CAPITAL SUBSIDIES AND THE PERFORMANCE OF FIRMS

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Abstract: In many countries, governments grant different capital subsidies to the business sector in order to promote growth. Also the EU, provides this type of subsidies. As De Long and Summers (1991) suggest there might be market failure justifications for public subsidisation of firms. However, because the use of subsidise is not unproblematic, it is far from clear how they affect long-run economic growth. This study examines the effects on total factor productivity of public capital subsidies to firms in Sweden between 1987 and 1993. Panel data which distinguish between subsidised and non-subsidised firms in the manufacturing industry are used. The results suggest that subsidisation can influence growth, but there seems to be little evidence that the subsidies have affected productivity.

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1. INTRODUCTION

De Long & Summers (1991) assert that investment in machinery and equipment has a positive influence on productivity growth and that the private return from equipment investment is below the social return. If their conclusions are correct, one implication would be that investment subsidies, which several governments, as well as the EU, have granted to the business sector, may have contributed to increased economic growth.[1] However, even if market failures exist which might justify government interventions, subsidisation of investments is not unproblematic. Financing the subsidies gives rise to deadweight losses, and because politicians and bureaucrats might be more interested in maximising political objectives than in economic efficiency, resources might be suboptimally allocated. Moreover, because subsidisation might give rise to both allocative and technical (X-) inefficiencies, it is far from clear whether subsidisation of investments is good or bad for long-term growth. Empirically, an earlier study of Korea (Lee, 1996) and another of Japan (Beason and Weinstein, 1996) both suggest that government intervention have negative effects on productivity growth.

The purpose of this study is to examine the effects on productivity, at the firm level, of capital subsidies that have been used in Sweden. Even though there are theoretical and some empirical indications that producer subsidies do not have a positive effect on productivity growth, there are several reasons why there is a need for more empirical studies in general and particularly in Sweden. First, the use of different types of investment subsidy has been much more important in Sweden than in Japan and Korea, and since Sweden became a member of the EU, the role of different types of producer subsidy will continue to be important in the foreseeable future. Second, although Sweden also has a long tradition of this type of "industrial policy" and although there are, to the best of our knowledge, no earlier systematic studies of productivity effects of subsidies, policy-makers in Sweden have for a long time asserted that different types of producer subsidy are growth enhancing. But are they? Finally, because Beason and Weinstein (1996)

[1] See OECD (1993, 1996) and EU (1996) for an international overview of the use of producer subsidies. See Blomström, Lipsey and Zejan (1996) for a general critique of De Long and Summers.

and Lee (1996) used aggregated data in their studies, a detailed study at the firm level can give some additional information about the effects of government intervention.

To study the effects of Swedish industrial policy, we have collected a set of data of subsidised and non-subsidised manufacturing firms for the period 1987-1993. By comparing the two types of firm and by estimating production functions, where we control for different factors that might affect productivity, we examine if there are any differences in productivity performance between the firms in the years after the subsidies were granted.

Many types of subsidy have been used in Sweden to support industry. In this study, we concentrate on regional policy subsidies. The subsidies that are examined are regional policy subsidies, whose main objectives have been to uphold and increase employment and growth in the northern regions of the country, and especially in the so called support areas. Basically, two types of support have been granted: general ones (e.g. lowered employer fees and employment support), which are granted to all firms that belong to the support areas, and selective ones (e.g. localisation subsidies and loans, different types of development support, support to sparsely populated areas and loans to investment firms), which the firms must apply for. Totally, about 1.7 billion SEK[2] have been granted annually in the 1980s and early 1990s.[3]

In this study we examine only the selective subsidies. These subsidies constitute about half of all regional policy subsidies (see NUTEK 1993:43). They are largely capital subsidies, where the total capital cost for the investment is subsidised by up to 40 %. For a firm to be eligible for a subsidy, it must be used primarily for investments in machinery and buildings. Moreover, if a firm is to be granted a subsidy it must be relatively profitable, and it must promise to increase the number of employees. The supports are administrated primarily by local officials. Larger supports are granted either by NUTEK (the Swedish Industrial Board for Industrial and Technical Development), which is the support-granting authority that monitors the supports, or the government.

