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COMPETITION POLICY IN SUBSIDIES AND STATE AID

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FOREWORD

This document comprises proceedings in the original languages of a Roundtable on Subsidies and State Aid which was held by the Committee on Competition Law and Policy in February 2001.

It is published under the responsibility of the Secretary General of the OECD to bring information on this topic to the attention of a wider audience.

This compilation is one of several published in a series entitled "Competition Policy Roundtables".

PRÉFACE

Ce document rassemble la documentation dans la langue d'origine dans laquelle elle a été soumise, relative à une table ronde sur les Subventions et les Aides Publiques, qui s'est tenue en Février 2001 dans le cadre de la réunion du Comité du droit et de la politique de la concurrence.

Il est publié sous la responsabilité du Secrétaire général de l'OCDE, afin de porter à la connaissance d'un large public les éléments d'information qui ont été réunis à cette occasion.

Cette compilation fait partie de la série intitulée "Les tables rondes sur la politique de la concurrence".

DENMARK

Part one of this paper considers two subjects. First the Danish sectors which are the biggest beneficiaries of subsidies and second, two studies by the Danish Competition Authority on the effects of subsidies.

Part two considers the rules and regulations governing aid and subsidies in Denmark with special focus on the new section 11 a in the amended Danish competition Act.

A draft working paper by the Danish Competition Authority on Public Subsidies and Productivity Growth is annexed to this paper.

1. Examples of competition distorting aid/subsidies

Correcting market failures and pursuance of political goals are the most common reasons for granting subsidies. But there are huge differences in the objectives for granting subsidies to different sectors. This is reflected in large differences in the size of subsidies that different sectors are granted.

E.g. transport via railway or buses are granted ten times as much state aid as the sector for research and development, cf. table 1. Of course there is a reason for the differences. Most parts of public transport in Denmark would not survive on a purely commercial basis and public transport in Denmark is given high priority.

Table 1: Top ten Danish sectors receiving subsidies, 1995

	Subsidies, Dollar per employee
Rail transport	85,300
Bus transport	31,900
Manufacture of sugar	28,500
Refuse collection and sanitation	19,300
Manufacture of diary products	15,700
Steam and hot water supply	15,200
Production and distribution of electricity	13,600
Casting of metal products	12,700
Recycling of waste and scrap	10,000
Research and development	8,000

Source: National accounts, Danish Statistics and calculation by the Danish Competition Authority. The Danish Competition Authority and the Ministry of Trade and Industry have done several studies on the effect of subsidies. The main issues have been the competitive and the productive effect of subsidies.

1.1 Subsidies can harm competition

The first study is focusing on the empirical effect of public financial subsidies on market competition. Subsidies are defined more broadly than the general definition of state aid in the EU-system.

Public support may keep inefficient firms alive, which may decrease market competition. But public financial support may also lower barriers to entry. And that may increase market competition.

Therefore, the aim of the study was to establish whether there were empirical evidence that public support most often go to sectors with high or low competition.

In general we did find clear evidence that subsidies often go to sectors with limited competition. This was the conclusion of several studies of partial indicators.

One indicator of low competition is the profit rate in the sector. We found that the profit rates in markets with high public financial support in general were larger than in markets with low public financial support. The study takes into account that the profit rate also depends on the entry rate, rate of capital etc.

Another indicator is taken from other studies. Each year The Danish Competition Authority identifies sectors in the Danish economy with low competition. When we compare the level of public support in the low competition sectors with the other sectors in Danish economy the trend is clear: Sectors with low competition are also granted the highest public financial support.

Other indicators were used in the study. All point in the same direction: Public support and low market competition go very often hand in hand.

1.2 Subsidies can harm productivity

The second study investigates the empirical effects of public financial support on firm productivity growth in enterprises.

The starting point of the study is that often the goal of giving public subsidies is not to increase the growth rate. But at other times it is.

In theory, public financial support can both increase and decrease firm productivity growth.

For example, public financial support can cause inefficiency in the receiving firms because the administration of support programs inside the firm can be seen as pure waste. But it can also cause technical inefficiency. For example if the public financial support mainly goes to one production factor.

And, if public subsidies have effects on growth rates, it is relevant to take these effects into account, when we design and evaluate the public financial support.

The study compares the growth rates of some 1 500 Danish firms, which all received some kind of public financial support form 1994 to 1997 with some 20 000 other, which did not.

The results are mixed, though, dependent on the sector receiving support and the aims of support.

But in general we do not find evidence that public financial support increases growth rates in the short run.

We did find evidence that firms receiving high public financial support in the transport sector and the trade, hotel and restaurant sector, generally increase their output slower than firms not receiving public financial support in the same sector.

The final results also show some evidence of public financial support for regional development and environment purposes may decrease growth rates. In particularly, it seems to be the case when the subsidies are granted to firms in the business sector.

Finally, when financial support is granted to firms in the business sector there is evidence that public financial support for R&D may decrease growth rates.

1.3 Recommendations

In most cases subsidies are used with god intentions. But unintended effects - or no effects at all - of the subsidies can harm good intentions. Considerations to the functions of the internal market and competition in national markets prompt state aid schemes to be run through a competition check. November 1999 the Danish Minister for Trade and Industry pointed this view out to her EU colleagues.

Finally the studies prove the need of a more systematic use of analyses of the effect of subsidies on competition and productivity.

2. Rules, regulations and mechanisms governing state aid and subsidies

2.1 Introduction

On 1 October 2000 the Danish Competition Act was amended. One of the amendments involved a new provision, which will contribute to ensuring that business activities of – or supported by - the State, the municipalities and county authorities takes place on equal competition terms with the private business sector. The rules are made to ensure that public as well as private business activities do not receive illegal aid, which distorts competition. The Danish Competition Authority administers the new provision and the full text of the provision is shown in annex A.

2.2 Definition of aid under this provision

The aid concept includes any kind of complete or partial public cover of costs granted by public funds. Thus, it does not only include direct cash aid but also indirect aid by way of tax exemption, guarantees and reduction of duties. Furthermore, it includes loans, renting and purchase or sale on terms, which are more favourable than ordinary market terms.

Thus, it is of no importance whether the activity or the undertaking receives aid by means of a straight money transfer or by means of certain financial benefits - which may be unintended. Neither is the purpose of the aid of any importance. The decisive fact is the effect on the financial position of the recipient.

The concept public funds must be construed in a broad sense. It includes funds granted by the State as well as other public authorities. Public funds also mean funds from foundations and institutions, provided that a public authority has appointed the relevant fund or institution to administer the aid. This also applies where the funds originate from private undertakings, which according to public regulation are obliged to grant a contribution to the fund. Furthermore, an internal transfer of funds within a public undertaking - from one activity to another - may for instance also be considered aid by means of public funds (please see below under cross subsidisation).

Box 2.1 Examples of Financial Advantages

An undertaking buys land owned by the public sector at a price, which lies below the market price.
For the purpose of business, materials or buildings are rented by the public sector at a price, which lies below the market price.
An undertaking receives consulting services paid with public funds.
A business activity is financed by a bank loan on terms, which are only obtainable, because the public sector guarantees the loan.

Cross subsidisation may also be subject to the provision. Cross subsidisation generally means that financial funds or assets are transferred from one market to another or from one activity to another.

If a private undertaking cross subsidises an activity with funds from a publicly supported activity, it will fall within the provision.

This is also the case if a public business activity is cross-subsidised by means of funds from a supported activity. Cross subsidisation of a public business activity may also take place with the public sector's own funds and it is of no importance whether the business activity is divested in a separate undertaking or not.

Box 2.2 Examples of Cross Subsidisation

Example 1
A public kindergarten starts washing the children's clothes. If the price for this service does not include all the costs involved in the activity, it is cross subsidised. This may distort competition, to the damage of private laundries.

Example 2
A public exhibition undertaking has "active workshops" where the visitors may watch how the old handicrafts are carried out. For instance the workshops sell ceramics. If the price of the ceramics does not include all the costs of the making, the ceramics production is cross subsidised. It may distort competition.

