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Evaluation of the regionally differentiated social security contributions in Norway

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Authors: Andreas Benedictow, Emil Cappelen Bjøru, Fernanda Winger Eggen, Vegard Salte Flatval, Marthe Norberg-Schulz, Marina Rybalka, Rolf Røtnes, Arne Stokka, Maja Tofteng and Lars Vik

Samfunnsøkonomisk analyse AS
Borggata 2B
N-0650 Oslo

VAT number: NO 911 737 752
post@samfunnsokonomisk-analyse.no

Preface

The Norwegian Ministries of Finance and of Local Government and Modernisation have commissioned Samfunnsøkonomisk analyse AS to evaluate the Norwegian scheme of regionally differentiated social security contributions. The evaluation has been completed in accordance with the European Commission's Common methodology for State aid evaluations.

As project manager, I would like to acknowledge the substantial input from my colleagues, Marina Rybalka, Marthe Norberg-Schulz, Emil Cappelen Bjøru, Fernanda Winger Eggen, Vegard Salte Flatval, Maja Tofteng and Rolf Røtnes at Samfunnsøkonomisk analyse AS. We would also like to thank Ragnar Nymoen for contributions to the theoretical and empirical frameworks, Michael Lechner as our project advisor and Michael Spjelkavik Mark and Roger Bjørnstad as project participators at an early stage.

SINTEF Technology and Society contributed to the evaluation with an analysis of the scheme's ripple effects. We would like to thank Arne Stokka and Lars H. Vik for a fruitful collaboration.

We thank the reference group members from the Norwegian Ministries of Finance, Local Government and Modernisation and Trade, Industry and Fisheries, and the EFTA Surveillance Authority for interesting discussions and useful feedback.

We especially want to thank Jan Oosterhaven from the University of Groningen and Frode Steen from NHH Norwegian School of Economics for helpful comments and suggestions as external referees for a previous draft.

Samfunnsøkonomisk analyse AS is responsible for the entire content of this report.

Oslo, 1 October 2018

Andreas Benedictow
Project manager
Samfunnsøkonomisk analyse AS

Abstract

Social security contributions through employer-paid payroll tax have been regionally differentiated in Norway since 1975. The objective of regionally differentiated social security contributions (RDSSC) is to reduce or prevent depopulation in the most sparsely populated regions of Norway by stimulating employment through reduced employment costs. The scheme is the most comprehensive regional policy measure in Norway.

Using detailed micro data on Norwegian firms and employees and state of the art empirical methods to study changes in the scheme, we find evidence that most of the tax incidence resides with the employers, implying that a change in payroll tax has relatively limited effects on wages. We find that employment increases directly because of reduced wage costs, allowing firms to reduce product prices to increase production and gain market share. The scheme also contributes indirectly to increased employment by shifting some of the tax reduction on to workers through higher wages, thereby increasing household demand for locally produced goods and services. In addition to positive effects on employment in existing firms, a descriptive analysis indicates that employment also increases through the establishment of new firms.

Overall, our estimates indicate moderate employment effects. However, it is reasonable to assume that the effects of changes in payroll tax are not linear. A small change could be expected to have a small or no effect, because the risk and costs associated with reallocating resources reduce firms' incentives to change their behaviour. However, if payroll tax had increased from the lowest to the highest tax rate, i.e. from 0 to 14.1 per cent, we would expect substantial effects. This is supported by our calculations, which show that such a jump would increase the share of firms with negative operating profits considerably. This suggests that RDSSC makes an important contribution to maintaining activity and employment, especially where the rates are low or zero. Thus, we cannot conclude from our moderate estimated effects that the impact of the scheme is low. The estimates should rather be considered conservative.

We find that RDSSC does enhance beneficiaries' competitiveness domestically, which is the intention of the scheme. Most firms receiving aid from RDSSC offer services locally, clearly limiting the potential impact on international competition and trade. The share of export-oriented firms is not significantly higher in the zones with reduced rates. Furthermore, the exporting firms in the zones with reduced rates tends to be capital-intensive, thus gaining relatively little from a tax scheme that reduces the relative cost of labour. We also argue that the scope of import competition is limited by a high level of specialisation and low intra industry trade. The evaluation also finds that the vast majority of exporting firms receive support that is under the threshold for de minimis aid and is thus not defined as anti-competitive state aid according to EU rules. We conclude that there is little evidence of RDSSC having a distortive impact on competition and trade to an extent contrary to the intent of the EEA agreement.

We put forward a clear recommendation of continuing the scheme, although we also suggest considering the possibility of allowing municipalities to choose between RDSSC and receiving the same amount of support but in the form of separate free income. We suggest that such an option be limited to municipalities in the zones with tax rates close to the highest level.

Executive summary

Based on an extensive empirical review, we find that RDSSC contributes to reducing or preventing depopulation in the regions eligible for the scheme. We submit a clear recommendation that the scheme be continued, although we also suggest considering the possibility of allowing municipalities to choose between RDSSC and receive the same amount of support but in the form of separate free income. We suggest that such an option be limited to municipalities in the zones with tax rates close to the highest level.

The Norwegian system of social security contributions is divided into seven different zones with rates varying from 14.1 pct. in central areas to 0 pct. in the northern most part of the country. This report evaluates the scheme of regionally differentiated social security contributions (RDSSC).

The Norwegian authorities notified the current scheme for the period 1 July 2014 to 31 December 2020 to the EFTA Surveillance Authority (ESA) in 2014. As part of the notification, the Norwegian authorities undertook to evaluate the scheme, in accordance with ESA's Regional Aid Guidelines (RAG). The Ministry of Finance and the Ministry of Local Government and Modernisation commissioned Samfunnsøkonomisk analyse AS and SINTEF Technology and Society to conduct the evaluation.

In line with the objective of the evaluation as stated by the Ministry of Finance and the European Commission Staff Working Document, *Common methodology for State aid evaluations*, the evaluation has tested and analysed whether RDSSC 1) has a well-defined objective of common interest, 2) is designed to achieve the objective of common interest, 3) is appropriate and correctly proportioned for achieving these targets and 4) has a distortive impact on competition and trade.

1) Does RDSSC have a well-defined objective of common interest?

RDSSC is the single most comprehensive regional policy measure in Norway and has been part of a broad regional policy since its introduction in 1975. The policy finds legitimacy through broad popular and political support. The objective of RDSSC is to reduce or prevent depopulation in the most sparsely populated regions in Norway by stimulating employment.

The Norwegian economy is characterised by low labour mobility and a national collective wage bargaining system, the latter leading to a relatively high degree of wage equalisation for equal work across geographical regions. As a result, wages do not perfectly reflect the scarcity of production factors. In remote areas with small labour markets and/or a one-sided industrial base, this could typically result in higher wages and lower employment than would have resulted from perfect competition. Under such circumstances, subsidising wages to offset the gap between tariff and market wages could offset relatively high labour costs in rural areas.

When RDSSC was introduced, the differentiation of tax rates was justified by a reduction in employment in primary industries in rural areas. In combination with low labour mobility across regions and nationally determined wages, this could create "hidden" unemployment. This may still be the case, but the arguments for stimulating rural employment have changed over the years. Today the main argument is the importance of stimulating rural employment to avoid depopulation, and RDSSC is justified as compensation for lower productivity in rural areas due primarily to poorer infrastructure and lack of economies of scale.

Whether and to what extent the objective of preventing or reducing depopulation is achieved through

RDSSC therefore depends on a positive relationship between employment and population.

The reasoning behind RDSSC is that the scheme will counteract discrepancies between market earnings and actual wages due to centralised wage formation and weak mobility in rural areas. However, the objective of RDSSC is politically determined, in contrast to most industrial policy schemes, which are usually justified as mitigating market failures. This does not undermine the legitimacy of RDSSC, although the academic justification is weaker.

Overall, the objective of the scheme is clear and easily understood and is sought accomplished through theoretically convincing means. Further, the scheme has broad and long-standing political support. We therefore conclude that RDSSC addresses a well-defined objective of common interest.

2) Is RDSSC designed to achieve the objective of common interest?

The scheme is designed to stimulated employment by offsetting employment costs. While employment is directly influenced by the payroll tax rate through labour costs, multiple factors can affect the population in the eligible regions: various demographic factors such as birth and death rates, migration, civil status, etc., making it hard to estimate the effect on population directly. Therefore, our approach to study effects of RDSSC on population in the most sparsely populated regions in Norway is to estimate the effect on employment.

A wide range of studies have analysed the interdependent processes of population and employment growth. They mainly suggest that population and employment are the subject of a dynamic adjustment process and are determined jointly. Despite varying evidence from the literature, aggregated studies suggest that stimulating job creation in the least populated regions of Norway will contribute to reducing, or preventing, depopulation in the eligible regions.

Employment may be increased directly by RDSSC reducing labour costs, allowing firms to reduce product prices to increase production and gain market share. RDSSC may also contribute to increased employment indirectly, if part of a tax reduction is shifted to workers through higher wages, which in turn leads to increased demand for goods and services, activity and employment in the local economy. It is the direct effect that explicitly justifies the choice of RDSSC as a policy instrument. The indirect effect might as easily, and maybe more effectively, be achieved by other means, addressing worker or household income directly.

In our empirical analyses, we use detailed micro data on Norwegian firms and employees and state of the art econometric methods to study the effects of changes in the payroll tax rate on wages, employment, value added and capital. We primarily focus on identifying the impact of differentiated payroll tax rates on wages and employment. Our chosen econometric approaches are mostly in line with previous studies of Norwegian payroll tax. In addition, we apply a regression kink design (RKD), which, at least to our knowledge, has not been used to study the effects of the Norwegian payroll tax scheme before.

Our main identification strategy is to use variation induced by different changes in the scheme, so-called exogenous shocks. There have been several changes in the scheme since the introduction of differentiated payroll tax rates in 1975. We exploit the three reforms of the scheme that took place in the period 2000-2007: (i) we use difference-in-differences to study effects of a lower tax rate for firms in municipalities that changed tax zone in 2000; (ii) we use both difference-in-differences and a regression

kink design to evaluate effects of increased payroll taxes in the period 2004-2006; (iii) we exploit all variation in the tax rates following the reform in 2004 and its reversion in 2007 to estimate long-run effects on the demand for labour using a GMM estimator.

Based on international studies of comparable schemes (Saez, Matsaganis and Tsakloglou 2012, Saez, Schoefer and Seim 2017) and previous studies of the Norwegian scheme (Johansen and Klette 1997, Gavrilova, et al. 2015, Stokke 2016, Ku, Schönberg and Schreiner 2018) we expect to find effects on both workers' wages and employment.

As expected and in line we Stokke (2016), we find positive effects on employment among firms that faced a lower tax rate after the change in 2000, both on the extensive and intensive margin. That is, both the number of employees and number of hours worked increased more among firms experiencing a reduction in the payroll tax rate than what would have been the case without the reduction. We also find that some of the tax reduction was shifted onto workers' wages; about 24 per cent of the tax incidence resides with the employees.

Applying the regression kink design (RKD) to study the changes in tax rates between 2004 and 2006, we find that somewhere between 0.5 and 4 pct. of the tax increase was shifted onto workers in Zone 4 and between 4 and 17 pct. in Zone 2. Thus, it seems that firms in different regions react differently to changes in the payroll tax rate.

Inspired by Johansen and Klette (1997) and Gavrilova, et al. (2015), we apply a two-step approach to estimate the long-run effects on labour demand. First, we find little or no effect on workers' wages, meaning that the tax incidence resides with the employers. Second, we find that changes in wage costs following changes in the payroll tax affects firms' demand for labour. In total, we find that changing the payroll tax rate with one percentage point changes employment in the affected firms with approximately one per cent.

In addition to affect employment in existing firms, changes in the payroll tax may affect firm entries and exits. In a descriptive analysis, we find that between 2000 and 2002 the share of new firms was larger in the treatment group, suggesting that the tax rate reduction in 2000 had a positive impact on firm entry. An econometric study of a pay roll tax reduction in northern Sweden finds evidence of increased employment through establishments of new firms (Bennmarker, Mellander and Öckert 2009).

We are unable to estimate effects for tax zones where there have been no changes in the payroll tax rate, i.e. Zone 1 and 5. Municipalities in Zone 1 faces the general payroll tax rate of 14.1 per cent and is outside the geographical scope of RDSSC. However, Zone 5 face a zero per cent payroll tax rate and is the region with largest differentiation. Looking at the increase in the share of firms with negative operating profits if the scheme was abolished, it is apparent that the increase is highest in Zone 5.

Overall, our results clearly indicate that RDSSC has the intended effects on the beneficiaries. In other words, the scheme does reduce or prevent depopulation in the eligible regions. Therefore, we conclude that the scheme is designed to achieve the objective of common interest.

3) Is RDSSC appropriate and correctly proportioned to achieve these targets?

We interpret this as an assessment of whether the objective could be achieved in a more effective way

by other means. To this end, it is useful to keep in mind what would have happened without the scheme and what alternative schemes are available or feasible.

First, we find that RDSSC contributes to reducing or preventing depopulation in the eligible regions. It follows directly from the results discussed above that repealing the regional differentiation of the social security contributions within a tax neutral framework would have resulted in lower employment and settlement in the eligible regions and higher employment and settlement in Zone 1.

Alternative measures may also achieve similar results. However, RDSSC is, in monetary terms, by far the most important scheme within the portfolio of rural and regional development policies. Moving all regional support from RDSSC to other schemes would therefore radically change all of them. This raises a serious question about appropriateness. Normally there would be a decreasing return on public schemes. If a scheme increases substantially in size, it is reasonable to assume that "the last million" will have very little effect.

Thus, alternatives to RDSSC should preferably be a mix of other schemes to boost employment and settlement in the eligible regions. For instance, capital and innovation subsidies could be increased in eligible regions to promote employment. Innovation Norway and the Research Council have several such schemes readily available. Evaluations indicate that such schemes affect employment in a similar way to RDSSC. However, these schemes are much smaller in scope, and we do not know whether the effects will persist if they are inflated. This would particularly be the case in Zone 5, where abolishing RDSSC would increase social security contributions the most and where alternative schemes would have to increase relatively substantially to achieve the same effect. Our assessment is that there is little to be gained by reorganising in this way.

Another alternative might be to increase income support to households directly, as is already done in Zone 5, especially in regions where a large share of the tax subsidy is shifted to workers anyway. Increased income support may boost regional settlement in two ways. First, through the same income-employment effect as higher wages through RDSSC and second, by making it more attractive to live in the eligible regions. However, income support to households will not result in direct employment effects. It is difficult to imagine that income support will be more effective than the RDSSC scheme.