[2] $1 = 8 SEK, in February 1998.
[3] See SOU 1996:69 and NUTEK 1993:43 for more detailed descriptions of the different types of support that are granted to industry in the support areas.

The remainder of the paper is organised as follows. In section 2, a theoretical framework is presented. In section 3, we discuss how we can test the effects of the subsidies empirically. In section 4, the data and some characteristics of the firms are presented. Section 5 presents the results and finally, section 6 concludes.

2. CAPITAL SUBSIDIES AND PRODUCTIVITY

Why should the government grant subsidies to firms located in backward regions? In the literature on regional economics one line of research argues that various forms of market failure give rise to agglomeration effects. For example, economies of scale and location advantages associated with easy access to large markets, skilled labour and technological knowledge, in combination with migration of the most highly skilled members of the labour force from the lagging regions, might lead to growing polarisation between different regions.[4] To soften this development the government can grant different types of support (e.g. direct subsidies and subsidised loans) and/or reduce taxes to firms located in the backward regions or to firms that decide to relocate in the backward regions.[5]

Although subsidisation of the business sector in the backward regions can lead to an increase of employment and capital investments, the main question is whether it can affect productivity. Productivity is important because of its implications for long-term growth. There are at least two reasons to suspect a

[4] Note, however, that the results of several studies suggest that per capita incomes across regions converge rather than diverge (see e.g. Sala-i-Martin, 1996, and Persson, 1997).

[5] See Begg (1989) and Tsoukalis (1997) for a discussion about why regional disparities might arise and why government interventions are important. In the official motivations for regional policy subsidies, market failure arguments are often used. For example, the European Investment Bank (EIB) claims: "At times of weak economic performance there would, without corrective mechanisms, be a tendency for capital investment and hence growth and employment within a unified economic area to gravitate largely towards the most prosperous regions. This is relevant to Europe, where two thirds of the regions accounting for 50% of its population still have a below-average per capita product. … That is why, in accordance with its primary remit, the EIB devotes on average more than two thirds of its financing to the development of regions facing structural or industrial redevelopment problems. Such operations interlink with grants from the Structural Funds managed by the European Commission in a mutually reinforcing way." (From the homepage of the European Investment Bank, http://www.eib.org/obj/dev.htm, 1 August, 1997).

positive connection between subsidisation and productivity. First, if the subsidies help to advance the technological development of the recipient firms then productivity increases. Second, if the subsidies can help the firms to better utilise economies of scale, productivity might increase as well.

However the use of producer subsidies is not unproblematic. Although governments argue that subsidies are growth enhancing and that they will allocate the resources efficiently, the "true" intentions might be to gain votes and/or to favour politically influential groups.[6] A consequence of this view is that resources might be transferred to less productive firms, or as Olson (1982, p. 63) argues: "Special-interest groups also slow growth by reducing the rate at which resources are reallocated from one activity or industry to another in response to new technologies or conditions. One obvious way in which they do so is by lobbying for bail-outs of failing firms, thereby delaying or preventing the shift of resources to areas where they would have a greater productivity".

Another problem with subsidisation, which we examine in more detail in the empirical part of this paper, is that it might make firms less productive for at least two reasons. First, because a subsidy gives the recipient firms an incentive to change the mix of capital and labour, it can give rise to allocative inefficiencies in the sense that a firm which, for example, is granted an investment subsidy might over-invest in capital. Second, subsidisation can give rise to technical (X-) inefficiencies. If the subsidy is captured by the firms as higher profits, then it gives the company stakeholders, in particular managers and workers, the potential to capture these profits in the form of slack or lack of effort. Leibenstein (1966, p. 408) has argued that monopolies which earn supernatural profits tend to be less efficient (i.e. more X-inefficient) because: "… where the motivation is weak, firm management will permit a considerable degree of slack in their operations and will not seek cost-improving methods". Similarly, if the subsidies help the supported firms to avoid bankruptcy then these firms are not forced to re-organise their activities and improve their performance to the same extent as non-supported firms, which are facing potential bankruptcy.[7] Finally,

[6] See e.g. Mitchell & Munger (1991) for a survey of interest group theories.