Example 3
A municipality offers its elderly citizens a possibility to buy extra home care in addition to the already existing home care paid by the municipality. If the price of the extra home care does not include all the costs involved in the activity, the service is cross subsidised. It may distort competition.

Not all types of cross subsidisation are affected by the provision. The cross subsidisation is only affected if it takes place on "non-market economic terms". The concept should be understood by considering how a commercial player would act in a similar situation.

Thus, it is for instance quite normal that an activity is loss-making in the start-up phase. Therefore, it will not contravene with the provision if funds are injected from other activities within a limited period of time. The duration of this period depends on the activity. It is decisive whether a market economic investor would accept the period of loss making. For instance, a market economic investor would probably be able to accept that more extensive, long-term projects are loss making during a period of 2-3 years. However, in connection with smaller business activities it would be required that the activity makes ends meet within a considerably shorter time frame. Furthermore, it may be well founded from an undertaking point of view to inject funds in connection with re-arranging/re-structuring an activity. Likewise, a short-lived and temporary deficit on ordinary activities due to changed market conditions does not mean cross subsidisation.

The assessment of whether a cross subsidisation takes place on "non-market economic" terms is, however, complicated by the fact that several activities may have a number of indirect costs - e.g. rent or staff.

In practice, the assessment is made by means of an analysis of the cost structure where it is established which costs are attached to the individual activities. If the costs of one activity are carried by the earnings from another activity, it will constitute cross subsidisation.

The Danish Competition Authority and the Danish Competition Council do not wish to impose upon the county authorities and municipalities etc. unnecessary administrative burdens. Thus, specific accounting standards etc. are not required. It is important that it is rendered probable that the earnings in connection with the sale cover all the relevant costs when a business activity is operated under the auspices of the public sector. "All the relevant costs" cover direct costs of pay, materials etc., however, it also covers the indirect costs, i.e. expenses for return on and depreciation of machines, equipment, land, goodwill etc. and a well-founded share of the indirect costs such as administration and rent. How the indirect costs are dispersed may vary from case to case, however, the dispersion must be well founded.

Thus, it must be clearly shown which costs have been defrayed in connection with the presentation of the service and how the costs are included in the price of the service. When all costs are included in the price, distortion of competition will as a principal rule not occur.

The costs may be dispersed on the various activities in several ways. The choice of method depends on how the aid will affect an activity. In the following lines it is assumed that an aided principal activity has been initiated. Now, the undertaking wishes to initiate yet another activity using the same facilities and perhaps a number of new facilities as well (e.g. staff, buildings, equipment etc.).

If the principal activity would not have been initiated without aid, all the costs must be related to the new activity. Thus, it is considered as if it is carried on completely separated from the principal activity and the total costs of the required facilities must therefore be related to the new activity. This method can be applied in all situations and when costs are related in this way, it will not constitute cross subsidisation.

If the principal activity may be operated without aid but perhaps at a lower activity level, you may choose to disperse the costs proportionally. If this method is to give a true and fair picture, it will be necessary to have fair, objective and transparent criteria. They must ensure that it is possible to find out whether the individual activities defray the costs corresponding to the drain they make on the facilities.

Cross subsidisation may also distort competition if aid is transferred to other undertakings than the receiver, e.g. if the original receiver offers a few traders "artificially" low-priced goods or services. If this occurs, it may give rise to distortion of competition in relation to the competitors of the customer.

Box 2.3

Example
A sports centre receives public aid. If the centre uses it to offer a fitness centre an "artificially" low rent, it may distort competition in relation to other fitness centres.
In this example one may at best avoid cross subsidisation by offering the premises or make sure that it can be documented that the rent of the premises corresponds to the market price.

2.3 When does aid falls within the act?

The Danish Competition Council may only intervene in connection with public aid when the two following conditions are both met:

- the aid distorts competition;
- the aid is illegal.

The Danish Competition Council will assess whether the aid distorts competition. The assessment of whether the aid is legal - i.e. whether it is authorised by the public regulation - is made by the competent minister or supervisory board.

In the following section, it is described when a business activity is considered anti-competitive. Furthermore, it is described how it is assessed whether a business activity has authority in the public regulation or not.

2.3.1 Distorting competition

It is not possible to give an unambiguous definition of when publicly aided or performed business activities are distorting competition. However, it is possible to point out a number of directional lines, which can be applied when assessing the individual activities.

In the assessment of the question of anti-competition, two matters are in particular relevant.

The first matter is whether all undertakings of the market have access to obtain the relevant aid or cover of costs on equal terms. If this is not the case, competition could be distorted between the undertakings receiving aid and the ones not receiving aid. In general, you could say that the wider, more objective and non-discriminating the possibility of receiving aids is, the more likely it is that it will not distort competition. A public authority will typically ensure equal competition by using public procurement.

The second matter is whether an actual effect at the affected markets may be established. In general, aid may affect the competition situation in two ways.

Firstly, it may affect the receiver's decision to set up an undertaking on or leave a market. If the aid makes the undertaking enter the market, it may impair the terms of competition for the established undertakings not receiving any aid.

Secondly, competition may be directly affected. This happens if the aid is of direct importance with regard to decisions relating to the production, capacity and prices, e.g. if the production costs of the

undertaking are reduced. In that case, it will distort competition in relation to other market competitors. For instance this will be the case if a municipality offers to let out business premises to an undertaking at a rent which is lower than the market rent.

This distortion of competition can be minimised and perhaps avoided if attention is paid to the fact that the possibility of participating in the activities should be as general, objective and non-discriminating as possible. Thus, all undertakings should have the same possibility of receiving advisory and consulting services etc. if it shows to be desirable to support a business activity.

2.3.2 Legal aid

If aid to a business activity has authority in the public regulation, the Danish Competition Council shall not require that it discontinues or is returned.

The concept public regulation includes laws, regulations, instruments, general budget rules and the power of attorney of the local authority. Furthermore, liabilities according to ratified conventions and EC regulations will fall within the concept of public regulation.

Moreover, it has to be examined whether aid having authority in the public regulation is used in accordance with the criteria of the granting if need be.

It may be an ordinary situation when a municipality wishes to increase its supply of additional services, e.g. by offering window cleaning to the elderly people. In itself, it will not represent distortion of competition; however, it will be appropriate if the municipality complies with the principles of the direction given by The Danish Competition Authority, e.g. regarding a true and fair statement of costs.

The assessment of whether aid to the business activity has authority in the public regulation will in many cases coincide with the assessment of anti-competition. This will, among other things, show in relation to the power of attorney of the local authority, which forbids municipalities to support undertakings or individual consumers if it does not take place on the market terms. Therefore, the Danish Competition Council's assessment of the competitive effects of the aid may be included in a number of cases in the relevant authority's assessment of the legality of the aid.

2.4 The relations to EC law

Pursuant to Article 87(1) of the Treaty establishing the European Community, any aid granted by the State or through State resources in any form whatsoever which distorts or threatens to distort competition by favouring certain undertakings or the production of certain goods shall, insofar as it affects trade between Member States, be incompatible with the common market.

Any aid falling within the Treaty establishing the European Community shall as a principal rule be reported to and approved by the European Commission before it is implemented. Notification to the Danish Competition Council shall not replace notification to the European Commission.

The state aid provision of the Treaty establishing the European Community has a number of similarities regarding section 11 a of the Danish competition act. However, an important difference is that according to Article 87(1) of the Treaty establishing the European Community it is required that aid shall influence the intra-Community trade whereas this is not a requirement according to s. 11 a.

Thus, each of the two provisions has its field of application. The European Commission has exclusive competence as regards aid falling within the Treaty establishing the European Community whereas s. 11 a does not include this type of aid.

Thus, the Danish Competition Council has no competence to consider neither notifications nor complaints of aid falling within the rules of the Treaty establishing the European Community.

Full text of section 11a.

Aid which distorts competition

Section 11 a. The Competition Council may issue orders for the termination or repayment of aid granted from the public funds, which has been granted to the benefit of specific forms of business activities.

(2) An order pursuant to subsection (1) may be issued, when the aid
i) Directly or indirectly has as its object or effect the distortion of competition, and
ii) Is not legitimate according to public regulation.