Transferring the support to the municipalities directly would enable them to increase the employment related to their responsibilities, invest in communal goods in the municipality or boost small municipal industrial funds where any such exist. Better municipal services or communal goods can be factors that help to keep or attract labour. However, this would likely shift employment from the commercial sector to the public sector, which in the long run may weaken the ability of rural regions to develop new income opportunities. Nevertheless, this could be a possible alternative to RDSSC as it is today.

Our assessment is that a total (revenue neutral) abolishment of RDSSC would clearly weaken the possibilities of achieving the stated regional policy objectives. The effects would be particularly large in Zone 5. As part of an ambitious regional policy, RDSSC appears to be appropriate in combination with other schemes. However, it is interesting to consider whether some municipalities may be better off with a different mix of policy instruments.

Data shows limited correlation between the zone division and the centrality index. We argue that there

may be grounds for reassessing at suitable intervals the zone division in the light of demographic changes, for example.

Overall, we argue that RDSSC seems appropriate and reasonably proportioned. However, as the scheme may be less efficient in certain municipalities, we suggest considering the possibility of allowing them to choose between RDSSC and receiving the same amount of support transferred in the form of separate free income.

4) Does RDSSC have distortive effects on competition and trade?

State aid that limit competition are prohibited by the EEA agreement. However, state aid facilitating the development of economic areas, where such aid does not adversely affect trading conditions to an extent contrary to the common interest, may be considered compatible with the functioning of the EEA agreement.

In line with the scheme's objective, we find that RDSSC does enhance beneficiaries' competitiveness domestically. The scheme is compensating firms in more rural areas for having competitive disadvantages through larger distances and inefficiently high wages. However, our analysis indicate that ripple effects reduce the domestic distortive effect of RDSSC somewhat, as they generate import "leakage" by creating increased demand in surrounding zones and Zone 1 in particular.

Most firms receiving aid from RDSSC are offering services locally, which reduces the potential impact on international competition and trade. We also find that the proportion of export-oriented firms is not significantly higher within the zones with reduced rates. Furthermore, the exporting firms tend to be capital intensive, thus gaining relatively little from a tax scheme reducing the relative cost of labour. Moreover, we find that very few of the exporting beneficiaries receives support above the limit of de minimis aid, under which support is not defined as distortive state aid according to the EEA agreement.

We are not able to quantify the scope of import competition due to lack of data. However, we argue that the fact that the economy is small and specialised in industries where Norway has a comparative advantage and the relatively low extent of intra-industry trade in Norway limits the scope of import competition.

We conclude that there is little evidence of RDSSC having a distortive impact on competition and trade to an extent contrary to the intent of the EEA Agreement.

Recommendations

We are not able to test the effect of the scheme in the region where the scope is greatest, i.e. in Finnmark and northern Troms (the Action Zone). This is due to a lack of variation in the scheme in this area during the evaluation period. It is reasonable to assume that the effects of changes are not linear. A small change could be expected to have a small or zero effect because the risk and costs associated with reallocating resources reduce firms' incentives to change their behaviour. But if the payroll tax had suddenly increased from 0 to 14.1 per cent in the Action Zone, for example, we would expect substantial effects.

RDSSC is the single largest rural policy scheme in Norway, but data variation within our data period is limited. This makes it challenging to identify effects. Our estimates may not reflect the size of the scheme, but rather the relatively limited adjustments of the scheme within the sample period. In other words, we cannot conclude from our modest estimated effects that the impact of the scheme is small.

Our estimates should rather be considered as conservative. This is supported by our analysis showing that an increase in the pay roll tax from 0 to 14.1 per cent in the Action Zone would substantially increase the share of firms with negative operating profits, which implies a potential for corresponding negative effects on employment.

We find effects on both wages and employment, indicating that there are direct as well as indirect effects on employment and population in the eligible areas. There is good reason to believe that the overall effect of the scheme is significant, especially in the zones with the lowest payroll tax rate. Furthermore, the scope of distortive effects on competition and trade appears to be limited.

Based on an extensive empirical review of RDSSC, we recommend that the scheme be continued. However, since some municipalities are experiencing challenges not covered by RDSSC, we suggest that the relevant ministries consider giving individual municipalities the freedom to choose whether they will carry on with RDSSC, or whether they want the same amount of support transferred in the form of separate free income for the municipality. This could, for example, take the form of a pilot scheme to test the municipalities' interest, but with the opportunity to revert to the previous arrangement later on.

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1 Introduction

Most OECD countries fund social insurance programs, such as retirement, health, disability, and unemployment benefits, with substantial social security contributions on employment earnings (Saez, Matsaganis and Tsakloglou 2012). Social security contributions (payroll taxes) collect about 26 pct. of total tax revenue on average in OECD countries and is the second largest source of tax revenue, after tax on goods and services (OECD 2018).

An employer-paid payroll tax was introduced in Norway in 1967. In 2016 this tax constituted almost 28 pct. of total tax revenues.

A key objective of the Norwegian post-war economic policy has been to achieve full employment for the country as a whole (NOU 1975: 2), and preservation of the distinctive features of the Norwegian settlement patterns has been an explicit objective for Norwegian regional policy since the 1970s (Meld. St. 13 (2012-2013)).

Following a discussion of labour subsidies as a regional policy measure, the payroll tax was regionally differentiated in 1975. The differentiation was in line with economic theory, showing that a reduction in labour taxes would be better suited than capital subsidies to stimulate regional employment in an economy with high capital mobility, low labour mobility and a national collective wage bargaining system.

Lower marginal labour costs in a selected area can lead to higher employment in the same area, partly through the opportunity to increase production and partly because it will be profitable to replace capital with labour in production, to the extent that it is technically possible (NOU 1975: 2).

The payroll tax is differentiated according to the periphery of the region (measured by geography, demography, labour market and income) and is lower in rural than in central areas. Today Norway is divided into seven different zones with rates varying from 14.1 pct. in central areas (Zone 1) to 0 pct. in the northern most part of the country (Zone 5).

1.1 Evaluation of the scheme

The scheme with regionally differentiated social security contributions (RDSSC) has undergone several changes since its introduction, both in terms of eligible regions (municipalities) and the difference in tax rates. The Norwegian authorities notified the current scheme for the period 1 July 2014 to 31 December 2020 to EFTA Surveillance Authority (ESA) on 3 June 2014.[1] As part of the notification, the Norwegian authorities committed to evaluate the scheme, in accordance with ESA's Regional Aid Guidelines (RAG).

The Ministries of Finance and of Local Government and Modernisation has commissioned Samfunnsøkonomisk analyse AS and SINTEF Technology and Society to conduct the evaluation. The main assignment is an *ex post* evaluation of the scheme, i.e. identify the causal impact of the scheme on the policy objective and quantify its effects.

Specifically, as stated by the terms of reference, the objective of this evaluation is to (1) assess the impact on job opportunities and employment in the eligible regions by differentiated rates in the scheme, and whether and to what extent, the objective of preventing or reducing depopulation is achieved. The evaluation should assess the incentive effect of the

[1] The scheme was notified by letter 13 March 2014 and the notification was completed, after submitting an updated notification, on 3 June 2014.

implicit aid following reduced rates and to what extent it changes the behaviour of firms (and employees), (2) assess the effects on competition and trade, (3) assess the effects of the new sector limitations, and (4) assess whether the objective could be reached in a more effective and less distortive way by other means.

To answer all tasks in a structured manner, we have organised the evaluation according to the European Commissions' *Common methodology for State aid evaluations* (European Comission 2014). This means that the evaluation is structured around describing the objectives of the scheme to be evaluated, assessing the direct impact of the aid on beneficiaries, assessing the indirect impact of the scheme and assessing the proportionality and appropriateness of the scheme.

1.2 Outline of the report

The following chapter presents the background for regionally differentiated social security contributions in Norway and changes in the scheme over time. In Chapter 3 we provide a theoretical framework to illustrate how the scheme is intended to work and empirically testable hypotheses. Both chapters cover the objectives of the scheme.

In Chapter 4 we present empirical results on the direct impact of the scheme on beneficiaries (e.g. effect on wages, employment, value added and capital). This is followed up in Chapter 5, where we present existing literature on the links between employment and population.

In Chapter 6 provides a summary of other (alternative) measures and discusses the proportionality and appropriateness of RDSSC.

We assess the ripple effects of the scheme, i.e. the scheme's indirect impact in Chapter 7, and in continuation of this we discuss potential distortive effects in Chapter 8.

We conclude with the main results, their implication and policy recommendations in Chapter 9.

2 Regional Differentiated Social Security Contributions

Social security contributions (through employer-paid payroll tax) have been regionally differentiated in Norway since 1975. The scheme is the most comprehensive regional policy measure in Norway. Prior to the introduction of the regionally differentiated payroll tax, regional policy measures were mainly targeted at supporting investments (NOU 1975: 2).

The objective of the regionally differentiated payroll tax is to reduce or prevent depopulation in the most sparsely populated regions in Norway by stimulating employment. The scheme is designed to offset employment costs. It is estimated a tax relief of about NOK 13.9 billion for the whole scheme in 2018, of which tax relief to the private sector account for NOK 8.2 billion (Prop. 1 S (2017-2018)).

In the following we present some of the arguments that was used to justify the implementation of the scheme, how it is administered and changes over time. Further, we present the seven current tax zones and some characteristics of these.

2.1 Initial rationale of the scheme

In an economy with perfect competition, prices for mobile products and input factors will be equal everywhere, while prices for immobile products and production inputs may vary (e.g. due to differences in demand).[2] However, when wages are largely determined through centralised wage bargaining, equal wages will arise for the same type of work throughout the country. Firms may then pay higher wages, and thus have lower employment, than what they would have if wages were adjusted freely according to local demand conditions (NOU 1975: 2).

The introduction of a regionally differentiated payroll tax in Norway was based on a series of theoretical studies that discussed the market failures of the regional labour markets, including the disparity between regional demand for labour and nationally determined wages (Hervik and Rye 2010).[3]

Johansen (1965) showed that if the objective is maximising total income, calculation prices providing the optimal solution must be such that common (mobile) resources have the same calculation rates in all regions, while regional (immobile) resources generally have different calculation rates across regions. Considering this, Johansen questioned the subsidisation of common resources, such as capital, rather than labour, which was assumed less mobile (or even immobile). He further specified that the actual wage paid to (equal) workers did not have to be different in different regions to satisfy the optimum requirements, but the firms' calculation cost of labour.

The demand for a production factor (input) normally depends on the price of the product (output) and the relative price ratio between the relevant input factor and all other factors of production. Thus, when the cost of labour changes due to a reduction in the labour tax, firms' optimal adjustment changes, and in turn the demand for different factors of production and level of production (NOU 1975: 2).[4]

[2] With perfect competition one often assumes no economies of scale and, thus, that there will be enough suppliers of the different products and input factors. However, with economies of scale the locations of production are likely to differ from locations of consumption and prices will differ depending on unit transportation cost and distances.

[3] For a more comprehensive description of the prelude to the scheme and different theoretical perspectives, we refer the reader to NOU 1975: 2 and Hervik and Rye (2010). Both in Norwegian. An English summary of the latter can be found online: "An empirical and theoretical perspective on regional differentiated payroll taxes in Norway".

[4] Mechanisms leading to these changes is elaborated in Chapter 3.

Given the above one could argue that subsidising capital would also lead to increased demand for labour.[5] However, several studies showed that under certain assumptions, labour subsidies was preferable to capital subsidies (e.g. Serck-Hanssen (1971)).

Serck-Hanssen (1982) argued that the reason one should subsidise labour and not the use of capital, when settlement is the objective, is not that it is impossible to achieve this objective by subsidising capital. Increased settlement (or at least reduced depopulation) could be achieved by other means than labour subsidies. It is only more expensive (or equally expensive) to use capital subsidies to achieve an employment target (Serck-Hanssen 1971, 15). He further points out that how much more expensive it will be, depends on how the opportunities for production are in the region.

2.1.1 Labour mobility

When implementing the regionally differentiated payroll tax, labour was considered immobile between regions. Studying the migration between municipalities, counties and the five regions of Norway, there are few indications that workers are more mobile today than in 1975 (cf. Figure 2.1). However, migration per 1,000 mean population between municipalities and counties has been higher the last decade than the average for the period 1975-2017.

Further, there have been tendencies towards more commuting between municipalities compared to the beginning of the 2000s (cf. Figure 2.2). More commuting between municipalities suggest larger labour market regions. More and higher quality infrastructure enables longer commuting distances at a given cost (time), which in turn gives access to a wider range of interesting work opportunities.

Figure 2.1 Migration per 1,000 mean population. 1975-2017

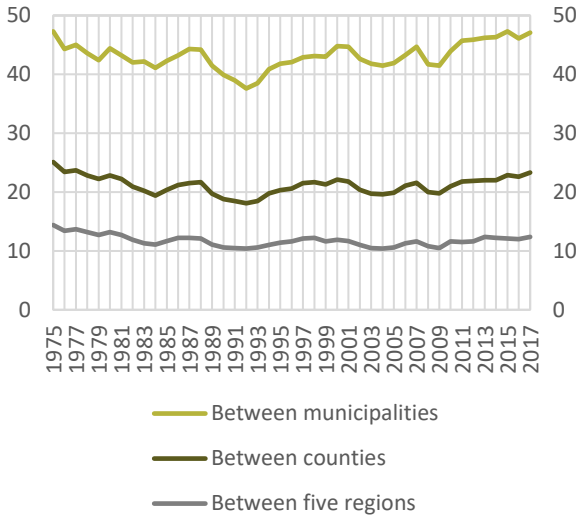
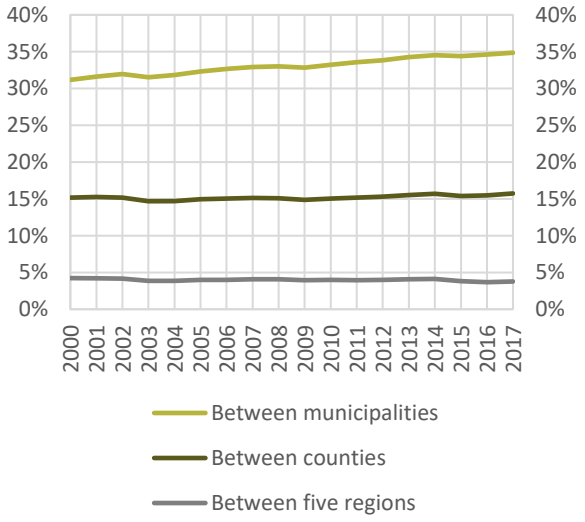


Figure 2.2 Commuting as share of total employment. 2000-2017



Note: Oslo and Akershus is considered as one county. The five regions are Eastern Norway, Agder-Rogaland, Western Norway, Trøndelag and Northern Norway.
Source: Statistics Norway

[5] A reduction in the price of another factor of production will increase employment if labour is complementary (in production) to the factor being subsidised.

