob). The programme is for people who receive disability benefits, which they continue to receive while participating in the Relief job programme. The wage subsidy (on top of the disability benefit) is 50 percent of the wage but no more than 1/6 of the agreed minimum wage. There is no time limit on the job. There are no rules concerning substitution.

On-the-job training: (Jobtræning). The programme is for people who have been unemployed for some time and have received unemployment insurance benefit or social assistance. Working conditions and wages follow ordinary terms. The wage subsidy is approximately equal to half of agreed minimum wage. If the duration of the job is longer than 6 months, part of the job-spell should consist of education. Establishment of on-the-job training should increase employment and is not allowed to distort competition.

Individual on-the-job training: (Individuel jobtræning). The programme is for people who receive social assistance or unemployment insurance benefit, but – as opposed to On-the-job training – the working time is individually determined. Compared to participants of On-the-job training, participants of Individual on-the-job training have greater difficulties obtaining a regular job. The wage subsidy is negotiated. The wage rate is negotiated for unemployment insurance beneficiaries. For social assistance recipients the wage rate equals the level of social assistance. Establishment of Individual on-the-job training is not allowed to distort competition, and the work carried out ought not to have been done so in the absence of the wage subsidy.

Adult apprentices: (Voksenlærlinge). The scheme may be closer to ordinary education than to a wage subsidy programme. The scheme is for people of at least 25 years of age wanting an education or wanting to re-educate themselves. The scheme is for employed as well as for unemployed. The apprenticeship may last for 4 years. The apprentice obtains an agreed minimum wage. Wage subsidies are paid from the apprentice fund The Employers' Pupil Reimbursement (Arbejdsgivernes elevrefusion), and in some cases also from the unemployment insurance fund. The wage subsidy is therefore usually relatively high compared to the wage rate.

In table 4.1, we attempt to relate the different wage subsidy schemes to the agreed minimum wage and with public benefit rates.

Table 4.1. Wage subsidies and benefit rates as an approximate proportion of agreed minimum wage

Unemployment insurance benefit	0.9
Social assistance	0.8
On-the-job training	$\geq$ 0.5
Individual on-the-job training	Negotiated or 0.8
Flex job	2/3
Relief job[1]	$\geq$ 0.9
Adult apprentices	1

[1] Participants in Relief jobs receives disability benefit. Until 2003, there were several levels for the disability benefit rate and the maximum level was approximately equal to the unemployment insurance benefit level

With the exception of on-the-job training, the wage subsidies are close to either the previously received benefit or an agreed minimum wage rate. The actual wage rate paid to the subsidized worker is however allowed to exceed the agreed minimum wage rate[4]. In our data set, we have wage information for some of the subsidized workers. Generally, wage statistics in Denmark are recorded by employers. There is however no established rule of whether or not firms should keep records of wages for subsidized workers. Table 4.2 shows the hourly wage rate for subsidized workers by the type of wage subsidy program. The table also shows the number of hours worked per week. The fraction of subsidized workers whose wage rate is recorded is low and it varies across the type of subsidy scheme. Hence, we do not know whether these statistics are representative for all subsidized workers.

[4] This is true for private firms. Public firms are not allowed to pay above a certain level for On-the-job training.

Table 4.2. Wage and work-hour statistics for subsidized workers, 2001

	Wage rate per hour (DKK)					Hours per week		
	No. of obs.	1st quartile	Median	3rd quartile	9th decile	No. of obs.	Mean	Third quartile
On-the-job training	2,913	90.0	97.4	109.9	129.9	17,641	36.2	37
Individual on-the-job training	1,983	90.3	96.7	108.7	126.9	17,612	30.4	37
Flex job	5,275	92.1	104.3	123.6	151.5	21,106	33.9	37
Relief job	235	91.5	101.6	124. 6	160.0	5,867	22.5	30
Adult apprentices	3,469	86.2	96.7	113.7	135.2	6,787	37.0	37

According to the figures in table 4.2, the wage structure is very flat among subsidized workers, and the median wage is low. A full-time job in Denmark consists of 37 hours of weekly work, and (surprisingly) many subsidized workers work full time.

The unemployment insurance benefit rate was approximately 80 DKK per hour in 2001. For comparison, the agreed minimum wage rate for uneducated workers was approximately 86 DKK, but not many earn such a low wage rate: the 25th percentile for the hourly wage rate was 120-125 DKK for women in a low-wage sector. (1 DKK equals 0.134 EUR.)

5. Description of firms' use of subsidized employment

Before continuing to tables containing descriptive statistics on Danish firms' use of different kinds of government subsidized labour, we first present the applied data.

5.1. Data description, definition of "subsidized" and data limitations

All data in this working paper stems from administrative registers maintained by Statistics Denmark. We have information on all persons who were in subsidized employment during 1999-2001, and we have information on all Danish workplaces and firms in the same three year period. Information on the participants in the subsidized programmes is from the AMFORA, which is a register of person-level detailed information on type of participation

in unemployment schemes, start and end dates of participation, the number of hours in the scheme per week, and the identity of the firm and work place in question. From the business registers FIDAFIRM, IDAS, and IDLH we included information on location, industry, sector, number of employed (in aggregate and by type of occupation and education), wage sum, average wage rates, value added, profits, and sales. Sample sizes are listed in table 5.1.

Table 5.1. Number of subsidized persons, work places and firms in November, 1999, 2000 and 2001

	1999	2000	2001
Persons	29,931	35,154	40,113
Firms	146,253	146,514	148,186

Note: Only subsidized persons who could be connected to a firm in November are included. For instance for 2001 the selection procedure reduces the number of subsidized from 63,002 (155,045 subsidy spells) to the mentioned 40,113 (71,781 spells)

The employment statistics in the official registers concerns subsidized and non-subsidized employment in the aggregate. Since we need to distinguish between the two, we combine firm registers with registers on the individual persons who receive wage subsidies. For each firm we are therefore able to count the number of people employed with a wage subsidy. However, some data manipulation is necessary. The information on firms is from the end of November in a given year, whereas information on a person's spells of subsidized employment covers the whole year. In order to secure period wise correspondence between persons and firms, only subsidized employment spells in November are considered. Furthermore, only spells which could be connected to a firm are included. Since a person can have more than one subsidized spell during the year and during November, the final spell attached to a person is the one with longest duration in November, which underestimates the number of subsidized persons. The number of subsidized is, however, less interesting in it self in this paper, whereas changes and relative distributions of the subsidized is of greater interest. But it creates some selectivity as persons with long subsidy durations have a higher probability of being selected into the data set, because we only include persons with subsidies in the month of November. E.g. subsidy schemes with no or long duration limits are overrepresented in the data set. After making the changes in the dataset, we have about 40,000 persons in subsidized employment in almost 150,000 firms in November 2001. The number of firms is fairly

stable from 1999 to 2001, whereas the number of subsidized persons increases with about 5,000 per year in the period - mainly due to the increased popularity of the flex job scheme which was introduced in the late 1990s.