(3) The minister in question or the Board of Supervision makes a decision regarding the legitimacy of aid from the public funds, unless otherwise provided for by law.

(4) An order for repayment of aid pursuant to subsection (1) may be issued to private undertakings, to private foundations and to corporate undertakings, which are wholly or partly owned by the public. The Minister for Trade and Industry may lay down further rules to the effect that orders for repayment of aid may also be issued to specific corporate undertakings, which are wholly or partly owned by the public.

(5) The Competition Council's powers pursuant to subsection (1) to order repayment of aid becomes statute-barred five years after payment. In accordance with the Act on Calculation of Interest, the Competition Council fixes the amount of interest accrued in connection with a repayment order pursuant to subsection (1), including rules that the interest due may be calculated from the time of payment of the distortive aid.

(6) Upon notification, the Competition Council may declare that on the basis of the facts in its possession, the public aid is not covered by subsection (2) i) and accordingly, there are no grounds for issuing an order pursuant to subsection (1). The Council may lay down further rules on notification, including rules on the use of specific notification forms.

ANNEX

1. Introduction

There may be many reasons why public authorities subsidise private firms. From an economic point of view, a subsidy may correct a so-called market failure. For example when the production of a firm harms or benefits others than themselves[1].

Also, political goals may be reached through a public subsidy. For example cultural goals. Goals of supporting geographical fringe areas. And goals of securing work for people with reduced working ability.

There are, however, also drawbacks linked to public subsidies. The drawback most frequently discussed is that subsidies may distort competition. The establishment of the EU Single Market causes this discussion, primarily. National subsidies clearly contravene the idea of the Single Market. They are, however, simultaneously, one of an EU Member State's last legal means of protecting its own business[2].

In general, also a so-called dead-weight loss follows from a subsidy scheme. Subsidies have to be financed via taxes. In practice, levying taxes always implies distortions of the market and there are costs in terms of less welfare.

This paper focuses on an effect, which may seem ignored in the debate about subsidies. It addresses the correlation between subsidies and the productivity growth. First it points out, that the correlation is interesting because, in theory, it is ambiguous. Furthermore, the relatively few empirical analyses in this area have partly confirmed this ambiguity. Different analyses of different subsidies have reached different conclusions. See for example Bergström (1998) and Sløk (1998).

Therefore, this paper analyses the empirical correlation between a number of Danish subsidies and productivity growth in Danish firms. The analysis covers the years 1994-1997, which means that the analysis shows nothing specific about current Danish subsidy schemes. Instead, the analysis is to be seen as an attempt at initiating a debate on how various subsidies affect productivity. The analysis is, however, also meant to kick-start the development of methods to include productivity analyses in a general assessment of Danish subsidy schemes.

The reason why this analysis says nothing about current Danish subsidy schemes is that new ones have already replaced many of the subsidy schemes included in the analysis. The Ministry of Business and Industry is continually evaluating the advantages and disadvantages of its subsidy schemes. The Ministry uses the results to optimise its subsidy schemes and since 1997 the Ministry has, in particular, replaced direct subsidies by indirect subsidies. Broadly speaking, direct subsidies are granted to assist individual firms. Indirect subsidies, by contrast, are supposed to assist all the firms of in industry by improving their general framework conditions.

The structure of this paper is as follows. Section 2 considers some general theories regarding the correlation between subsidies and productivity growth. Section 3 accounts for the empirical model used[3], including what is understood by productivity growth. Section 4 accounts for the data used. Section 5 contains the results. Finally, section 6 concludes.

2. Public subsidies and productivity

Theories about public subsidies and productivity show why consideration for productivity growth may provide arguments both for and against subsidising private firms.

There are, primarily, two arguments for a positive correlation between subsidies and productivity growth. The first is that subsidies may make it more profitable to employ staff and/or invest in new training, technology, equipment, and machines. The second is that subsidies may enable firms to realise economies of scale by producing more. The surveys of Sløk (1998) and Hoffmann *et al.* (1999) show that there may be some truth in it. At any rate, with regard to public subsidies granted for innovation in Danish firms.

By contrast, other factors direct attention to a negative correlation between subsidies and productivity growth. One of them is that the political interests overshadow economic interests. At the same time, politicians grant the subsidies and have interest in getting re-elected. This combination presents a risk that subsidies will favour interest groups that carry much political clout[4], which may result in subsidies benefiting inefficient firms and industries. It may reduce mobility in society, and it may harm society's ability to adjust to new conditions. See for example Olsen (1982).

It may also impact negatively on the increase in firms' productivity if public subsidies distort or reduce competition. The Danish Competition Authority (1999d) has shown that large subsidies and little competition often go hand in hand. Others have shown that productivity increases most in markets subject to keen competition[5]. One explanation may be that the subsidies indirectly prop up firms, which would have gone bankrupt in a more competitive market. This may have a negative effect on society's ability to adjust. It may tie down too many resources and increase earnings in inefficient industries. Simultaneously, it may raise the prices of resources in all industries.

In addition, theoretical studies such as Schmidt (1997) have pointed out that a so-called "hard budget constraint" stimulates productivity growth. Firms exposed to the market forces with the risk of going bankrupt are, in theory, more efficient than firms with a "soft budget constraint" are. One explanation could be that subsidies might render private firms' budget constraint softer, primarily if the firm has relatively large debts.

Similarly, if subsidies are earmarked for specific purposes, they may impact negatively on firm productivity growth. Specific subsidies may favour one production factor and thus make firms turn their projects in a direction, which triggers maximum subsidies instead of maximum productivity growth. This is particularly the case if the projects are turned in a direction so those firms undertake activities that are not needed, but necessary in order to obtain subsidies.

3. The empirical model

This section sets out an empirical model to be used later for analysing the correlation between Danish subsidies and firm productivity growth. Readers not familiar with mathematics may want to go directly to relation (5).

The model is a standard industrial economic model, also used by Bergström (1998). It may also be used to explain the correlation between other factors and the increase in productivity.

The model is based on a standard production function:

(1) $Y_t = A_t F(C_t, L_t)$

Y_t is the production at the time t as a function of three variables, L_t, C_t and A_t which represent the use of labour, capital input and the efficiency of the factors of production. A_t is also referred to as total factor productivity (TFP)

For analyses of the correlation between public subsidies and productivity growth, the growth rate of TFP is relevant. It is found by expressing the growth rate of Y_t as a function of the growth rate of L_t, C_t and A_t.

Disregarding the subscript (t), the absolute growth of Y (in the period t) may be written as follows through differentiation:

(2) $\dot{Y} = \dot{A}F(C,L) + A\left[F_C\dot{C}+F_L\dot{L}\right]$.

F_L and F_K represent the derivative of F with respect to L and C. And $\dot{C} = dC/dt$, $\dot{L} = dL/dt$, and $\dot{A} = dA/dt$.

If we divide by Y on both sides, the growth rate of Y will be

$$\frac{\dot{Y}}{Y} = \frac{\dot{A}F}{Y} + \frac{A\left[F_C\dot{C} + F_L\dot{L}\right]}{Y}.$$

Or as Y=AF and $C/C = L/L = A/A = 1$

$$\frac{\dot{Y}}{Y} = \frac{\dot{A}F}{AF} + \frac{AF_C\dot{C}}{AF}\frac{C}{C} + \frac{AF_L\dot{L}}{AF}\frac{L}{L}.$$

Then we define $R = \dot{A}/A$ and use the fact that the elasticity of Y with respect to C and L is, generally, given by $\alpha(C) = F_C C/C$ and $\alpha(L) = F_L L/L$. The final expression of the growth rate of Y is then reduced to

(3) $$\frac{\dot{Y}}{Y} = R + \alpha(C)\frac{\dot{C}}{C} + \alpha(L)\frac{\dot{L}}{L}$$

If the elasticities $\alpha(C)$ and $\alpha(L)$ are assumed constant, (3) is a Cobb Douglas production function expressed in growth rates. The growth rate of Y, that is, may then be explained by three conditions:

- A larger input of labour L, that is $\dot{L}/L > 0$.
- A larger input of capital C, that is $\dot{C}/C > 0$.
- An increase in TFP, that is R>0.