Such access is a decisive factor when choosing where to live. Easy access to work through commuting increase the number of possible places of residence. The share of workers commuting between counties and regions are unchanged during the same period.

Migration between labour markets are not fully captured by migration between municipalities or counties. However, increased migration between municipalities, together with increased commuting, may indicate that the choice of workplace and residence are two separate decisions within a functional labour market region. People can change workplace without moving. Labour market regions may overlap both municipality and county borders. The same explanation can thus be made for migration between counties. Oslo and Akershus accounted for more than one third of the domestic migration in 2017 and a significant share of it is migration between these two counties (Statistics Norway 2018). Moving from Oslo to the neighbouring county Akershus does not necessarily indicate increased labour mobility.

The limited labour mobility in Norway may be exemplifies by the response to declining oil prices, and following reduction in investment activity, in the petroleum industries in 2015. This caused nearly 8,300 employees to be laid off in the period from November 2015 to June 2016. Only 4 pct. of those who lost their job in the first half of 2016, and who were still living in Norway, moved to another county and few of them were from Rogaland where many became unemployed (Statistics Norway 2018). By November 2016 employment was higher among the few who moved from Rogaland, than those who stayed. Thus, it seems reasonable to claim that employment is not necessarily a sufficient factor in the decision about whether to move or not.[6]

2.1.2 Regional unemployment

When the differentiated payroll tax was introduced in 1975, overall unemployment was 2.3 pct.[7] The conception was that full employment was achieved, partly through extensive migration from weakly developed regions to central areas. However, there was a concern that different forms of "hidden" unemployment was present in regions where primary industries had previously been a significant employer, as well as underemployment among specific groups of workers in regions with narrow employment opportunities (NOU 1975: 2).

Assuming that immobile labour and nationally determined wages are the cause of regional unemployment, it would be profitable to subsidise labour, insofar as this compensates for the difference between the actual wage and the wage that would be derived from a free wage formation in the regional labour market (L. Johansen 1965, NOU 1975: 2).

In 2017 total unemployment was 4.2 pct., but with significant variation across municipalities.[8] It seems that the unemployment rate increases with centrality (cf. Figure 2.3). However, the highest rates of unemployment occur more frequently among the most rural municipalities.

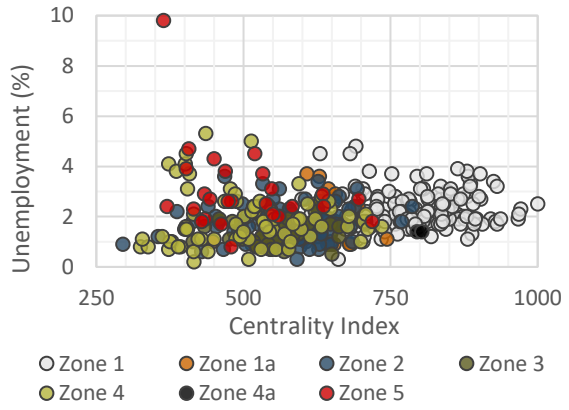
It cannot be ruled out that some share of the disability pensioners should be considered as a form of "hidden" unemployment. Looking at the share of disability pensioners we find little evidence that this is

[6] This is further discussed in Chapter 5.
[7] Statistics Norway's Labour Force Survey.

[8] The total unemployment rate refers to unemployment in the Labour Force Survey, whereas municipal unemployment refers to registered unemployed. Thus, the average of the unemployment rates in Figure 2.3 is lower than 4.2 pct.

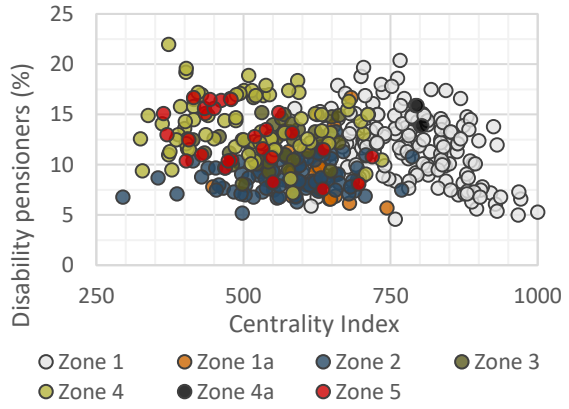
a greater issue in more rural municipalities (cf. Figure 2.4).

Figure 2.3 Unemployment[1] and index[2] of centralisation by municipality. November 2017



1) Registered unemployed 15-74 years
2) Ranging from 295 (lowest centrality) to 1,000 (highest centrality). Oslo is assigned the highest value.
Source: Statistics Norway

Figure 2.4 Disability pensioners[1] and index[2] of centralisation by municipality. November 2017



1) As a percentage of the population 18-67 years
2) Ranging from 295 (lowest centrality) to 1,000 (highest centrality). Oslo is assigned the highest value.
Source: Statistics Norway

2.2 Administration of the scheme[9]

According to Chapter 23-2 of the National Insurance Act,[10] all employers in Norway have a legal obligation to contribute to the national social security scheme. The contribution is calculated as a share of gross wages paid to the employees. The general rate in Norway is 14.1 pct. The regional (notified) aid constitutes the reductions of the social security contributions below the general rate. The tax rates are determined annually by the Norwegian Parliament. According to paragraph 12 of Chapter 23-2, the Parliament may adopt regionally differentiated contribution rates, as well as specific provisions for employers within certain sectors.

2.2.1 Eligible recipients

Prior to 2007 the tax rate for each employee was determined by the residence of the employee. After 2007 differentiated payroll taxes implies that the rates vary according to where the firm is located. The employer (firm) is automatically entitled to the reduced rate, i.e. no application is required. If the firm has establishments with different addresses, a reduced tax rate only applies to employees who work within the eligible area (see Chapter 2.4 for description of eligible areas). If employees spend half or more of their working time in a tax zone other than the one in which their employer is located, the tax rate is based on the applicable rate in the zone in which the employees spend most of their time.[11]

[9] This section is based on EFTA Surveillance Authority decision of 18 June 2014 on regionally differentiated social security contributions 2014- 2020 and mainly describes the scheme as notified for the period 2014-2020. Changes in rates and eligible areas are presented in the next section.
[10] LOV-1997-02-28-19.

[11] From 1 January 2016, it was no longer possible for employers with ambulatory activities to pay a lower rate than the rate applicable to the zone in which the firm had its address.

2.2.2 Sectoral exceptions

Firms operating in the following sectors or activities are not eligible for aid (reduced tax rate) under the scheme:[12]

a. Steel[13]
b. Synthetic fibres[14]
c. Transport[15]
d. Airports[16]
e. Energy[17]
f. Financial and insurance activities[18]
g. Head office and consultancy activities[19]

Firms with activities both inside and outside the scheme will be eligible for a reduction in the payroll tax for the labour costs strictly related to the eligible activities. However, this requires keeping separate accounts, clearly identifying direct and indirect labour costs and allocating them based on consistently applied and objectively justifiable principles, to demonstrate that the ineligible activities will not benefit from a reduced tax rate.

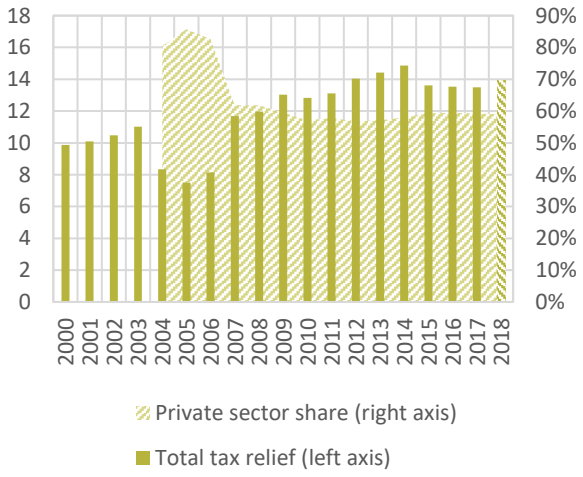
Firms with outstanding recovery orders and firms in difficulties will not be eligible for aid under the scheme.

2.2.3 Annual budget

The scheme had a budget of about NOK 13.5 billion in 2017 (estimated loss of tax revenues). Apart from years with restrictions in the scheme (due to ESA regulations), there has been a steady increase in annual budgets (cf. Figure 2.5). Since 2007, private sector has accounted for almost 60 pct. of the estimated forgone tax revenues.

Forgone tax revenues are calculated as the difference between the potential tax revenue if all firms faced a payroll tax rate of 14.1 pct. and what is paid with differentiated rates. Thus, increased wages, and increased employment, is the main explanation for the increase in annual budgets. It is worth noting that the calculation of annual forgone tax revenue assumes everything will continue as is if the differentiation was removed, i.e. assuming no firm closures and no layoffs. [20]

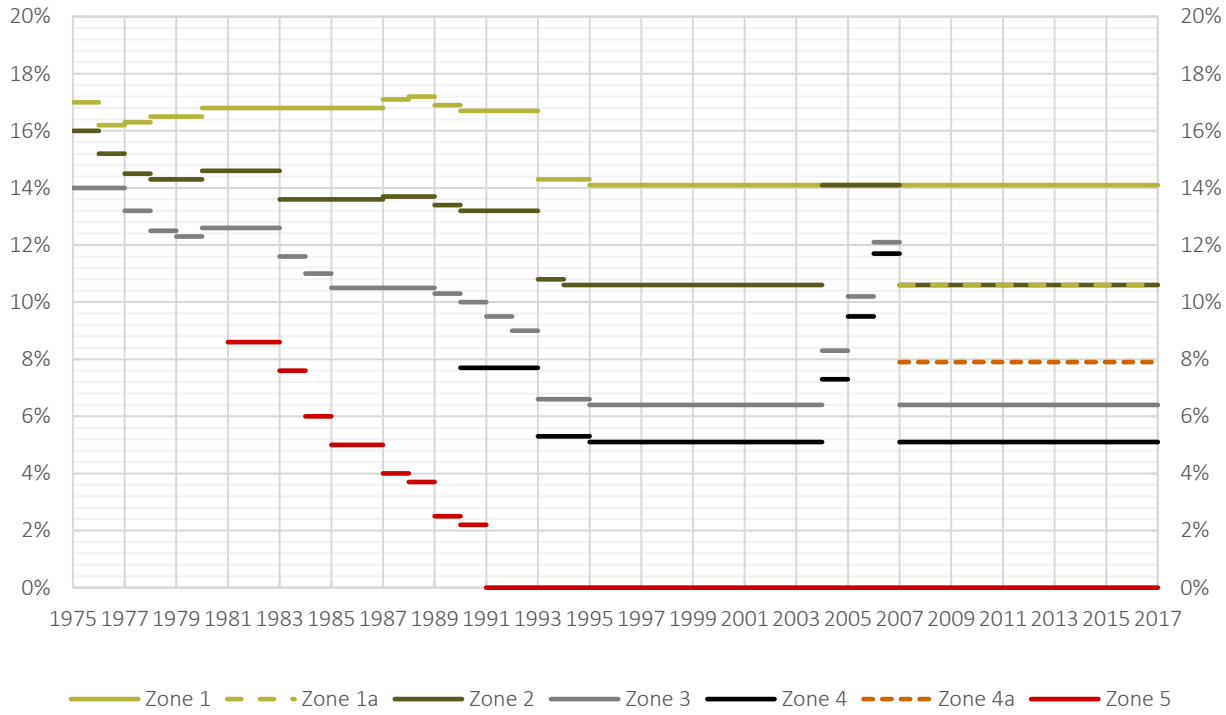
Figure 2.5 Estimated loss of revenue (tax relief). NOK billion. Constant 2017 prices. 2000-2018[1,2]



1) Proposal for 2018.
2) Budgets prior to 2004 do not distinguish between loss of revenue from private and public sector.
Source: Ministry of Local Government and Modernisation (annual budget proposals)

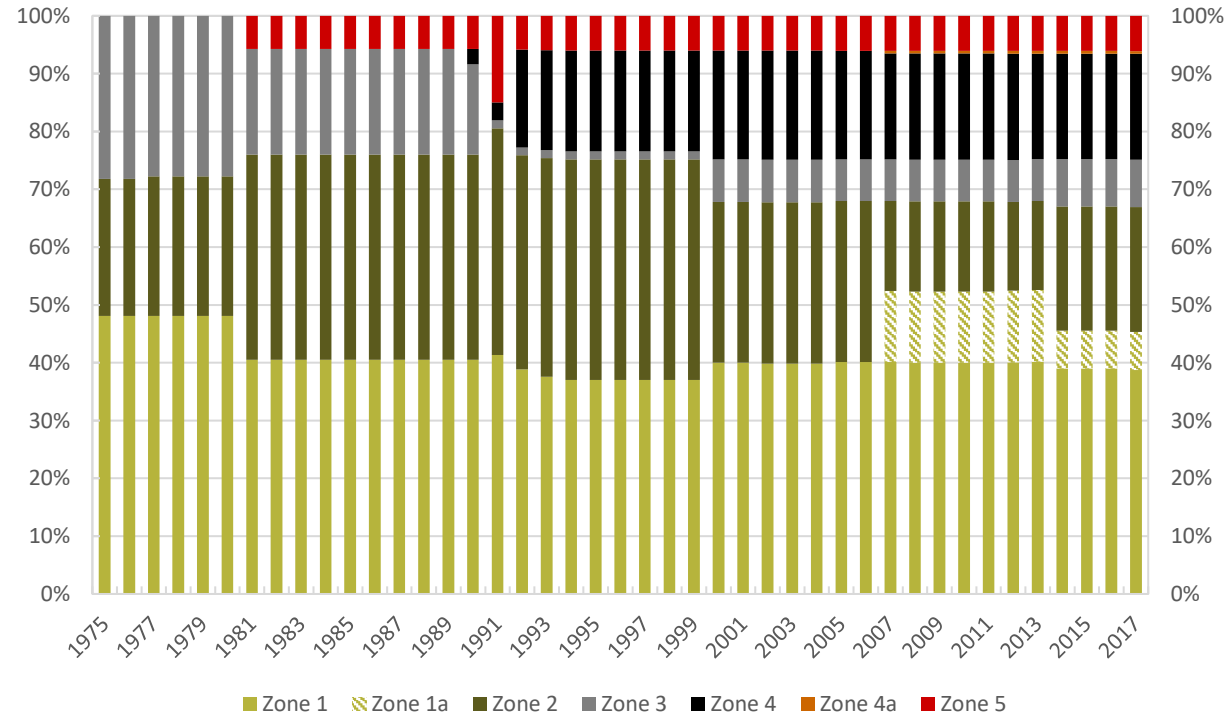
[12] As of 1 January 2018, firms operating within the transport and energy sector are eligible for reduced tax rates.
[13] As defined in Annex IV of Guidelines on regional State aid for 2014-2020 (p. 43). For the purpose of the evaluation we have defined the steel sector as NACE Rev. 2 group 24.1.
[14] As defined in Annex IV of Guidelines on regional State aid for 2014-2020 (p. 43). For the purpose of the evaluation we have defined the synthetic fibres sector as NACE Rev. 2 groups 13.1, 13.2 and 13.3.
[15] NACE Rev. 2 classes 49.100, 49.200, 49.311, 49.312, 49.391, 49.392, 49.393, 49.410, 50.101, 50.102, 50.109, 50.201, 50.202, 50.203, 50.204, 50.300, 50.400, 51.100, 51.210
[16] See Guideline on regional State aid for 2014-2020 (p. 3).
[17] NACE Rev. 2 division 35
[18] NACE Rev. 2 division 64, 65 and 66 (Section K)
[19] Undertakings performing intra-group activities and whose principal activity fall under NACE Rev. 2 classes 70.10 or 70.22
[20] This may be likely in the long run; those who lose their jobs due to closures or downsizing get another job. In the short run, however, unemployment might result in lower tax revenues than what would be the case if all existing firms paid a tax rate of 14.1 pct. for all existing employees.