Subsidized labour includes all persons who are employed with some kind of subsidy from the government. That primarily includes flex job, on-the-job training, adult apprentices, relief job, individual on-the-job training, and service job, see Section 4.1 for details.

5.2. Distribution of subsidized labour in firms

Subsidized labour can be employed in the private as well as in the public[5] sector, but somewhat different sets of rules apply to the two sectors, see section 4. With 138,000 firms in the private sector, it has the main share of firms (Table 5.2). About 10,000 firms existed in the public sector in 2001. Less than 500 firms were owned by foreigners or ownership was not possible to determine. Because the decisions about whether to employ subsidized labour most likely differs between sectors, we will distinguish between subsidized employment in the public and private sector. Furthermore, production is much more difficult to measure in the public sector.

Table 5.2. Sectoral distribution of firms in Denmark, 1999-2001

	1999	2000	2001
Public	9,889	8,255	9,871
Private	136,117	137,822	137,957
Foreign	247	437	358
Total	146,253	146,514	148,186

94 per cent of firms without subsidized labour were private, while the fraction of private firms among firms with subsidized labour is only 86 per cent (Table 5.3). Thus, although firms are mostly in the private sector, almost half of all 40,000 subsidized persons in November 2001 were employed in the public sector. On average public firms employ 1.90 subsidized persons per firm, while private firms employ 0.15 subsidized persons per firm. All in all, the average firm employs 0.27 subsidized persons.

[5] Statistics Denmark's definition of public sector is applied, see e.g. Offentlige Finanser, Statistiske Efterretninger, February 2006. Thus, the public sector includes the general government sector, public quasi-corporations, public corporations, public corporations including e.g. railways, S-train, buses, marinas and industrial harbours, airports, sewerage and refuse disposal

Table 5.3. Public and private employment of subsidized labour in firms, 2001

	Firms with Subsidized labour		Firms without subsidized labour		Total no of subsidized workers	Average no of subsidized workers
	Number	Per cent	Number	Per cent		
Public	2,224	13.8	7,647	5.8	18,748	1.90
Private	13,841	86.0	124,116	94.0	21,329	0.15
Foreign	21	0.1	337	0.3	36	0.10
Total	16,086	100	132,100	100	40,113	0.27

Public firms on average employ 0.72 persons in flex job schemes, 0.62 get on the on-the-job training, and 0.23 persons are in relief jobs. The most applied schemes in the private sector are flex job, on the on-the-job training and adult apprentices, each of which have an average of 0.04 per firm. These four schemes are the most applied as they account for almost 90 per cent of all subsidized employment in 2001 (Table 5.4).

Table 5.4. Sector and scheme distribution of subsidized employment in Denmark, 2001

	Job training	Individual job training	Flex jobs	Relief jobs	Service jobs	Adult appren-tices	Other	All
Average number of subsidized per firm								
Public	0.62	0.06	0.72	0.23	0.19	0.07	0.01	1.90
Private	0.04	0.01	0.04	0.02	0.00	0.04	0.00	0.15
Foreign	0.03	0.01	0.04	0.01	0.00	0.01	0.00	0.10
All	0.08	0.02	0.09	0.03	0.01	0.04	0.00	0.27
No of subsidized	11,378	2,423	13,101	4,410	1,982	6,670	148	40,113
- Per cent	28.4	6.0	32.7	11.0	4.9	16.6	0.4	100

A major part of subsidized employment (approximately 12,000 persons in 2001) is located in the capital Copenhagen or in one of the three other biggest cities in Denmark (Table 5.5). Localization pattern is due to more subsidized employment per firm in big cities, especially in the public sector, where the average subsidized employment is 3-5 persons per firm in big cities and only 1.5 persons in other cities.

Table 5.5. Sector and geographical distribution of subsidized employment in Denmark, 2001

	Public	Private	Foreign	Total
Number of subsidized				
Copenhagen	3,438	1,648	5	5,091
Odense	879	833	0	1,712
Aarhus	1,547	1,688	0	3,235
Aalborg	973	706	0	1,679
Other	11,911	16,454	31	28,396
	18,748	21,329	36	40,113
Average number of subsidized per firm				
Copenhagen	2.97	0.11	0.38	0.31
Odense	3.94	0.22	0.00	0.42
Aarhus	4.45	0.25	0.00	0.46
Aalborg	5.02	0.20	0.00	0.44
Other	1.50	0.15	0.10	0.24
	1.90	0.15	0.10	0.27

Almost half (19,600) of all subsidized labour is employed in public and personal services, and a large part of those (18,000) is in the public sector (Table 5.6). The public sector has very few in other industries, only about 500 are employed with transportation, storage and communication, and 200 are in financial intermediation and other business activities. In the private sector subsidized employment is more equally distributed among industries. Almost 1/3 (6,700) is occupied in wholesale, retail trade, hotels and restaurants. 5,500 are occupied in manufacturing, and 3,400 in construction.

Table 5.6. Sector and industry wise distribution of subsidized employment in Denmark, 2001

	Public	Private	Foreign	Total
Number of subsidized				
Agriculture, fishing and quarrying	0	838	0	838
Manufacturing	1	5,534	4	5,539
Electricity, gas and water supply	55	5	0	60
Construction	5	3,366	3	3,374
Wholesale and retail trade, hotels, restaurants	54	6,745	0	6,799
Transport, storage and communication	523	1,110	2	1,635
Financial intermediation, business act.	195	1,977	0	2,172
Public and personal services	17,915	1,722	11	19,648
Activity not stated	0	31	0	31
Missing	0	1	16	17
All	18,748	21,329	36	40,113

The preceding tables illustrates that explaining differences in subsidized employment must take into account whether the firm is in the public or private sector, and where it is located as well as to which industry it belongs. But a part of these characteristics' explanatory power may very well be due to underlying differences in firm sizes/sales which are correlated with the same variables, e.g. larger firms in the capital area or in manufacturing industry.

5.3. Firm characteristics: subsidized and non-subsidized employment levels

A first impression of how subsidized employment in a firm depends on its activity level and changes in the activity level is possible by simple descriptive tabulations. Here we will look at employment and sales, both their levels and changes in levels.

Subsidized and non-subsidized employment

There seems to be a positive (linear) correlation between the number of ordinary employed workers in a firm and the average number of employees at the firm level, cf. Figure 5.1. Public firms with up to 5 ordinarily employed workers on average have between 0.02 and 0.1 subsidized workers employed, and private firms have between 0.03 and 0.09. Subsidized employment increases to 0.4 for public firms and 0.2 for private firms with 11-15 ordinary employees, and to about 1 subsidized employee per public and 0.5 per private

firm with ordinary employment at 36-40 workers. Thus, subsidized employment increases with the number of ordinarily employed workers in both the public and the private sector, but the increase seems to be much faster in public firms than in private firms, when the number of ordinarily employed is above a certain level (approximately 8). The positive correlation is also very much present when looking at single subsidy schemes presented in Table 5.4.

