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Does subsidizing transport help localized disadvantaged firms? – The case of the Swedish freight transport subsidy scheme

Tillväxtanalys
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Förord

Tillväxtanalys uppdrag är att utvärdera och analysera effekterna av statens insatser för en hållbar nationell och regional tillväxt. Vi ska också ge underlag och rekommendationer för utveckling, omprövning och effektivisering av politiken.

Syftet med den här rapporten är att utvärdera effekter av gods transportstödet som funnits sedan 1971.

Chizheng Miao har varit projektledare. I projektet har också Kent Eliasson, Tillväxtanalys, och Jonas Månsson Blekinge tekniska högskola (BTH), Institutionen för industriell ekonomi medverkat. Projektets referensgrupp har bestått av Christer Gerdes, Tillväxtanalys; Eva Hagsten, Imber Råbock, Malin Carlberg, Tillväxtverket; Sigrid Hedin, Näringsdepartementet, Örjan Hag, Maxi Nachtigall, Landsbygds- och infrastrukturdepartementet. Vi har även fått synpunkter från Transportbidragsgruppen, Tillväxtverket; seminariet på BTH.

Ett varmt tack till er som har bidragit med värdefulla inspel: Prof. Johan Klaesson, Jönköping International Business School har varit diskutant på en tidig version av detta working paper.

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Contents

Abstract

The regional freight transport subsidy (RFTS), as one important component of place-based policy, is used in Sweden and in many other countries. The aim of the Swedish RFTS, according to the government, is to compensate for the long transport distance between the firms and markets and to stimulate the degree of refinement of the industry in the supported region. Although the Swedish subsidy has existed since 1971, there have been few attempts to examine its impact, both in the Swedish case as well as in other countries. To fill this knowledge gap, this study aims at measuring its impact on the performance of firms that have received the support. The outcomes used are turnover, value added and profits per employee. The design of this evaluation poses three separate questions, chosen based on the possibility of having a strong identification. The questions are:

Does an increase in the rate of subsidy have a positive impact on industry performance? To answer the question, the reform which took place in 2007 is used for the identification strategy. In the year of the reform, some municipalities got an increase in the rate of the subsidy while other municipalities got decreased or unchanged rates. A difference-in-difference approach is used and the results indicate that there were no causal effects on the performance of the industry of wood and wood products among municipalities where the subsidy rate increased.

Does the loss of the support have a negative impact on firm performance? For this question, the fact that in the reform in 2000 some municipalities were no longer covered by the subsidy is used to identify the effects. A difference-in-difference approach is used for the analysis and the results suggest that there were no causal effects on firm performance related to the loss of eligibility for the support.

Does increased intensity in the support increase firm performance? For this question, the variation in the intensity of the support is used to identify the effects. A dose-response framework is used for the analysis: the results are that there is a positive and significant impact, of support levels above 80% of the maximum support, on value added. However, the effect is small and is unlikely to be economically significant. No statistically significant effects were found for the other outcomes.

The conclusion of this study is that there is no evidence that the change in the level of transport cost covered, loss of the support, or having more support of the Swedish RFTS had any significant impact on firm performance. As in almost all causal evaluations of effects, there is a trade-off between internal validity and external validity. Thus, RFTS might be important for a limited number of firms, for instance, firms located in areas which were not covered in the analysis. The recommendation is thus that the RFTS should be used with care and needs to be more precise in which firms to target.

1. Introduction

Industrial policy has recently regained attention. A recent survey of the OECD points out that industrial policy still plays an important role for a country to achieve a green, digital, and inclusive economy (Criscuolo, et al., 2023). Among industrial policies, place-based policies are a group of policy instruments that usually refer to state efforts to support the economic performance of certain areas that typically, by some criteria, are defined as disadvantaged regions. The aim of such a policy is often linked to increasing competitiveness, creating job opportunities, and maintaining sustainable growth.

In Sweden, and in many other countries, one important place-based policy is a regional freight transport subsidy (RFTS).[1] The Swedish RFTS is a cash transfer to firms that are located in defined areas.[2] The aim of the subsidy, according to the government, is to compensate for the cost disadvantage due to the long transportation distance between the firms and markets and to stimulate the degree of refinement of the industry in the supported region. According to the Swedish National Road and Transport Research Institute, firms in the supported region on average have a disadvantage in term of transport costs in comparison with firms outside of the supported region, especially when it comes to road transport (VTI, 2023). Although the subsidy is a non-discretionary support, certain basic eligibility criteria, such as production activities, must be fulfilled in order to receive the subsidy, which is discussed in detail in the next section.

Even though the Swedish RFTS has been implemented since 1971, there have been few attempts to investigate the impact of an RFTS in general. A literature review about the effectiveness of place-based policies has shown that knowledge about the effect of regional freight transport subsidies is rather limited or even non-existent, neither internationally nor nationally.[3] The only studies which, to some extent, have had the ambition to study the policy, are two policy reports from the authorities under the Swedish Ministry of Climate and Enterprise (see Tillväxtanalys, 2012; Tillväxtverket, 2020).

To fill this knowledge gap, the aim of this study is to examine the effect of Swedish RFTS in terms of three outcomes: turnover, value added and profits. To study the policy, the subsidy data from the operating agency, the Swedish Agency for Economic and Regional Growth (Tillväxtverket), and firm register data from Statistics Sweden between 1997 and 2019 is used. Three different identification strategies are applied, which address three research questions.

Does an increase in the rate of subsidy have a positive impact on the performance of the industry? To answer this question, the reform in 2007 is used for the identification strategy. In that reform, some municipalities got an increase in the rate of the subsidy while other

[1] Similar schemes exist in several high-income countries, such as Norway and Finland, but also low-income countries such as India where regional transport subsidy is used to compensate for the transport cost of raw material and finished goods in remote areas (see https://www.india.gov.in/transport-subsidy-scheme).

[2] A variant of the cash subsidy is to subsidize fuel, such as in the U.K.

[3] See Section 2 for a literature review. Furthermore, there is an extensive literature that studies the effects of transportation infrastructure on economic growth (Redding and Turner; 2015) and there is an emerging literature that studies how firms respond to a substantial change in transport cost (see, e.g., Branco et al. (2023) for a study of the case of Portugal).

municipalities got decreased or unchanged rates. A difference-in-difference approach is used and the results indicate that there are no causal effects on the performance of the industry of the production of wood and wood products (from now on referred to as the "wood industry") among the municipalities where the subsidy rate increased.

Does a loss of the support have a negative impact on firm performance? For this question, the fact that in the reform in 2000 some municipalities lost their coverage by the subsidy is used to identify the effects. A difference-in-difference approach is used for this analysis and the results suggest that there are no causal effects on firm performance related to the loss of eligibility for the support.

Does an increased intensity in the support have a positive impact on firm performance? For this question, the variation in the intensity of the support is used to identify the effects. A dose-response framework is used for this analysis and the results are that there is a positive and significant impact, of support levels above 80% of the maximum support, on value added. However, the effect is small and is unlikely to be economically significant. No significant effects were found for the other outcomes.

The conclusion of this study is that there is no evidence that indicates that a change in the level of transport cost covered, a loss of this support, or having more support from the Swedish RFTS has any significant impact on firm performance. As in almost all evaluations of causal effects, there is a trade-off between internal validity and external validity. Thus, the RFTS might be important for a limited number of firms, for instance, firms located in areas which are not covered by our analysis. The recommendation is thus that the RFTS should be used with care and needs to be more precise in which firms to target. This means that only firms with a true disadvantage should be eligible for the freight transport subsidy.

The rest of this paper is organized as follows: In Section 2, there is a discussion of the challenges in evaluating place-based policies in general. Section 3 provides an overview of the support and some descriptive statistics. Section 4 presents the data for the empirical analyses. Section 5 presents the results of the evaluation, based on three separate evaluation questions. In Section 6, the conclusions and some concluding remarks are presented.

2. Methodological challenges in evaluating place-based polices

The aim of place-based polices is often linked to increasing competitiveness, creating job opportunities, and maintaining sustainable growth in certain geographical areas. To achieve those aims, different forms of special treatment have been given in lagging regions, such as public investment, venture capital, tax subsidies or special regulations. However, causal evidence about the effectiveness of place-based policies is rare and previous studies have, according to Neumark and Simpson (2015), only examined limited topics regarding place-based policies. For example: Regional payroll tax subsidy (Bennmarker, et al., 2009; Korkeamäki and Uusitalo, 2009; Månsson & Quoreshi, 2015); subsidy to capital investment (Bernini and Pellegrini, 2011; Cerqua and Pellegrini, 2014; Criscuolo et al., 2019); subsidy to a firm's choice of location (Crozet, et al., 2004; Greenstone, et al. 2010); and structural funds (Becker et al., 2010; Becker et al., 2018, Månsson et al., 2024).

The econometric challenge to evaluating an industrial policy is to isolate the effect of the business support program from other cofounding factors and to control for the high selection bias. According to Neumark and Simpson (2015), there are several challenges in evaluating effects which are more specific to place-based policies: one such problem is to isolate the effect of a specific policy when areas are subject to multiple interventions; a second problem is to handle spillover effects between areas; a third problem is in the comparison between subsidy recipients and nonrecipients, since both the decision to apply for the subsidy and the decision to award it can be endogenous. Furthermore, in many cases, a place-based policy is offered, as a non-discretionary support, to all firms in the supported region satisfying some basic eligibility criteria, which makes it difficult to find a good comparison group.

To address those issues, researchers use different identification strategies. Many studies use matching methods (or a combination of matching and regression methods, such as conditional difference in difference) to evaluate regionally targeted policies (O'Keefe, 2004; Korkeamäki and Uusitalo, 2009; Accetturo and de Blasio, 2012; Givord, et al., 2013; Månsson and Quoreshi, 2015). Such studies usually compare the support recipients (treatment group) with the untreated firms in neighboring regions (control group). A variation of this approach is to use unsuccessful applicants as the control group. One advantage in using such information is that the selection problem due to self-selection is, to some extent, mitigated (Bernini and Pellegrini, 2011; Muraközy and Telegdy, 2023).

The matching method relies on statistical methods to construct a control group and assumes that the treatment and control group do not differ in terms of unobservable characteristics that are relevant for treatment status and outcome. However, this is a strong assumption and it is untestable. To avoid this assumption, recent studies rely on exogenous variations (natural experiments) to investigate the effect of place-based policies. The advantage of using policy changes to identify treated and control groups is that such variation is exogenous and independent of firm characteristics (both observable and unobservable) and therefore is less likely to be subject to the selection problem or omitted variable bias (OECD, 2022). Several examples of using natural experiment to

evaluate place-based policies follow: Criscuolo et al. (2019) study the effect of the investment subsidy program "Regional selective assistance" in the UK, using the exogenous changes in the eligible areas due to the changes in EU policy. The average grant amount is about 56,000 GBP in the late 1990s and around 36,000 GBP in the 2000s. Becker et al. (2010) and Becker et al. (2018) exploit the discrete jump in the probability of EU transfer receipt at the 75% threshold to identify the effect of EU structural funds on regional performance. Cerqua and Pellegrini (2014) evaluate the same policy as Bernini and Pellegrini (2011) but use a natural experiment to assess the effect of the program for firms near the cut-off point of the ranking system. However, a natural experiment has also its limitations. Firstly, a natural experiment is not always available to researchers/authorities who want to assess its effects. Secondly, despite the strong internal validity of the estimates, the effect identified from a natural experiment is sometimes considered as a "local effect", such as a regression discontinuity, and the external validity is questionable. A third drawback is that many times the evaluation question must be tweaked to fit the setting of the natural experimental.

Furthermore, there is also an emerging literature that highlights the heterogenous responses to business support programs. Using a dose-response method, Bia and Mattei (2012) showed, e.g. that too small a grant is ineffective at generating a positive effect on firm performance (for a specific financial support program in Italy). Srhoj et al. (2019) assess the impact of a business development grant in Croatia. Using a dose-response function, the study shows that the positive effect of a grant on firm performance is restricted to firms whose grant is over 9 percent of their profits.