In other words, R is the part of the growth rate of Y, which cannot be explained, by the growth rates of labour and capital. When R is positive, the firm may produce the same volume by using less labour and capital than previously. That means the firm is more productive.

With data for the growth rates of Y, C and L, (3) may be used to examine the correlation between subsidies and the growth rate of TFP. As in for example Dilling-Hansen *et al.* (1999) and Bergström (1998) it is assumed that R (the growth rate of TFP) is a linear function (g). We assume that TFP is a function of three factors:

- subsidy intensity at firm level (expressed as subsidies to the firm divided by the firms net turnover);
- subsidy intensity at industry level (expressed as subsidies to the industry divided by the industry's gross domestic product at factor cost);
- a vector X with other conditions which contribute to determining the increase in the productivity of the firm.

The subsidies, which are included in the subsidy intensities, are assumed to depreciate completely from one year to another. Technically, this implies that the subsidies are not part of the assets. This is, naturally, a simplification which implies, that it is difficult to interpret the effects of the subsidies in terms of return of the subsidies.

The function R (the growth rate of TFP) may, therefore, be written as

(4) R= g (public subsidies, X),

and the final empirical model is obtained by inserting (4) in (3). The result is

(5) $y = \alpha_C C + \alpha_L l + \gamma X' + \varepsilon$,

where y, c, and l are the growth rates in value added, use of capital, and use of labour, where γ is the vector of estimated parameters for the information in the vector X, where α_i, i= C, L are the elasticities, and where ε is a stochastic error.

The X vector comprises six pieces of information in this analysis. Most of them contain information about the individual firm. The rest of them contain information about the industry which the firm is part of.

The first piece of information is a dummy for whether the firm is subsidised or not. Technically, the dummy is defined to carry the value one if the Danish Agency for Trade and Industry or the Danish Environmental Protection Agency granted the firm subsidies in 1994-1995. Otherwise it carries the value zero. The idea of the dummy is to allow for any selection bias. That means to take into account whether the level of the productivity growth rate is, in general, at another level in firms, which are subsidised than in firms, which are not subsidised. If, for example, the subsidies are targeted at inefficient firms, this dummy will appear negative in the estimations

The second is an industry dummy at double-digit level. It follows the so-called main groups of industrial statistics according to Statistics Denmark. The hope is to allow for the differences between firms, which are due to the fact that they address various markets, such as differences in legislation.

The third is an indicator of the firm's solvency or credit standing. The indicator is defined here as the firm's equity capital in percentage of the value of its total assets. Low (high) credit standing indicates a hard (soft) budget constraint. Consequently, a negative correlation between productivity growth and credit standing must be expected (see section 2).

The fourth is a dummy for the age of the firm. If the firm was set up within the last 10 years, the value of the dummy is one. Otherwise it carries the value zero. The idea is that the age of the firm may, theoretically, impact on productivity growth in two ways, pulling in opposite directions, cf. Bergström (1998). On the one hand, increase in productivity may be linked to a learning-by-doing effect for two reasons: *1)* the more experienced the staff of the firm, the more productive the firm becomes, or *2)* the older the firm is, the more and better are its procedures and guidelines. By contrast, old firms may be less inclined to invest in new technology than younger firms do. Procedures and guidelines may also lead to bureaucracy and have a negative impact on productivity.

The fifth variable is a dummy for the number of employees of the firm, which is supposed to be an indication of the size of the firm. The value of the dummy equals one if the firm has more than 75 employees. Otherwise, it carries the value zero. Also the size of the firm may, in theory, impact on the growth rate in both directions. If large firms realise economies of scale, they will have the biggest growth rates. By contrast, the staff of large firms may, to put it in a popular manner, be in the way of each other, which may mean lower growth rates in large firms than in small ones.

Finally, there is a dummy for whether the firm is an ordinary joint-stock company (Ltd). Other surveys, e.g. Dilling-Hansen *et al.* (1999) have indicated that productivity (not the growth rate) is, in general, higher in a joint-stock company than in other types of firm (for example a private company, a co-operative society etc). One explanation may be that shareholders generally make the toughest demands on management for maximising efficiency.

4. Data

To estimate (5), a database has been used, which was set up by cross-tabulating several data sources

- The Danish Agency for Trade and Industry and the Danish Environmental Protection Agency have provided information on what firms were promised subsidies by the two authorities and how big subsidies the individual firms were promised in the years 1994-1997. The Danish Agency for Trade and Industry has also broken down the subsidies by various subsidy schemes.

- Firm account data from a corporate database of the Danish Ministry of Business and Industry.

- For 1995 Statistics Denmark has broken down the subsidies included in central government accounts and in the municipal and county council accounts by 130 industries. Subsequently, the subsidy intensity of the 130 industries has been calculated by comparing the subsidies to the industry's gross domestic product at factor cost.

- In addition, there are a great many other data, primarily publications from Statistic Denmark. For example, price indexes used to deflate the accounting and subsidy figures. Furthermore, there are wage figures used to compute the wage bill of firms on the basis of the number of employees.

4.1 Definitions and delimitation

The firms included in the analysis have been chosen on the basis of certain definitions and selection criteria. Firstly, firms have been divided into "subsidised" and "non-subsidised" firms.

- A "subsidised firm" obtained subsidies from the Danish Agency for Trade and Industry or the Danish Environmental Protection Agency in 1994 and/or in 1995. It is also included in the corporate database of the Ministry of Business and Industry with accounting figures for each of the years 1994-1997. Among the subsidised firms there are firms which were subsidised only in 1994 and/or in 1995. However, most of them were also subsidised in 1996 and/or 1997.

- A "non-subsidised firm" received neither subsidies from the Danish Agency for Trade and Industry nor from the Danish Environmental Protection Agency in 1994-1997.

The two definitions imply that firms, which were subsidised in 1996-1997 only, are not included. This ensures that all subsidised firms are followed for at least two years while being subsidised. This will contribute to minimising any noise from subsidies, which have not yet had any effect on the firms.

Secondly, the analysis is limited to five sectors. They are

- construction;
- manufacturing;
- transport;
- business activities etc. (e.g. insurance, engineering consultancy activities and banks), and
- wholesale, and retail trade, hotels, and restaurants.

It means that some sectors have been sorted out completely. They are agriculture etc; electricity, gas and water supply; post and telecommunications, and public and personal services.

The reason for not including electricity, gas and water as well as post and telecommunications is that there are hardly any subsidised firms in the database. With regard to agriculture etc. as well as public and personal services, it is difficult to estimate a production function, and thus productivity, on the basis of account data. With respect to agriculture etc, land and natural resources are important for the production. Furthermore, agriculture is heavily subsidised by the EU, which makes it difficult to assess the effect of Danish subsidies.

Also, small inactive firms have been sorted out. This has been achieved by requiring:

- that the firms have at least one employee;
- that the total assets and equity capital should be positive;
- that the book value of the firms capital assets should be positive.

However, in order to cross tabulate with other data, the firm must also have a tax registration number and industrial classification in the corporate database of the Ministry of Business and Industry.

Moreover, subsidies promised have been equated with subsidies disbursed. This is the case most often, but of course not always.

Table 1: Firms broken down by sectors, 1995

Sector	Manufacturing	Business Activities	Wholesale, and retail trade, hotels and restaurants	Transport	Construction	Random sample total
Firms	5,456	4,690	8,209	1,311	3,636	23,603
Number of subsided firms	803	281	260	38	109	1,491
Subsidised in percentage	14.7	6.0	3.0	3.0	3.0	6.3
Number of industries in sector	52	16	11	7	2	88

Source: Own data.

The analysis is, as mentioned in the introduction (section 1), limited to the period 1994-1997. Value added, which is normally defined as net turnover minus cost of goods sold is computed as operating income plus depreciation and payroll costs[6]. Capital and labour input is used as a measure of capital assets and number of employees, respectively. All amounts are calculated in fixed 1994 prices.