Figure 2.6 Payroll tax rates by tax zone. 1975-2017



Note: Zone 1a was introduced in 2007 with the same tax rate as Zone 2 up to a threshold (see Figure 2.8).
Source: Statistics Norway

Figure 2.7 Share of municipalities by tax zone. 1975-2017



Source: Statistics Norway

2.3 Changes in the scheme

Effective from 1 January 1975, the payroll tax was differentiated in three zones with tax rates varying from 14 pct. in Zone 3, 16 pct. in Zone 2 to 17 pct. in Zone 1. The tax rate per employee was initially dependent on where the employees lived. Thus, firms hiring from different tax zones, faced different costs on potentially equal labour.

A fourth zone (which today is Zone 5) was added to the scheme in 1981, with a tax rate of 8.6 pct. The tax rate was gradually reduced in this zone, and in 1990 another tax zone was added with a tax rate between Zone 3 and (the now) Zone 5 (cf. Figure 2.6). From 1991 the tax rate in Zone 5, also called the "Action Zone", has been zero. The Action Zone covers all municipalities in the county of Finnmark in addition to seven municipalities in Nord-Troms (i.e. the northernmost part of Norway, marked in red in Figure 2.9).

From 1990 to 2007 municipalities were divided into five different payroll tax zones.[21]

In 1993, an additional tax was introduced for all employees with earnings exceeding 16 times the basic amount in the National Insurance Scheme (16G).[22] When introduced, this tax rate was 10 pct. on the amount above 16G, regardless of tax zone. It was increased to 12.5 pct. in 1998. This scheme lapsed in 2006.

In 1999, the EFTA Court ruled that regional differentiated social security contributions implied illegal state aid. However, later that year, following several changes, ESA approved the Norwegian scheme, partly due to a flexible interpretation of rules for transportation support in ESA and the Commission's regional aid guidelines. In 2000, the justification of the scheme was changed to supporting firms through reduced payroll taxes to compensate for travel distance in sparsely populated areas. The scheme was thus considered to be operating aid in accordance with the EEA State aid rules and approved as an indirect transport aid scheme.

Effective from 1 January 2000, further changes in the scheme led to 53 municipalities changing tax zone. In total 39 municipalities faced lower tax rates (most of them moving from Zone 2 to Zone 3), whereas 14 municipalities moved to a zone with higher rates (from Zone 2 to Zone 1).[23]

In 2002 new rates were introduced for employees who were 62 years and older and who were obligated to pay taxes. This was put in place to stimulate employment of workers who might otherwise retire. It was, however, removed in 2007.

The tax rate increased in Zone 2, 3 and 4 for a short period in 2004-2006 due to EEA regulations. However, in 2006 EFTA adopted new Regional Aid Guidelines, which gave greater flexibility to grant state aid in the least populated regions (EFTA Surveillance Authority 2006). Hence, payroll taxes were again decreased in the three zones in 2007. In addition, the scheme was extended to seven zones (adding Zone 1a and 4a).[24]

During the period of increased tax rates between 2004 and 2006, firms in the affected tax zones only

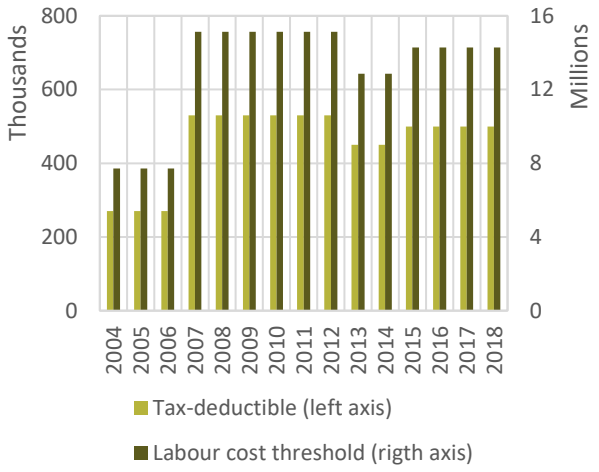
[21] We have omitted to elaborate on a temporary experiment with six tax zones in 1990 and 1991. This has no practical meaning for the review of the scheme or the empirical analysis. Norwegian readers are referred to Helde (1998) for an elaboration of this period.
[22] Equalled 16 x NOK 37 300 (yearly amount) in 1993.
[23] This reform is described in more detail in our empirical approach in Chapter 4.1.
[24] This reform is described in more detail in our empirical approach in Chapter 4.2.

faced the higher tax rate on labour cost above a threshold. This still applies for firms in Zone 1a. That is, when labour costs exceed the threshold, the firm faces a higher tax rate on the amount above the threshold. In 2018 the tax-deductible amount is NOK 500 000, which corresponds to following labour cost threshold

$$lcost \geq \frac{500\,000}{0.141 - 0.106} \cong 14.3\ mill.$$

There have been several changes in the labour cost threshold since 2004 (cf. Figure 2.8).

Figure 2.8 Tax-deductible amount and corresponding wage cost threshold. 2004-2018



Source: The Norwegian Tax Administration

From 1 January 2007, the determination of the employees' payroll tax rate changed from their place of residence to the location of the firm.

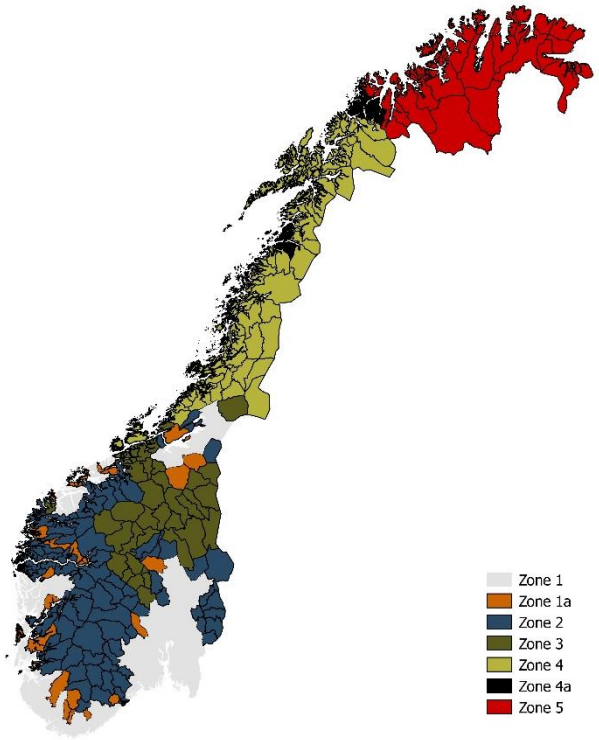
Further changes were made in July 2014, relocating 31 municipalities to zones with reduced tax rates. In addition, selected sectors and activities, regardless of municipality, were no longer eligible for aid under the scheme (EFTA Surveillance Authority 2014). These changes still apply. They are, however, not part of the current evaluation due to data limitations.

2.4 Seven different tax zones

Since 2007 Norway has been divided in seven different tax zones (cf. Figure 2.9). The designation of eligible areas is guided by the principles that (i) the relevant region should face a real need for regional aid and that (ii) regions facing similar challenges should be treated equally (EFTA Surveillance Authority 2014).

Though the eligible municipalities account for more than half of all municipalities, they only account for one fifth of the population. Further, the tax zones consist of municipalities which vary greatly in both size and development in central characteristics such as population and employment. To assess a municipality's degree of regional disadvantages, the authorities has developed a *periphery index*.

Figure 2.9 Municipalities by payroll tax zone. 2018



Source: Statistics Norway
Map: ©Kartverket

The Ministry of Local Government and Modernisation revised the periphery index in 2018, which now comprises three indicators intended to reflect geographical disadvantages and societal challenges resulting from these disadvantages; the municipality's centrality index captures the geographic disadvantages, whereas growth in employment (economic growth) and population growth (demography) captures societal challenges (Ministry of Local Government and Modernisation 2018).

The next sections discuss some important characteristics of the seven tax zones briefly, including the indicators behind the periphery index.

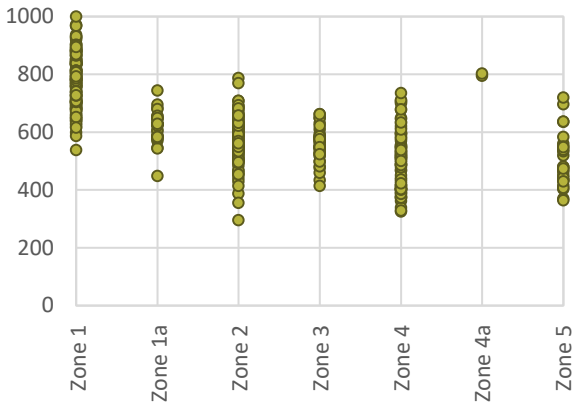
2.4.1 Geographic disadvantages

Geographic disadvantages are associated with small local and regional labour and service markets with long distances to larger and more specialised markets. These disadvantages are captured in the so-called centrality index, which is calculated based on the number of workplaces and different service functions that can be reached by car within 90 minutes (Ministry of Local Government and Modernisation 2018, Høydahl 2017).

The centrality index takes on values from 295 to 1,000 along a continuous scale, where the most central municipality (Oslo) is assigned the highest value.[25] In the calculation of the periphery index, the centrality index is given the most weight (60 of 100).

Municipalities in Zone 1 faces the general payroll tax rate of 14.1 pct. and is outside the geographical scope of RDSSC. However, measured by the centrality index, several of these municipalities faces the same geographical disadvantages as municipalities covered by the scheme (cf. Figure 2.10).

Figure 2.10 Municipalities by payroll tax zone and centrality index. 2017



Source: Statistics Norway

Given the high weight on centrality, the distribution of municipalities along the periphery index is almost identical to the distribution of municipalities along the centrality index (only scaled from 0 to 100). Thus, municipalities in different tax zones may have the same periphery index. However, the periphery index is mainly used to assess regional disadvantages and is not the only determinant of the municipalities' tax zone. Another important parameter when determining the eligible geographic areas is, according to ESA's Regional Aid Guidelines (RAG), population density (EFTA Surveillance Authority 2014).

2.4.2 Population growth and density

The objective of the scheme is to reduce or prevent depopulation in the most sparsely populated regions in Norway. Municipalities facing the general payroll tax rate of 14.1 pct. (Zone 1) covered 78 pct.

[25] In theory the index can go from 0 to 1,000.

of the Norwegian population in 2014 (the last year in our evaluation period), whereas slightly less than 2 pct. of the population lives in Zone 5, where the payroll tax rate is zero (cf. Table 2.1).[26]

Table 2.1 Population growth and density in the seven different tax zones

Zone	Share of population 2014	Population density 2014	Annual population growth 2004-2014
Zone 1	78.0 %	78.6	1.4 %
Zone 1a	2.8 %	9.4	0.6 %
Zone 2	6.7 %	4.7	-0.1 %
Zone 3	2.1 %	2.5	-0.3 %
Zone 4	6.2 %	5.1	0.0 %
Zone 4a	2.4 %	32.0	1.4 %
Zone 5	1.8 %	1.7	0.2 %
Norway	100 %	16.9	1.1 %

Note: Population density measured as people per square kilometre of land area. Annual population growth is calculated as average annual growth in total population within each zone.
Source: Statistics Norway

Apart from Zone 4 and 4a, the tax rate corresponds to the tax zones' population density, i.e. the tax rate is lower in zones with lower population density. Zone 4a has the second highest population density, though the tax rate is lower than in both Zone 1a and 2. Zone 4a consists of only two municipalities (Tromsø and Bodø), both of which are larger cities (in Norwegian context). However, they are both surrounded by more sparsely populated areas and it is argued that a higher tax rate in Tromsø and Bodø could have undesirable effects on the neighbouring regions (Ministry of Finance 2014). Municipalities in Zone 4 are characterised by their remoteness from central markets and travel distance to Oslo.

The overall population density in Norway is a little over 17 people per square kilometre, which underlines that large parts of Norway is not populated.

All tax zones but Zone 3 has experienced positive average annual population growth the last decade (cf. Table 2.1). This tax zone covers the most peripheral areas of Southern Norway and is largely consisting of mountain areas (Ministry of Finance 2014).

2.4.3 Employment and wage growth

Employment (measured by place of work)[27] is distributed between the seven tax zones with similar shares as the population. The share of employees in Zone 1 is almost identical with the zones' share of the population, i.e. almost eight out of ten jobs are in Zone 1.

The variation in employment growth between the different tax zones is somewhat smaller than the variation in population growth (cf. Table 2.2). Average annual employment growth was 1.5 pct. in the period 2004-2014.[28] Employment growth is highest in the most central tax zones, including Zone 4a (covering the two cities Tromsø and Bodø). There is a clear relationship between employment and population growth, though there is no clear answer to whether people follow jobs or the other way around (see Chapter 5).