[7] See Burton (1983, p.44) for a discussion along these lines. Schmidt (1991) shows, among other things, that the managements of firms that are more likely to be liquidated have an incentive to work harder for cost reductions in order to avoid liquidation. A similar argument has been put forward by Dahmén (1998). He argues that it is important to distinguish between competitiveness and development potential. The

firms which are potential recipients of subsidies might, if the pay-off is high enough, become more interested in investing in subsidy-seeking activities (e.g. lobbying) than other more productive activities (e.g. R&D investments).[8]

Empirically, some studies have systematically examined industrial policy targeting and industry performance. A recent study by Lee (1996), for example, finds that the South Korean government has primarily targeted low-productivity industries since the 1960s. Furthermore, it is found that Korean industrial policies have not been successful in promoting productivity growth. As a plausible explanation for the results Lee suggests that targeted industries might have become less productive because targeting, which can be seen as a form of protection, decreases competition, which in turn might make firms less efficient. See also Beason & Weinstein (1996), who report similar results for Japanese industrial policy.

3. AN EMPIRICAL FRAMEWORK

On the basis of the discussion in the preceding section, there is a possibility that subsidised firms might become less productive over time. To examine the effects of subsidies (as well as other industrial policy measures) on productivity a standard approach in the literature on industrial policy is to examine if a vector of policy variables can be used after controlling for various differences between the examined industries, to

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former is related to prices and costs of production while the latter, which is most important for long term growth, has to do with the possibilities and the ability to bring in something new and more productive. If a firm's profits and liquidity improve, due to e.g. a devaluation or a subsidy which eases the transformation pressure that the firm is exposed to, "It cannot be ruled out that efforts expended on finding ways to something new can seem less urgent, and those measures which the transformation pressure calls forth are postponed", (p.70). That is to say, the firm might not fully utilise its development potential.

[8] See Baumol (1990), who argues that the allocation of productive entrepreneurial activity is heavily influenced by the relative payoffs that society offers to such activities compared with unproductive activities. Similarly, Kornai (1986, p.10) argues that subsidisation might give rise to soft budget constraints which might lead to inefficient use of resources: "The most important issue is dynamic adjustment. If the budget constraint is hard, the firm has no other option but to adjust to unfavourable external circumstances by improving quality, cutting costs, introducing new products or new processes, i.e. it must behave in an entrepreneurial manner. If however the budget constraint is soft such productive efforts are no longer imperative. Instead the firm is likely to seek external assistance asking compensation for unfavourable external circumstances. The state is acting like an overall insurance company taking over all the moral hazards with the usual well known consequences: the insured will be less careful in protecting his wealth".

explain some industry performance variable.[9] In this paper a similar approach is chosen to evaluate the performance of the firms that have been granted regional policy supports. Because the subsidies basically are capital subsidies the analysis focuses on a capital-augmenting production function model.[10] This model consists of four variables: output (Y), capital (K), labour (L) and "effectiveness" of capital (A). The production function is defined as follows:

$$Y(t) = F(K(t)A(t), L(t)), \tag{1}$$

where t denotes time. The growth rate of Y is a function of the growth rate of K, L and A:

$$\dot{Y}(t) = \frac{\partial Y(t)}{\partial K(t)}\dot{K}(t) + \frac{\partial Y(t)}{\partial A(t)}\dot{A}(t) + \frac{\partial Y(t)}{\partial L(t)}\dot{L}(t), \tag{2}$$

where a dot denotes a time derivative, and $\partial Y / \partial K$ and $\partial Y / \partial A$ denote $[\partial Y / \partial (AK)]A$ and $[\partial Y / \partial (AK)]K$, respectively. Dividing both sides by Y(t) and rewriting yields

$$\begin{aligned} \frac{\dot{Y}(t)}{Y(t)} &= \frac{K(t)}{Y(t)}\frac{\partial Y(t)}{\partial K(t)}\frac{\dot{K}(t)}{K(t)} + \frac{A(t)}{Y(t)}\frac{\partial Y(t)}{\partial A(t)}\frac{\dot{A}(t)}{A(t)} + \frac{L(t)}{Y(t)}\frac{\partial Y(t)}{\partial L(t)}\frac{\dot{L}(t)}{L(t)} \\ &\equiv \alpha_K(t)\frac{\dot{K}(t)}{K(t)} + R(t) + \alpha_L(t)\frac{\dot{L}(t)}{L(t)} \end{aligned} \tag{3}$$

[9] See e.g. Beason & Weinstein (1996) and Lee (1996).