Figure 5.1. Subsidized employment and ordinary employment, 2001

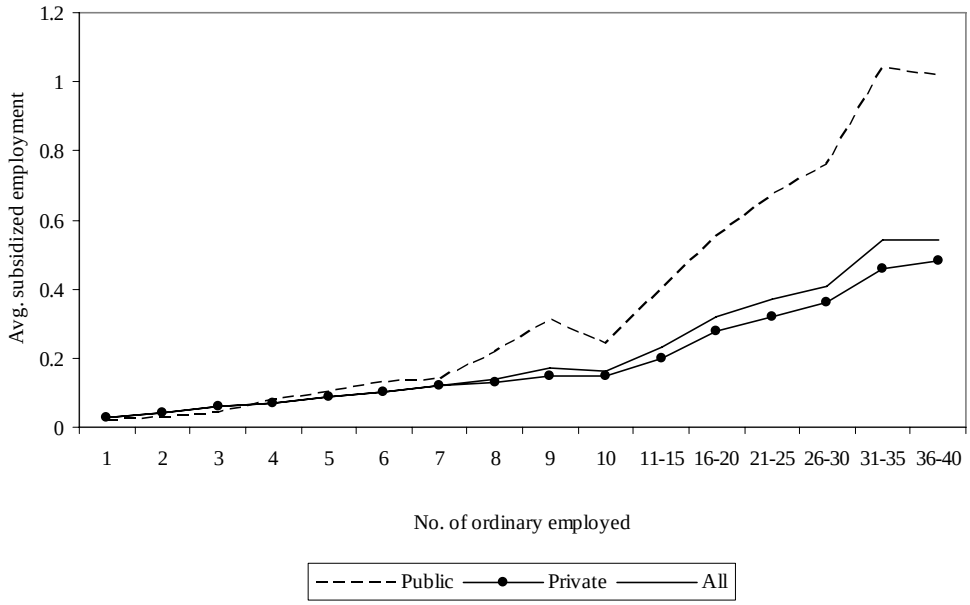


Figure 5.1 seemingly rejects the hypothesis that employment of subsidized labour reduces the employment of non-subsidized labour. Different explanations for a rejection can be put forward, an important one being that firm production levels most likely are not constant when subsidized or non-subsidized labour increases or decreases. Thus, a positive correlation between production and subsidized employment, and between production and non-subsidized employment can cause a spurious positive correlation between subsidized and non-subsidized labour.

Since some firms with many ordinary employed workers, as expected, also generally employ many subsidized workers, it is clearly not possible to detect any substitution effect without a third variable to control for firm size, i.e. the income effect.

Sales

Our data does not directly include a production variable so instead we use firm sales from sale of products and services as a proxy for production levels indicating firm size. Sales are measured in nominal terms at producer prices.

Table 5.7. Subsidized and non-subsidized employment and private firms' sales, mio. DKK, 2001

	Average employment		Relative distribution of employment, %	
	Non-subsidized	Subsidized	Non-subsidized	Subsidized
Under 1 mio.	1.9	0.04	2.9	5.3
1.01- 2 mio.	2.7	0.06	4.0	7.6
2.01- 3 mio.	3.8	0.08	3.8	6.3
3.01- 4 mio.	5.1	0.11	3.3	5.5
4.01- 5 mio.	6.1	0.12	2.8	4.3
5.01- 6 mio.	7.3	0.13	2.3	3.3
6.01- 7 mio.	8.4	0.15	2.0	2.9
7.01- 8 mio.	9.2	0.16	1.7	2.4
8.01- 9 mio.	10.6	0.17	1.5	1.9
9.01-10 mio.	11.3	0.20	1.4	2.0
10.01-15 mio.	14.0	0.23	5.5	7.2
15.01-20 mio.	17.9	0.28	3.8	4.7
20.01- mio.	78.7	0.73	54.7	40.5
Missing	15.7	0.12	10.3	6.1
Total	12.3	0.15	100	100
Employment			1,700,505	21,329

Since sales are usually not a meaningful concept for public firms, only private firms are included in the following. Firms with less than 1 mio. DKK in sales on average have 1.9 non-subsidized employee and 0.04 employed workers with subsidies. These numbers increase to 6.1 and 0.12 for sales between 4 and 5 mio. DKK, and about 18 and 0.3 for firms with sales in the range 15-20 mio. DKK, cf. Table 5.7. As expected, the positive relationship between subsidized and non-subsidized employment of labour in Figure 5.1 reflects differences in production. About 60 per cent of subsidized labour is employed in

firms with sales less than 20 mio. DKK, while that is only the case for about 45 per cent of non-subsidized workers, which means that subsidized labour, is overrepresented in smaller firms.

Industry

Manufacturing has an average of 0.42 subsidized workers per firm, which is the highest average among industries, but the observation simply reflects that manufacturing firms on average are large, see Table 5.8. Otherwise there is not much correlation between subsidized and non-subsidized firm employment and industry. Thus, industry seems to have some explanatory power regarding variations in subsidized employment.

Table 5.8. Subsidized and non-subsidized employment in industries. Private firms, 2001

	Average employment		Relative distribution of employment, %	
	Non-subsi-dized	Subsi-dized	Non-subsi-dized	Subsi-dized
Agriculture, fishing and quarrying	3.6	0.06	3.1	3.9
Manufacturing	33.9	0.42	26.5	25.9
Electricity, gas and water supply	7.5	0.02	0.1	0.0
Construction	9.8	0.21	9.2	15.8
Wholesale and retail trade, hotels, restaurants	11.9	0.17	28.0	31.6
Transport, storage and communication	14.1	0.13	7.0	5.2
Financial intermediation, business act.	11.7	0.08	17.7	9.3
Public and personal services	7.4	0.09	8.2	8.1
Activity not stated	4.7	0.05	0.2	0.1
Missing	5.8	0.13	0.0	0.0
Total	12.3	0.15	100	100
Employment, 1,000			1,701.0	21.3

Looking at the relative distribution of the two labour types, it is clear that subsidized employment is overrepresented in construction (16 and 9 per cent of total subsidized and non-subsidized labour) and wholesale etc. (32 and 28 per cent). Subsidized employment is underrepresented in financial intermediation etc. (9 and 18 per cent), which is most likely due to the relatively more unskilled labour is employed in the two former industries compared to the latter.

Location

Although the capital Copenhagen employs the greatest number of non-subsidized workers per firm (19), it employs the lowest number of subsidized employees (0.11), see Table 5.9. While Odense has much lower non-subsidized employment (12) than Copenhagen, it employs double the number of subsidized workers (0.22). Again, location also seems to contribute to explaining variations in the number of subsidized employees.