There is little knowledge about the impact of the regional freight transport subsidy on firms. This is the case in the Swedish context as well as in other countries. There are two authority reports that were identified. The operating agency, The Swedish Agency for Economic and Regional Growth, has previously tried to examine the effect of the subsidy on value added and turnover in the period 2012-2015 (Tillväxtverket, 2020). The study simply compares the firms who receive the subsidy with those firms who do not receive the subsidy in the same county, industry and firm size. The results show that the development of value added and turnover is positively correlated with the participation in the subsidy. However, the identification strategy used in the report is highly questionable, which leads the authors to talk about correlations rather than causality. The Swedish Agency Growth Analysis (Tillväxtanalys) has also evaluated the impact of this subsidy, focusing on the period between 1997-2009 and the sawmill industry (Tillväxtanalys, 2012). Comparing the geographically nearby firms located on the border of the supported area, the report shows there is a positive correlation between taking up the subsidy and value added and emphasizes that the causal relation is unclear. Furthermore, the report points out that there are two challenges in estimating the effect: first, the policy has been implemented for a long time, which makes it difficult to estimate the effect due to the lack of a pretreatment period; secondly, there are also other regional support programs in the areas where the transport subsidy is given, which makes it difficult to isolate the effect of the transport subsidy from other regional business support programs. As we have seen, the empirical results about the RFTS, so far, only point to a correlation between the subsidy and firm performance. However, whether such correlation is driven by selection or other relevant unobserved firm characteristics is the question.

3. Institutional framework and overall descriptive statistics

The regional transport subsidy was introduced in 1971. The aim of the program is to compensate for cost disadvantages in remote regions due to high transportation costs and to stimulate the value added at workplaces located in the supported areas. At present, the eligible areas consist of all municipalities in the four most northern counties of Sweden (Västernorrland, Jämtland, Västerbotten and Norrbotten). If firms are located or have workplaces in these areas, they can apply for the subsidy. Firms are entitled to get the subsidy, provided that certain criteria are fulfilled. The main motivation for this subsidy is that government investigation has shown that there is a transport cost disadvantage for firms who operate in northern Sweden. This cost disadvantage even exists nowadays, as shown in several government investigations (see SIKA, 2006; VTI, 2023).

The transport subsidy is a non-discretionary subsidy. All firms who have workplaces in the eligible area can receive the subsidy if certain basic requirements are met. This distinguishes the transport subsidy from other regional business support programs in Sweden, which tend to be more selective and are awarded in competition. The basic requirements include: i) the goods must undergo significant processing in the support area, ii) the transport distance must be at least 401 kilometers, and iii) the transport needs to take place either by rail, by road or by sea. Transport costs for inputs going to the eligible area are also subsidized if the above conditions are met (the subsidy rate for transport into the area is 5 percentage points lower than the corresponding rate for transport out of the area). For international transport, the program covers the domestic part of the transport only. There are also some goods that are not eligible for transport subsidies (e.g., ore, roundwood, pulp, and paper).

The subsidy rate today varies from 5 to 45 percent of the transportation cost, depending on which municipality the workplace is located in. Since the subsidy was first introduced in 1971, the geography of the eligible areas and the different subsidy rates have changed somewhat over time in connection with reforms of the program. After Sweden entered the European Union (EU) in 1995, the design of the support had to be further changed so as to comply with EU regulations and also approved by the European Commission. Between 1997-2019, for which period we have access to the data, two major reforms have been identified. One was implemented in 2000 and the other in 2007. They were connected to the applications for the permission at EU level for the program periods 2000-2006 and 2007-2013. The main motivation behind the reform in 2000 was partly due to a concern of high financial cost for the state as well as the fact that the government believed a too low subsidy rate is less meaningful to firms.[4] As one result of the reform, several municipalities were excluded from the supported area. In the reform of 2007, a major change was that the determination of the subsidy rate was switched from the zone level to the municipal level. One important motivation was that a government investigation in 2006 showed that there was a large difference in transport cost even among municipalities within the supported areas.[5] After the reform, the subsidy rate in

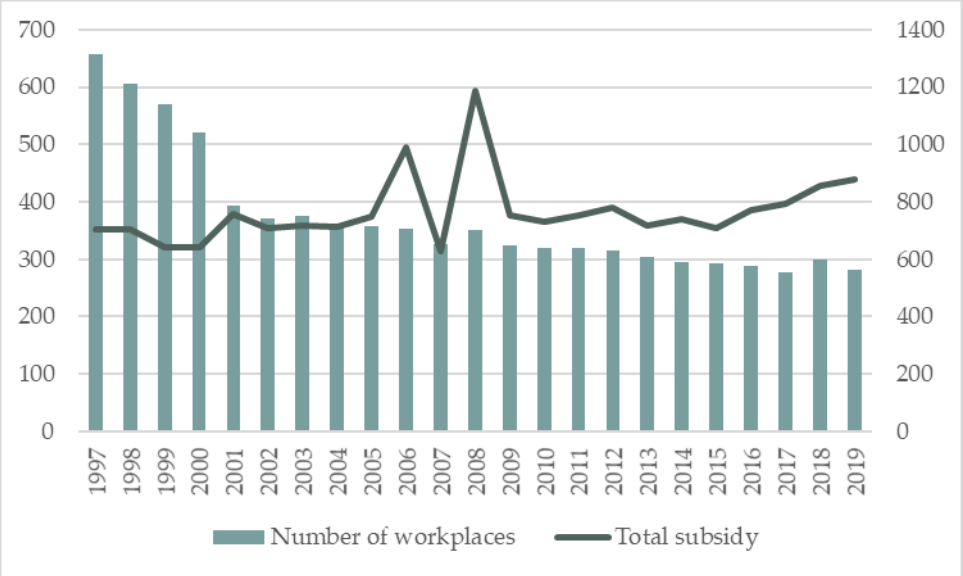
[4] See Proposition (1997/98:62).

[5] See SIKA (2006).

several municipalities has increased (or decreased). This new rule is still valid today. In the empirical analyses, we explore those two reforms to identify the (causal) effects of the subsidy (see Section 5).

Figure 1 presents descriptive statistics in terms of the total amount of transport subsidy and the number of workplaces receiving the subsidy. During the study period (1997-2019), the total amount of transport subsidy has varied around 400 million SEK per year. The number of workplaces receiving the subsidy each year varies between 600-1300 (a bit higher in the beginning of the period). However, the total number of recipients has decreased from about 800 workplaces in 2001 to about 600 workplaces in 2019.

Figure 1 Total amount of transport subsidy (million SEK, left axis) and number of workplaces receiving the subsidy (right axis).



Note: Transport subsidy in current prices.

Table 1 presents the top five industries in terms of the number of workplaces receiving transport subsidies and the total amount of the received subsidy. Workplaces in the wood industry dominates: 22 percent of the subsidy recipients are in this industry and 38 percent of the total subsidies goes to these workplaces. Over time, the wood industry has consistently dominated among workplaces receiving transport subsidies.

Table 1 The top five industries in terms of the number of workplaces receiving transport subsidies in 2019.

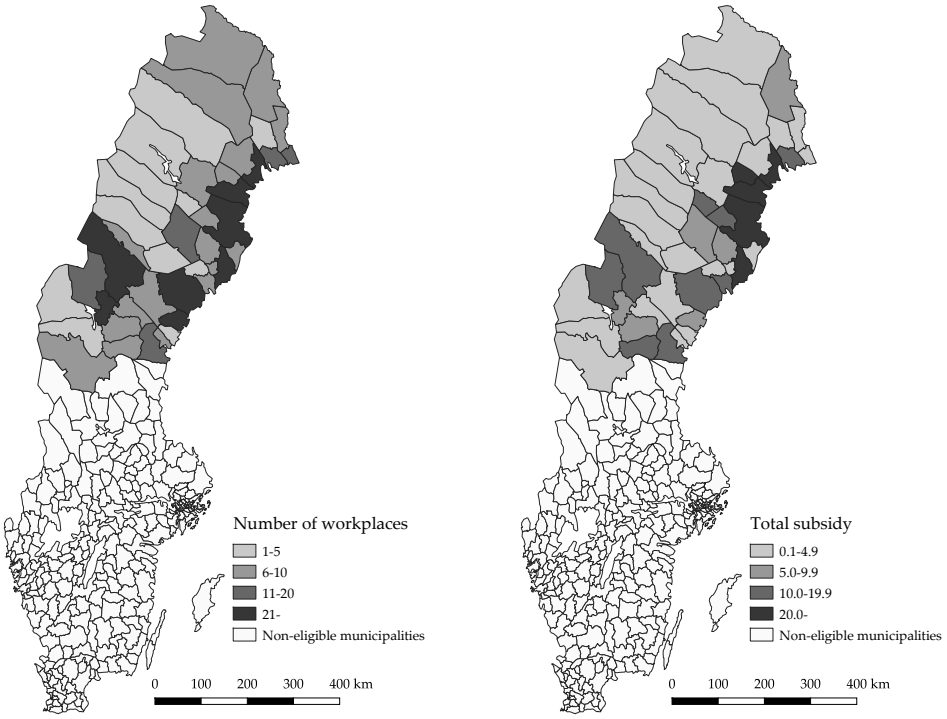
Industry	Number of workplaces	Total subsidy (million SEK)
Wood and wood products	125 (22%)	162.8 (38%)
Fabricated metal products	87 (15%)	26.9 (6%)
Machinery and equipment	48 (9%)	41.7 (10%)
Food products	45 (8%)	35.7 (8%)
Rubber and plastic products	34 (6%)	18.8 (4%)

Note: Share of total in parentheses.

In terms of geography, a large number of workplaces receiving transport subsidies are located along the coastal side of northern Sweden. Figure 2 presents the number of

subsidy recipients and total subsidies by municipality. The geographical distribution of the transport subsidy has been fairly stable over time.

Figure 2 Number of workplaces receiving transport subsidies (left) and total amount of subsidies (million SEK, right) by municipality in 2019.

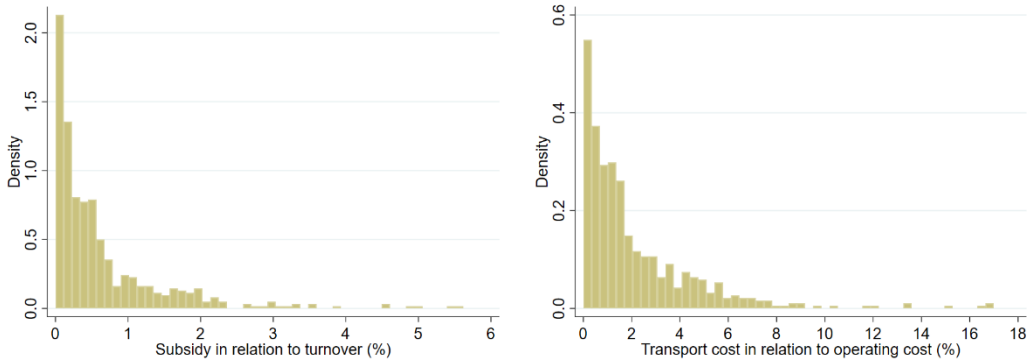


It is important to examine how large the transport subsidy is in relation to the scope of the recipients' economic activities. Figure 3 presents two types of distributions. The left panel shows the share of transport subsidy in relation to firm turnover. The right panel shows the share of transport cost in relation to firm total operating cost.[6] The median recipient receives SEK 119,581 in transport subsidy. This corresponds to less than 0.4 percent of firm turnover. For the vast majority of recipients, the subsidy is quite small in relation to turnover. Nevertheless, for the top decile in the distribution, the subsidy amounts to between 1.7 and 5.6 percent of firm turnover. Looking at the transport cost in relation to firm total operating cost, we see that for most firms the transport cost represents a fairly small part of the total operating cost. For the median recipient, the transport cost corresponds to 1.4 percent of the total operating cost. For the top decile in the distribution, the transport cost amounts to between 5.4 and 17.0 percent of the total operating cost. There are two major takeaways from these descriptive statistics. Given that the "dose" of transport subsidy is rather modest for most firms, the expected average effect of the subsidy is likely to be small. But there is also a potential for heterogeneous effects across the "dose" distribution, given that the transport subsidy is quite large in

[6] The balance sheet data does not contain information about the firm's transport costs. The transport cost is thus estimated by dividing the transport subsidy for each workplace with the subsidy rate in the municipality in which the workplace is located. This number is in turn aggregated to the firm level. The estimated transport cost thus only refers to the transport cost that is related to the transport subsidy.

relative terms for some firms. We will return to this issue in the empirical analysis (see Section 5).