Hourly wages are highest in the most central tax zones. This may be explained by the fact that people with high levels of education, and hence relatively high wages, tend to be attracted to cities with

[26] These shares are almost identical in 2018.
[27] To give an indication of the number of existing jobs in the various tax zones.
[28] Starting in 2015, the employment statistics are based on new data. Thus, employment figures are not comparable before and after this change.

urban qualities. These mechanisms are discussed in more detail later.[29]

Table 2.2 Employment and wage growth in the seven different tax zones

Zone	Annual employment growth 2004-2014	Average hourly wage growth 2004-2014	Mean unemployment rate 2004-2014
Zone 1	1.7 %	4.3 %	2.0 %
Zone 1a	1.6 %		1.6 %
Zone 2	0.3 %	4.3 %	1.7 %
Zone 3	0.6 %	4.3 %	1.4 %
Zone 4	0.7 %	4.4 %	2.0 %
Zone 4a	1.4 %		1.9 %
Zone 5	0.8 %	4.9 %	2.8 %
Norway	1.5 %		2.0 %

Note: Population density measured as people per square kilometre of land area. Annual employment growth is calculated as average annual growth in total population within each zone. Growth in hourly wages is based on the sample used in Chapter 4.3 (Zone 1a and 4a did not exist in 2004). Unemployment is calculated as total number of unemployed (15-74 years) divided by total population (15-74 years) in each zone.
Source: Statistics Norway

Wages in Norway is to a large degree determined through centralised negotiations, which is reflected in the small differences in wage growth between the different tax zones. However, Zone 5 (with zero payroll tax) differs somewhat from the other zones. Employees in Zone 5 has had the highest growth in average (and median) hourly wages (for full-time employees) in the period 2004-2014 (cf. Table 2.2).

There is no systematic pattern in unemployment, considering the tax rates the different zones are facing. Zone 5 has the highest share of unemployed and higher than the overall unemployment rate (cf. Table 2.2). Apart from Zone 1 and Zone 1a, unemployment has decreased in all tax zones after the global financial crisis. Some of the rise in unemployment rates in the two former zones may be explained by immigration and national migration patterns.

2.4.4 Establishments

Jobs can be created by expanding existing firms or establishing new firms. Establishments is highly concentrated in Zone 1 (cf. Table 2.3). About 80 pct. of new firms are established in Zone 1, of which almost 40 pct. are established in Oslo and Akershus.

Table 2.3 Establishment of firms in the seven different tax zones

Zone	Establishments 2014	Annual growth in establishments 2004-2014
Zone 1	48,312	2.4 %
Zone 1a	1,270	1.9 %
Zone 2	3,090	2.5 %
Zone 3	802	1.1 %
Zone 4	2,726	2.0 %
Zone 4a	1,230	2.3 %
Zone 5	744	1.5 %
Norway	58,174	2.3 %

Source: Statistics Norway

All tax zones, as well as most municipalities within the zones, has experienced growth in the number of new firms between 2004 and 2014. Zone 4a, facing a tax rate of 7.9 pct., has experienced growth on level with Zone 1 in which firms face the general tax rate of 14.1 pct. However, it is worth noting that most newly established firms do not have employees and therefor do not pay payroll taxes, regardless of tax zone.

It is further worth mentioning that for most figures discussed above there is variation (sometimes significant) between municipalities within the same tax zone.

[29] Chapter 5 discusses the dynamics of regional population growth.

3 Theoretical framework

Under the assumption of perfect competition, including no economies of scale, prices of tradable products and mobile factors of production will be equal everywhere.[30] Conversely, the prices of products and factors of production that are not mobile may wary between different geographical locations. The economy is characterised by optimal allocation of resources, i.e. there will be nothing to gain from reallocating resources within existing production processes, to production of other goods or services or to other regions.

In practice, the mobility of labour is limited, while capital mobility is high, especially in the long run. In Norway, wages are to a large extent determined in centralised wage negotiations. This leads to a relatively high degree of wage equalisation for equal work between geographical regions. Thus, wages (and prices of capital) will not perfectly reflect the scarcity of production factors. This may lead to higher wages and lower employment than what is implied by "the free market solution". This could typically be the case in more remote areas with small labour markets and/or a one-sided industrial base.

Demand for labour will in general depend on the profitability of the firm, not the overall social welfare. From the firm's point of view, it is profitable to employ labour up to the point where the value added of the last hour worked equals the hourly wage. The firm's volume of production and composition of labour and capital in the production depend on input prices (wages and interest rates) and on the marginal income (which depends on the properties of the demand curve facing the firm). When the relative prices of factors of production is changed, e.g. due to lower payroll taxes, the firm's optimal decision is changed, and could thus be changed towards the solution one would get without centrally determined wages.

A widely used argument against labour subsidisation is that it ultimately leads to lower capital intensity, which in turn leads to lower productivity and, in the longer term, welfare losses. However, in the case with centralised wage bargaining the effect of reducing local labour cost is to counteract deviations between market earnings and actual wages that exists in the first place. By reducing labour cost through reduced payroll tax, the difference between the national wage and the locally optimal wage can be removed, which in turn leads to a more optimal resource allocation, e.g. higher employment. However, the strength of this (direct) effect on employment depends on to what degree the reduction in labour cost is transferred to higher wages.

The regionally differentiated payroll tax in Norway was introduced in line with economic theory, showing that labour subsidies would be better suited than capital subsidies to stimulate regional employment in an economy with high capital mobility, low labour mobility and a national collective wage bargaining system.

In the following, we will discuss theoretically how employment and wages may react to a change in the pay roll tax under alternative assumptions. We use a stylised framework suited to illustrate the main mechanisms at work.

From the theoretical discussions below, we derive several hypotheses we wish to test in our empirical analysis in Chapter 4, i.e. effects of changes in the

[30] See footnote 2.

payroll tax on wages, employment, capital services, value added and establishment of firms (and exits).

3.1 Demand for labour

Standard textbook micro economics, assuming all firms are profit maximising and can employ as many workers as they wish at the going market wage rate, implies that a relative reduction in the price of a factor of production will increase a firm's preferred use of this factor. This is easily demonstrated in the case of a firm utilising two inputs (without loss of generality), labour and capital. If the payroll tax is reduced, so is the cost of labour (relative to capital), and firms will switch towards a more labour-intensive production. The effect on capital demand is not so clear; it is determined by the net effect of a positive income effect (with lower labour costs the firm can increase production and, thus, the use of capital without increasing total costs) and a negative substitution effect (capital has become relatively more expensive than labour). The net effect on capital is therefore an empirical question.

Three simplified, yet enlightening, examples from economic theory are: (i) if an increase in the price of one factor of production leads to an increase in the use of the other, ceteris paribus, we say that the factors have positive cross-price elasticity and are *alternative factors of production* or *substitutes*; (ii) if an increase in the price of one factor leads to a reduction in the demand for the other, the two factors have a negative cross-price elasticity and are *complementary factors of production*, i.e. the factors are mutually dependent in the production; (iii) if the price of one factor changes without any impact on the demand for the other, the factors are said to be *independent*.

Following these examples, the net effect on the demand of capital, from a reduction in the labour cost, is positive if the two factors are complementary factors of production. That is, the production requires an increase in capital along with the increase in the use of labour.[31]

In addition to the case of complementarity, market imperfections could lead to increasing capital investments from reduced payroll taxes. If a firm wishes to increase production when the labour cost is reduced, but additional labour is not available, investing in labour saving technologies could be an option. Another possibility is that credit restrictions have been limiting the firm's investment possibilities, and that a lower payroll tax releases funding for capital investments.

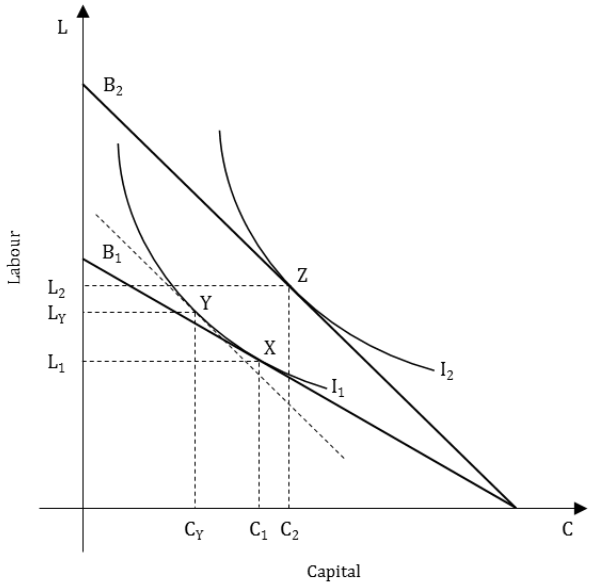
The different effects of a change in price of labour is illustrated in Figure 3.1. The initial (optimal) composition of labour and capital of a firm is given by point X, where the budget constraint (line B_1), indicating feasible combinations of labour and capital at a given cost, and the isoquant (curve I_1), indicating all factor combinations that produce the same amount of product, are tangent. In this case the optimal level og labour and capital is L_1 and C_1, respectively.

A reduction in the pay roll tax implies that the firm can employ more labour without increasing costs, and the budget constraint shifts to B_2. If the firm, however, keeps production at the same level as before the reduction in the payroll tax, i.e. reduce their

[31] The net effect can also be positive in a case of alternative factors of production if the positive income effect outweighs the negative substitution effect.

costs for a given production, the new budget constraint is illustrated by the dashed line B_Y, with the same slope as B_2.[32] Then the optimal use of labour and capital would be where B_Y is tangential to I_1 (point Y), i.e. increasing the use of labour to L_Y and reducing the use of capital to C_Y. This is the *substitution effect*; capital is relatively more expensive and the demand for capital is reduced.

Figure 3.1 Demand for labour and capital. Income and substitution effects of reduced labour costs



The *income effect* follows from the budget constraint moving outwards, indicating the new feasible level of production (I_2) with the same costs as before the change in the payroll tax. The new budget constraint (B_2) if tangent with I_2 at point Z, and the new composition of labour and capital is indicated by L_2 and C_2, respectively. Note that the net effect on capital is positive in this case. This follows if the income effect is greater than the substitution effect, which need not be the case.

The effect on labour demand of lower labour costs is always positive. This may also be illustrated by a downward sloping demand curve in a wage-labour diagram (see Chapter 3.3). In an "opposite" case of reduced cost of capital (e.g. due to capital subsidies), there would be an unambiguously positive effect on capital and an undecided net effect on labour.

The magnitude of the effects depends on the slope of the budget constraints, i.e. the relative price of labour and capital, the size of the price change and the shape of the isoquant. The latter is determined by the degree of substitutability between the two factors of production.

3.2 Supply of labour

In the previous section, we discussed the demand for labour and capital (in partial equilibrium). To illustrate the total effect on a regional labour market of a change in relative factor prices, we need to introduce the supply side. Standard microeconomic theory for the labour market assumes that people are rational and maximise their utility in a trade-off between positive preferences for leisure and income resulting from time spent working. If the income is spent in full on consumption, the trade-off is between leisure and consumption.

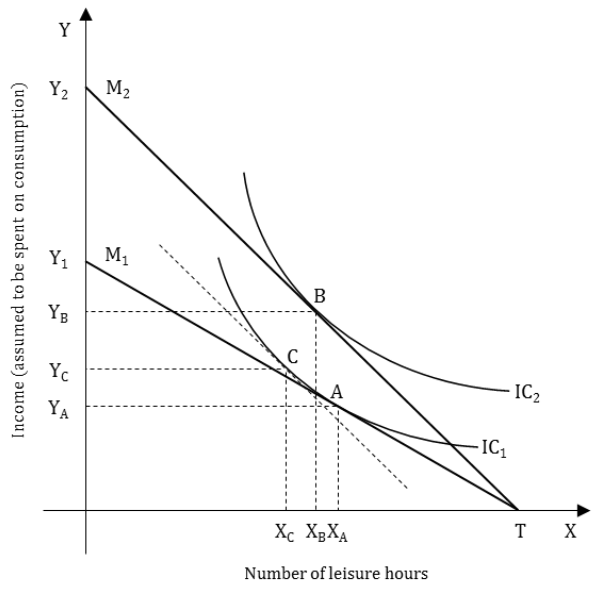
This is illustrated in Figure 3.2, where the line M_1 represents the initial budget constraint; if every hour is spent on leisure there is no consumption and, conversely, consumption is maximised if all hours are spent working. Every additional hour of leisure must be met by an equal reduction in hours worked

[32] The slope of the budget constraint equals the ratio between the prices of the two input factors, i.e. the market-exchange ratio between labour and capital.

and a corresponding loss of income (and consumption). All combinations of leisure and consumption generating the same level of utility is represented by an indifference curve, where IC_1 is the indifference curve defining maximum achievable utility given the budget constraint M_1.

The initial utility maximising combination of leisure and consumption is defined by point A, giving leisure X_A and consumption Y_A. If a reduction in the payroll tax is partly passed over to increased wages, possible consumption with no leisure increases from Y_1 to Y_2, as income increase. The new budget constraint (M_2) is tangent with an indifference curve with higher utility in point B. Again, the move from A to B can be decomposed in two separate effects, an income effect and a substitution effect.

Figure 3.2 Supply of labour. Income and substitution effects of increased wage



The substitution effect is illustrated by the dashed line, tangent with the initial indifference curve (IC_1) in point C. The corresponding levels of leisure and consumption, X_C and Y_C, is the optimal allocation with a higher wage, but keeping the utility at the same level as before the change in the wage. With a higher hourly wage rate, each hour with leisure is now relatively more expensive than before (the alternative to one hour of leisure is one hour of work with a higher wage). Thus, the substitution effect is negative ($X_C < X_A$). However, with a higher wage it is possible to increase the utility without increasing the number of hours worked. This is the income effect (parallel shift of the dashed line to point B).

With an increase in the wage rate, the net effect on consumption is unambiguously positive; income is higher for all possible choices of hours worked. In the case drawn in Figure 3.2 the net effect on leisure (work) is negative (positive), compared to the initial adjustment (point A). As discussed in the previous section, this may not be the case. Thus, the net effect on labour supply of a wage increase is uncertain.

Individual supply curves may, under standard assumptions, be aggregated to a macro supply function. Given that the substitution effect is greater than the income effect (as above), the aggregated labour supply curve is upward-sloping in a wage-labour diagram (cf. Figure 3.3).

3.3 Market equilibrium

In this section we combine the labour demand and supply from the two previous sections in a labour market model to illustrate the total effect on employment and wages of a reduction in the pay roll tax, as well as how the effect may depend on the demand and supply elasticities (i.e. the slopes of the two curves).