4.2 Description of firms and subsidies

The database is a so-called balanced set of data. It means that all firms are included for all the years 1994-1997. A total of 23 603 firms are included in the database.

1 491 or 6.3 percent of the 23 603 firms were subsidised by the Danish Agency for Trade and Industry or the Danish Environmental Protection Agency in the years 1994- 1997 (see table 1). With regard to manufacturing, 14.7 percent were subsidised. With respect to construction, transport as well as wholesale, and retail trade, hotels and restaurants only three were subsidised.

Table 2: Description of the firms broken down by sector[1]

		Manufacturing	Business activities etc.	Wholesale, retail trade, hotels and restaurants	Transport	Construction
Number of firms	Subsidised	803	281	260	38	109
	Non-subsidised	4,653	4,409	8,209	1,283	3,527
	Sector in DK	31,779	54,403	96,133	11,699	28,489
Balance sheet total million DKK	Subsidised	100.0	37.5	18.1	30.3	33.8
	Non-subsidised	34.6	39.3	19.6	32.5	5.5
	Sector in DK	10.7	3.8	3.2	6.2	2.0
Number of employees	Subsidised	94	47	23	45	65
	Non-subsidised	41	12	18	27	14
	Sector in DK	14	2	3	3	2
Age in years in 1999	Subsidised	19	16	18	18	17
	Non-subsidised	18	16	17	17	15
C/L[2]	Subsidised	369.56	447.16	326.31	561.98	185.42
	Non-subsidised	389.38	5,111.35	437.52	785.97	271.83
Y/L[3]	Subsidised	74.5	73.5	111.3	88.1	69.5
	Non-subsidised	84.0	179.8	118.6	89.1	54.8
Y/C[4]	Subsidised	0.71	0.92	1.08	0.27	0.50
	Non-subsidised	0.86	0.64	1.77	0.50	1.03
Growthrate TFP, 1997	Subsidised	-0.056	0.203	0.164	-0.897	0.027
	Non-subsidised	0.009	-0.001	-0.004	0.028	-0.001
Subsidy per subsidised firm DKK 1,000		483.7	2,548.9	201.7	436.9	649.7
Subsidy per employee, DKK 1,000		23.4	128.2	35.0	16.6	13.7

1. All numbers are means.
2. Booked value of capital assets in DKK 1,000 by number of employees.
3. Value added in DKK 1,000 by number of employees.
4. Value added in DKK 1,000 by booked value of capital assets in DKK 1,000.

Source: Own data and Generel erhvervsstatistik og handel 1996:16, Statistic Denmark.

Both the subsidised and non-subsidised firms seem to be relatively large compared to the total Danish sector. Table 2 shows that their total assets and number of employees are, on average, higher than the corresponding figures for the total population in the sectors. Table 2 shows, simultaneously, that the subsidised firms have, on average, more employees than the non-subsidised firms do.

The subsidised firms are also, if not altogether unambiguously, less capital intensive that the non-subsidised firms. On average, the subsidised firms have the smallest capital-labour ratio (C/L). By contrast, the total assets total is larger for the non-subsidised firms.

Finally, it appears from table 2 that the largest subsidies both per firm and per employee are to be found in business activities etc, that a subsidised firm receives the least in wholesale, and retail trade, hotels and restaurants, and that the smallest subsidy per employee is to be found in construction.

The fact that large firms are over-represented in relation to the population in the five sectors may be explained by two factors. Firstly, the above-mentioned delimitation of data. The overrepresentation is, however, especially due to the fact that only firms, which submit their annual accounts to the Danish Commerce and Companies Agency, are included. And they are only companies (e.g. ordinary joint-stock

companies, private companies and partnerships) as well as privately owned firms with no less than 10 employees.

The 1 491 subsidised firms received a total of about DKK 1 300 million in subsidies during the years 1994-1997. The Danish Environmental Protection Agency accounted for slightly more than half of it. The Danish Agency for Trade and Industry supplied the rest of it.

In table 3 the subsidies are grouped according to objective and sector[7]. The grouping has been conducted in such a manner that all firms which received subsidies for more than one objective are categorised under "several objectives" (second column from the right). The remainder of the subsidised firms which all received subsidies for one objective only are broken down by six objectives. This grouping has been chosen in order to best isolate the correlation to productivity growth for the individual objectives.

With regard to each subsidy objective, it is shown in table 3 for each of the five sectors how many firms received subsidies and the amount of subsidies in DKK 1 000. Both pieces of information comprise the period 1994- 1997.

First, only subsidies granted to subsidised firms, which received subsidies for one objective only, are considered. It appears that subsidies for research and innovation, environmental subsidies and regional subsidies are the three objectives which received most subsidies. These three received approximately DKK 250 million.

Then the individual sectors are considered. It appears that two sectors manufacturing and business activities etc. received a total of approximately 90 percent of the subsidy funds.

Finally, it appears from table 3 that 319 firms received subsidies for more than one objective and that these firms were subsidised by approximately DKK 800 million. More than DKK 560 million was granted to 65 firms in the sector of business activities etc. Primarily, these subsides includes subsidies paid to consulting engineers for large, costly environmental projects in Denmark and abroad.

Table 3: Breakdown of subsidies by sectors and objectives, DKK 1,000, 1994-1997

		Research and innovation	Quality and competence development	Exports and International co-operation	Entrepreneurs	Environment, energy, and working environment	Regional business development	Several objectives	Total
Construction	Number	16	57	10	0	6	5	15	109
	Amount	8,901	3,721	3,878	315	4,872	2,364	47,079	70,815
Manufacturing	Number	149	193	92	26	56	83	204	803
	Amount	45,612	12,913	22,686	4,055	31,808	99,458	171,901	388,433
Business Activities etc.	Number	31	101	41	6	29	8	65	281
	Amount	29,936	7,128	11,120	811	77,110	30,083	560,056	716,244
Wholesale, retail trade, hotels and restaurations	Number	51	122	31	5	11	10	30	260
	Amount	7,525	8,137	6,762	1,017	2,731	7,506	18,773	52,451
Transport	Number	10	11	5	0	1	6	5	38
	Amount	1,634	726	677	0	1	11,156	2,401	16,604
Total	Number	257	484	179	37	103	112	319	1,491
	Amount	93,608	32,625	45,123	5,883	116,522	150,576	800,210	1,244,727

1. Subsidies to environment, energy and working environment cover subsidies both from the Danish Agency for Trade and Industry and all subsidies from the Danish Environmental Protection Agency.

5. Results

Table 4 shows the first empirical evidence concerning the theories behind (5). With regard to the correlation between the subsidy intensities and productivity growth, the signs of the subsidy intensities at firm and industry level and their significance constitute a total indication of whether the correlation is positive or negative in practice.

Similarly, the signs of the dummies as to whether the firms receive subsidies and their significance constitute a total indication of whether the subsidies are, generally, targeted at inefficient firms, or the opposite. That is, whether there is selection bias. See section 3.

Table 4: Public subsidies and productivity growth, total estimate for all sectors, 1994-1997

(1)	All firms, subsidies not by objectives (2)	All firms, Subsidies by objectives (3)
Constant	1.400**	1.393**
	(0.098)	(0.093)
C	0.013	0.014
	(0.008)	(0.013)
L	1.026**	1.026**
	(0.013)	(0.018)
Credit standing	-0.006**	-0.006**
	(0.001)	(0.001)
Dummy for established after 1989	-0.083**	-0.056*
	(0.033)	(0.033)
Dummy for whether firm is a Ltd	-0.004	-0.005
	(0.037)	(0.037)
Dummy for more than 50 employees	-0.086	-0.073
	(0.061)	(0.062)
Dummy for whether firm received direct subsidy, all subsidies together	-0.180	
	(0.343)	
Dummy for whether firm received direct subsidy for:	-	
• Several objectives	-	-0.804**
		(0.322)
• Research and innovation	-	-0.118
		(0.349)
• Quality and competence development	-	0.223
		(0.297)
• Exports and international cooperation	-	-0.119
		(0.232)
• Entrepreneurs	-	-0.446**
		(0.190)
• Environment and working environment	-	0.052
		(0.407)
• Regional business development	-	-0.608
		(0.601)
All firm-specific subsidies together	-1.370	-
	(0.974)	
Firm-specific subsidies to:	-	
• Several objectives	-	0.371
		(3.067)
• Research and innovation	-	-0.481**
		(0.190)
• Quality and competence development	-	-13.885
		(10.304)
• Exports and international cooperation	-	2.904
		(3.414)
• Entrepreneurs	-	2.637**
		(1.186)
• Environment and working environment	-	0.902
		(1.344)
• Regional business development	-	-2.849**
		0.150)
Subsidy intensity at industrial level	-6.325**	-6.300**
	(2.070)	(2.061)
R^2	0.414	0.415
Number of observations	20,607	20,607

1. In each square, the top figure is a parameter estimate, whereas the figure in the parenthesis is the standard deviation of the estimate.
* (**) indicate that a zero hypothesis that the parameter equals zero is rejected at a significancelevel of 10 (5) per cent.
2. Tests indicated heteroscedasticity in business activities etc. Therefore, the standard deviations
are taken from White's asymptotic covariance matrix. See for example Maddala (1992 pp 211-212).