[10] Alternatives to the capital-augmenting definition of technological progress are either a Hicks neutral definition, Y = AF(K, L), or a labour-augmenting definition, Y = F(K, AL). If one uses Cobb-Douglas production functions then the definition of the type of technological process is essentially the same.

where $\alpha_K(t)$ and $\alpha_L(t)$ are the elasticities of output with respect to K and L, respectively. $R(t)$ reflects all sources of growth other than the contribution of capital and labour. If output is measured as value added then $R(t)$ measures total factor productivity growth (TFP-growth).[11]

Because the firms which are granted a capital subsidy must promise to hire more employees, the subsidies can lead to an increase of total output in three ways: either through an increase in K and/or L or through $R(t)$. If $R(t)$ is positive the firm can produce more over time with given inputs, i.e. productivity growth is positive. To examine how subsidies affect productivity growth we assume that $R(t)$ can be expressed as a function of subsidies and a vector X. The X vector consists of various factors that might affect productivity growth. That is to say $R(t)$ can be expressed as follows:

$$R(t) = h(SUBSIDY, X) \tag{4}$$

To test if the subsidies affect productivity growth positively or negatively, a panel data set which consists of a large number of subsidised and randomly chosen non-subsidised manufacturing firms is examined and a variable is included which measures how large subsidies a firm has been granted. To be able to isolate the effects of the subsidies the X vector should, ideally, consist of all factors that affect productivity growth and which differ between the two types of firms. For example, variables which measure competitive conditions, organisational influences and labour relations might be important.[12] However, due to data limitations at the firm level many variables which it might be relevant to include have been excluded. The X vector consists of three variables: the age of the firm, a location factor, and industry dummies.

[11] Like most other studies of productivity growth, our analysis focuses on the growth of value added and not on growth of output (total real sales). Output and value added are related to each other in the following way: Q = F(AK, L, I), where Q is total real output, I is intermediate goods and A, K and L are as in the text. Change of total output can be written as $dQ = (F_{AK}K)dK + (F_{AK}A)dA + F_L dL + F_I dI$, where F_h denotes the partial derivative. Rearranging gives $dQ - F_I dI$ = change of (real) value added = $(F_{AK}K)dK + (F_{AK}A)dA + F_L dL$.

[12] See Caves & Barton (1990, Ch. 5) for a further discussion about various variables which might affect performance of firms.

An effect which might affect productivity is related to learning by doing, which is supposed to be related to the age of a firm. An older firm is expected to become more productive over time if for instance it has improved its organisation and learned how to utilise the workers and the capital in the best possible way.[13] On the other hand, an older firm might have become petrified in some sense or might not have as strong an incentive as a younger firm to invest in new technology.[14] Moreover, due to vintage effects a younger firm might be more productive if its capital stock is more modern than the capital stock of an older firm.[15]

In the official motivations for the support it is also argued that regional policy subsidies are motivated because it is more troublesome to run a business in the sparsely populated areas (the so called support areas) in the north of Sweden. Similarly, in the growth literature, and as we discussed in section 2, it has been argued that firms which are located closer to larger markets are more productive than firms located in the periphery. Because some firms are located inside the support areas and some firms outside the support areas (about 80% of the non-supported firms) and because we like to control for the effect of localisation, an area dummy variable has been included.

Finally, to control for differences across industries ISIC 2-digit level industry dummies are included. The industry dummies pick up the influence of factors that are common to all firms that belong to the same industry. The statistical model which is finally estimated is specified as follows:

$$\begin{aligned} GROWTHY_{i,t-t_0} &= b_0 + b_1 GROWTHK_{i,t-t_0} + b_2 GROWTHL_{i,t-t_0} + \\ &+ b_3 AGE_{i,t-t_0} + b_4 AREA_{i,t-t_0} + b_5 SUBSIDY_{i,t-t_0} + \\ &+ \text{Industry dummies} + e_{i,t-t_0} \end{aligned} \qquad (5)$$