With a strictly negative relationship between wage costs and demand for labour (labour demand decreases with increasing wages), the demand curve (D) is downward-sloping in a wage labour diagram

(cf. Figure 3.3).[33] The less sensitive – or inelastic – demand is to a change in wages, the steeper the slope of the demand curve.

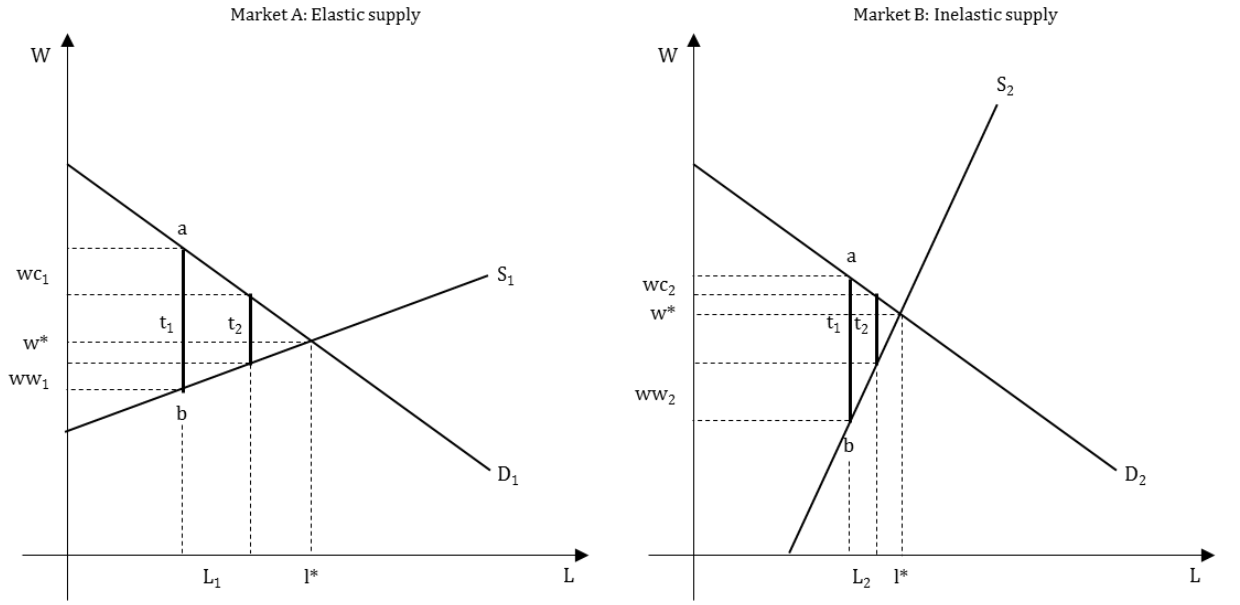
Assuming labour supply increases with an increase in real wages (as shown in the previous section), the labour supply curve is upward-sloping. The slope of the curve is determined by the labour supply elasticity.

In equilibrium, demand equals supply. For a given demand curve, the equilibrium wage depends on the elasticity of labour supply, as illustrated in Figure 3.3. In market A, supply is relatively elastic, i.e. a wage increase causes a relatively large increase in the supply of labour. In contrast, market B illustrate the case of inelastic supply, where a wage increase lead to a relatively small increase in the supply of labour.

In both markets, the market clearing wage is indicated by w^*, with corresponding employment l^*. To illustrate possible effects of a reduction in the payroll tax on both wages and employment, we start with an initial payroll tax equal to t_1. At this tax rate the demand curve is shifted downwards (not shown in the graphs) and intersect the supply curves in point b. The wage payed to the employees is given along the y-axis by the dashed line from point b and supply of labour, at this wage, along the x-axis in the same point. Both the wage payed to the employees and the supply of labour is lower than without a payroll tax. The employers' wage cost is, however, higher than w^*, given along the y-axis by the dashed line from point a.

The tax wedge after a reduction of the pay roll tax is illustrated by t_2. The resulting increase in employment in the two segments are shown by L_1 and L_2, respectively. With an equal change in the payroll tax

Figure 3.3 Labour market equilibrium with different supply elasticities



[33] Strictly negative implies that the effect on labour demand of increased wages cannot be zero.

(from t_1 to t_2) and a given demand, the employment effect depends on the elasticity of supply and is larger in market A where supply is more elastic, i.e. where supply is more price sensitive.

With elastic labour supply, most of the tax incidence resides with the employers, i.e. the difference between the market clearing wage and the wage cost, including payroll tax, is larger than the difference between the market clearing wage and the wage payed to the employees. With inelastic supply it is the opposite. Thus, for a given change in the payroll tax, the reduction in wage cost per unit of labour (given by the distance wc) is larger and the increase in wage payed to employees per unit labour (ww) smaller in market A than in market B.

The elasticity of demand (the slope of the demand curve) could, off course, also vary. One can imagine that demand for workers with high education and skills could be relatively inelastic, assuming it is harder to substitute high-skilled labour with low-skilled workers or machines (capital). This illustrates the importance of the industrial base for the effect of a change in the payroll tax. A steeper demand curve (inelastic demand) would lead to a lower employment effect, smaller increase in the after-tax wage payed to the employees and larger reduction in the employer's labour costs per unit of labour.

To sum up, the model above illustrates effects under the idealised conditions of perfect competition and predicts a positive effect on employment and wages of a reduction in the payroll tax. The magnitude of the effects depends on the elasticity of supply (and demand), which may vary between different segments of the labour market and regions. In regions where labour supply is inelastic, reduced pay roll tax would be a less effective measure to increase employment.[34]

3.4 Effects with centralised wage negotiations

The Norwegian labour market differs significantly from the case of perfect competition, as depicted above, which does not fully consider modifications caused by centralised wage negotiations. This is non-negligible as close to half of Norwegian workers are organised (see NOU 1996: 9 for a discussion). It is likely that a reduction in the pay roll tax is more efficient when wage negotiations are centralised (Cappelen and Stambøl 2003, Bennmarker, Mellander and Öckert 2009).

A region-specific reduction in the pay roll tax will to a lesser extent lead to a region-specific wage increase when wage growth is regulated by centralised agreements. Lower wage costs increase competitiveness and makes it possible to increase production and the use of relatively less expensive factors of production, in this case employment. This may explain why empirical studies tend to find higher employment effects in the Nordic countries, and in Norway in particular. Alternatively, the firm could use the gain from reduced labour costs in local wage negotiations to attract more high-skilled workers.

With nationally determined wages, there may be regional discrepancies between supply and demand for labour. Figure 3.4 illustrate two such cases; one with a regional supply surplus (i.e. regional unemployment) and one with a regional demand surplus (labour shortage). The nationally determined wage W^N is higher than the market clearing wage in panel

[34] With inelastic supply more of the tax reduction is shifted on to higher wages, which in turn may have an indirect effect on labour demand through increased household demand for goods and services. This is discussed in Chapter 3.5.

A (representing rural regions). Conversely, in central regions (panel B) the market clearing wage is higher than W^N. Differences in productivity, e.g. due to long travel distances in sparsely populated region, may explain the differences in the market clearing wage in the two regions, all else equal.

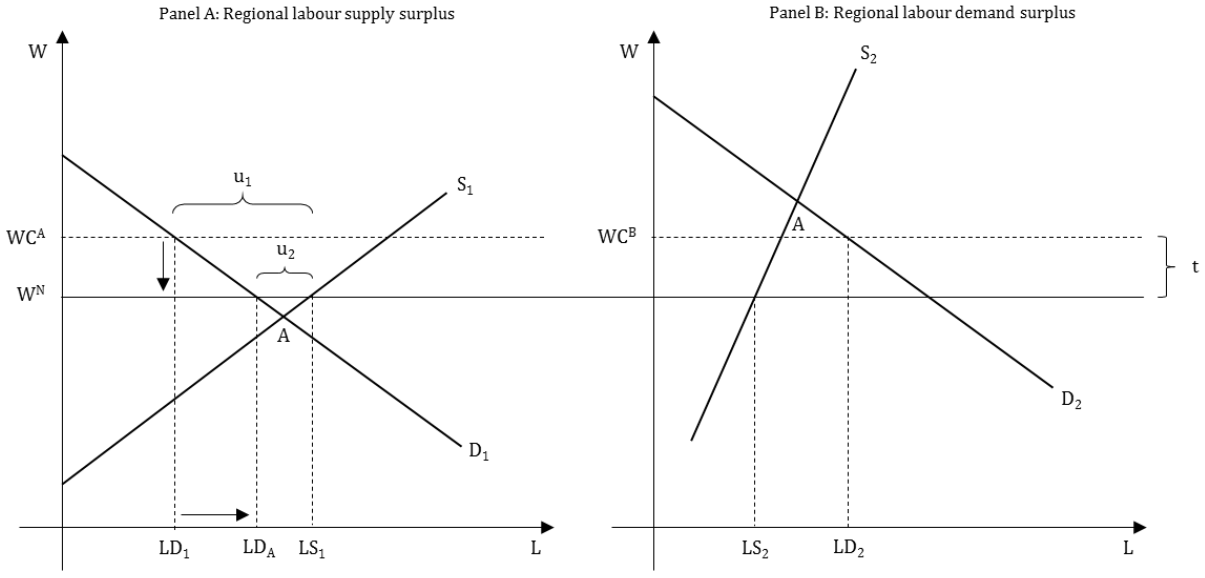
With equal payroll tax, t, in both regions the wage cost per unit of labour is WC. A national set wage above the equilibrium wage leads to regional unemployment in rural regions, irrespective of the size of the payroll tax (here illustrated by $LS_1 > LD_1$). In the opposite case it is created an excess demand for labour ($LS_2 < LD_2$), as in panel B. With a high enough payroll tax, the excess demand will diminish (a tax such that $LS_2 = LD_2$).

Panel A illustrates the initial situation in the rural region, with nationally fixed wages and the *short run effects* of a reduction in the payroll tax. The supply and demand curves represent *existing* workers and firms, respectively. Prior to the reduction in the payroll tax, unemployment is given by the gap between regional supply (LS_1) and demand (LD_1) of labour, equal to u_1. Removing the payroll tax reduces the labour cost per unit of labour from WC^A to W^N (i.e. labour cost equals the wage payed to the employees).[35] With the decrease in labour cost, labour demand increases to LD_A and unemployment decreases to u_2.

In the central region the payroll tax remains unchanged and in the short run, nothing changes. Thus, reducing the payroll tax only in the market where the national determined wage exceeds the market clearing wage, increases total welfare compared to the situation with equal tax rates in both regions.[36]

The above is somewhat hypothetical. Wages are, in most cases, a result of both central and local wage

Figure 3.4 National wages and heterogenous labour markets



[35] Assuming the only difference between labour cost and wage per unit of labour is the payroll tax.

[36] Reducing the payroll tax with an initial demand surplus will only increase the surplus.

negotiations, allowing for regional deviations and reduction in regional unemployment without reduction in the payroll tax. Furthermore, the above discussion is concentrated on short run effects. In the longer run demand for labour could increase through new and in-migrating firms. On the supply side, growing in-commuting and in-migration must be considered in the longer term and inactive people may become active. Long run effects are discussed in more detail in the following section.

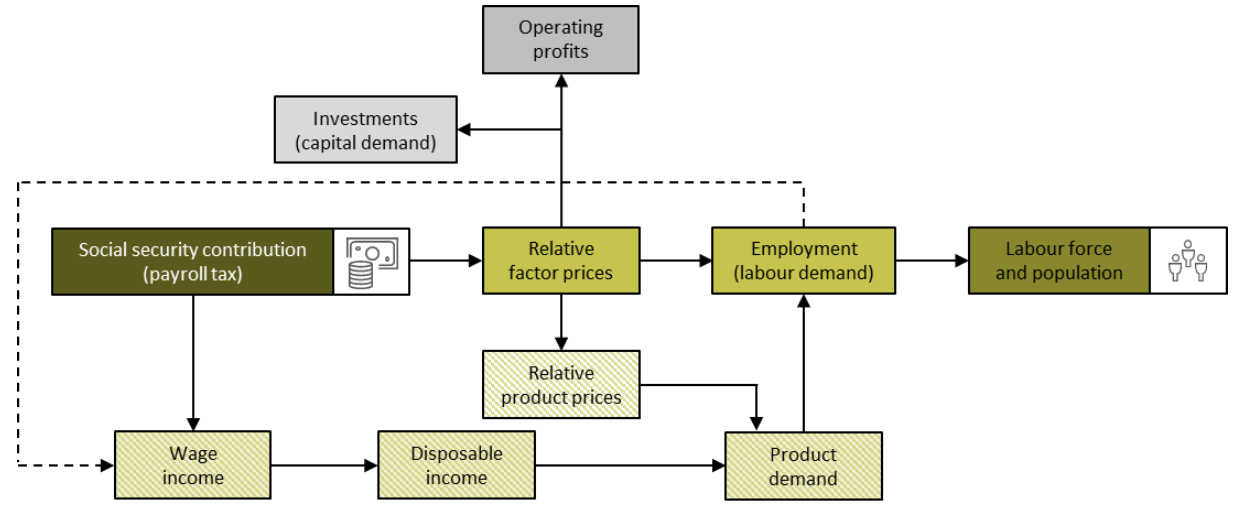
3.5 Time and direct versus indirect effects

In the short run employees' bargaining power may be weak and the main effect of a reduction in the payroll tax is likely reduced labour costs. If so, the effect on employment is likely to be relatively strong in the short run as well. However, both theory and empirical results on a national level show that, over time, bargained wage increases will counteract the initial effect of a reduced tax rate and one may experience little, or even no, direct effect on employment.

Lack of direct effects on employment does not mean that total (regional) employment cannot increase. Higher disposable income (through higher wages) for those already employed is likely to increase their demand for (locally produced) goods and services.[37] Thus, higher wages may indirectly affect employment. A reduction in factor prices may also lead to increased operating profits, trigger new capital investments and dividends (cf. Figure 3.5). If we assume that both capital and workers are mobile, though not instantaneously, relocation of firms (and workers) to regions with lower payroll tax may also give a long-term (positive) effect on employment.

There may also be additional positive effects on employment. So far, we have assumed price taking behaviour. Realistically, most industries are characterised by a degree of monopolistic competition. In that case firms will respond to a reduction in factor prices by a certain reduction in product prices, leading to increased demand for their products. According to economic theory, monopolistically competitive firms

Figure 3.5 Direct and indirect effects of a change in payroll taxes



Source: Samfunnsøkonomisk analyse AS

[37] Assuming the number of hours worked stays constant despite higher wages.

normally respond to increases in demand by increasing their demand for employment and other inputs.[38]

If reduced payroll tax leads to higher employment and lower capital intensity than the optimal market solution, a too low capital intensity is associated with lower productivity and thus a welfare loss.