Table 5.9. Subsidized and non-subsidized employment and firm location. Private firms, 2001

	Average employment		Relative distribution of employment	
	Non-subsidized	Subsidized	Non-subsidized	Subsidized
Copenhagen	18.6	0.11	16.6	7.7
Odense	12.2	0.22	2.8	3.9
Aarhus	18.1	0.25	7.1	7.9
Aalborg	12.7	0.20	2.7	3.3
Other	11.1	0.15	70.8	77.1
Total	12.3	0.15	100	100

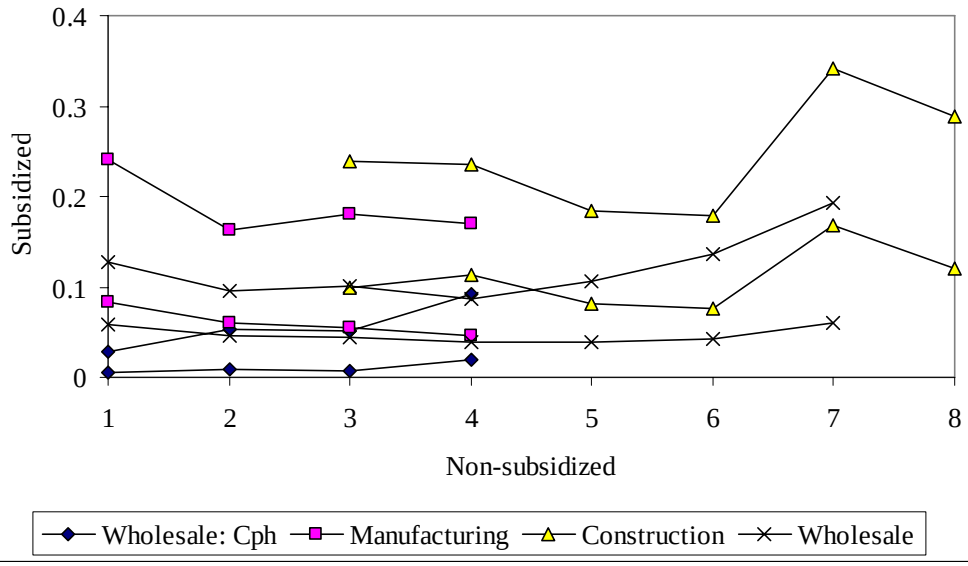
Sales, industry, and location specific sub-samples

Non-subsidized and subsidized employment clearly varies with sales levels, industry and location of firm. In Figure 5.2 we simultaneously try to control for all three factors, and thus try to get more homogenous firms. For Copenhagen we have included firms with sales between 1 and 4 mio. DKK in 2001, but only included firms in wholesale etc., because sample sizes are too small in other industries (less then 100 firms). In non-big cities we could limit sales even more (to 3-4 mio. DKK) and still have reasonable sample sizes (over 100 firms). In the figure we have depicted lower and upper values of 95 per cent confidence intervals for the mean value of the number of subsidized employed (second axis) conditional upon a given number of non-subsidized employed (first axis).

Figure 5.2 reflects that different industries have different levels of subsidized employment. We also see that subsidized employment varies somewhat with the level of non-subsidized employment, but not in a systematic way, i.e. there is not an entirely positive correlation between the two types of employment, which is in contrast to Figure 5.1. Furthermore, we see that changes in subsidized employment are often insignificant for different levels of

non-subsidized employment, suggesting again that the positive relationship is questionable, and thus that a substitution between subsidized and non-subsidized labour is not ruled out.

Figur 5.2. Subsidized and non-subsidized employment in private firms in Copenhagen (Cph) and in non-big cities. 95% confidence intervals (lower and upper limits)



Note: Only observations with at least 100 observations are included. Firms in Copenhagen are limited to those with sales between 1 and 4 mio. DKK, firms outside the biggest cities in Table in 5.9 are limited to those with sales in the range 3-4 mio. DKK.

5.4. Firm characteristics: changes in subsidized and non-subsidized employment

Another way of detecting substitution effects between subsidized and non-subsidized labour is by looking at changes in employment levels. In order to calculate changes we need information on the same firm for the two years 2000 and 2001. Almost 104,000 firms were observed in both years (Table 5.10). About 41,000 of those firms did not experience any change in non-subsidized employment, while 93,000 did not go through any changes in subsidized labour. 39,000 firms did not have any change in either kind of employment. More than 2/3 (71,000) of the firms only had a change of 1 employee in any type of employment. Thus, relatively few firms change the number of subsidized workers.

Table 5.10. Change in subsidized and non-subsidized employment in private firms, 2000-2001

	Change in subsidized employment:										
	-6 or less	-5 to -4	-3 to -2	-1	Unchan-ged	1	2-3	4-5	6 or more	All	Per cent
Change in non-subsidized employment:											
-6 or less	17	25	178	500	2,601	343	113	14	11	3,802	3.7
-5 to -4	1	2	33	234	2,299	253	37	3	0	2,862	2.8
-3 to -2	1	2	54	458	8,537	704	86	1	1	9,844	9.5
-1	0	0	51	462	14,662	762	49	3	0	15,989	15.5
Unchanged	1	1	43	791	38,962	741	49	0	1	40,589	39.3
1	1	1	65	829	13,411	499	49	4	2	14,861	14.4
2-3	0	1	81	718	7,772	483	77	2	1	9,135	8.8
4-5	0	1	40	262	2,137	259	54	1	2	2,756	2.7
6 or more	6	13	125	393	2,256	506	189	42	27	3,557	3.4
All	27	46	670	4,647	92,637	4,550	703	70	45	103,395	
Per cent	0.0	0.0	0.6	4.5	89.6	4.4	0.7	0.1	0.0		100

Table 5.11. Average change in subsidized employment conditional on change in non-subsidized employment from 2000 to 2001

	All			Wholesale, 1-10 mio. DKK Copenhagen		
	Average	Std. error	No. of firms	Average	Std. error	No of firms
Change in non-subsidized employment:						
-11 or less	-0.2330 *	0.0435	1,691	0.1250	0.1548	16
-10 to -6	-0.0114	0.0168	2,111	-0.0800	0.0554	25
-5 to -4	0.0087	0.0108	2,862	-0.0435	0.0692	46
-3 to -2	0.0307 *	0.0045	9,844	-0.0164	0.0212	183
-1	0.0190 *	0.0026	15,989	0.0108	0.0130	277
Unchanged	-0.0010	0.0011	40,589	-0.0043	0.0069	694
1	-0.0234 *	0.0030	14,861	-0.0070	0.0192	286
2-3	-0.0234 *	0.0050	9,135	0.0452	0.0294	155
4-5	0.0167	0.0122	2,756	-0.0426	0.0523	47
6-10	0.0520 *	0.0180	1,981	-0.0313	0.0838	32
11 or more	0.3655 *	0.0578	1,576	0.4444	0.2422	9
All	0.0033 *	0.0016	103,395	0.0006	0.0067	1,770

* Significant at 5 per cent level or less

On average subsidized employment was almost unchanged from 2000 to 2001 (Table 5.11). Firms who increased their non-subsidized employment by 1 reduced their subsidized

employment by 0.0234, the same reduction was seen in firms with non-subsidized employment increases of 2 or 3 from 2000 to 2001. Firms who reduced their ordinary employment by 1, 2 or 3 non-subsidized persons had an increase in subsidized employment. This negative correlation somewhat lends support to a relationship saying that increases in subsidized employment decreases the employment of non-subsidised labour.

Changes in subsidized employment for firms increasing their non-subsidized employment by 4-5 workers or reducing it by 4-10 were only associated with insignificant changes in the levels of subsidized labour.