[13] An example of this process is the so called Horndahl-effect, see Lundberg (1961) or Ohlin (1962).
[14] In the endogenous growth literature on leapfrogging a similar argument has been put forward. Nations (as well as regions and firms) that have a great deal of experience with an old technology may not be able to take advantage of new technologies because they do not have such strong incentives as nations which are not as dependent of old technology to implement the new technology, see e.g. Brezis et al (1993) for a discussion.
[15] Wolff (1996) finds that the vintage effect is an important determinant of the post-1973 productivity slowdown among OECD countries.

where $GROWTHY_{i,t-t_0}$ is firm i's growth of value added for various periods.[16] Value added is defined as operating profits after depreciation plus wages. $GROWTHK_{i,t-t_0}$ and $GROWTHL_{i,t-t_0}$ are growth of the capital stock and the number of employees, respectively. The capital stock is defined as the book value of total assets. The number of employees is used because data do not allow us to use a more precise measure (e.g. total working hours). AGE_{i,t_0} is defined as the year firm i was founded. $AREA_{i,t_0}$ is a dummy variable which takes on the value one for firms located in the support areas and zero otherwise.[17] $SUBSIDY_{i,t_0}$ measures the total value of all subsidies (in M.SEK) firm i has been granted between 1989 and 1993 divided by the number of employees in 1989. $e_{i,t-t_0}$ is the error term. To examine if the effects of the subsidies change over time the model is re-estimated for four periods: 1989-90, 1989-91, 1989-92, and 1989-93, respectively.

4. DATA

To estimate (5) a data set which consists of subsidised and non-subsidised manufacturing firms has been constructed. Information from NUTEK has helped us to identify a group of firms which received their first capital subsidy in 1989. Both financial and some non-financial information for all firms has been collected from UC AB, a credit report firm that collects annual reports from every Swedish firm,. The firms in the control group, which have been randomly selected from the whole population of firms, have not received any subsidies between 1980 and 1995.[18]

Several selection criteria have been used. The first problem is to decide how long one should follow the firms after the subsidies have been granted. If one uses a period that is too short, there is a risk the the

[16] All variables are in 1994 prices.
[17] The support areas are defined in SOU 1996:69.
[18] Note that both types of firm might have received other subsidies. Unfortunately data do not allow us to control for this problem.

evaluation will misrepresent the success/failure of the subsidies. Having too long a time span might make it difficult to isolate the effects of the support. What is too short and too long is difficult to say. We follow the firms from 1987 until 1993. Information for 1987 and 1988 has been collected so as to be able to examine the historical performance of the firms. Due to data limitations, 1993 is chosen as the terminal year. A problem with our data set is the missing observations. In 1989 there are 832 non-subsidised firms and 72 subsidised. In 1993 the numbers of firms have dropped to 634 and 56 respectively. Firms are missing for at least three reasons: they have been liquidated, they have merged with other firms or the lack of observations for some years has made it impossible to calculate the measures of change that we utilise in the estimations. Missing observations might be a problem if e.g. low productivity firms to a larger extent are missing for one group; then the estimations might overestimate the performance for this group. However, this is probably not a severe problem because the proportions of missing observations are about the same for both groups.

Because the capital subsidies that are studied in this paper are primarily granted to the manufacturing industry (see Table 1) another selection criterion is that only manufacturing firms are examined. Moreover, all firms have between 1 and 75 employees and none had an operating income of zero in 1989. These criteria were used in order to remove very small and inactive firms, and large firms. Finally, only joint-stock companies are studied.

Table 1. Distribution of support between 1983 and 1994. 1994 prices.

ISIC	1	2	3	4	5	6	7	8	9	Total support
Share of support, %	<1	5	52	<1	<1	9	3	22	7	11 B.SEK

[a] ISIC is ISIC 68 which is called SNI 69 in Sweden. 1 = Agriculture, forestry, hunting and fishing; 2 = Mining and quarrying; 3 = Manufacturing industry; 4 = Electricity and water services; 5 = Construction; 6 = Wholesale and retail trade, restaurants and hotels; 7 = Transport and communication; 8 = Finance, insurance, real estate and business services; 9 = Community, social and personal services.
Source: NUTEK and own calculations.