Figure 3 The share of transport subsidy in relation to turnover (left panel) and the share of transport cost in relation to total operating cost (right panel) in 2019.



Note: the estimated transport cost only refers the transport cost that is related to the transport subsidy.

4. Data and empirical definitions

The initial subsidy data include 17,124 observations measured at the workplace level between 1997-2019, which have received non-zero cash transfer. After connecting workplace and geographical data, 15,914 observations (workplace-year) have been identified which receive non-zero cash transfer and where the workplaces are located in the eligible area.

In the population register data from Statistics Sweden (SCB), the firm characteristics and the balance sheet data are measured at the firm level. Therefore, the subsidy data is aggregated from the workplace level to the firm level. Although the majority of the sample include firms with only one workplace, there are a few firms who have several workplaces. In such a circumstance, firms which have several workplaces but are facing the same subsidy rate(s) is kept. By imposing this restriction, the sample is reduced from 15,914 to 14,517 observations (workplace-year), corresponding to 14,343 observations at the firm-year level and about 78 percent of the total payments of the subsidy in the period 1997-2019.

A simple comparison of the firm outcomes may be misleading because a larger firm is usually associated with a larger turnover, value added and profits. To take this into consideration, the outcome variables are standardized by dividing by the number of employees.[7] Therefore, the three main outcome variables are: turnover per employee, value added per employee and profit per employee. Those variables are measured in 1000 Swedish Kronor (SEK) and inflation adjusted using the Producer and Import Price Index (PPI) from Statistics Sweden.

[7] It is possible that a firm has zero employees. To address this issue the total number of employees is measured as the actual number of employees plus one.

5. Empirical evidence

This section presents the results of three separate analyses, which answer three different research questions. In the first two empirical exercises, the exogenous variations are used as identifiers (natural experiments). In the third analysis, a dose--response function is applied to study the effect on the treated firms, focusing on the intensity of the subsidy.

5.1 Does an increase in the rate of subsidy have a positive impact? – Evidence related to the reform in 2007

Our first empirical exercise explores the 2007 reform, in which the transport subsidy zones disappeared and the subsidy rate changed across municipalities. Between 2000-2007, the operating agency divided the eligible area into four subsidy zones: each zone contained several municipalities. The subsidy rate was determined at the zone level. In the 2007 reform, the division into zones disappeared and the subsidy rate was determined at the municipality level. As a result, some municipalities that belonged to the same subsidy zone in the old system faced different subsidy rates in the post-reform period.

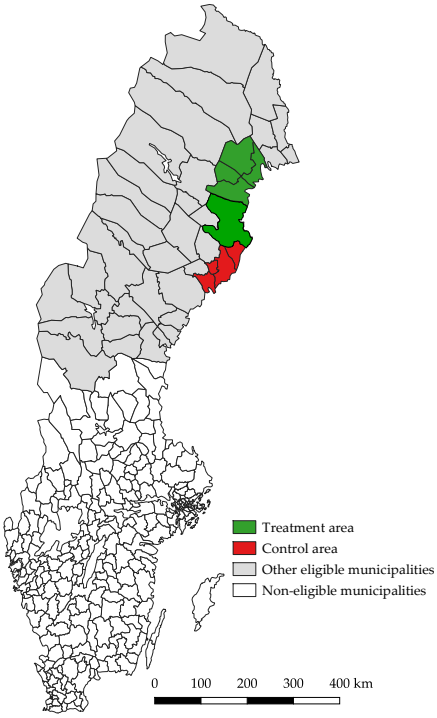
5.1.1 Sampling strategy

We restrict the sample to firms located in the regions of subsidy zone 4, where a significant number of subsidized firms are identified. The subsidy zone 4 includes the municipalities of Luleå, Boden, Älvsbyn, Piteå, Skellefteå, Robertsfors, Umeå, Vännäs and Nordmaling. Those municipalities are located in a narrow geographical area along the coastal in the north of Sweden. More importantly, by narrowing the analysis to zone 4, it is plausible to argue that firms in those municipalities are exposed to similar external conditions or regional shocks. They face similar labour market conditions, access to similar transport infrastructures (such as highways and railways) as well as natural resources, and compete in the same local product market.

Before the 2007 reform, firms in subsidy zone 4 faced a common subsidy rate of 30 percent (the rate for out-going transport). After the reform, the rate among the municipalities in northern part of the zone – Luleå, Boden, Älvsbyn, Piteå, and Skellefteå – increased from 30 to 35 percent.[8] The subsidy rate among the rest of the municipalities – Robertsfors, Umeå, Vännäs, and Nordmaling – decreased from 30 to 25 percent. This exogenous variation in the rate of the subsidy is used to form the treatment and control groups. The treatment area is defined as municipalities who receive a higher rate of subsidy after 2007 while the rest of municipalities in the zone 4 are defined as the control area. Since all firms in the zone 4 face the same subsidy rate prior reform, the selection issue about firm's location choice, which is discussed in Section 2, is addressed. Furthermore, it is plausible to argue that firms in the treatment area, on average, has similar probability to receive other regional business supports compared with their counterpart in the control area. The geographical location of the two groups is illustrated in Figure 4.

[8] The subsidy rate in the municipality Älvsbyn has increased from 30 to 40 percent.

Figure 4 Treated and control municipalities after the 2007 reform



The sample is further restricted to the wood industry and the period 2001-2019, which is the industry most affected by the subsidy both in terms of the number of subsidized firms and the amount of subsidy.[9] One reason to focus on the period between 2001-2019 is that there was another important reform in 2000.[10] The final sample includes 4676 observations (firm-year) between 2001-2019, which corresponds to 396 and 203 distinct firms which belong to the wood industry and are located in the treatment and control area, respectively. The share of firms in the wood industry who have received the subsidy is on average about 17.8 percent in the treatment area in the prior reform period and 17.1 percent in the post reform period. The corresponding figures in the control area are about 16.4 and 16.5 percent.[11]

5.1.2 Empirical strategy

The aim for this empirical exercise is to compare the performance of the wood industry in the treatment area with its counterpart in the control area. To examine the effect of the 2007 reform, the following diff-in-diff specification is used:

$$Y_{ikt} = \alpha Post \times Treat + \boldsymbol{\beta X}_{ikt} + \gamma_t + \delta_k + \theta_i + \varepsilon_{ikt} \quad (1)$$

[9] According to the Swedish Standard Industrial Classification (SNI) at the two-digit level, the wood industry is classified as number 16 in the 2007 version and 20 in the 2002 version.

[10] In the 2000 reform, among many other things, there was a change in eligible areas and the requirement for transport distance. In the next exercise, we will study this particular reform as a complement to the current analysis. However, our results are still valid even if we use the data for the whole sample period 1997-2019, which is shown in the robustness checks.

[11] In the Appendix subsidy zone 4, we present a more detailed analysis of the distribution of subsidy amount in Figure A1, how the subsidy is related to a firm's turnover and operating costs in Figure A2 and summary statistics about the sample for treatment and control areas in Table A 1.

Here, i, k, t indicates firm, municipality and year respectively. Y_{ikt} is our outcome variable, measured at the firm level. $Post$ is a dummy variable which is 1 if it is after reform period (2007-2019) and equals 0 if it is prior the reform (2001-2006).[12] $Treat$ is a dummy variable which equals 1 if the municipality belongs to the treatment area and 0 if not. The estimated coefficient α associated with the interaction term $Post \times Treat$ is the variable of interest: it is the diff-in-diff estimator. An important identification assumption under diff-in-diff is that the wood industry in the treatment and control area would follow a similar trend in the period prior to the reform. $\boldsymbol{X}$ is the vector of control variables and $\boldsymbol{\beta}$ is the vector of estimated coefficients associated with $\boldsymbol{X}$. The vector of control variables includes dummy variables to control for firm size (three groups: micro, small, medium and big firms) as well as whether a firm has export or import activities (goods). The transport subsidy may be more relevant for firms involved with international trade: previous studies have also shown that such firms are more productive than non-export/import firms (Melitz, 2003). Furthermore, year (γ_t), municipality (δ_k) and firm fixed effects (θ_i) are also included in the regression. Those fixed effects address the concerns regarding countrywide macroeconomic shocks, and unobserved time-invariant factors which are municipality and firm specific. The standard errors are clustered at the firm level.

In addition to the three outcome variables in Section 4, a fourth outcome variable is also used, which measures the take-up of the subsidy. It is a binary variable and equals 1 if a firm receives the subsidy in a given year (t) and equals 0 otherwise. This variable measures the share of firms in the wood industry receiving the subsidy. If the reform works, it is expected that the take-up rate among the wood industry in the treatment area would significantly increase in comparison to the control area in the post reform period.

5.1.3 Results

The statistical test for the parallel trend assumption is shown in Figure 5.[13] The reference year is 2006. The estimated coefficients are statistically insignificant in the pre-reform period (2001-2006) for the four different outcome variables. The results indicate that the wood industry in the treatment area is comparable to the wood industry in the control area in the pre-reform period in terms of take-up rate, turnover, value added and profit. In other words, the parallel trend assumption is likely to be fulfilled. Furthermore, the insignificant estimated coefficients in the post reform period, in panel A of Figure 5, suggest that a small difference in subsidy rate between treatment and control area does not create a significant divergence in the take-up rate.[14]

[12] The reform of 2007 was decided on in December 2007, however, the new rules were applied to transports made from January 2007 (SFS 2007:953).

[13] An important assumption for diff-in-diff estimation is that the treatment and control group should display a similar trend in the pre-reform period. In other words, the estimated coefficients should overall not be statistically significant in the pre-reform period.

[14] Since this is not a full compliance program, an alternative method is to use an instrumental variable approach to estimate the effect for the policy induced switchers. To do that, a strong first stage effect, e.g., take-up, is needed. The results indicate no such effect. As an additional check, the subsidy per employee for the wood industry in the treatment area has not increased significantly in comparison with the control area.

Figure 5 Parallel trend test for wood industry in zone 4, 2001-2019.

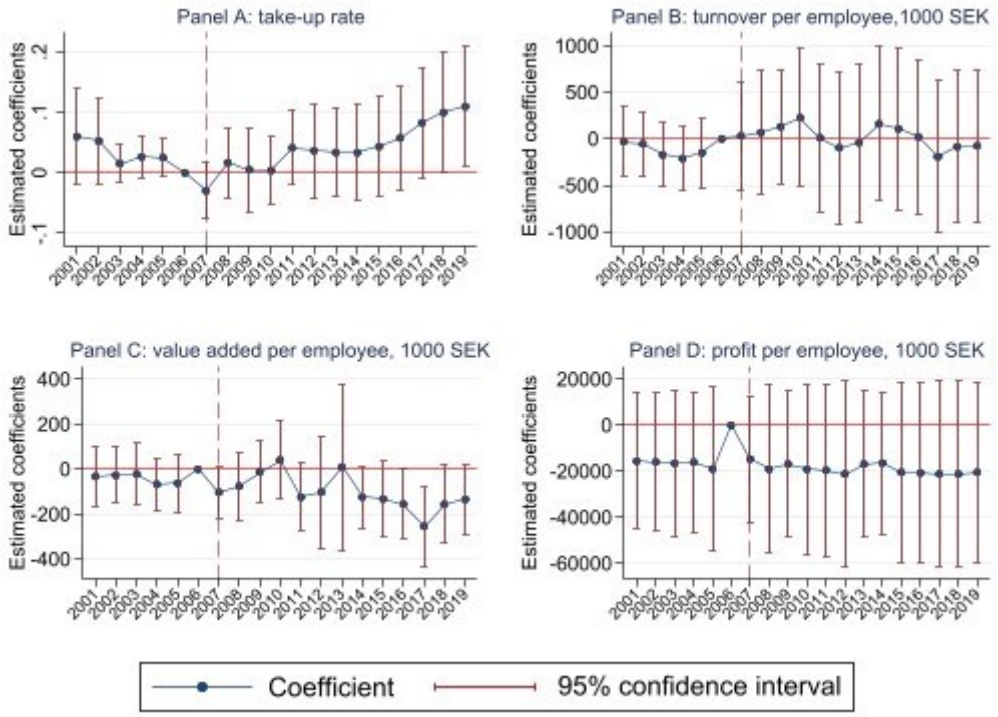


Table 2 shows the estimated reform effects. A stepwise introduction of the control variables is used to discuss the robustness of the results. If a policy shock is completely random, the estimated effect would be less sensitive to the inclusion of additional control variables. In model specification 1, year and municipality fixed effects are included. In specification 2, time varying firm characteristics are further controlled for. In specification 3, a firm fixed effect is also included, which is the preferred specification. The results show that none of the estimated coefficients are statistically significant under different model specifications.[15]

[15] In the baseline results, firms with extremely large turnover, profit or value added are kept. This group is interesting because those firms are likely to receive a significant amount of subsidy. In the robustness analysis, we exclude outliers. The results suggest that the effects are not significant.