Finally, increases in non-subsidized employment exceeding 6 persons are correlated with significantly positive increases in subsidized employment. And decreases in non-subsidized employment exceeding 11 are associated with a significant decrease in subsidized employment of 0.23. This positive correlation is evidence against the substitution hypothesis.

In order to again control for production effects, the second half of Table 5.10 only includes firms in wholesale etc. in Copenhagen with sales between 1 and 10 mio. DKK in 2000. All changes in subsidized employment in these firms are insignificant at the 5 per cent level, leaving us with no evidence for or against the substitution hypotheses.

6. Estimation

In this section we estimate the relationships between the central variables: subsidized labour, non-subsidized labour and production. In section 6.1 we estimate across firms. In section 6.2 we remove (level-) fixed firm effects by using differenced variables. Basically we seek to estimate the relationships between non-subsidized labour, o, subsidized labour, s, and production, y. We do, however, not estimate a well specified production function, but rather some empirical relationships between the variables. Thus, we ignore i.e. use of capital and productivity parameters. In terms of section 2, we estimate the

substitution of subsidized for non-subsidized workers within the firm for current and new workers in the aggregate. We do not estimate distortion of competition between firms.

6.1. Employment levels

In this section we estimate the relationship between employment of subsidized labour, employment of non-subsidized labour and production (all in levels). In equation (6.1) below, the β s are the parameters to be estimated, and e is the error term. We include other characteristics of the firm (e.g. industry dummies) denoted by x. The model is

$$o = \beta_0 + \beta_s s + \beta_y y + \beta_x x + e \tag{6.1}$$

We expect that the employment of one extra subsidized worker reduces the employment of non-subsidized workers by up to one, i.e. $\beta_s \in (-1, 0)$. In model (6.1), small and large firms are compared, and we control for firm size by including (a) production level (proxy), *y*. Alternatively, a more mechanical way of estimating the relationship between production and labour is

$$\frac{o}{y} = \beta_0 + \beta_s \frac{s}{y} + \beta_x x + e \tag{6.2}$$

Principally, model (6.1) is of course less restrictive than model (6.2), because (6.2) assumes a particular relationship between labour and production. But given the fact that we do not estimate the dynamics of the relationship between labour and production and that research shows the relationship to be sluggish, (6.2) may nevertheless represent a better long run relationship between labour and production. Table 6.1 shows the results from estimating the two models.

Table 6.1. Estimation of firms' ordinary employment, 2001.

	Model (6.1)	Model (6.2)
	Parameter (std. dev.)	Parameter (std. dev.)
Subsidized employment (2001)	51.16	
	(0.159)	
Sales (2001)	0.118	
	(0.00056)	
Subs. empl./sales (2001)		18.11
		(0.095)
No. of firms	94,840	92,451
R^2	0.71	0.28

Note: OLS estimations, 27 industry dummies included. Table A1 in the appendix lists summary statistics for the applied data set

In both models the parameter related to subsidized employment does not make much sense as a 'substitution parameter', i.e. the estimate of β_s is far outside the range of -1 to 0 (meaning that one subsidized worker - according to these estimates - doesn't substitute between 0 and 1 non-subsidized worker, as anticipated). The positive, large and statistically significant estimates, $\hat{\beta}_s$, presumably simply reflects the fact that firms with many employees of one type of labour also have many employees of other types of labour. The inclusion of the production level, y, apparently, is not sufficient to control for firm size. Perhaps the lack of a description of the dynamics between labour and production is a reason for the insufficiency. Estimates may be biased if for example some firms are labour intensive and thus use more of all (both) types of employment. To account for such fixed effects (fixed with respect to levels), we estimate the production function in differences in section 6.2.

6.2. Differences in employment

We estimate the models

$$\Delta o = \beta_0 + \beta_s \Delta s + \beta_y \Delta y + \beta_x x + e$$

(6.3) and

$$\Delta \frac{o}{y} = \beta_0 + \beta_s \Delta \frac{s}{y} + \beta_x x + e$$

We define differences over two years, i.e. from 1999 to 2001 (the entire data period). Table 6.2 shows the results

Table 6.2. Estimation of change in firms' ordinary employment, 1999-2001.

	Model (6.3) Response variable: Δo	Model (6.3) Response variable: $\Delta \frac{o}{y}$
	Parameter (std. dev.)	Parameter (std. dev.)
Change in subsidized employment	61.03 (0.24)	
Change in sales	0.246 (0.0013)	
Change in the ratio of subsidized Employment to sales		69.93 (0.015)
No. of firms, N	94,522	91,876
R^2	0.65	0.996

Note: OLS estimations, 27 industry dummies included

The conclusion drawn from estimations in Table 6.2 is similar to that in the previous section drawn from estimations in levels, i.e. we do not estimate "sensible" substitution parameters in the range -1 to 0. Presumably, the explanation is similar to that in section 6.1, namely that firms with a large increase of some type of employment also increase their use of other types of employment.

Application of annual rather than bi-annual periods to define differences reduces the estimated parameters significantly, which is expected, since short term fluctuations become more important.

In models (6.1) to (6.3) we ignore any dynamic adjustments to long run equilibrium. In order to control for dynamic adjustments in a simple manner, we included lagged variables, but qualitatively the conclusions remain unchanged, meaning the estimated parameters $\hat{\beta}_s$ were still outside the (-1,0) interval.

Differences in employment, controlling for sales changes

Here we again estimate parameters based on differences in employment levels, i.e. changes in ordinary employment from an initial year (1999 or 2000) to a destination year (2000 or 2001). This gives us three possible regressions based on the years: 1999-2000, 2000-2001,

and 1999-2001. Production is controlled for by only including firms whose sales, from the initial to the terminal year, changed less than average sales per employee in the same firm in the initial year. If production change is caused by a change in employment, we expect employment to be almost unchanged.

Table 6.3. Regression of change in firms' ordinary employment on subsidised employment. (Only firms with sales change less than sale per employee)

	Estimate	Std. dev.	R^2	No of firms
Change in sales from 1999 to 2000 was less than:				
Average sales per worker	-0.14	0.03	0.003	55,881
- after removal of extreme observations	-0.40	0.02	0.007	53,998
90% of average sales per worker	-0.15	0.03	0.002	53,522
- after removal of extreme observations	-0.40	0.02	0.007	51,757
110% of average sales per worker	-0.17	0.03	0.003	57,908
- after removal of extreme observations	-0.39	0.02	0.007	56,015
Change in sales from 2000 to 2001 was less than:				
average sales per worker	-0.18	0.03	0.001	58,180
- after removal of extreme observations	-0.41	0.02	0.009	56,349
90% of average sales per worker	-0.21	0.03	0.002	55,952
- after removal of extreme observations	-0.44	0.02	0.010	54,177
110% of average sales per worker	-0.17	0.03	0.002	60,120
- after removal of extreme observations	-0.40	0.02	0.009	58,173
Change in sales from 1999 to 2001 was less than:				
average sales per worker	0.72	0.04	0.007	48,420
- after removal of extreme observations	-0.21	0.02	0.004	47,426
90% of average sales per worker	0.77	0.04	0.008	45,955
- after removal of extreme observations	-0.22	0.02	0.004	45,052
110% of average sales per worker	0.68	0.04	0.007	50,552
- after removal of extreme observations	-0.20	0.02	0.004	49,470