In Table 2 some characteristics of the supports are summarised. In 1989 there were 832 non-supported firms and 72 supported firms. Between 1989 and 1993 the supported firms were granted about 73.4 M.SEK, which corresponds to about 1.02 M.SEK per firm or 70.5 T.SEK per employee.

Table 2. Size of samples and distribution of support in 1989.

	Non-supported firms	Supported firms
No. of obs. per sample in 1989	832	72
Total support 1989-1993, M.SEK[a]	0	73.4
Avg. supp./firm., M.SEK	0	1.02
Avg. supp./employee, T.SEK	0	70.5

[a] 1994 prices.

5. RESULTS

A problem when one tries to evaluate the effects of subsidies is to assess to what extent the historical performance of subsidised firms affects their future performance. If they performed worse than the non-subsidised ones prior to the year the subsidies were granted, and if this development continues after the subsidies have been granted, then it is difficult to assess how the subsidies have affected the firms' development. To examine if there are any historical differences between the firms a standard logit model is estimated, which examines if different firm characteristics can be used to discriminate between the two types of firm.[19] The dependent variable is the binary variable TYPE, which is defined as.

$$\text{TYPE}_i = \begin{cases} 1 & \text{Subsidised firm} \\ 0 & \text{Non-subsidised firm} \end{cases}$$

and the probability that a firm *i* is granted a subsidy is estimated as a function of k explanatory variables.

Table 3 displays the result of the estimation. Column 1 reports the results for 1989. The only significant differences between the firms are that the subsidised firms to a larger extent are located in the support areas, that they are younger and that they are less labour productive. The capital intensity coefficient has a positive sign but is insignificant at the 10% level (p-value = 11%). In column 2 a group of variables which measure change between 1987 and 1989 are included (change of value added, number of employees,

capital, labour productivity and capital intensity). The coefficients should be carefully interpreted because 37 out of 72 non-supported firms were missing. None of the included variables are significant, i.e. it seems as if the firms have performed equally well before the subsidies were granted.

Table 3. Coefficient estimates for the logit model.

Dependent variable: Type of firm (TYPE)		
	1	2
Variables		
Y (Value added)	3.2E-09	6.6E-08
	0.04	*0.47*
K (Capital stock)	1.5E-08	2.3E-08
	0.73	*0.85*
L (Number of employees)	0.02	-0.005
	1.05	*-0.17*
AGE (Year firm was founded)	0.05	0.006
	3.75[a]	*0.42*
AREA (Support area dummy)	2.12	2.18
	7.58[a]	*5.43*[a]
Y/L (Labour productivity)	-2.2E-06	-2.3E-06
	-1.73[c]	*-0.98*
K/L (Capital intensity)	3.7E-07	4.5E-07
	1.63	*1.45*
$\dot{Y}_{87-89}$	-	0.01
		0.09
$\dot{K}_{87-89}$	-	0.46
		1.02
$\dot{L}_{87-89}$	-	-0.12
		-0.31
$\dot{VL}_{87-89}$	-	-0.11
		-0.38
$\dot{KL}_{87-89}$	-	-0.40
		-0.76
Constant	-7.50	-4.43
	-6.47[a]	*-3.50*[a]
Log Likelihood	199.25	114.28
N (No. of supp. firms)	896 (72)	659 (35)

Notes: t-statistics in italics. [a], [b] and [c] indicate significance at 1, 5 and 10 percent respectively, using a two-tailed test. $\dot{Y}_{87-89}$, $\dot{K}_{87-89}$, $\dot{L}_{87-89}$, $\dot{VL}_{87-89}$ and $\dot{KL}_{87-89}$ measure change of value added, capital, labour, labour productivity, and capital intensity between 1987 and 1989, respectively.

Does subsidisation affect the firms' productivity performance? The growth accounting framework, presented in section 3, says that any correlation between a policy variable and output growth could come from two effects. First, the subsidies may influence capital accumulation and thus output growth. And

[19] See Maddala (1989) for a discussion about logit models. An alternative to the logit model is the probit model. Probit models have also been estimated in this study. The estimated parameters differed slightly but

second, they could affect the output growth by influencing TFP growth. To answer the question we begin by examining Table 4 which displays the correlation between SUBSIDY and change of value added, capital and labour for various periods. The table suggests that there is a positive correlation between subsidisation and the three variables.