Table 2 Baseline results for wood industry in zone 4, 2001-2019.

	Specification 1	Specification 2	Specification 3
Panel A: take-up rate			
Post x Treat	-0.008	-0.001	0.002
	(0.036)	(0.024)	(0.032)
Panel B: turnover per employee			
Post x Treat	-20.40	-2.21	137.29
	(215.68)	(206.40)	(288.06)
Panel C: value added per employee			
Post x Treat	-51.70	-48.90	-55.40
	(43.43)	(40.72)	(62.18)
Panel D: profit per employee			
Post x Treat	-3459.91	-3444.88	-5432.64
	(3252.32)	(3249.90)	(5368.10)
Year FE	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes
Firm controls		Yes	Yes
Firm FE			Yes
Observations	4676	4676	4676

Note: The standard error is shown in parentheses and is clustered at the firm level.

The results suggest that the reform has not stimulated more firms to apply for the subsidy in the treatment area and the wood industry in the treatment area is not performing better than its counterpart in the control area in the post-reform period. Table A 2 and Figure A 3 in Appendix A present the results of several robustness checks regarding the change of composition of the sample, one-workplace firms, outliers, a broader industry level (manufacturing sector), previously subsidized firms and the data period 1997-2019 (see Appendix A for a discussion in detail).[16] Furthermore, one concern is that the above analysis focuses on one specific supported area while the rest of the supported area is ignored. Another concern is that the importance of the subsidy may vary across subsidized firms (as Figure 3 shown). To address the heterogeneity concern, we use the treatment intensity to classify previously subsidized firms (in the pre-reform period 2001-2006) into the treatment and control firms. The treatment firm has relatively higher percent of subsidy to turnover than the control firm, implying that reform is more likely to have a stronger impact on the treatment firm than the control firms. The municipalities are also classified into two groups: which gets increased (decreased) subsidy rate *vs* which gets unchanged subsidy rate. To address the selection issue and unobserved time varying regional shocks, a diff-in-diff-in-diff (triple-difference) method is performed. The description of the analysis and results is presented in Table A3 in Appendix A. The robustness analysis indicates that the results in Table 2 are likely to be valid.

[16] Previously subsidized firm is defined as a firm that received the subsidy at least once in the period 2001-2006.

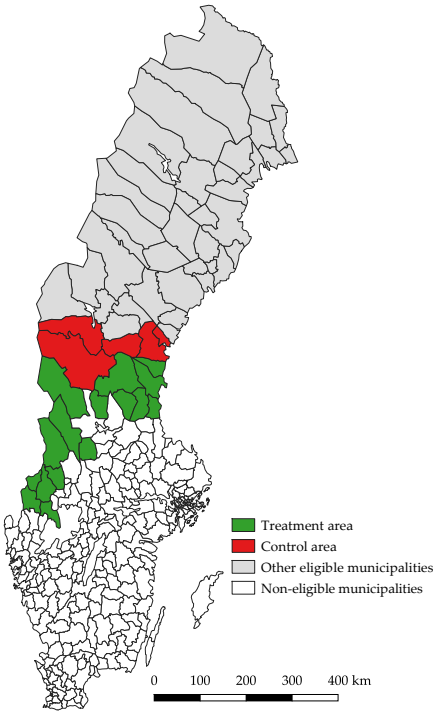
5.2 Does the loss of support have a negative impact on firm performance? – Evidence related to the reform of 2000

In the 2000 reform (SFS 2000:281), transport subsidy zone 1 disappeared. This reform created an exogenous variation related to the eligible areas, where some areas were eligible before the reform but were non-eligible after the reform. Before the 2000 reform, several municipalities in the counties of Värmland, Dalarna and Gävleborg were also eligible for the subsidy.[17] The subsidy rate was 5 percent. As a result of the reform, firms in those municipalities were no longer eligible for the subsidy. The aim of this exercise is to check whether a loss of eligibility is associated with a worse firm performance.

5.2.1 Sampling strategy

In the analysis, those municipalities no longer belonging to the supported area are defined as the treatment area. The control area includes the municipalities of Ånge, Timrå, Sundsvall, Berg and Härjedalen. These five municipalities are located in the south of Jämtland or Västernorrland, which are geographically closer to the treatment area. The subsidy rate for the control area varies between 5 to 25 percent before the reform and varies between 15 and 25 percent after the reform.[18] See Figure 6 for the geographical locations of the treatment and control areas.

Figure 6 Treated and control municipalities after the 2000 reform.



[17] The treatment area includes the municipalities of Arvika, Eda, Sunne, Säffle, Torsby, Årjäng, Malung, Orsa, Vansbro, Älvdalen, Bollnäs, Hudiksvall, Ljusdal, Nordanstig, Ovanåker and Söderhamn.

[18] Another important component of the 2000 reform is that the subsidy is only given to transportation that is longer than 401 km. Before the reform, transport distances between 251-400 were also eligible for the subsidy and the subsidy rate was 5 percent.

In the analysis, the sample is further restricted to the previously subsidized firms, which is defined as firms which received the subsidy, at least once, in the period 1997-1999. One reason to not focus on the population of firms is that the average take-up rate is very low and it is less likely to find any significant effect. A limitation with this sampling strategy is that the previously subsidized firms are not random and thus may not represent the population of firms in both the treatment and control areas.

Those firms are followed until 2006, which is the year prior to the 2007 reform when the subsidy system significantly changed again.[19] In total 1951 observations (firm-year) with 169 and 69 distinct firms in the treatment and control area are respectively identified. The average take-up rate is about 86 percent in the pre-reform period 1997-1999 for the previously subsidized firms in the treatment area. For the previously subsidized firms who operate in the control area, the average take-up rate is about 81 percent between 1997 and 1999 and 56 percent between 2000-2006.[20] Summary statistics are presented in Table B 1 and the distribution of the subsidy in Figure B 1 in Appendix B.

5.2.2 Results

In the analysis, a similar diff-in-diff specification as in Section 5.1 is performed. In addition, an industry fixed effect is also included, which is measured at the two-digit level.

In Figure 7, both the parallel trend and diff-in-diff estimates are illustrated.[21] Although the point estimates are negative in the post-reform period for all three outcomes, they are not statistically significant (see the note under the figure for the estimated coefficients and standard errors in parentheses).[22] The results indicate that the firms that had access to the support for the whole period (control group) are on average not performing better than the firms who lost access to the support after the reform (the treatment group). The insignificant results are found among all three outcomes: turnover, value added and profit per employee.

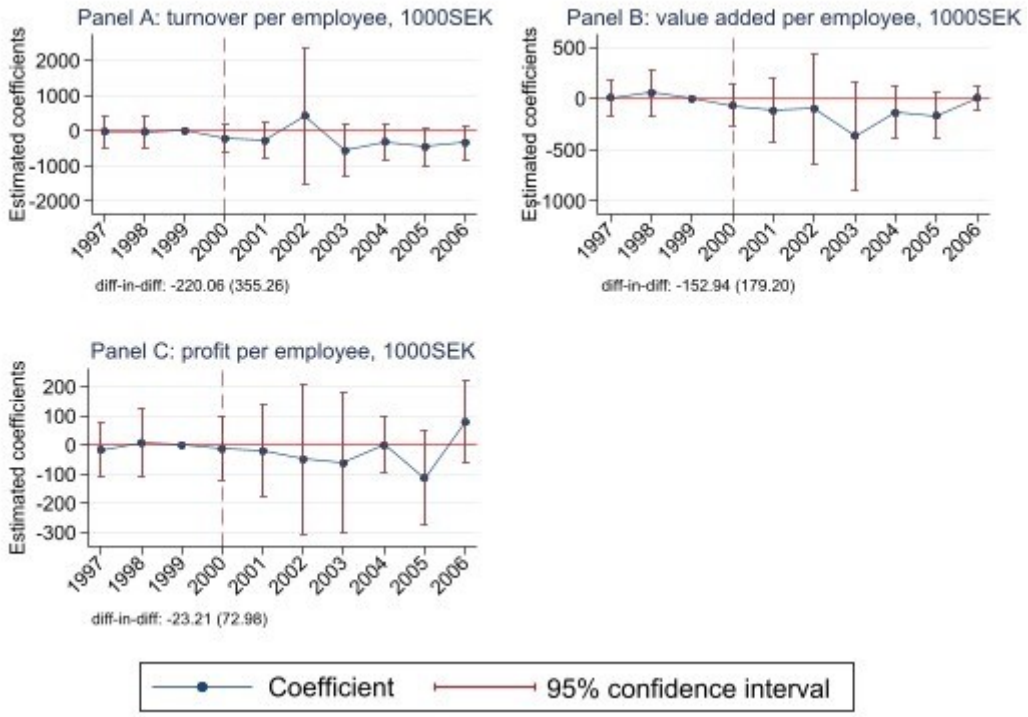
[19] Another concern is that the longer time series that is used, the stronger selection problem might exist due to the exit of firms in the sample. For example, firms are followed between 1997-2019, but in later years, only "best" firms exist in the data, e.g., 2019, while "poorly performing" firms drop out from the sample over time.

[20] One possible explanation for the lower take-up rate after the reform in 2000 is that transportation distances between 251 and 400 km are no longer eligible for the subsidy.

[21] Table B 2 in Appendix B shows diff-in-diff estimates and robustness checks regarding outliers and firms with only one workplace.

[22] In this analysis, the effect on the take-up rate is not studied since firms in the treatment area are no longer eligible for the subsidy after the reform.

Figure 7 Parallel trend test and estimated diff-in-diff results for zone 1, 1997-2006.



It is worth pointing out that firms might sort into different areas with different subsidy rates. This raises one potential concern for using this empirical strategy, especially among previously subsidized firms. Firms who view transport cost as an important business strategy, are more likely to choose an area that offers a higher subsidy rate. As a consequence, even if firms in two geographically close regions are compared, it might lead to an overestimation of the true difference in the outcome variables between the two groups.

5.3 Does increased intensity in the support improve firm performance? – A dose-response analysis

The focus on the analysis presented in Sections 5.1. and 5.2. is on the extensive margin of the subsidy. However, the recent literature has also pointed out that the intensive margin (dose-response, DR) is also important in determining the effectiveness of business support programs (Bia and Mattei, 2012; Srhoj et al., 2019). In the third analysis of this study, all firms are treated but treated with different amounts. Thus, the traditional selection problem is not relevant for this approach; instead, caution is needed to address the issue that there are endogenous factors related to the eligibility criteria and the amount of support that need to be handled (e.g., size, industry, municipality, etc.). This is approached by looking at support per employee and controlling for industry and region in the DR-model.