3.6 A stylised model

To formalise the line of thought above, it may be useful to consider a stylised model for medium-run employment determination, assuming that employment is determined from demand, i. e. that demand for labour is always accommodated by corresponding supply adjusted for wage effects.[39] For that purpose, we define the following textbook system of equations:

$$N = N\left(\frac{W(1+\tau)}{Q}, D\right), \qquad N_1 \leq 0, \qquad N_2 \geq 0 \qquad (3.1)$$

$$D = D\left(\frac{P}{\overline{P}}, Y\right), \qquad D_1 < 0, \qquad D_2 > 0 \qquad (3.2)$$

$$Y = Y\left(\left(\frac{W}{CPI}\right)\gamma N + T\right), \qquad Y_1 > 0 \qquad (3.3)$$

Equation (3.1) gives the conditional demand for labour in the case of monopolistic competition, where N is employment, W is wage earnings per unit of labour, τ is social contribution taxation rate, Q is the price of variable inputs in production[40] and D is product demand. Given the assumption of monopolistic competition, demand is set equal to output.

The second equation, (3.2), is a product demand function with conventional assumptions about the partial derivatives, where P[41] and $\overline{\mathrm{P}}$ is the product price and price on competing products, respectively, and Y is income.

Equation (3.3) is a simple functional relationship for aggregate income in the geographic region we study, where CPI is the consumer price and T is transfers (alternative policy measures). For simplicity, we only consider wage income and transfers. If we apply the framework to a single firm (N is firm employment), total employment is almost unaffected. That is, if only one firm face a reduced payroll tax the effect on employment through income is negligible, hence we set $\gamma \cong 0$. Conversely, if the change in the tax apply to all firms (N is regional employment), $\gamma \cong 1$.

Based on this framework the different effects of a reduction in the payroll tax can be expressed compactly as:

$$\frac{\frac{\partial N}{-\partial \tau}}{} = \frac{-N_1\left(\frac{\partial W}{\partial \tau}(1+\tau)+W\right)\frac{1}{Q} - N_2 D_1 \frac{\partial P}{\partial \tau}\frac{1}{P} - N_2 D_2 Y_1 \frac{\gamma N}{CPI}\frac{\partial W}{\partial \tau}}{1 - N_2 D_2 Y_1 \gamma \frac{W}{CPI}}$$

The first term in the numerator represents the effect of relative factor prices on conditional labour demand (direct effect). The effect is negative if $N_1 < 0$ and is largest in absolute value when wage earnings are unaffected, $\frac{\partial W}{\partial \tau} = 0$. As mentioned above, this is most realistic in the short run.

[38] If demand is not perfectly inelastic.

[39] As shown in Chapter 3.2, the slope of the supply curve is ambiguous, as it depends on the relative strength of the opposing forces of the substitution and income effect. It is common to assume that the substitution effect dominates, leading to an upward sloping supply curve (as discussed). However, for the sake of clarity, we simplify the supply side further in this section.

[40] In this setup we assume that there exist only two inputs of production; labour and another. The number of these may depend on the time horizon of the analysis, e.g. capital being fixed in the short-term analysis but variable in the long-term perspective.

[41] With monopolistic competition P is a function of unit labour costs. For simplicity this equation is left out of the system.

If the tax change is transferred to higher wages, then $\frac{\partial W}{-\partial \tau} > 0$. Theoretically, this may be the case if there is collective bargaining and firms and unions have targets for their respective shares of value added in the firms.

The second and third terms represent the indirect effect on employment through the effect on demand. The second term follows from the assumption of monopolistic competition: monopolistic firms adjust their product price ($\frac{\partial P}{\partial \tau} \geq 0$) to changes in labour costs and consumers change their demand to changes in consumer prices.

The third term in the numerator illustrates that demand is increased if a change in payroll taxes is transferred to wage earnings ($\frac{\partial W}{\partial \tau} < 0$). Hence, the more wage earnings are affected, the more the effect through changes in relative factor prices (the first term) is moderated and the effect through changes in demand (the third term) is amplified.

The denominator is always positive. It is less than one if γ is reasonably large, i.e. a reduction in firms' employment has a numerically significant effect on the region's total employment.

With $\frac{\partial P}{\partial \tau} > 0$ (mark-up price setting due to monopolistic competition), $\frac{\partial W}{\partial \tau} < 0$ (changes in the payroll tax affects wage earnings) and $N_1 < 0$ (the direct price derivative of labour demand is negative) all three terms contribute to higher employment. Even if there are negligible possibilities of substitution, $N_1 \approx 0$ (may be realistic in the short run), there can still be effects on employment stemming from the two channels of increased product demand.

The theoretical framework presented in this chapter helps understanding the central mechanisms and indicate the sign of the effects of a reduction in the pay roll tax on wages and employment (and in some cases a ranking of the effects). The composition of industries, the organisation of the labour market and wage formation in the different regions will affect the efficiency of the tax measure. Thus, based on standard theoretical considerations, we cannot say much about the magnitude of the effects. That remains an empirical question, which we will address in the next chapter.

4 Empirical evidence

Using different well-established econometric approaches, we find evidence that changes in the payroll tax to some degree are shifted onto workers, i.e. changes in the payroll tax affects wages. This holds for both reductions and increases in the tax rate. However, it seems that less of the tax is levied on the employees in the case of an increase in the payroll tax than in the case of a decrease, indicating an asymmetry in adjustments to new tax rates. This is in line with what we would expect, especially in an economy with a relatively high share of organised workers and centralised wage negotiations. Further, the size of the tax incidence residing with the employees seems to be sensitive to sample and model specifications, but in general we find that most of the tax incidence resides with the employer. We further assess how the payroll tax (change in relative factor prices) affects firms' labour demand, value added, capital investments and operating profit. We find a positive effect on firm's demand for labour, but the effects are moderate. Our findings are mostly in line with previous studies of the regionally differentiated payroll tax.

The person who has the legal obligation to make a tax payment may not be the person whose welfare is reduced by the presence of the tax. That is, the economic incidence may differ from the statutory incidence due to changes in behaviour and consequent changes in equilibrium prices (Fullerton and Metcalf 2002). The theoretical discussion in Chapter 3 illustrates how the economic incidence varies with supply and demand elasticities and how effects of changes in the payroll tax may differ between different labour markets (regions).

There is a general expectation that labour demand is more elastic than labour supply. Thus, the most common assumption in applied incidence studies of payroll taxes is that the incidence is borne by the workers (through decreased wages), regardless of who has the legal obligation to pay the tax (i.e. the statutory incidence). If this is the case, there is little reason to believe that we will find effects on employment, precisely because the cost is shifted to the workers, who do not change their behaviour significantly due to their relatively inelastic labour supply.

However, more recent studies find somewhat contradicting results. Saez, Matsaganis and Tsakloglou (2012) use a reform of payroll taxes in Greece to study long-run tax incidence. They find that the employer-paid payroll tax fully resides with the employer, whereas the employee-paid payroll tax resides with the employee. Thus, their results suggest that employers do not pass on the extra cost of increased employer payroll taxes to the employees.

In 2007 (and 2009) Sweden introduced a country-wide lower payroll tax rate for young workers to fight youth employment.[42] A recent study show that the payroll tax rate cut from 31 pct. down to 15 pct. for worker 26 and younger had no effect on net-of-tax wages for the young workers, compared to slightly older (untreated) workers, i.e. no tax shifting on to employees. However, it seems that the reduced tax rate had positive effects on the employment rate of the treated young workers, and larger in places with initially higher youth employment (Saez, Schoefer and Seim 2017).

The statutory incidence of the Norwegian payroll tax is on the employer. Previous studies (e.g. Stokke (2016), Gavrilova, et al. (2017), Johansen and Klette (1997) find some shifting of the tax incidence on to the workers through decreased wages, but not

[42] The scheme was abolished in 2015.

fully. That is, it seems that the employers do take some of the tax burden, at least in the short run. A newly published discussion paper, exploiting the changes in RDSSC in 2004-2006, find that Norwegian firms are only partially able to shift the increased costs from higher payroll tax rates onto workers' wages, and that firms in large respond to the tax increase by reducing employment (Ku, Schönberg and Schreiner 2018).

The objective of the regionally differentiated payroll tax is to reduce or prevent depopulation in the most sparsely populated regions in Norway by stimulating employment. Based on the abovementioned studies, we expect to find effects on employment from changes in the payroll tax rate.

To identify the causal effects of the scheme, we must perform a counterfactual analysis, i.e. compare the actual level of any outcome variable with the level that would have been realised in the absence of the differentiation. Ideally, the counterfactual outcome should be determined by a controlled experiment, randomly dividing the population of firms into different groups facing different tax rates. The effect of a higher (lower) tax rate could then be measured by the difference in response between the groups with increased (decreased) labour costs and the group facing the general tax rate (the placebo group).

A random experiment is obviously not possible. Comparing firms from different tax zones with each other is also far from the golden standard of randomly selected groups. The introduction of different payroll tax rates and their adjustment over time were primarily intended to stimulate employment in rural areas and areas experiencing depopulation. Thus, we cannot use employment growth in tax zones with higher tax rates (experiencing less or no depopulation) to infer how much employment would change in zones with lower rates in the absence of a differentiated payroll tax rate.

In this chapter we seek to overcome these challenges with different econometric approaches to assess the effects of changes in the payroll tax on wages, employment, value added and capital services in existing firms, as well entry and exits of firms. We exploit the three reforms of the scheme that took place in the period 2000-2007 (see Chapter 2.3): (i) we use difference-in-differences to study effects of a lower tax rate for firms in municipalities that changed tax zone in 2000; (ii) we use both difference-in-differences and a regression kink design to evaluate effects of increased payroll taxes in the period 2004-2006; (iii) we exploit all variation in the tax rates following the reform in 2004 and its reversion in 2007 to estimate long-run effects on the demand for labour using a GMM estimator.

The tax rate in Zone 1 and Zone 5 has remained unchanged at 14.1 and 0 pct. throughout our evaluation period, respectively. Zone 1 is outside the geographical scope of the scheme and the lack of variation in the tax rate within this zone is thus not a problem. It is, however, challenging that we cannot identify effects in Zone 5, which is the tax zone with the largest difference between the actual and general payroll tax rate. To meet the latter challenge, we present a descriptive analysis of how removing the differentiation in Zone 5 will affect the firms' operating profits.

Table 4.1 summarise samples, econometric approaches and findings. A detailed presentation is given in the following chapters.

Table 4.1 Overview of the empirical results

				Effects			
Reform	Years	Approach	Sample[1]	Wages	Employment	Capital	Value added
2000: 53 municipalities changed tax zone, of which 34 municipalities from Zone 2 to 3 with reduced tax rate	1997-2003	Diff-in-diffs	All workers and firms in selected municipalities in Zone 2 (control group) and Zone 3 (treatment group)	Significantly higher wage growth in treatment group. Tax shifting onto employees around 24 pct. in the main specification (29 pct. in tertiary sector). The tax incidence residing with the employees varies between 0 and 53 pct. in other specifications.	Positive short-term effect of 3-4 per centage points on employment growth of the reduced tax rate (both on the extensive and the intensive margin). The effect is driven by the tertiary sector.	Positive effects in the secondary sector, dominated by manufacturing.	Some positive effects, similar to the employment effects.
2004: Increased tax rates in Zone 2 to 4 for firms with labour costs above a threshold	2000-2006	Diff-in-diffs	All employees in firms in Zone 2, 3 and 4	Significantly lower wage growth in Zone 2. In Zone 3 and 4 the effect only applies to firms reaching the highest threshold in 2004.	Not assessed.	Not assessed.	Not assessed.
	2004-2006	RKD	Selected firms in Zone 2 and 4	4-17 pct. of the increase in total wage costs is shifted onto workers in Zone 2 and 0.5-4 pct. in Zone 4.	Not applicable (too data demanding).	Not applicable (too data demanding).	Not applicable (too data demanding).
2004 and 2007: Variation in rates following changes in the scheme	2003-2014	FE, BE, GMM	All firms in Zone 1a-4	0-29 pct. of increase in total wage costs is shifted onto workers (0 pct. with FE and GMM, 29 pct. With BE and 8 pct. with OLS).	Long-run labour demand elasticity (on the extensive margin) equal to -1.1	Not assessed.	Not assessed.

1) Detailed descriptions of the samples in the following chapters.

4.1 Evaluation of the reform in 2000

In our evaluation of the effects of the regionally differentiated payroll tax rate, we rely on so-called exogenous shocks, or quasi- experiments, to employ valid research methods and acquire results that satisfy certain methodical standards. One such shock is the change in the scheme that occurred in 2000 (see Chapter 2.3). Effective from 1 January 2000, 53 municipalities were included in different tax zones than prior to the change, facing new tax payroll tax rates. Of these, 32 municipalities were moved from Zone 2 to Zone 3, which meant a reduction in the payroll tax rate, while 14 municipalities were moved from Zone 2 to Zone 1, resulting in an increase in the payroll tax rate. Further, six municipalities moved from Zone 3 to Zone 4 and one Zone 1 to Zone 2.

Table 4.2 Changes in tax zones 1 January 2000

Initial zone	New zone	No. of. municipalities	Change in tax rate (percentage points)
Zone 2	Zone 3	32	-4.2
Zone 2	Zone 1	14	3.5
Zone 3	Zone 4	6	-1.3
Zone 1	Zone 2	1	-3.5

Source: Strøm (2002)

The reform came as a response to a change in classification of the scheme as a compensation scheme for disadvantaged regions regarding transportation distances. The reclassification meant there was a need to make some adjustments in some municipalities' tax rates. Purely geographical elements, like centrality were given a large weight in the revisions. Other indicators used as basis for the changes, but given less weight, were changes in population, share of females and youths, income per tax taxpayer, unemployment share and the share of disability pensioners.

Table 4.3 Indicators and weights used as basis for the changes 1 January 2000

Indicator category	Indicator	Weight	Category weight
Geography	Centrality	0.30	
	Population density	0.10	
	Share of population residing in urban area	0.10	0.5
Demographics	Population change	0.15	
	Population shares; everyone aged 18-30	0.05	
	Population shares; women aged 20-39	0.05	0.25
Labour market	Share of unemployed	0.10	
	Share on disability	0.05	0.15
Income	Income per tax payer	0.10	0.10

Source: Mønnesland et al. (2002)

The indicators used to determine which municipalities should change zones, and the weights used, are listed in Table 4.3. Only using these indicators as basis for the differentiation of the payroll tax rate would lead to a messy and complex map of tax zones, and an inexpedient differentiation by municipalities that form larger economic and labour market regions. Therefore, a certain degree of discretion was used to adjust the indicator-based proposals for changes. The conservative party disagreed with the government's proposal for changes, stating that the proposal was to a great extent based on discretion, as opposed to more objective criteria.