Note: Extreme observations are defined as observations with Cook's distance above $4/(N\text{-}k\text{-}1)$, cf. Fox (1991). N is number of observations before removal and k is the number of explanatory variables. OLS estimation, 27 industry dummies included. Table A2 in the appendix lists summary statistics for the applied data set

The estimated parameters are now -0.14 in 1999-2001, -0.18 in 2000-2001 and 0.72 in 1999-2001 (Table 6.3). Apart from the two-year period, ordinary employment thus seems to be reduced in firms with subsidised labour, but the effect is not great. Next, influential observations with high Cook's distances are removed – some of these observations are characterised by abnormally great changes in sales per employed person. The removal

changes the substitution effect to around -0.4 using one-year differences, and to -0.2, using two-year differences. Thus, the parameter is also negative for two-year changes. All parameters are very significant.

The estimated parameters are almost identical when comparing the estimation periods 1999-2000 and 2000-2001, and also rather insensitive to whether or not we include firms with changes in sales that are +/- 10 per cent from the average sales per employed worker in the firm, cf. Table 6.3. Regressions including differences in sales as explanatory variable were also carried out, but the inclusion did not change parameters much. Thus all in all, Table 6.3 supports the substitution hypotheses, but with a restricted/selected sub sample of firms, e.g. firms with only little change in sales over a period of one or two years, which makes the result less representative - compare Table A2 with Table A1 in the appendix.

Table 6.3a. Regression of change in firms' ordinary employment on subsidised employment: Separately for different wage subsidy schemes. (Only firms with sales change less than sale per employee)

	1999-2000	2000-2001	1999-2001
	Estimate[1]	Estimate[1]	Estimate[1]
On-the-job training	-0.43 **	-0.42 **	-0.35 **
Individual on-the-job training	-0.14 *	0.09	1.74 **
Flex job	-0.45 **	-0.35 **	0.31 **
Relief job[1]	-0.27 *	-0.09	0.16
Adult apprentices	-0.38 **	-0.52 **	-0.51 **
All schemes	-0.40 **	-0.41 **	-0.21 **

[1] The stars next to the estimates indicate the level of significance of the estimate. No stars indicate statistical insignificance at a significance level of 5 percent. One star indicates significance at a level between 1 and 5 percent, while 2 stars indicate significance at a level below 1 percent.
Note:
- R^2 is around 0.01, and the number of observations are at least 47,000 in each regression
- Included firms: Only firms whose change in sales was less than average sales per worker. After removal of extreme observations
- The more detailed estimations behind this table are available in Table A3 in the appendix

Taking each wage subsidy scheme separately but maintaining the selection of the firms as in Table 6.3 produces the estimates in Table 6.3a. In the one year transitions (1999 to 2000, and 2000 to 2001) the estimated substitution parameters are usually significant and with the expected sign, but this is not entirely the case with two-year transitions (1999 to 2001). The degree of substitution seems to depend somewhat on the subsidy scheme, but the main schemes, namely on-the-job training (-0.43 and -0.42), flex job (-0.45 and -0.35), and adult apprentices (-0.38 and -0.52) very much resembles the "aggregate" parameter in

Table 6.3 (-0.40 and -0.41). While the minor schemes individual on-the-job training (-0.14 and 0.09) and relief job (-0.27 and -0.09) shows significantly lower substitution than the aggregate.

6.3. Cumulative logit estimation

Several issues could be raised concerning the choice of method when evaluating the policy effects of the Danish wage subsidy programs on the employed level of regular employment. In particular, the validity of the use of the OLS method could be questioned for several reasons, especially given the somewhat counter intuitive results of the first more general regressions (Table 6.1 and 6.2). Re-specification of the set-up using OLS generated intuitively meaningful results (Table 6.3). Limiting the dataset and the statistical model does, however, prevent one from drawing conclusions for the labour market as a whole. This limited possibility might be more due to the choice of model rather than due to the lack of an economically interpretable relationship between the variables of interest. In order to explore this possibility, we will in the following make use of a cumulative logit model. A modelling of the problem at hand would be to specify the effect of a change in the number of subsidized employees as whether or not a move from decreasing the number of subsidized personal to increasing it would affect the probability of decreasing or increasing the number of regularly employed people. We do this modelling by applying the entire data set for private firms and looking at changes from 1999 to 2001. We start by estimating the average probability of being in one of the categories: decrease, no change, or increase in the number of ordinary employees from 1999 to 2001, conditional on having decreased, not changed, or increased the number of subsidized employees in the firm during the same period.

Cumulative logit assuming change in subsidized labour is continuous

In this subsection we estimate the average effect of moving from the category 'Decreased number of subsidized employees' to the category 'No change in the number of subsidized employees', and moving from 'No change in the number of subsidized employees' to 'Increased the number of subsidized employees'. The effect is measured by the change in the average estimated probability of a given firm reducing, not changing, or increasing its number of regular employees.

Results from implementing the cumulative logit model are reported in table 6.4. The parameter estimates have no direct interpretation, but do allow us to evaluate the degree of significance of the effect of the explanatory variable in question.

Table 6.4. Cumulative logit estimation of changes in firms' ordinary employment, 1999-2001

		Model 1 (no other explanatory variables)			Model 2 (also industry dummies and sales change included as explanatory variables)		
		Δ subsidized employees			Δ subsidized employees		
		Decrease	*No change*	*Increase*	*Decrease*	*No change*	*Increase*
		Fitted probabilities, %					
Change in ordin. empl.	*Decrease*	31.7	32.6	33.5	31.5	33.4	35.5
	No change	33.6	33.6	33.6	32.2	32.2	32.2
	Increase	34.7	33.8	32.9	36.3	34.4	32.3

		Change in above fitted probabilities			
		Δ (%-points)		Δ (%-points)	
		Decrease to *No change*	*No change* to *Increase*	*Decrease* to *No change*	*No change* to *Increase*
Change in ordin. empl.	*Decrease*	0.9	1.0	1.9	2.1
	No change	0.0	0.0	0.1	0.0
	Increase	-0.9	-1.0	-2.0	-2.1

	Parameter	Parameter
Change in subsidized employees	0.0316**	0.0702**
Change in sales	-	-0.021**
No. of firms	103,469	91,997

Note: In the cumulative logit estimation in model 2, 27 industry dummies are included

The results in table 6.4 indicate a small substitution effect between subsidized and non-subsidized employment. Model 1 includes no other explanatory variables than subsidized employment. Model 2 includes the change in sales from 1999 to 2001 along with industry dummies. The inclusion of these other explanatory variables increases the measured substitution effect. The changes in the conditional probabilities of model 2 thus predicts an average change of the probability of decreasing the number of ordinary employees of about 2 percentage points from both not changing the amount of subsidized personel instead of decreasing the number of subsidized personel, and increasing the number of subsidized compared to not changing the number of subsidized. Likewise, the probability of hiring personal on ordinary terms falls, 2.0 and 2.1 percentage points respectively, as the change in subsidized employees goes up from a decrease to not changing the amount, and from not changing the amount to an increase.