The method of dose response analysis (DR) is not new and has been used for a long time, e.g., in medicine, where a common question is how a treated person reacts to an increased dose of the evaluated medicine (see, e.g., Robertson et al. 1994). In the policy evaluation literature, the DR framework was first introduced by Hirano and Imbens

(2004) for measuring effects when the treatment is continuous. In recent years, the application of DR has obtained attention in the policy evaluation literature (see, e.g., Bia and Matei, 2012; Nilsen et al., 2020; Cerulli and Ventura, 2021; Spallone and Cerulli, 2022; Yitayew et al., 2023).[23]

5.3.1 Identification strategy

A few limitations of the empirical strategies in Sections 5.1 and 5.2 follow: the first limitation is that the design has not taken the variation in treatment intensity into consideration. It should be noted that the variation in the subsidy is large. Some firms receive significantly more support per employee than other firms. The second limitation relates to the external validity of using the reforms to identify the effect. Using the exogenous variation in the subsidy rate or eligible areas, the empirical results capture only the local effect: the areas that are covered by the analysis. To what extent the subsidy works in other supported areas and how relevant is the support today could be questionable. Thus, the external validity today might be questionable. To at least give some indications of possible effects close to the present and address the concern about heterogeneity, the fact that there are variations in the subsidy amount is used. The question for this part of the study is whether more support (dose) results in greater outcomes (response). This variation in the amount of monetary support will not answer the question of the general impact. However, it is possible to say whether more monetary support is more effective than less monetary support, which gives us insights about the distributional effect of the subsidy.

5.3.2 Descriptive statistics – a few comments

In this analysis, data covering the period 2011-2018 is used. 2019 is excluded to ensure that no 'Covid' effects are captured in the analysis and 2011 as a starting year is chosen because the other analyses presented in this study use variations from earlier periods. Further, during this period, better data exist on competing support programs, which is used as a control variable in this analysis. The 'dose' variable is the real support per employee divided by the maximum support per employee. The support variable is further divided by employee to directly control for firm size effects. Using the maximum support as reference, the dose variable ranges from <0-100%. Finally, since the range of support is big, the data has been trimmed using a threshold of SEK 50,000 per employee. This is to avoid a mass point around zero. As a result, 41 of the highest receivers have been excluded. In Figure 8, the distribution of support per employee is presented.

[23] The authors of this paper would like to express a large thank you to Giovanni Cerulli for practical help with programing issues. The DR analysis presented in this study make use of the stata package ctreatreg (Cerulli, 2015)

Figure 8 Subsidy per employee.

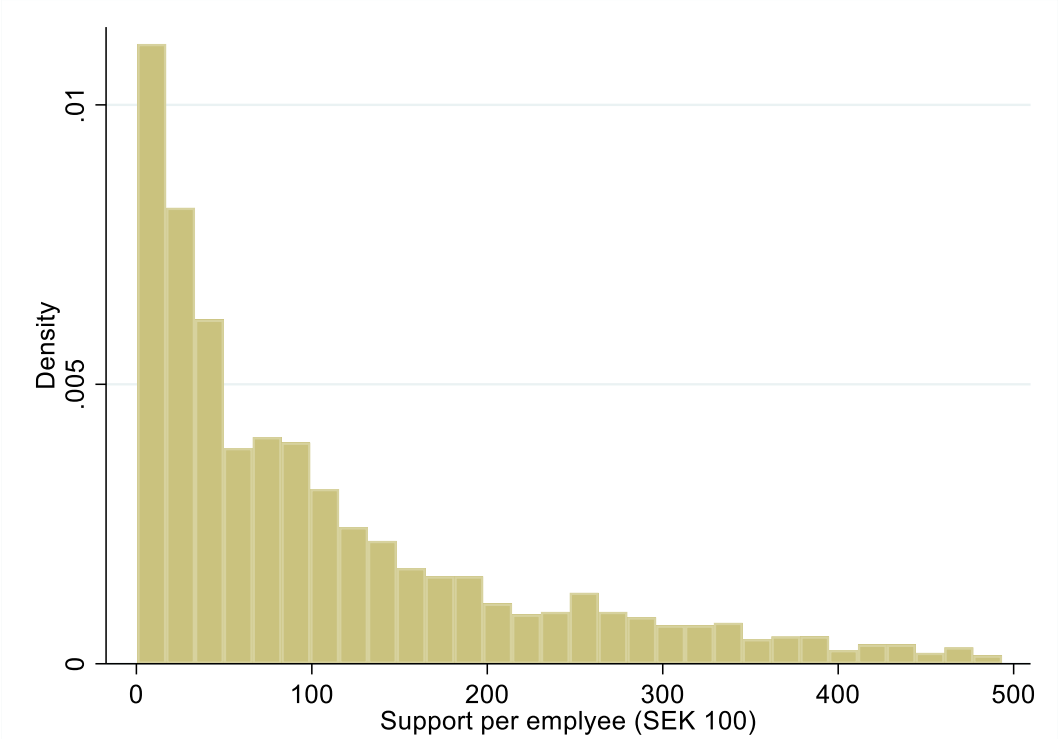


Figure 8 shows that the majority of firms receive less than SEK 10,000 in subsidy per employee. The median subsidy per employee is about SEK 7000 and the average for the whole studied period is SEK 10,800. Looking at the support at the firm level, the median support is SEK 123,626 and the average is SEK 509,655. The firm that gets the least support receives around SEK 30,000 and the firm that gets the largest support receives almost SEK 15 million. The descriptive statistics indicate that the expected impact of the subsidy is most likely to be modest, since the 'dose' is small. However, for some firms, the figure indicates that the transport subsidy can be very important since the 'dose' is substantial.

One of the cornerstones in a dose and response framework is to allow for heterogeneity among the treated. This is done in the first step, before deriving the dose and response function. In the analysis, the control variables are used to control for the heterogeneity between years, municipalities and industries. Further, to control for market dominance, the Hirschman-Herfindahl index (HHI) is also included as a control variable. The HHI measures market concentration: a high value indicates that the firm has a dominant position in the market in which it operates. With a few exceptions, most firms in the sample are small and have low market power: their HHI is close to 0. Finally, 'receiving other business supports' is included as a control variable. The logic is that firms that have applied and got other funding could be more likely to apply for and get FRTS.

5.3.3 Results

In the evaluation literature, two common effect estimators are used: the average treatment effect (ATE) and the average treatment effect on the treated (ATET). The difference between ATE and ATET is, in simplified terms, related to what population is used in the denominator when averaging. The ATE use the whole population while

ATET average over the treated population. In a situation where there is selection, i.e. some are treated, and some are not, randomly, the standard is to use ATET as the estimator. However, if there is no selection, e.g. RCT, then ATE and ATET will be the same. In the dose response framework, the variation in a continuous treatment is used as the identifier, since every firm included in the analysis is treated. Thus, the common practice in DR is to report the development of the ATE over all possible values of the treatment level (see, e.g., Spallone and Cerulli 2022). As in Sections 5.1 and 5.2, three outcomes are used: turnover, value added and profits per employee. The relative dose is measured as the support per employee/ maximum support, giving a range $0 < \text{dose} \leqslant 1$.

Figure 9 The average treatment effect on real turnover per employee (SEK 1000) as a function of increased real support per employee.

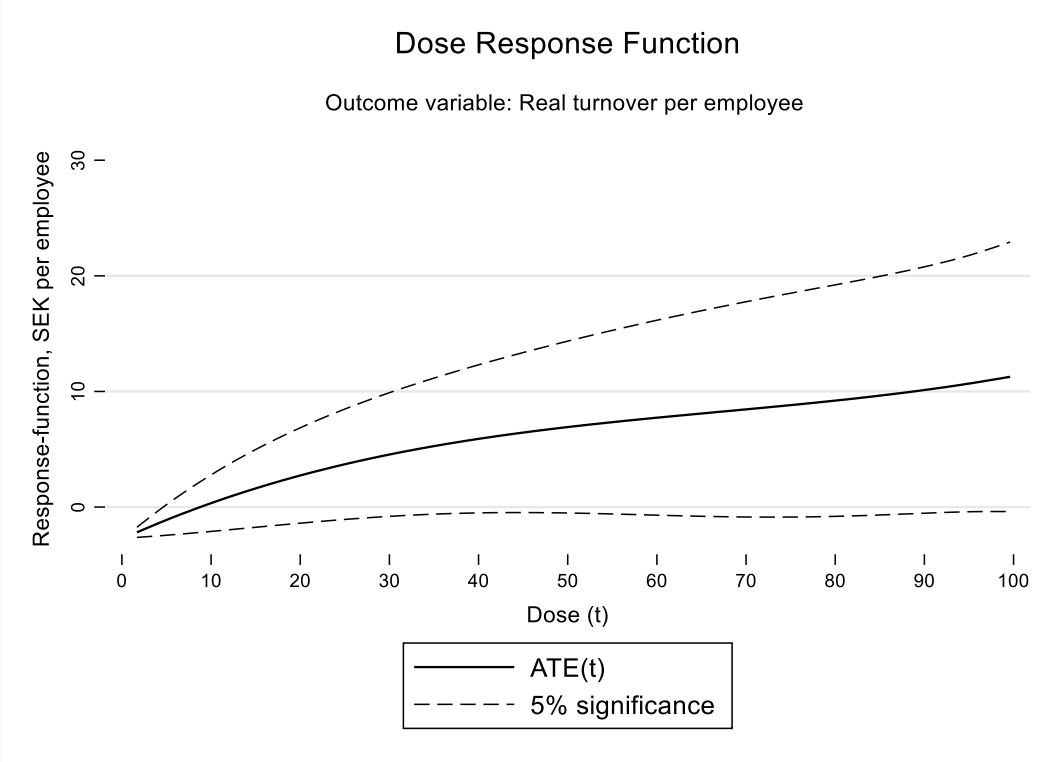


Figure 9 shows the result for turnover per employee (per 1000 SEK). The relative dose is shown on the horizontal axis and the impact (ATE) is presented on the vertical axis. The dotted lines represent a confidence interval with a significance level of 5%. As seen in the figure, the ATE is an increasing function of the dose received, but for all levels of treatment, the confidence interval includes zero, suggesting that the impact on all level of the dose is not significantly different from zero.

Figure 10 Development of the dose response function over amount of dose – turnover.