Table 4, column 2 will be considered first. It shows the result of an aggregate estimate of (5) with firms from all sectors and with all subsidies from the Danish Agency for Trade and Industry and the Danish Environmental Protection Agency included in one dummy and one subsidy intensity.

Table 4, column 2 shows, firstly, that both the parameters for the dummy and for the subsidy intensity at firm level are negative, but not significant. From table 4, column 2 it is, therefore, not possible to conclude that the subsidised firms have lower or higher growth rates than the average firm. Nor is it possible to conclude anything regarding the correlation between direct subsidies and productivity growth in the firms.

Secondly, table 4, column 2 shows that there is a significant and negative correlation between the industry's subsidy intensity and the firm's productivity growth. From table 4, column 2 it is, therefore possible to conclude that firms in an industry with high subsidy intensity increase their productivity less that a similar firm in an industry with low subsidy intensity.

Table 4, column 3 shows, however, that the correlation between a direct subsidy and productivity growth depends on the objective of the subsidy. The only difference between column 2 and column 3 is that column 3 breaks down the direct subsidies to firms and the related dummies for whether the firms have or have not received subsidies by the objective of the subsidies. It means that column 3 has seven dummies and seven subsidy intensities (one for each of the six objectives as well as one for subsidies for several objectives) where column 2 has only one dummy and one subsidy intensity.

A more nuanced picture of the correlation between subsidies and productivity growth emerges once the subsidies have been broken down by objective. Four conclusions stand out in table 4, column 3:

The dummies for whether firms received or did not receive subsidies show first of all that firms that receive subsidies for several objectives have, in general, a lower growth level than non-subsidised firms. The same applies to the subsidy intensity at firm level.

Secondly, table 4, column 3 shows a significant, negative correlation between the subsidy intensity for subsidies targeted at regional business development and subsidies granted to research and innovation.

Thirdly, column 3 shows, by contrast, a significant, positive correlation between the subsidy intensity for subsidies granted to entrepreneurs and the growth rate of the firm.

Fourthly, column 3 shows a significant and negative correlation between the industry's subsidy intensity and the productivity growth of the firms when subsidies to firms are broken down by objectives.

5.1 Separate estimates for the five sectors

The correlation between the subsidies and productivity growth varies from one sector to another. This appears from table 5, columns 2-6.

In table 5, columns 2-6, relation (5) is estimated separately for the five sectors of the analysis. As was the case in table 4, column 3, seven dummies and seven subsidy intensities are included for the firm-targeted subsidies granted by the Danish Agency for Trade and Industry and the Danish Environmental Protection Agency.

Before discussing the results of table 5 in details, it should be mentioned that it makes greater demands on the data when the analysis is broken down by sector. With the same data, uncertainty increases. In other words, details come at a price.

The move from an estimation with all five sectors which distinguishes only between the objectives of the subsidies (table 4, column 3) to separate estimates for the five sectors (table 5), makes higher demands on the data. Especially, this poses a problem to the estimates of transport (column 5) and construction (column 6) where there are none or few firms that receive subsidies (observations) within some subsidy objectives. This makes it impossible to estimate a statistical correlation between these subsidies and productivity growth.

The uncertainty which the break down by sectors causes must be kept in mind at all times when table 5 is considered and interpreted. A first glance at the table confirms the suspicion that the break down primarily causes data problems and uncertainty for the estimates of the transport and construction sectors. It is, at any rate, in these two sectors that the largest variations in the parameter values are observed.

If, in spite of the uncertainty, the results for the individual sectors are interpreted, table 5 shows some interesting tendencies for the combinations of sectors and objectives. First, the dummies in table 5, columns 2-6 for whether firms have or have not been subsidised show that, in general, there is no significant difference in the level of productivity growth rates in any of the five sectors.

However, there are four combinations where the dummy is significant. For three of the four combinations the dummy is negative. It involves subsidies to entrepreneurs and subsidies granted to firms that receive subsidies to several objectives in business activities etc. as well as subsidies granted to quality and competence development in transport. Thus, these subsidies are granted to firms that are losing ground compared to their direct competitors. For the fourth combination, that is subsidies for regional business development in business activities etc, the indication is the opposite. The dummy is here significant and positive.

With regard to the statistical correlation between subsidy intensities and productivity growth, a number of new results appear from table 5. The first result concerns the correlation between the subsidy intensity at industry level and productivity growth (third line from the bottom). Table 4, column 3 showed a significant, negative correlation in the total estimate, but table 5 shows that this tendency covers various results in the five sectors. The significant, negative correlation holds good only in transport (column 5) and in wholesale, and retail trade, hotels and restaurants (column 4). In manufacturing (column 1) the correlation is, by contrast, significant and positive. In business activities etc. (column 2) the correlation is insignificant. And in construction (column 6) there are, unfortunately, not enough industries included in the database to estimate any correlation.

Table 5: The correlation between subsidies and productivity growth, breakdown by sectors and objectives, 1996-1997

Variables	Manufacturing	Business activities	Wholesale, and retail trade, hotels and restaurants	Transport	Construction
(1)	(2)	(3)	(4)	(5)	(6)
Constant	-0.080	2.167**	0.286**	0.513**	-0.118**
	(0.073)	(0.237)	(0.085)	(0.173)	(0.040)
C	0.078**	-0.101**	0.077**	-0.038	0.066**
	(0.018)	(0.038)	(0.012)	(0.038)	(0.008)
L	0.963**	1,136**	0.983**	0.944**	0.920**
	(0.028)	(0,057)	(0.020)	(0.058)	(0.011)
Credit standing	-0.001**	-0.025**	-0.001	-0.001	0.000
	(0.000)	(0.004)	(0.001)	(0.003)	(0.000)
Dummy for established after 1989	0.033	-0.537**	-0.006	-0.031	-0.000
	(0.040)	(0.170)	(0.036)	(0.154)	(0.000)
Dummy for whether firm is a Ltd	-0.019	-0.166	0.038	0.151	0,96**
	(0.040)	(0.187)	(0.25)	(0.152)	(0.031)
Dummy for more than 75 employees	-0.004	-0.105	0.002	0.020	0,046
	(0.062)	(0.440)	(0.08)	(0.263)	(0.070)
Dummy for firm specific subsidies to:					
• Several objectives	-0.089	-3.734**	0.047	-0.626	-0.316
	(0.124)	(1.120)	(0.230)	(2.700)	(0.673)
• Research and innovation	-0.389	1.307	0.006	-1.346	-0.178
	(0.990)	(1.910)	(0.098)	(2.252)	(0.392)
• Quality and competence development	0.031	1.148	-0.082	-5.723**	0.103
	(0.079)	(1.040)	(0.197)	(1.635)	(0.293)
• Exports and international co-operation	-0.252	-0.155	-0.058	0.470	0.039
	(0.163)	(0.950)	(0.182)	(2.790)	(0.581)
• Entrepreneurs	-0.010	-1.850**	-0.685	-	-
	(0.118)	(0.430)	(0.490)		
• Environment and working environment	0.078	-1.021	0.104	-	-0.070
	(0.110)	(1.960)	(0.917)		(0.852)
• Regional business development	-0.115	1.579**	-	0.876	-0.458
	(0.190)	(0.330)		(1.283)	(1.069)
Firm specific subsidies to:					
• Several objectives	0.609	3.344	-8.444	-1.092	14.058
	(0.930)	(2.420)	(6.090)	(15.193)	(36.103)
• Research and innovation	-17.81	-1.407	-18.515**	416.486	5.824
	(95.33)	(0.920)	(10.24)	(619.007)	(14.808)
• Quality and competence development	-1.650	-33.311	11.493	117.637**	-10.703
	(4.180)	(21.050)	(13.880)	(55.743)	(28.546)
• Exports and international co-operation	7.903	3.321	11.893**	-	-4.411
	(4.711)	(3.230)	(4.690)		(61.429)
• Entrepreneurs	-5.813	13.690	4.547**	-	-
	(3.955)	(2.540)	(2.310)		
• Environment and working environment	6.585	0.209	3.645	-	-144.913
	(6.150)	(1.450)	(5.910)		(238.676)
• Regional business development	-1.158	-3.628**	-	-14.457	13.371
	(3.860)	(0.274)		(9.256)	(29.285)
Subsidy intensity at industry level	0.708**	9.019	-15.000**	-24.457**	-
	(0.346)	(5.520)	(1.956)	(1.410)	
R^2	0.707	0.283	0.575	0.416	0.781
Number of observations in the estimation	4,838	3,193	7,798	1,261	3,549