By estimating (5) the effects of subsidisation on TFP growth can be isolated. Table 5 displays the results of the estimations for the period 1989 to 1993. Pre-testing revealed heteroskedasticity so the estimates for all regressions have been corrected, using White's (1980) method. The table suggests that during the first year after the subsidies were granted subsidised firms seem to be more productive (Col. 1). However, by extending the period of evaluation it seems as if after the first year productivity growth decreases compared with that of the non-subsidised firms (Cols. 2-4).

Examination of different influence statistics revealed that outliers might have affected the results. To control to what extent this was a problem the regressions were reestimated using a bounded influence estimation technique which minimises the influence of influential outliers.[20] The results of the estimations are displayed in Columns 5-8. The most important changes are that the coefficient values for the capital and labour elasticities drop considerably. The result, that the more subsidies a firm is granted the more inefficient it becomes, is relatively robust. The SUBSIDY variable follows the same pattern as in the OLS estimations. In the short run productivity growth increases but after the first year it begins to drop and after three years the subsidised firms are significantly less efficient than the non-subsidised firms.

Table 4. Correlation matrix for support per employee (SUBSIDY) and growth of value added (*GROWTHY*), labour (*GROWTHL*) and capital (*GROWTHK*) for various years.

	1989-90	1989-91	1989-92	1989-93
GROWTHY	0.10	0.14	0.05	0.08
GROWTHL	0.28	0.23	0.24	0.23
GROWTHK	0.12	0.15	0.12	0.12

the qualitative results did not change.

[20] The influence of outliers is minimised using DFFITS as weights. See Maddala (1989, pp. 417) for a further discussion

Table 5. Subsidisation and productivity growth.

Dependent variable: Growth of value added (*GROWTHY*)								
	OLS				Bounded influence estimation			
	1	2	3	4	5	6	7	8
Year	1989-90	1989-91	1989-92	1989-93	1989-90	1989-91	1989-92	1989-93
Variables								
Constant	-0.44	-2.02	7.33	7.96	0.03	0.14	0.79	0.72
	-0.73	*-0.62*	*1.47*	*1.46*	*0.22*	*0.73*	*1.47*	*1.29*
GROWTHK	0.07	-0.78	2.62	2.77	0.26	0.31	0.46	0.43
	0.27	*-0.47*	*1.81*[c]	*1.82*[c]	*4.34*[a]	*2.81*[a]	*2.88*[a]	*2.72*[a]
GROWTHL	-0.80	2.42	2.67	2.26	0.66	1.03	1.15	1.33
	-0.89	*5.26*[a]	*5.09*[a]	*4.44*[a]	*5.94*[a]	*2.89*[a]	*4.07*[a]	*3.99*[a]
AGE	0.009	0.04	-0.10	-0.10	-0.001	-0.003	-0.01	-0.01
	1.02	*0.80*	*-1.28*	*-1.25*	*-0.44*	*-1.15*	*-1.38*	*-1.37*
AREA	-0.14	-0.44	1.32	1.54	0.01	0.08	0.07	0.08
	-1.18	*-0.60*	*1.30*	*1.37*	*0.30*	*0.91*	*0.83*	*0.85*
SUBSIDY	1.93	-1.66	-8.14	-4.57	0.29	-0.71	-1.53	-0.84
	1.71[c]	*-0.76*	*-2.61*[a]	*-2.30*[b]	*1.07*	*-1.02*	*-1.98*[b]	*-1.09*
R^2_{adj}	0.09	0.51	0.48	0.43	0.15	0.23	0.24	0.31
F	7.01	62.27	50.34	38.61	10.77	19.26	18.89	24.56
N	829	780	724	690	829	780	724	690
No. of Sup. firms	63	63	59	56	63	63	59	56

Note: The OLS estimations in Cols. 1-4 are based on White's (1980) adjustment for heteroskedasticity. The bounded influence estimations in Cols. 5-8 minimise the influence outliers have on the estimated coefficients, see Maddala (1989, pp. 417) for a description of the technique. t-statistics in italics. [a], [b] and [c] indicate significance at 1, 5 and 10 percent respectively, using a two-tailed test. Industry dummies at the two-digit industry level (ISIC 31-39) are estimated and available upon request from the author.