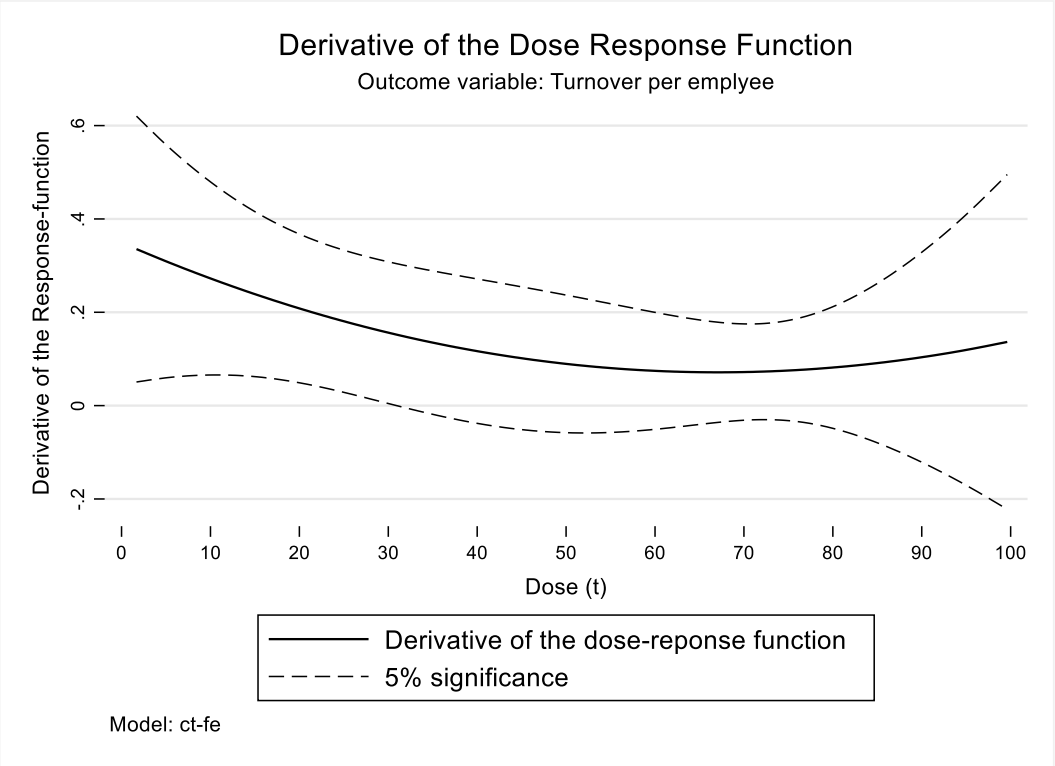


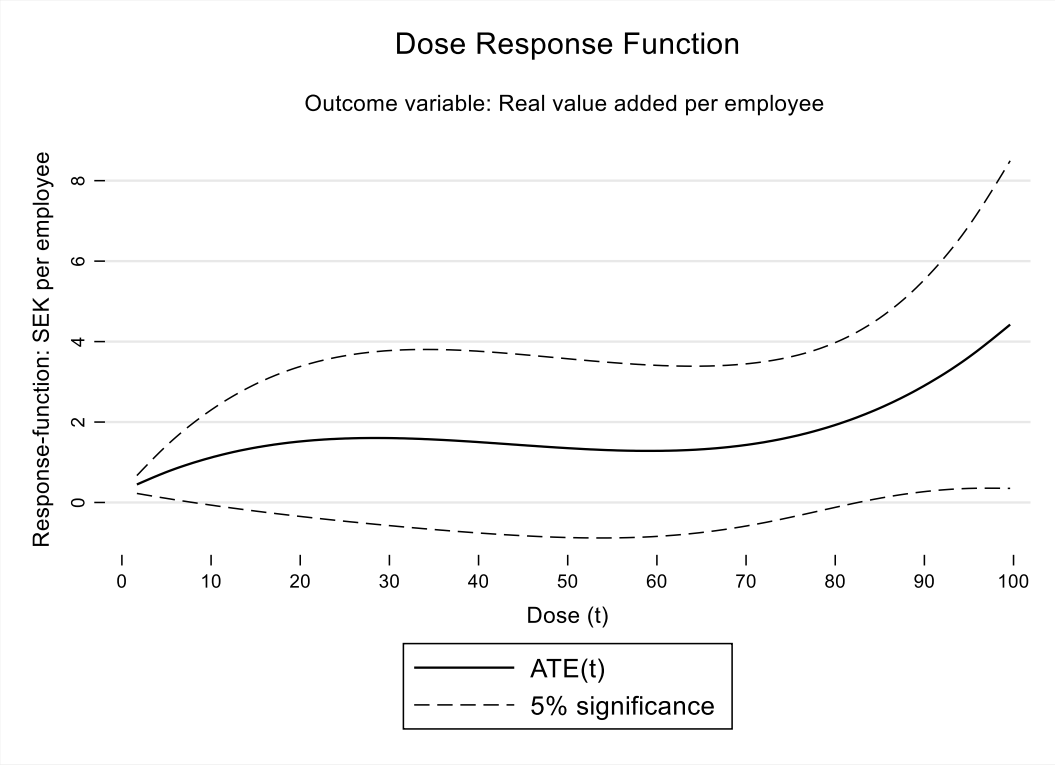
Figure 10 illustrates the development of the ATE over dose level, i.e. in mathematical terms the derivative of the dose-response function, but for practical reasons evaluated as discrete changes. As above, the support per employee in relation to maximum support is presented on the horizontal axis. The derivative of the dose response function is shown on the vertical axis. A positive value indicates an increased ATE as the dose increases and a negative value indicate a decreased ATE as the dose increases. The growth of an impact can be of great importance since it reveals whether an increasing subsidy increases the ATE. For example, if there is a significant impact and the ATE becomes bigger but at a slower rate, the derivative will be positive, but the slope of the derivative is negative indicating that there might be support levels where support should stop increasing

The results show that the dose-response function is significantly increasing for doses between 0%-30% of the maximum support per employee (derivative greater than zero). For all other levels of support, the result indicates no significant changes in the growth/decline in ATE. This is since the lower confidence bounds are below zero.

To summarize the findings regarding real turnover per employee: Increased support, which is defined as support per employee, does not have any significant effect on the turnover per employee. Neither can a significant growth in ATE for doses above 30% of maximum support be seen.

In Figure 11, the dose-response function for the outcome value added per employee (SEK 1000) is presented.

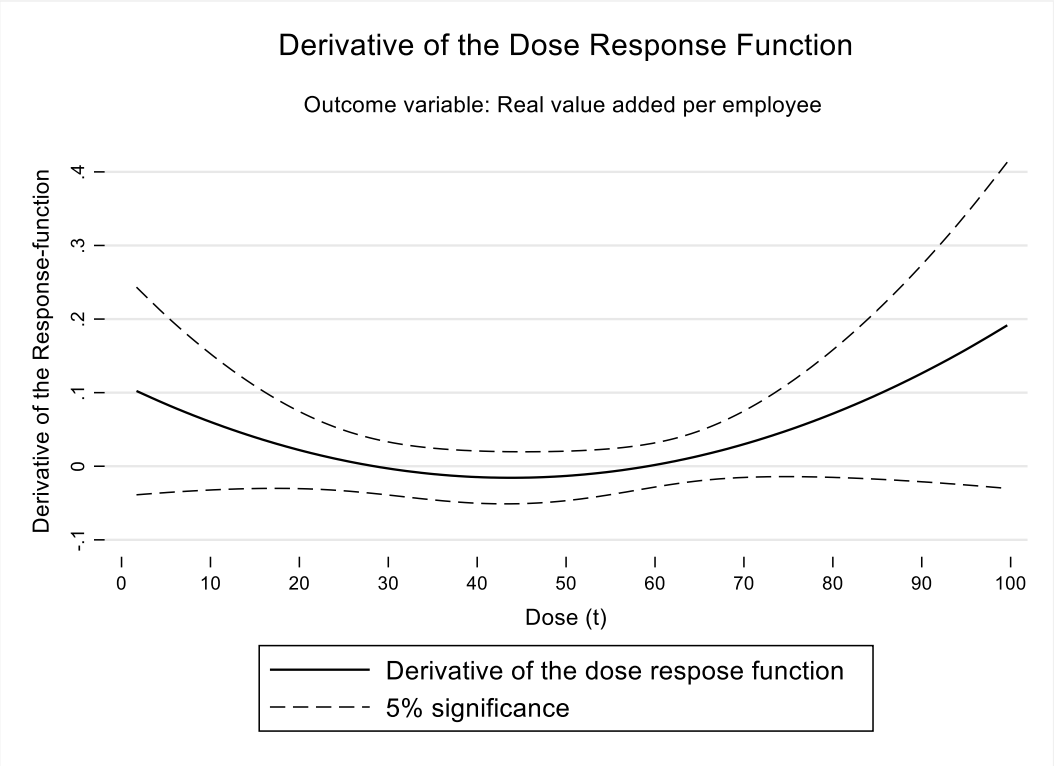
Figure 11 The average treatment effect on real value added per employee (SEK 1000) as a function of increased real support per employee.



The descriptive statistics shows that the support per employee on a yearly basis is modest among the majority of firms. However, some firms receive relatively large supports. The ATE for value added is insignificant for all levels of support up to around 80% of maximum support, as Figure 11 shows. After this level, the effect on value added becomes statistically significant, although the coefficient is small. For example, for firms receiving 90% of maximum support, the value added is increased by around SEK 3000 per employee.

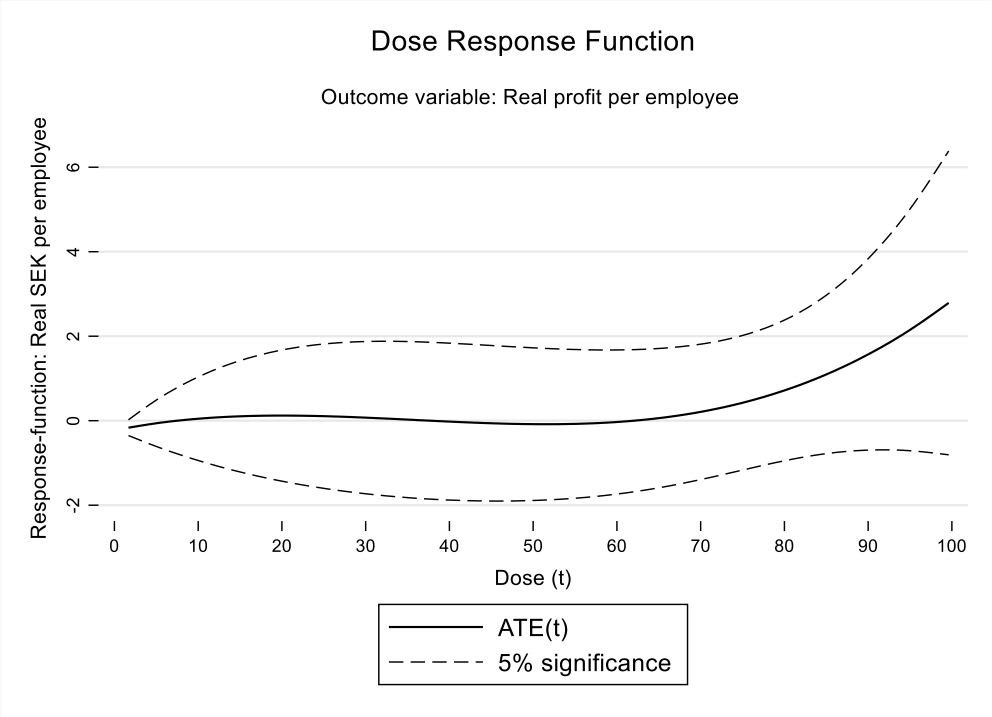
As for turnover, the derivative of the dose-response function for the outcome value added per employee is reported. This is shown in Figure 12.

Figure 12 Development of the dose response function over amount of dose - value added.



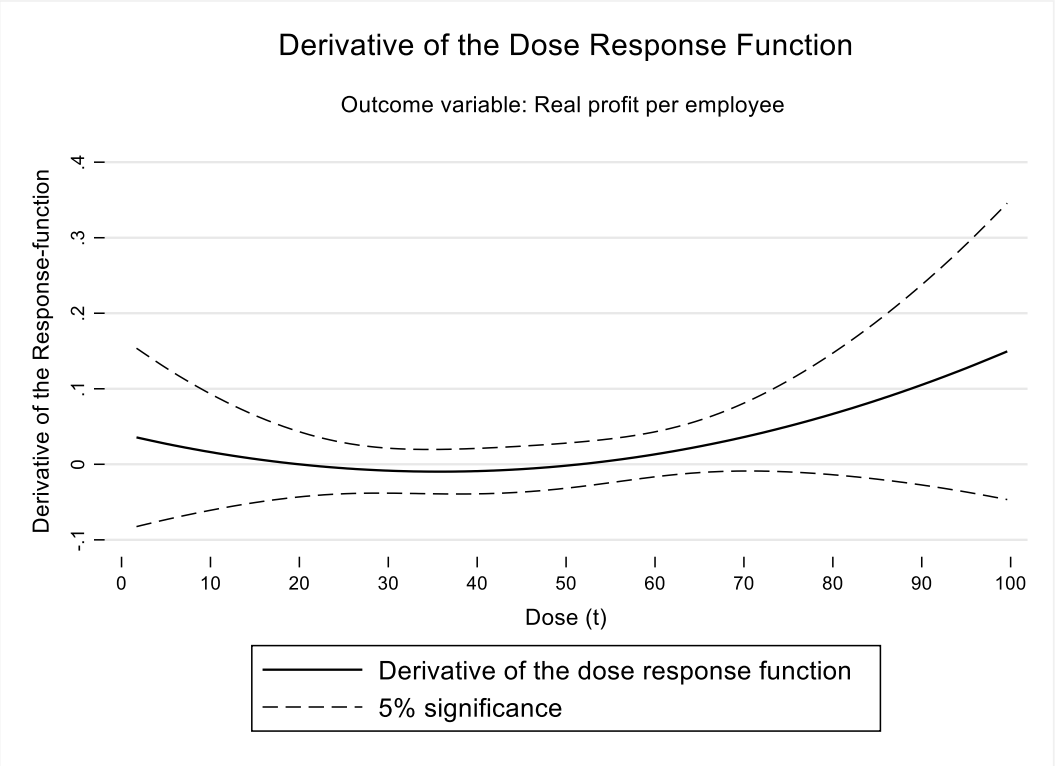
As seen in Figure 12, the value of the derivative of the dose-response function is always positive. However, this increase is diminishing up to around the median subsidy rate. Thereafter, the growth is positive, indicating an increasing ATE with an increasing rate. However, the plotted confidence interval covers zero for all levels of support, suggesting non-statistically significant effects.