1. In each square, the top figure is a parameter estimate, whereas the figure in parenthesis is the standard deviation of the estimate. *(**) indicate that a zero hypothesis that the parameter equals zero is rejected at a significance level of 10 (5) per cent.
2. Tests showed signs of heteroscedasticity in business activities etc. And there are standard deviations and t-values computed by White's asymptotic covariance-matrix, see Maddala (1992, pp. 211-212).
3. Squares with '-' indicate less than 5 subsidised firms in the database.

Second, table 5 shows that the significant, negative correlation for the firm-targeted research and innovation subsidies may only be traced to the sector for wholesale, and retail trade, hotels and restaurants (column 4). In all other sectors there is no significant correlation between these subsidies and productivity growth.

Third, it appears from table 5, column 3 that the negative correlation between firm specific subsidies for regional business development and productivity growth from table 4, column 3 is to be found, only, in the sector for business activities etc. In the other sectors the recipients of subsidies for regional business development raise neither their productivity significantly more nor significantly less than their competitors within the same sector.

Fourth, table 5 shows that the significant and positive correlation for firm specific subsidies from table 4 is a local phenomenon which is to be found only in the sector for wholesale, and retail trade, hotels and restaurants (column 3). In the other four sectors there are either too few observations to estimate a correlation (transport as well as construction, columns 5-6)) or no significant correlation (manufacturing and business activities etc. (columns 1-2)).

Fifth, the industry specific estimates of table 5 show two result, which disappeared, in the total estimate of table 4. First, there is a significant, positive correlation between growth and subsidies for quality and competence development in the transport sector (column 6). The limited data basis of transport and the very substantial parameter value mean, however, that the result is rather uncertain. Second, in the sector of wholesale, and retail trade, hotels and restaurants there is a significant, positive correlation between growth and subsidies for exports and international co-operation (column 4).

Sixth, it appears from table 5 that the models explanatory power (R^2) varies from 0.283 to 0.782 within the five estimates. This variation is, however, not a signal that the estimates are better or worse in some of the sectors. The fact that the model does not explain all variation in data is, naturally, an indication that other factors are excluded. In general, however, excluded variables impact only on the parameters for the included variables if the excluded variables are heavily correlated with the included variables. See for example Maddala (1992).

5.2 Possible explanations of differences in growth rates

The correlation between the productivity growth and the firm specific subsidies varies between objectives and sectors. Tables 4 and 5 demonstrate this.

This variation may be due to several factors. First, the data may not be sufficiently good. As mentioned above, there may, primarily, be reason to fear this when separate estimates for the five sectors in table 5 are included. And, in particular, when estimates for the transport, (table 5, and column 5) and the construction sectors (table 5, column 6) are included.

However, if the data are compared with the data of other empirical studies (e.g. Bergström (1998)), there is no reason to fear that the data are of worse quality than that of others. Thus, there is reason to believe that the variation in the results contained in tables 4 and 5 are not only due to data problems.

Second, the variation in results between both sectors and subsidy schemes may be caused by a large empirical variation in the effect of subsidies on the firm's productivity between both sectors and subsidy schemes.

Also, the dummies for whether firms are subsidised or not may catch all selection bias. However, an in-depth examination for selection bias requires, that the firms be followed both before and after the firms receive their first subsidies. The current data does not allow such an analysis but if we transfer the Swedish results in Bergström (1998) to Danish conditions, it is the subsidies, which impact on the growth rates, and not a selection bias. Bergström (1998) found, as a matter of fact, that selection bias did not explain a significant part of the variation in the results.

Table 6: Logit-analysis of differences between subsidised and non-subsidised firms, 1995

Explanatory Variables	Explained variable: Subsidised (non-subsidised) firm = 1 (0)
(1)	(2)
Constant	-3.5583**
	(0.0690)
Value added (Y)	-0.0000
	(0.0000)
Capital input (C)	0.0000
	(0.0000)
Number of employees (L)	0.0004
	(0.0003)
C/L	-0.0004**
	(0.0000)
Y/L	-0.0000**
	(0.0011)
Y/C	-0.0005
	(0.005)
Dummy for more than 75 employees	0.6711**
	(0.0909)
Dummy for younger than 10 years	-0.0029
	(0.0622)
Dummy for joint stock company (Ltd)	1.3027**
	(0.0676)
Number of firms in the estimation	22,550
Number of subsidised firms in the estimation	1,455
-2 log L	664.29
	(0.0001)

1. The top figures in the bottom row is test statistics for a likelihood-ratio-test for whether the model as a whole is significant. The zero by hypothesis is that the model is not significant. The figure in parenthesis in the bottom row is the p-value of the test.
2. In all other rows that the bottom one, the top figure is the parameter estimate. The figure in parenthesis is The standard deviation of the estimate. *(**) indicates that a test for whether the parameter differs from zero is rejected at a significance level of 10 (5) percent.

There is, therefore, reason to believe that the subsidies must be part of the explanation of the variation in the results. In order to gain a further overview of whether certain types of firm are subsidised, it is examined whether the subsidised and non-subsidised firms' varying productivity growth is due to other differences between the subsidised and non-subsidised firms. Specifically, it is examined whether

differences in age, size, corporate form, capital intensity, labour intensity or capital-labour ratio are part of the explanation.

Technically, a so-called logit model is formulated. For this, a binary variable is defined first for all firms. The binary variable is assigned the value 0 (1) for a subsidised (non-subsidised) firm and is with the logit model sought explained by a number of explanatory variables, which describe some characteristics of the individual firms. If a variable of the logit model proves positive (negative) and simultaneously significant, it is, other things being equal, an expression of the fact that an increase in the variable makes it more (less) likely that the firm is subsidised.

The logit estimate is shown in table 6. The analysis is only shown for all five sectors together as the analysis for the five sectors showed no decisive variations at this point. It appears that subsidised firms' capital-labour ratio (C/L) and labour productivity (Y/L) is, in general, smaller than that of non-subsidised firms (column 2). It may, *inter alia*, indicate that the subsidy schemes generally favour investments in labour rather than capital. If that is the case, it may lead to inefficient production processes and thus contribute to explaining that the subsidised firm's productivity growth rates are, generally, lower than those of the non-subsidised ones (see section 2).