Cumulative logit estimations assuming change in subsidized labour is categorical

The above estimates suggest an equally large effect on the decision of hiring regular employees of going from one category of change in the number of subsidized personal to another. That is, the model estimates the average effect of moving from one situation of having to decrease ones number of subsidized personal to another of not having to, and of going from one situation of not having to decrease ones number of subsidized to one of being able to hire more. There is, however, no reason to expect such a simple linear relationship. In an attempt to incorporate non-linearities into the model, we apply two dummy variables instead of one "continuous" variable representing subsidized labour; we call this model 3, the result of the estimation of which is outlined in table 6.5. We continue using all the explanatory variables of model 2.

Table 6.5. Cumulative logit estimation of changes in firms' ordinary employment, 1999-2001, conditional probabilities

		Model 3		
		Change in subsidized employees		
		Decrease	*No change*	*Increase*
Change in ordinary employees	*Decrease*	26.8	33.9	32.0
	No change	31.5	32.3	32.2
	Increase	41.7	33.8	35.8

		Δ (%-points)	
		Decrease to *No change*	*No change* to *Increase*
Change in ordinary employees	*Decrease*	7.1	-1.9
	No change	0.8	0.0
	Increase	-7.9	1.9
No. of firms		91,997	

Note: Cumulative logit estimation of model 3, 27 industry dummies and Change in sales included

We see that the effect of going from a decrease in the number of subsidized to no change in the number of subsidized is greater than indicated by the "continuous" variable. On the other hand, the effect on ordinary employment of going from a decrease to an increase in the number subsidized personel is smaller than previously estimated and smaller than the effect of moving to the category of no change, which indicates a rather strong substitution effect of "increasing" the amount of subsidized personal from a decrease to not changing the amount. On the other hand it seems that there is no substitution effect of increasing

the amount of subsidized persons from no change to an increase. Table 6.5 thus indicates a non-linearity in the effect of discrete steps from one category to another. In conclusion, there is no unambiguous effect of increasing the level of subsidized labour. Increasing the level instead of decreasing the level has a negative effect on regular employment, but increasing the level instead of not changing the level has a minor positive effect. Thus, the effect depends on the alternative, i.e. the states of comparison.

Cumulative logit estimations assuming change in subsidized labour is categorical: Additional categories

Just as the assumption of one linear effect proved to be too restrictive, one might consider the categorization of all employee changes into three categories: decrease, no change, or increase, too rough. In the following model 4 we continue the cumulative logit analysis by breaking up the changes in firms' employment into categories along the lines of table 5.10, but we limit the number of categories to 9 for changes in ordinary employment, and 5 for subsidized employment. The results are outlined in table 6.6.

Table 6.6. Cumulative logit estimation of changes in firms' ordinary employment, 1999-2001, conditional probabilities

		Model 4				
		Change subsidized employees				
		≤-2	*-1*	*0*	*1*	*≥2*
Change in ordinary employees	*≤-6*	4.7	2.2	4.5	2.9	1.4
	-5 to -4	3.3	1.6	3.2	2.1	1.0
	-3 to -2	10.4	5.4	10.1	6.9	3.5
	-1	14.9	9.0	14.5	11.1	6.2
	0	32.0	27.4	31.7	29.9	22.1
	1	14.6	18.4	14.8	17.5	18.3
	2 to 3	10.6	17.1	11.0	14.7	20.4
	4 to 5	3.7	7.1	4.0	5.7	9.6
	≥ 6	5.8	11.9	6.3	9.2	17.6

		Δ (%-points)			
		≤-2 to -1	*-1 to 0*	*0 to 1*	*1 to ≥2*
Change in ordinary employees	*≤-6*	-2.5	2.3	-1.6	-1.5
	-5 to -4	-1.7	1.6	-1.1	-1.1
	-3 to -2	-5.0	4.7	-3.2	-3.4
	-1	-5.9	5.5	-3.4	-4.9
	0	-4.6	4.3	-1.8	-7.8
	1	3.8	-3.6	2.7	0.8
	2 to 3	6.5	-6.1	3.7	5.7
	4 to 5	3.4	-3.1	1.7	3.9
	≥ 6	6.1	-5.6	2.9	8.4
No. of firms		91,997			

Note: Cumulative logit estimation of model 3, 27 industry dummies and Change in sales included

Table 6.6 tells us that firms that "increase" the amount of subsidized personal from having decreased this number by 2 or more to only decreasing the number by one, will have a lover probability of decreasing ordinary personal and a higher probability of hiring ordinary personal. That is, a fall in the amount of subsidized personal that a firm ceases to employ gives no indication of a substitution between ordinary and subsidized employees.

A clear sign of substitution occurs when firms do not change the amount of subsidized employees compared to decreasing this amount by one. In this case the probability of a firm ceasing to employ ordinary personel goes up, while the probability of hiring additional ordinary employees goes down. Notice, however, that the magnitude of substitution is no

greater than what is the case of the indication of the opposite of substitution in the change from category ≤-2 to category *-1*.

The above conclusions are based on changes in fitted probabilities that do not offer an explanation as to why the observed pattern looks the way it does. The problem of estimating the effects comes from not having a better understanding of the hiring and firing process. This lack of understanding may lead to misspecifications of the estimated model. Due to lack of information, the model for example does not include each firm's expectations about future earnings or demand for its product, which is one factor likely to greatly influence the decision of investing or disinvesting in employees.

7. Conclusion and discussion

The aim is to estimate how ordinary employment is affected by subsidized employment. Descriptive and simple estimations do not show that employment of labour with wage subsidies reduces the employment of ordinary labour. But the simple models do not estimate sensible substitution parameters. An increase in subsidized employment presumably mainly captures firms' growth in the estimations presented. If we only consider firms whose production change approximately by the average labour product, we do find substitution parameters in the expected range. The estimations based on such sub samples are therefore qualitatively in line with other studies that find substitution between subsidized and non-subsidized workers (Bishop and Montgomery, 1993, some of the studies reviewed in Calmfors et. al., 2001, the National Labour Market Authority, 2005). Our estimates are however in the lower end of previously obtained results. Applying a cumulative logit model gives mixed results, i.e. does not unambiguously support the substitution hypothesis.