Figure 13 The average treatment effect on real profits per employee (SEK 1000) as a function of increased real support per employee.



In Figure 13, the dose-response relation for the outcome profit per employee is illustrated. As seen from the figure, the ATE associated with profits per employee is very close to zero until the dose reaches 70% of the maximum dose. At that level and above, the ATE is increasing. However, the lower bound of the confidence interval is below zero for all levels of support, indicating a non-significant impact of increase support per employee on the profit per employee.

Figure 14 Development of the dose response function over amount of dose – profit.



As seen from Figure 14, the ATE is very close to zero until the amount of the dose reaches around 70% of the maximum dose. After that, the ATE is increasing, however, the width of the confidence interval has also increased. Thus, for all levels of support, there are no significant increases/decreases in the dose-response relation.

6. Conclusion

As mentioned in the introduction, a recent report from the Swedish National Road and Transport Research Institute shows that firms in the supported regions on average have a higher transport cost in comparison with firms in the rest of the country (VTI, 2023). This is the main motivation behind the existence of the RFTS. The aim of this paper is to investigate if there are any effects of this transport subsidy on three outcomes: turnover, value added and profits. The design of our evaluation has addressed three questions:

Does an increase in the rate of subsidy have a positive impact on industry performance? To answer this question, the reform in 2007 is used to identify the effects. A difference-in-difference approach was used: the results indicate that there are no causal effects on the performance of the wood industry in relation to an increase of the rate of this subsidy.

Does a loss of support have a negative impact on firm performance? To answer this question, the reform in 2000 is used to identify the effects. The consequence of the reform was that some firms located in some municipalities lost the possibility of applying for the subsidy. A difference-in-difference approach was used and the results suggest that there are no causal effects on firm performance related to the loss of eligibility to receive this subsidy.

Does increased intensity in the support increase firm performance? For this question the variation in support intensity is used to identify the effects. A dose-response framework is applied and the results reveal that there is a positive and significant effect for support levels above 80% of maximum support on value added. However, the effect is small and less likely to be economically significant. For the other outcomes, no significant effects were found. The results shows that only for support shares exceeding 80% of the maximum support is these a positive impact on value added per employee. This underline concerns that the support is small in relation to all outcomes. However, even if the average value is low, and the shares of support in relation to turnover on average is small, there most likely exist individual firms for whom the support is vital.

As we discussed in the paper, there are several methodological challenges in evaluating regional policies, such as the regional transport subsidy. Since all methods have their strengths and limitations, we therefore perform three empirical analyses using either the natural experiment or dose-response analysis. Furthermore, we are also aware the limitations of using turnover, value added and profit as the outcome variables, which may not perfectly measure firm performance. An alternative outcome, which can be used in future study, is to look into the productivity measure.

To summarize the findings of the paper, the empirical evidence from the two previous reforms, together with the dose-response function, indicate that, *on average*, the Swedish RFTS is less likely to generate significant positive impacts on firms, in terms of turnover, value added and profit per employee. To some extent, the results are not surprising. The amount of subsidy is, on average, a very small fraction of a firm's turnover. One interpretation of the results is that the eligibility rules are so general that many of the supported firms do not need a support. For them, the support is more of a 'icing on the

cake'. Note, however, this does not rule out the possibility that the support could be vital for certain firms.[24]

Our policy recommendations are that the Swedish RFTS should be used with care. A recommendation to the operating authority, the Swedish Agency for Economic and Regional Growth, is to sharpen the eligibility rule so that the support is only given to highly disadvantaged firms. The work with overseeing the eligibility rules should be done jointly with the evaluating authority, the Swedish Agency Growth Analysis, to ensure possibilities for future evaluations. To get a deeper understanding of the level of importance that the support has for an individual firm, a recommendation is to combine qualitative and quantitative research methods since both methods have their advantages and limitations.

[24] This is partly shown in the dose-response analysis. When the outcome value added is used and the 'dose' is over 80 percent, the estimated coefficient is statistically significant. Meanwhile, previous survey study also revealed that some survey respondents answered that the support hade positively contributed to the business (Tillväxtverket, 2020).

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Appendix

6.1 Appendix A - Zone 4

Figure A 1. The size of subsidy among subsidized firms in wood industry in zone 4, 2001-2019.

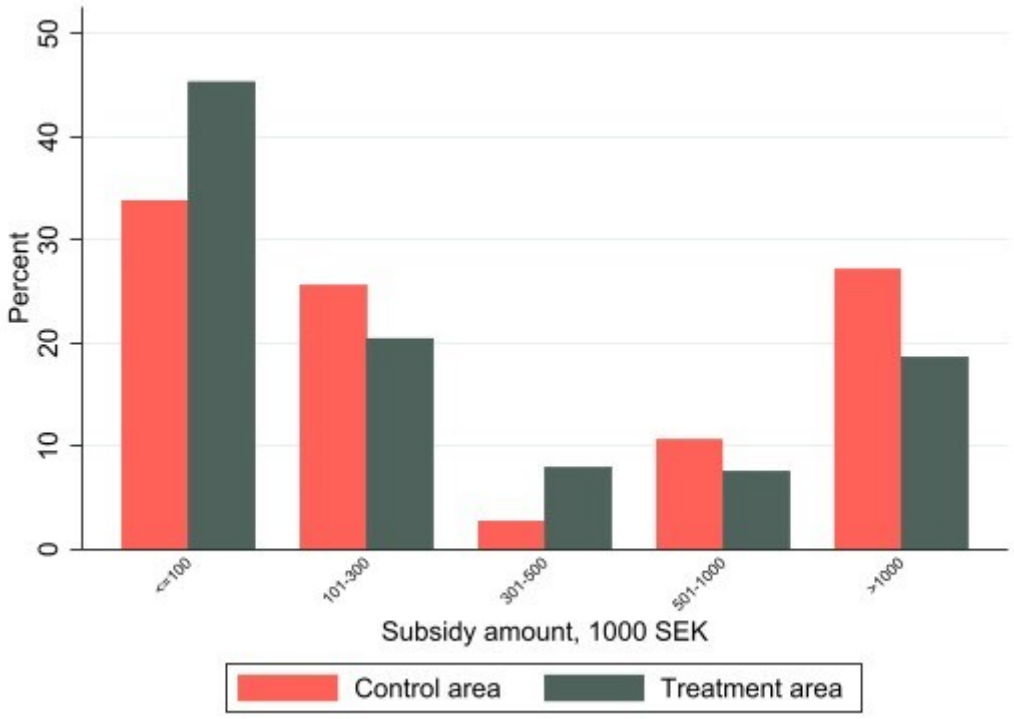
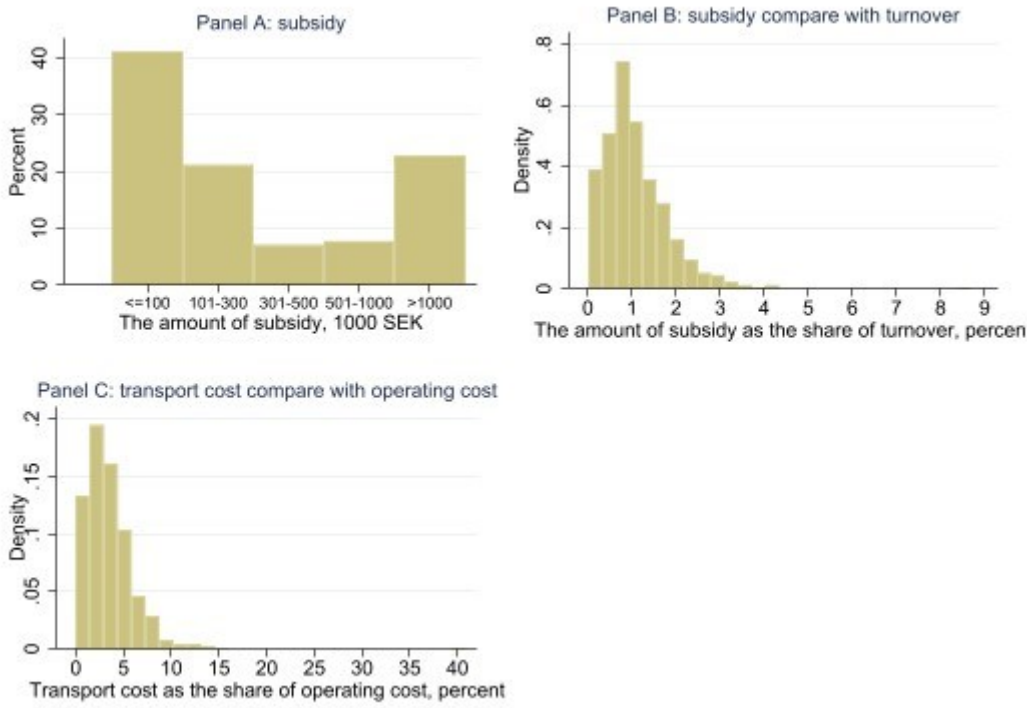
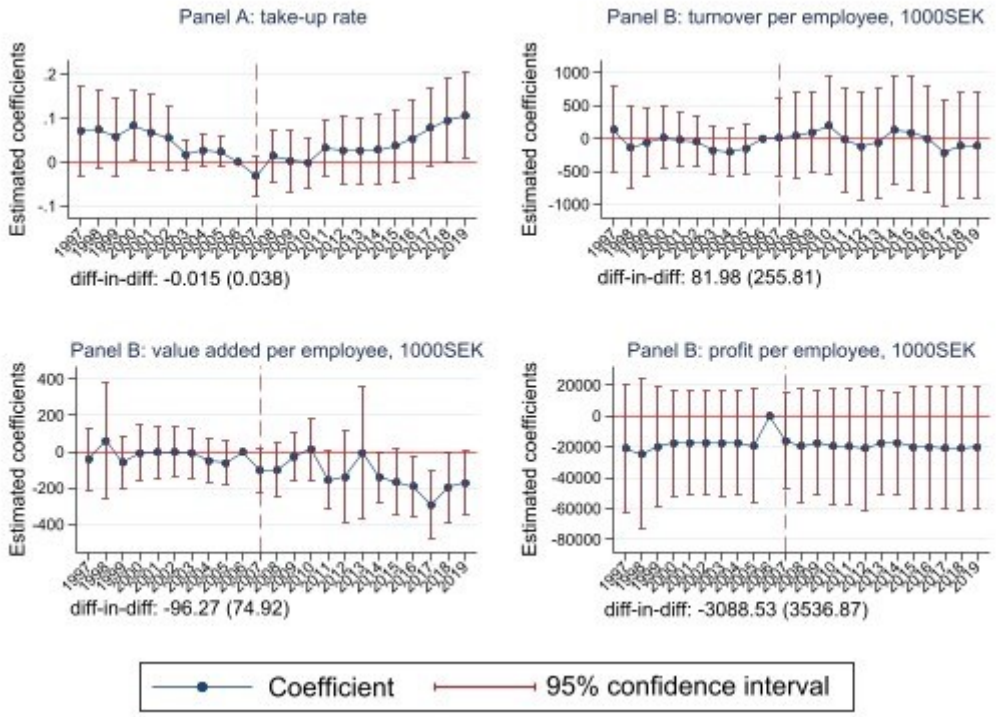


Figure A 2. The size of subsidy among subsidized firms in wood industry in zone 4, 2001-2019.



Panel A in Figure A 2 shows that about 40 percent of subsidized firms receive the support that is below 100,000 SEK. Panel B shows that the subsidy amount is relatively small in comparison with turnover. The medium is around 1 percent of turnover. In panel C, we further check how important the transport cost, among the subsidized firms, is in relationship with firm's operating cost. Notice that our estimated transport cost captures only the part of firm's total transport cost that is related to the subsidy. The estimated transport cost is computed as the subsidy amount divide by subsidy rate (based on the rate for out-going transport).