One explanation for the lower TFP growth of subsidised firms might be that it was firms with economic problems that applied for and were granted the supports. However, the fact that no larger differences in performance could be found between the firms prior to 1989 indicates that it was relatively normal firms which were subsidised. Therefore it seems, instead, as if effects of subsidisation which give rise to allocative inefficiencies (a suboptimal mix of labour and capital) and/or technical (X-) inefficiencies (the management has captured the subsidies in the form of slack or lack of effort and/or they have become more interested in subsidy-seeking activities than productive activities) were more important than the positive effects (e.g. investment in new technologies which help firms to advance their technological development). That is to say, the results suggest that subsidisation can influence growth, but there seems to be little evidence that the subsidies have affected productivity and hence competitiveness. Or, in the spirit of Dahmén, one could argue that subsidisation seems to have hindered rather than helped the firms to utilise their full development potential.[21] Growth through subsidisation seems to have been achieved simply by

[21] See footnote 7.

using more inputs but not by improving on their usage.[22] Moreover, by transferring resources to firms which become less productive, the subsidies have also disfavoured non-subsidised firms because they have been forced to partly finance the subsidies. A strategy which, if it was used on a much larger scale, would have had negative effects on regional as well as national growth.

From a regional policy perspective the estimated coefficient for the AREA variable is also interesting. In the official motivations for the support it is argued that it is more troublesome to run a business in the sparsely populated support areas. However, because the coefficient is insignificant it seems as if no differences can be observed between firms located in the support areas and firms located outside the support areas. This holds for both the OLS estimations and the bounded influence estimations. Although positive agglomeration effects might make firms located in more populated areas more productive, congestion effects can have a negative effect on productivity. It should be noted, however, that we only test if firms located in the support areas are more or less productive than firms located outside the support areas. Agglomeration effects might be more important if one explicitly compares firms located in less populated areas with firms located in larger cities, where the population density is much higher.

6. CONCLUDING REMARKS

Because investment subsidies are seen by many politicians in Sweden as well as in the EU as an efficient instrument to increase growth in firms located in backward regions, and because it is unclear how government subsidies influence the growth of firms' productivity, the purpose of this study has been to examine differences in productivity performance between Swedish non-subsidised firms and firms which have been granted capital subsidies. By comparing the firms and by controlling for different factors that might affect total factor productivity growth we have tried to isolate the effects of subsidisation.

[22] Because it is impossible to examine what would have happened if no supports had been granted we cannot with certainty say that it was subsidisation that led to a lower productivity growth for the subsidised firms. It might be the case that these firms for some other reasons, which we have not been able to control for, have developed less well. To examine if other factors than the ones we have controlled for affect

The study shows that subsidisation is positively correlated with growth of value added and that productivity of the subsidised firms seems to increase the first year after the subsidies were granted. But, after the first year it seems that the more subsidies a firm has been granted, the worse TFP growth develops. An implication of this study, as well as of the results from e.g. Beason & Weinstein's (1996) and Lee's (1996) studies of industrial policy in Japan and Korea, is that even if there might be market failure justifications for subsidies, it is not certain that resources will be efficiently allocated. The influence of important pressure groups can lead to subsidisation of less productive firms, which implies that industrial policy prevents or delays the structural transformation of the industry. Moreover, subsidisation can also make firms less efficient.

In official evaluations of the effects of producer subsidies, the number of (gross) jobs a support program creates is often used as a measure of its effectiveness.[23] This measure is, however, insufficient for several reasons. For example, by neglecting indirect negative effects (such as the number of jobs lost due to the financing of the supports), the evaluations tend to overestimate the employment effects of the subsidies. But perhaps more importantly, most evaluations do not take into account any growth effects. Therefore, an important task for future research and for future public evaluations of support programs is to examine, to a larger extent, the effects of subsidisation on productivity.

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productivity growth Ramsey RESET tests of omitted variables have been calculated. The tests are significant. One should therefore be aware of the possibility of bias in our estimated coefficients.

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[23] For example, the 8th Annual report on the Structural funds of the EU claims that the result of Objective 2 assistance (the conversion of regions in industrial decline) is that more than 870 000 gross jobs will be either created, saved or redistributed as a result of assistance over the period 1997-99 period.

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