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Appendix

Table A1. Summary statistics for data applied in Table 6.1 regressions. 2001 levels

	Mean	Median	Std.dev.	Minimum	Maximum
Number of regularly employed	13.39	4.00	93.63	0	14,161
Number of subsidised	0.17	0	1.11	0	201
Sales, mio. DKK	18.66	3.08	315.24	0	79,258
Business activity:					
Agriculture, fishing and quarrying	11.43	0	31.81	0	1
Manufacturing	11.59	0	32.01	0	1
Construction	12.92	0	33.54	0	1
Wholesale and retail trade, hotels, restaurants	31.22	0	46.34	0	1
Transport, storage and communication	6.94	0	25.42	0	1
Financial intermediation, business act.	16.58	0	37.19	0	1
Location:					
Copenhagen	9.68	0	29.57	0	1
Odense	2.79	0	16.97	0	1
Aarhus	4.76	0	21.29	0	1
Aalborg	2.58	0	15.85	0	1
Other	80.19	1	39.86	0	1

Table A2. Summary statistics for data applied in Table 6.3 regressions. 2001 levels. (Only firms with sales change less than sale per employee)

	Mean	Median	Std.dev.	Minimum	Maximum
Number of regularly employed	3.87	2.00	4.95	0	181
Number of subsidised	0.06	0	0.27	0	9
Sales, mio. DKK	4.23	2.08	31.97	0	6,225
Business activity:					
Agriculture, fishing and quarrying	14.70	0	35.41	0	1
Manufacturing	7.65	0	26.58	0	1
Construction	12.19	0	32.72	0	1
Wholesale and retail trade, hotels, restaurants	32.33	0	46.77	0	1
Transport, storage and communication	6.81	0	25.20	0	1
Financial intermediation, business act.	14.09	0	34.79	0	1
Location:					
Copenhagen	8.05	0	27.20	0	1
Odense	2.77	0	16.42	0	1
Aarhus	4.32	0	20.32	0	1
Aalborg	2.38	0	15.26	0	1
Other	82.48	1	38.02	0	1

Table A3. Regression of change in firms' ordinary employment on subsidised employment. (Only firms with sales change less than sale per employee)

	Estimate	Std. Dev.	R^2	No of Firms
Change in sales from 1999 to 2000 was less than:				
Average sales per worker			0.003	55,891
On-the-job training	-0.19	0.04	**	
Individual on-the-job training	0.04	0.08		
Flex job	-0.19	0.08	*	
Relief job	-0.27	0.13	*	
Adult apprentices	-0.06	0.07		
- after removal of extreme observations			0.007	53,905
On-the-job training	-0.43	0.03	**	
Individual on-the-job training	-0.14	0.07	*	
Flex job	-0.45	0.06	**	
Relief job	-0.27	0.11	*	
Adult apprentices	-0.38	0.05	**	
90% of average sales per worker			0.003	53,522
On-the-job training	-0.19	0.05	**	
Individual on-the-job training	-0.01	0.08		
Flex job	-0.22	0.09	*	
Relief job	-0.31	0.13	*	
Adult apprentices	-0.07	0.07		
- after removal of extreme observations			0.007	51,626
On-the-job training	-0.43	0.03	**	
Individual on-the-job training	-0.22	0.07	**	
Flex job	-0.40	0.06	**	
Relief job	-0.28	0.11	*	
Adult apprentices	-0.39	0.05	**	
110% of average sales per worker			0.004	57,908
On-the-job training	-0.21	0.04	**	
Individual on-the-job training	-0.07	0.08		
Flex job	-0.21	0.08	*	
Relief job	-0.27	0.13	*	
Adult apprentices	-0.06	0.07		
- after removal of extreme observations			0.007	55,908
On-the-job training	-0.43	0.03	**	
Individual on-the-job training	-0.20	0.06	**	
Flex job	-0.48	0.06	**	
Relief job[1]	-0.27	0.11	*	
Adult apprentices	-0.40	0.05	**	

	Estimate	Std. Dev.	R^2	No of Firms
Change in sales from 2000 to 2001 was less than:				
average sales per worker			0.003	58,180
On-the-job training	-0.27	0.04	**	
Individual on-the-job training	0.37	0.08	**	
Flex job	-0.08	0.07		
Relief job	0.07	0.12		
Adult apprentices	-0.45	0.05	**	
- after removal of extreme observations			0.009	56,201
On-the-job training	-0.42	0.03	**	
Individual on-the-job training	0.09	0.07		
Flex job	-0.35	0.05	**	
Relief job	-0.09	0.10		
Adult apprentices	-0.52	0.04	**	
90% of average sales per worker			0.004	55,952
On-the-job training	-0.33	0.04	**	
Individual on-the-job training	0.39	0.08	**	
Flex job	-0.08	0.07		
Relief job	0.01	0.12		
Adult apprentices	-0.46	0.06	**	
- after removal of extreme observations			0.01	54,019
On-the-job training	-0.46	0.03	**	
Individual on-the-job training	0.10	0.07		
Flex job	-0.36	0.05	**	
Relief job	-0.15	0.10		
Adult apprentices	-0.55	0.04	**	
110% of average sales per worker			0.005	60,120
On-the-job training	-0.26	0.04	**	
Individual on-the-job training	0.57	0.08	**	
Flex job	-0.04	0.07		
Relief job	0.03	0.12		
Adult apprentices	-0.52	0.05	**	
- after removal of extreme observations			0.009	58,073
On-the-job training	-0.39	0.03	**	
Individual on-the-job training	0.19	0.07	**	
Flex job	-0.32	0.05	**	
Relief job[1]	-0.10	0.10		
Adult apprentices	-0.55	0.04	**	

	Estimate	Std. Dev.	R^2	No of Firms
Change in sales from 1999 to 2001 was less than:				
average sales per worker			0.020	48,420
On-the-job training	0.17	0.07	*	
Individual on-the-job training	2.90	0.13	**	
Flex job	1.90	0.10	**	
Relief job	0.58	0.16	**	
Adult apprentices	-0.17	0.08	*	
- after removal of extreme observations			0.014	47,053
On-the-job training	-0.35	0.04	**	
Individual on-the-job training	1.74	0.10	**	
Flex job	0.31	0.07	**	
Relief job	0.16	0.10		
Adult apprentices	-0.51	0.04	**	
90% of average sales per worker			0.022	45,955
On-the-job training	0.18	0.08	*	
Individual on-the-job training	3.08	0.13	**	
Flex job	2.07	0.11	**	
Relief job[1]	0.62	0.17	**	
Adult apprentices	-0.17	0.08	*	
- after removal of extreme observations			0.014	44,671
On-the-job training	-0.36	0.04	**	
Individual on-the-job training	1.87	0.11	**	
Flex job	0.29	0.07	**	
Relief job	0.16	0.10		
Adult apprentices	-0.53	0.05	**	
110% of average sales per worker			0.019	50,552
On-the-job training	0.19	0.07	**	
Individual on-the-job training	2.72	0.12	**	
Flex job	1.80	0.10	**	
Relief job	0.54	0.16	**	
Adult apprentices	-0.18	0.08	*	
- after removal of extreme observations			0.013	49,094
On-the-job training	-0.33	0.04	**	
Individual on-the-job training	1.54	0.09	**	
Flex job	0.29	0.06	**	
Relief job	0.13	0.10		
Adult apprentices	-0.52	0.04	**	

*, **) The stars next to the estimates indicate the level of significance of the estimate. No stars indicate statistical insignificance at a significance level of 5 percent. One star indicates significance at a level between 1 and 5 percent, while 2 stars indicate significance at a level below 1 percent.