Figure A 3. The diff-in-diff estimator for the wood industry in zone 4, 1997 – 2019.



As a robustness check, Figure A 3 shows the estimated coefficients using the whole data period 1997-2019. The results are in line with the baseline results.

Table A 1. Summary statistics about wood industry in zone 4.

	Treatment area		**Control area**	
	2001-2006	2007-2019	2001-2006	2007-2019
Take-up rate	0.18	0.17	0.16	0.17
	(0.38)	(0.37)	(0.37)	(0.37)
Turnover per employee	756.11	785.46	931.31	993.73
	(1454.7)	(1427.56)	(2228.37)	(1710.37)
Value added per employee	238.45	246.39	219.11	280.46
	(460.59)	(668.85)	(254.07)	(502.69)
Profit per employee	3270.04	76.89	75.05	116.53
	(101835.3)	(627.57)	(154.45)	(461.80)
Micro firm (0-9)	0.89	0.88	0.89	0.89
	(0.31)	(0.32)	(0.31)	(0.32)
Small firm (10-49)	0.06	0.08	0.09	0.08
	(0.24)	(0.27)	(0.28)	(0.27)
Medium and big firm (50-)	0.05	0.04	0.02	0.03
	(0.22)	(0.19)	(0.15)	(0.17)
Export	0.16	0.14	0.16	0.15
	(0.37)	(0.35)	(0.36)	(0.36)
Import	0.08	0.08	0.09	0.09
	(0.27)	(0.27)	(0.28)	(0.29)
Observations	1074	2063	493	1046

Note: mean average and standard deviation in parentheses.

Table A 2. Robustness analysis – zone 4.

	Take-up rate	Turnover per employee	Value added per employee	Profit per employee
Panel A: sample composition				
Post x Treat	0.00033	181.76	39.31	-195.37
	(0.031)	(274.91)	(58.63)	(171.83)
Observations	3 690	3 690	3 690	3 690
Panel B: one-workplace firms				
Post x Treat	0.014	206.83	-38.29	-212.05
	(0.031)	(287.70)	(61.40)	(193.48)
Observations	4489	4489	4489	4489
Panel C: exclude outliers (top 1% in turnover, value added and profit per employee)				
Post x Treat		-69.77	-19.46	-7.12
		(73.99)	(20.26)	(15.72)
Observations		4629	4629	4629
Panel D: manufacturing sector				
Post x Treat	0.00028	494.28	-18.07	-219.02
	(0.0094)	(463.18)	(18.86)	(252.81)
Observations	35 195	35 195	35 195	35 195
Panel E: previously subsidized firms				
Post x Treat	-0.039	-289.19	-91.12	-24659.46
	(0.10)	(384.63)	(89.55)	(24612.37)
Observations	861	861	861	861
Year FE	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes

Several robustness checks have been performed and the baseline results still survive. Those results are shown in Table A 2: (1) In panel A, we have looked into if the baseline results are driven by the change of sample composition before and after reform. We have excluded new firms that come into the data after the reform and we have also focus on the firms who exist both before and after the reform. The results indicate that the change of sample composition is less likely to affect the main results. (2) Our firm register data is based on the headquarter office and it is possible that some firms may have several workplaces and get subsidies from different eligible areas. To address such concern, we have also conducted the analysis by focusing on the firms that have only one workplace. Those results are shown in panel B. (3) We have also checked that how outliers may influence our results. We perform additional analysis by excluding firms that have extreme large turnover, value added and profit, for instance, the top 1 percent. The results are presented in panel C. (4) In panel D, we have taken an analysis at a broader industry level, through evaluating the whole manufacturing sector. Again, we do not see any significant effect. (5) In panel E, we perform the analysis for previously subsidized firms, which the group is defined as those firms who have received the subsidy at least

once between 2001-2006. The results reveal that the effects of reform are not statistically significant.

Table A 3. Robustness analysis – triple difference-in-difference analysis.

	Take-up rate	Turnover per employee	Value added per employee	Profit per employee
Panel A municipality which gets increased subsidy rate vs municipality which gets unchanged subsidy rate				
Treat firm × Post	-0.013	140.17	-44.03	-49.19
	(0.083)	(293.47)	(83.02)	(67.60)
Treat area × Post	0.15	451.65	274.39	242.94
	(0.098)	(360.24)	(197.62)	(179.09)
Treat area × Treat firm	0.41***	-19.58	128.56	66.58
	(0.11)	(489.77)	(157.56)	(128.19)
Treat firm × Treat area × Post	**-0.18**	**350.87**	**-276.83**	**-225.63**
	(0.12)	**(611.13)**	**(190.04)**	**(167.60)**
Observations	2411	2411	2411	2411
Panel B municipality which gets decreased subsidy rate vs municipality which gets unchanged subsidy rate				
Treat firm × Post	-0.024	111.05	58.58	46.03
	(0.084)	(309.01)	(74.11)	(62.72)
Treat area × Post	-0.10	53.09	-675.07	-342.25
	(0.12)	(1168.86)	(665.17)	(325.08)
Treat area × Treat firm	-0.44***	-918.40	-824.06***	-1142.37***
	(0.064)	(282.34)	(82.65)	(74.80)
Treat firm × Treat area × Post	**0.21**	**456.26**	**693.60**	**326.08**
	(0.14)	**(1176.51)**	**(668.18)**	**(319.91)**
Observations	2107	2107	2107	2107
Firm controls	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes

Note: *, ** and *** indicates the significance level at 10, 5 and 1 percent respectively. Firm controls include the variables to control for firm size and export (import) activities. In the regression, year, municipality and firm fixed effects are also controlled for.

This analysis uses the variation in subsidy rate across the supported area where municipalities who get *increased, decreased or unchanged* subsidy rate. A simple comparison between different firms in supported areas may capture selection effects: firms selected into municipalities with different subsidy rate. Moreover, given it is a larger geographical area, a simple diff-in-diff may also capture the time varying regional-

specific shocks. One way to address the issue is to find a control group that locates in the same municipality who is less likely to be affected by the reform.

The support might be more relevant or important for some subsidized firms and less relevant for other subsidized firms. To define the treatment firms, the subsidy as the percent of turnover in the pre-reform period (2001-2006) is used as a measure of treatment intensity. In this case, the percent is defined as follow: the total subsidy 2001-2006 is divided by the total turnover 2001-2006. The treatment firm is defined as those firms whose percent is above 80 percentiles (above 1.08% of turnover) of the distribution *vs* control firms whose percent is below 20 percentile (below 0.086% of turnover). Those firms are included in the final sample for the triple-difference estimation.

The following difference-in-difference-in-difference is estimated:

$$Y = \alpha + \beta Treat\ area * Post + \gamma Teat\ firm * Post + \delta Treat\ area * Treat\ firm$$

$$+\theta Treat\ firm * Treat\ area * Post + \rho X + kommun\ FE + \text{år}\ FE + \text{företag}\ FE + \varepsilon$$

The estimated coefficient θ is the coefficient of interests, which is interpreted as the effect of the reform on the outcome variable. Table A3 reveals that the estimated coefficients θ are not statistically significant for the outcome variables.

6.2 Appendix B – Zone 1

Figure B 1. The size of subsidy among previously subsidized firms in both treatment and control area, 1997-2006.

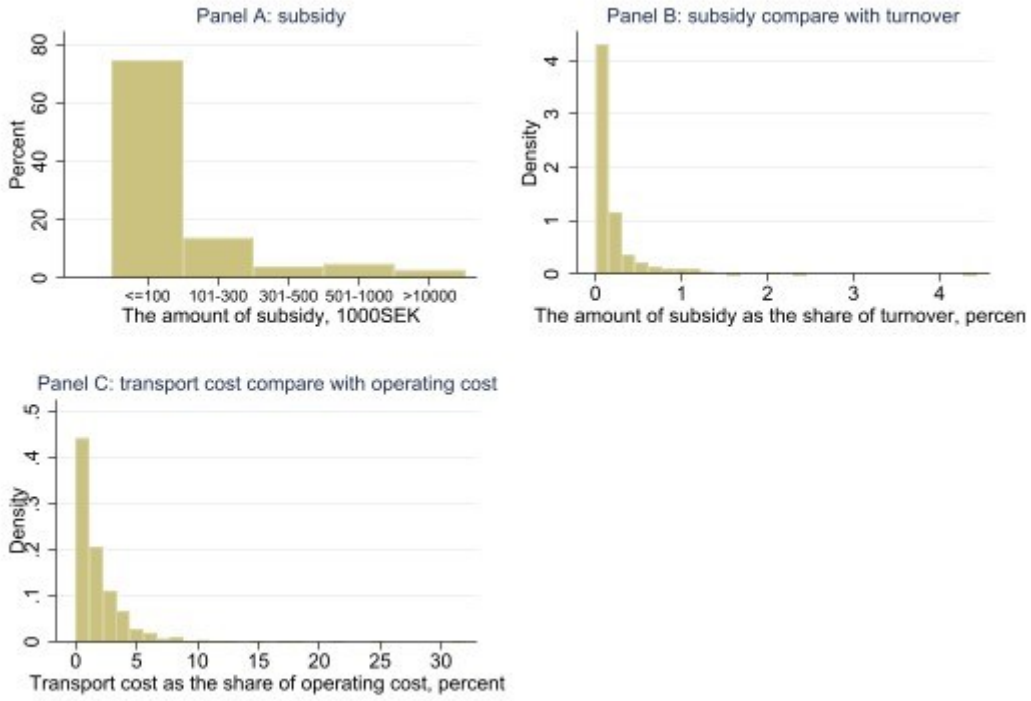


Table B 1. Summary statistics, 1997–2006.

	Treatment area		**Control area**	
	1997-1999	2000-2006	1997-1999	2000-2006
Turnover per employee	1645.35	2105.54	1521.42	2071.87
	(1218.16)	(4294.01)	(1543.72)	(3448.03)
Value added per employee	471.11	569.70	492.39	744.62
	(287.47)	(936.85)	(768.75)	(1976.52)
Profit per employee	65.22	134.81	89.39	187.32
	(201.14)	(640.36)	(437.15)	(903.15)
Micro firm (0-9)	0.26	0.29	0.47	0.47
	(0.44)	(0.45)	(0.50)	(0.50)
Small firm (10-49)	0.48	0.44	0.32	0.28
	(0.50)	(0.50)	(0.47)	(0.45)
Medium and big firm (50-)	0.26	0.27	0.21	0.25
	(0.44)	(0.44)	(0.41)	(0.43)
Export	0.85	0.81	0.64	0.62
	(0.36)	(0.39)	(0.48)	(0.49)
Import	0.66	0.65	0.52	0.46
	(0.47)	(0.48)	(0.50)	(0.50)
Observations	471	934	195	351

Note: mean average and standard deviation in parentheses.

Table B 2. The diff-in-diff estimation results, 1997-2006.

	Turnover per employee	Value added per employee	Profit per employee
Panel A: main results			
Post x Treat	-220.06	-152.94	-23.21
	(355.26)	(179.20)	(72.98)
Observations	1 951	1 951	1 951
Panel B: one-workplace firms			
Post x Treat	-244.06	--167.08	-30.93
	(407.63)	(200.64)	(81.13)
Observations	1752	1752	1752
Panel C: exclude outliers (top 1% in turnover, value added and profit per employee)			
Post x Treat	-64.09	-8.95	21.61
	(100.78)	(27.62)	(19.42)
Observations	1918	1931	1931
Year FE	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes

6.3 Appendix C – Does response function

Table C 1 presents the average treatment effect on the treated (ATET), which is measured as the average across all dose levels.

Table C 1. Average treatment effect of the treated.

Outcome	ATET	Standard error	z-value	p-value
Value added per employee	0.16	1.19	0.89	0.134
Profit per employee	0.16	1.20	0.13	0.893
Turn-over per employee	-0.02	2.20	-0.01	0.993
Municipality fixed effects	YES			
Industry fixed effects	YES			
Year fixed effects	YES			

Note: bootstrapped standard errors with 1000 replications.

The result reveals that on average increased dose, i.e., support per employee, do not significantly influence the response in either of the outcomes: value-added, profits or turnover independent of if ATE or ATET is computed. Those findings are in line with the results in previous sections.

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