1. Furthermore, the fact that the firm is a joint-stock company or has more than 75 employees makes it more likely that the firm should be subsidised (see table 6, column 2). The latter aspect is altogether in line with the picture presented in table 2. It showed that the subsidised firms have, in general, more employees than the non- subsidised firms. However, tables 4 and 5 showed that neither of the two factors has any impact on the firms' productivity growth rate. It means that the low productivity growth rate of the subsidised firms cannot be explained as a result of the majority of the recipients being joint-stock companies and large firms. By contrast, both factors may distort competition and prove unfortunate from a competition point of view.

5.3 Other empirical results

Finally, other results of the estimations will be briefly considered. They will be considered against the background of table 5 where (5) is estimated by sectors and where the subsidies are broken down by objectives.

Firstly, it may look paradoxical when the parameters for increase in capital input are very small or even negative. It must be interpreted as if increased capital input is without any effect on or directly harmful to the firms' productivity growth. The paradox may, however, be caused by the Danish economy having experienced relatively large net investments in the years after 1994[8]. The costs of large net investments are immediate, but often have no effect until a few years later. This may explain why increased capital input had no impact on or reduced the growth rates in 1997.

Another result of table 5 is that the credit standing has a negative effect only on the productivity growth in the sectors of manufacturing (column 2) and business activities etc. (column 3). In the other sectors, table 5 contains no indication that the credit standing has a significant effect on productivity growth. The result indicates that a hard budget constraint only benefits productivity growth in business activities etc. (see section 3).

The claim that new firms (established after 1989) increase their productivity growth less than older firms (see section 3) is not general either. Table 5 only indicates a significant, negative correlation between firm age and productivity growth in the sector of business activities etc. (column 3).

Finally, there seems to be no empirical evidence for the theses that productivity increases more or less in large firms and joint-stock companies than in other firms. Only in the construction sector (column 6) does it look as if joint-stock companies increase their productivity significantly less than other firms do.

6. Conclusion

This analysis comprises only the period 1994-1997. The analysis is therefore historical and contains little about current Danish subsidy schemes. The reason is that many of the public subsidy schemes included in the analysis have already been replaced by new subsidy schemes.

Simultaneously, the data could have been better. The four-year analysis period is not sufficiently long to include any long-term effects of the subsidies. The analysis would also have benefited from more data on the individual subsidy schemes in some of the five sectors of the analysis. Better data might, finally, have provided better measures for value added, capital input, labour input etc.

These reservations do, however, not imply that the analysis does not serve a purpose. The intention of the analysis is in no way to classify and label certain subsidies as "bad" or "good". The intention is to draw attention to the fact that analyses of how subsidies impact on productivity are natural and necessary when the effects of subsidy schemes are to be evaluated. The analysis is a success if it gives rise to a debate on how best to include productivity analyses in cost- benefit analyses of subsidy schemes.

The analysis showed first why a productivity analysis should be an integral element when subsidy schemes are evaluated and why increased knowledge in this field is needed. The analysis pointed out, initially, that public subsidies may, in theory, both benefit and harm productivity growth in the firms. That is also the case when increase in productivity is not the direct, explicit objective of the subsidies. Subsequently, the analysis stated that the empirical correlation between public subsidies and productivity growth has not been analysed much and that the few analyses that have been conducted have reached mixed conclusions.

The empirical part of the analysis underscores the need for better knowledge of the empirical correlation between public subsidies and productivity. The analysis examined five Danish sectors to discover whether productivity develops differently in firms that benefit from public subsidies granted by the Danish Agency for Trade and Industry and the Danish Environmental Protection Agency than in firms which receive no subsidies. The conclusion is that there are variations in productivity developments. However, the analysis does not answer all questions and it raises, simultaneously, new ones.

The analysis shows, on the one hand, that some types of subsidy are granted to firms with productivity growth rates corresponding to or higher than the average. By contrast, the analysis shows also that the efficiency development in subsidised firms seems almost only to differ for the worse. The analysis does, however, not explain why the subsidised firm's growth rates differ for different subsidy schemes. The reason may be poor data. It may be that some subsidy schemes attract firms with high or low growth. And it may be that the subsidies impact on the growth of the firms.

The analysis also draws attention to the fact that the subsidies are granted, in particular, to firms that are larger than average and to joint-stock companies. This may give rise to alarm as it may distort competition in the markets where the firms compete. Unfortunately, the analysis does not explain the background to the result.

The results of the analysis should be used as a starting point for further analysis. Apart from the fact that the data must be improved, the results of the analysis should encourage analyses of what factors decide whether a subsidy scheme is harmful to, has no effect on, or benefits productivity growth. The aim and objective of an analysis of this kind must be to obtain an idea of how subsidies should be designed to get maximum value for money. The results in tables 4 and 5 may constitute the point of departure and the reference framework for an analysis of this kind.

Appendix

Table A1: The subsidy schemes of the analysis broken down by objectives, 1994-1997

	1994		1995		1996		1997	
	Number	DKK total	Number	DKK total	Number	DKK total	Number	DKK total
Subsidies from the Danish Agency for Trade & Industry								
Research and innovation:								
Design network	1	450						
Føtek	15	3,374						
Eureka	8	29,674	7	20,146	7	13,936	6	17,079
Development companies					6	13,314		
Knowledge and quality programme	356	66,190						
Product and process development in construction	3	750	2	16,227				
Subsidy to the Ørsted satellite	1	7,876	1	1,100				
Quality and competence development:								
Icebreaker project	359	23,564	264	17,392				
Ethnic icebreakers					11	726	6	396
Home Service					4	40		
Initiative area./Subcontractors	48	6,928						
Stride	3	2,196						
Supplementary financing Nordic Industrial Fund	5	263					1	67
Collective business promotion							1	75
Standardisation of feed equipment	1	120						
Exports and international co-operation:								
General export promotion	16	16	51	14,320	12	2,815	1	150
International co-operation	26	6,299						
Export network	78	16,461	20	5,203				
Export studies							13	627
Export development programme							2	611
Business related sector programme in Eastern Europe	46	7,554	79	20,589	32	8,051	23	7,764
Tendering for international contracts	15	1,998	26	3,003	17	1,709	14	1,762
Customs and forwarding	4	930						
Entrepreneurs:								
Entrepreneurs, analyses and tests			1	100				

Table A1: The subsidy schemes of the analysis broken down by objectives, 1994-1997 (cont'd)

Entrepreneurs, new product ideas	15	4,987	4	1,464	3	1,105			
Inventions, research, consultancy and sparring			2	83					
Entrepreneurial voucher	1	19							
Environment, energy and working environment									
KONVER	1	140							
Environmental icebreaker							9	556	
Environment, energy and working environment									
Environmental management and auditing etc.						2	2,616		
Environmental technology	108	23,653							
Regional business promotion:									
MUP2	45	58,337	5	231			2	68	
Target 2 Lolland			18	3,894	7	1,840	10	2,304	
Target 2 Nordjylland	25	8,860	64	36,630	39	29,652	17	3,676	
Target 1 5b			33	8,121	4	601	15	2,829	
National co-financing (EFRU)	26	9,213	109	38,955	47	17,804	40	8,638	
Perifa					1	110	2	680	
Regional development programmes	1	285			1	155			
Subsidies from the Danish Environmental Protection Agency	3	1,667	109	181,690	93	190,843	79	259,687	

NOTES

1. It is an economic expression that activities have negative or positive externalities. See for example the Danish Competition Authority (1999a) or European Economy (1999).

2. For example Lavdas and Merdrinou (1999, pp 1-2).

3. Readers with no knowledge of mathematics may omit section 3.

4. To gain an overview of the theories about political interest groups' rent seeking, see for example Mitchell and Munger (1991).

5. Inter alia, Dilling-Hansen et al (1999).

6. Operating income and depreciation are drawn from the firm's income statement. Pay is calculated on the basis of number of employees and average pay per employee in Pay and Income Statistics of Statistic Denmark.

7. In the Appendix, the subsidies are broken down by specific subsidy schemes.

8. According to the national accounts, published by Statistics Denmark net investments increased from 1993 to 1994 from DKK 13.4 billion to DKK 31.6 billion. In the forecasts for 1995, 1996 and 1997 Statistics Denmark estimates that net investments have increased further to DKK 46.3 billion, DKK 48.9 billion and DKK 60.8 billion, respectively.