Even though the tax zone changes were endogenous in terms of the listed indicators, we argue that the discretion used in the decisions of which municipalities that would change zones, and the large weight given to geographical indicators, means the reform was "exogenous enough" for the variables we are interested in. To provide evidence for this, we show that the treatment and control groups have common trends in our variables of interest in the period prior to the reform.

The change in the scheme in 2000 is previously analysed by Stokke (2016).[43] In this part of the evaluation we will follow Stokke's approach and focus on the municipalities that moved from Zone 2 to Zone 3. This group is most suited for several reasons. First, we need a large amount of data to be confident in our results. Second, there is a potential issue of the prevalence of "commuter municipalities"[44] among municipalities that moved from Zone 2 to Zone 1. Note that it was the worker's municipality of residence that mattered for the differentiation of payroll tax in this period. This was changed from worker to firm location in 2007.

Most workers commuting across tax zones will, in most cases, commute to a zone with a higher tax rate than the tax rate in the zone in which they live. This is because the payroll tax rate is higher in "well-performing municipalities". So, if someone commutes to a municipality where the payroll tax rate is different, it is most likely a well-performing municipality, since it has job opportunities. This means that the worker's municipality of residence is part of a different labour market, in terms of characteristics, not just geographically, than municipalities that form whole labour markets or economic regions with the same payroll tax rate in all parts of the region. In such (latter) regions, the price of labour is the same in all parts of the region. Thus, comparing or grouping labour markets with differing payroll tax rates to labour markets with nondifferentiated payroll tax rates, could potentially lead to biased estimates.

We are interested in estimating the effect of a change in the payroll tax rate on wages and employment. A reduction in labour costs, which occurs in the case we will look at in the following, could lead to higher wages since workers will want to partake in the firm's improved profitability. Further, a reduction in labour costs could lead to an increase in employment, since labour becomes relatively cheaper than it previously was and compared to other factors of production, such as capital.

4.1.1 Sample construction and restrictions

There are several issues to consider in our empirical analysis. We are studying an eight-year period and a policy with many elements, many of which changed during those years. During our estimation period (1996-2003), several industry exemptions were put in place in accordance with ESA rulings. Firms in these industries paid the general payroll tax rate of 14.1 pct. regardless of geographic location. These industries are:

- Production and distribution of electricity
- Extraction of crude petroleum and natural gas
- Services activities incidental to oil and gas extraction excluding surveying
- Mining of non-ferrous metal ores, except uranium and thorium ores, as well as some firms in mining of chemical and fertilizer materials
- Building and repairing of ships
- Manufacturing of basic iron and steel and of ferro-alloys
- Financial intermediation
- Freight transport by road (firms with more than 50 full-time employees)
- Telecommunications

In addition to excluding firms in these industries[45], we also exclude the public and primary sectors[46].

[43] Currently only available in a working paper version. See http://www-sre.wu.ac.at/ersa/ersaconfs/ersa16/Paper169_HildegunnStokke.pdf
[44] Municipalities where a large part of the workforce is employed in another municipality. In this case, many of the municipalities are neighbours of Bergen.
[45] This means dropping 5 pct. of worker-year observations in the treatment and control regions.
[46] This means dropping 39 pct. of worker-year observations in the treatment and control regions.

We exclude the primary sector because of the extensive subsidies and the considerable degree of self-employment in these industries. Regarding the public sector, the centralised wage bargaining and national regulation with respect to public sector wages warrants their exclusion from our wage regressions. However, we also exclude them from our subsequent regressions, to ensure a consistent data set.

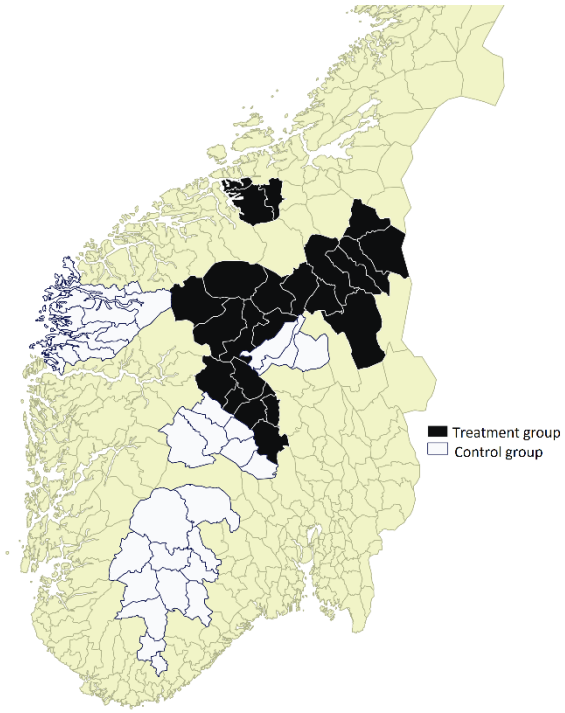
We exclude high-paid workers[47] and those aged above 55 years[48] due to other changes in the scheme that could potentially affect our identification of the change in the payroll tax rate (see Chapter 2.3 for information about these changes).

We exclude municipalities in economic regions where more than one payroll tax rate is prevalent. Each economic region constitutes one labour market, meaning there is a great deal of commuting between municipalities within the region, but relatively little commuting out of the region. We exclude individuals working in Zone 4 and 5[49], which is the case for only a very small part of our sample, since these workers travel quite far to find work.

We choose to estimate effects at the firm level[50], not the establishment level. The data quality is better at the firm level and workers sometimes change employer within the same firm (i.e. change establishment within the same firm). In addition, we avoid potential issues related to re-organisation of establishments within firms, where divisions are split up or grouped together.

We exclude individuals and firms with missing information on variables included in the regressions, as well as individuals and firms who are not present both before and after treatment is effectuated or have "holes" in their time series[51]. We further restrict our observations to include only those who are observed for at least three consecutive years. In regressions at the firm level, we only include firms located in the regions of interest.

Figure 4.1 Municipalities in the estimation sample by treatment and control group



Note: Only economic regions where the payroll tax rate is the same for all municipalities are included in the sample.
Source: Samfunnsøkonomisk analyse AS
Map: ©Kartverket

[47] This means dropping 0.2 pct. of worker-year observations in the treatment and control regions.
[48] This means dropping 12 pct. of worker-year observations in the treatment and control regions.
[49] This means dropping 0.4 pct. of worker-year observations in the treatment and control regions.
[50] We use firm to address what Statistics Norway call enterprise in their StatBank.
[51] This means dropping 42 pct. of worker-year observations in the treatment and control regions.

To avoid skewed results due to outliers in our regressions, we trim our sample by dropping the top and bottom 2 pct. of the distribution of the dependent variable. Our results affect our recommendations regarding a large and important scheme and we do not want observations of a small minority to influence them. We comment on the significance of this trimming in each of the results sections.

We exclude firms who have establishments outside the economic regions that define our treatment and control groups (see Figure 4.1). In addition, we remove firms with employees from both groups. The differentiated payroll tax rate lowered labour costs in the regions that are affected. In the period 1996-2003, this made employees residing in these regions relatively cheaper labour, compared to those residing in the unaffected regions. The objective, then, was for these residents to gain employment or remain employed, not for workers commuting from other tax zones to gain employment.

To study employment effects, we have aggregated our individual-level data to the firm level. This allows us to study employment effects for those residing in the affected regions, since we can count the number of employees in each firm that resides in any given municipality. Our dependant variable is therefore based on employees residing in the treatment and control regions only, not total employment, which could include commuters from other regions. Consequently, we estimate employment growth for treated and control regions. This way, we examine the "pure employment effect" for those that were affected by the policy.

Table 4.4 present some descriptive statistics for the treatment and control regions. The population in the control regions is almost twice as large as in the treatment regions, although this follows from the larger number of municipalities. In the period 1996-1999, the population dropped marginally more in treatment regions than in control regions. Average net immigration and unemployment are also equivalent between the two groups, as both face net out-migration in the pre-reform period (1996-1999) and have an unemployment share of 1.5 pct. In the post-reform period, the share of municipalities on the ROBEK list was much higher in the control regions, suggesting poor economic conditions and/or financial management in municipalities in this group.

Table 4.4 Descriptive statistics on municipality level. Means over the period 1996-1999

Variable	Treatment group	Control group
No. of municipalities[1]	23	36
Payroll tax zone after 1999[1]	3	2
Percentage point change in tax rate[1]	-4.2	0
Population	72,989	135,213
Population growth	-0.58 %	-0.06 %
Net immigration[2]	- 124	- 206
Unemployment[3]	1.5 %	1.5 %
Share of mun. on the ROBEK list[4]	22 %	39 %

1) Not means.
2) From other parts of Norway.
3) As share of population aged 15-74
4) Indicates either poor financial management of municipal finances or poor economic conditions. Included if on the ROBEK list at some point during 2001-2004. Note that most were taken off the list one year (or less) after inclusion
Sources: Statistics Norway, Samfunnsøkonomisk analyse AS and www.government.no

Table 4.5 and 4.6 presents descriptive statistics from our individual- and firm-level data sets. Differences between the two tables are largely due to the inclusion of part-time workers in the firm level data, which most notably affects the share of female workers, and the fact that the firm level data partly includes data based on workers not residing in the treatment and control regions. However, data on worker characteristics is based on the employees residing in either treated or control regions.

The two groups are comparable at the individual level in terms of the various characteristics, although there is a difference in levels of average hourly wages. The hourly wage is contracted wage divided by contracted hours and does not include overtime or other forms of payment, but it is internally consistent.

Table 4.5 Descriptive statistics for individual-level data of treatment and control groups. Means over the period 1996-2003

Variable	Treatment group	Control group
Worker-year observations	21 694	39 712
Hourly wage (2015-NOK)	165	172
Wage growth (2015-NOK)	5.6	5.7
Age composition		
25-34 years old	29.2 %	30.9 %
35-44 years old	36.9 %	36.2 %
45-55 years old	33.9 %	32.9 %
Share of immigrants	1.8 %	3.0 %
Share of female workers	19.2 %	22.0 %
Education composition		
Primary education	22.3 %	23.3 %
Secondary education	71.0 %	68.7 %
Higher education	6.8 %	7.9 %
Industry/sector composition		
Manufacturing	35.1 %	30.2 %
Secondary sector	51.5 %	46.9 %
Tertiary sector	48.5 %	53.1 %
Share of commuters[1]	8.9 %	7.5 %
Worker-year obs. by centrality[2]		
Level 4	30.9 %	23.6 %
Level 5	51.0 %	62.1 %
Level 6	18.1 %	14.3 %

Notes: Statistics are reported after doing the same adjustments as done prior to estimation.
1) Commuters out of tax zone as share of group.
2) Percentage of group residing in a municipality with the given centrality level.
Source: Samfunnsøkonomisk analyse AS

Table 4.6 Descriptive statistics for firm-level data of treatment and control groups. Means over the period 1996-2003

Variable	Treatment group	Control group
Firm-year observations	3 577	8 237
Firm size (reported)	9.6	9.5
Firm size (calculated)[1]	7.0	6.8
Value added growth	0.4 %	-0.5 %
Capital services growth	-0.3 %	3.2 %
Age composition		
25-34 years old	32.9 %	34.9 %
35-44 years old	35.4 %	35.5 %
45-55 years old	31.7 %	29.6 %
Share of immigrants	2.1 %	2.0 %
Share of female workers	36.0 %	35.8 %
Education composition		
Primary education	23.4 %	24.9 %
Secondary education	66.7 %	63.3 %
Higher education	10.0 %	11.8 %
Industry/sector composition		
Manufacturing	28.7 %	23.6 %
Secondary sector	47.3 %	39.4 %
Tertiary sector	52.7 %	60.6 %
Share of commuters[2]	2.6 %	2.7 %
Firm-year obs. by centrality[3]		
Level 4	33.7 %	27.5 %
Level 5	46.7 %	58.6 %
Level 6	19.6 %	14.0 %
Share of full-time workers	76.7 %	78.1 %

Notes: Statistics are reported only for firms located in the treatment and control regions.
Statistics are reported after doing the same adjustments as done prior to estimation
1) Based on observations in employer-employee register for employees residing in the treatment and control regions.
2) Commuters out of tax zone as share of observed workers in individual level dataset.
3) Percentage of group located in a municipality with the given centrality level.
Source: Samfunnsøkonomisk analyse AS

At the firm level, the treatment group has more firms in manufacturing than the control group, and relatively more employees in this group as well. This could potentially be a problem in our efforts to identify causal effects but will be tested for.

Note that no firms in our estimation sample are located outside the treatment and control regions. The number of employees residing in the regions as a share of the total number of employees in the firms is about 91 pct.

4.1.2 Econometric strategy

Our regression models follow Stokke (2016), though with some modifications. That is, we estimate effects on our selected dependent variables with a difference-in-differences (DiD) approach, using indicator variables to evaluate the effects of a change in the payroll tax rate on various dependent variables, most notably growth in wages and employment.

As noted in Stokke (2016), the methodological challenge in the study of effects of the payroll tax rate in Norway is that municipalities are not randomly chosen to have a low or high tax rate. Rather, they are picked based on economic and demographic indicators, meaning there are differences in characteristics between those with high and low tax rates. Stokke (2016) argues that this can be solved by exploiting the payroll tax reform in 2000 and using the municipalities that remained in Zone 2 as controls for those who were moved to Zone 3 with a lower payroll tax rate.

First, we estimate the effect of a lower payroll tax rate on wages. We apply our individual level data set and use the change in log hourly wages as dependant variable. Doing this, we account for unobserved individual level variation in wages. We estimate the following equation

$$\begin{aligned}\Delta \ln w_{ijsrt} = {} & a_0 + a_1 T_r + a_2 P_t + a_3 T_r P_t \\ & + \bar{X}_{jt}\beta + \varphi_r + \rho_t + \mu_s \rho_t \\ & + \varepsilon_{ijsrt}\end{aligned} \qquad (4.1)$$

where $\Delta \ln w_{ijsrt}$ is the change in log hourly wage from year $t-1$ to year t for worker i in firm j in industry s located in region r, $\mathrm{T_r}$ is a dummy that equals 1 if the labour market region is part of the treatment group facing lower payroll tax rate, and $\mathrm{P_t}$ is a dummy that equals 1 in the post reform years (from 2000 onwards). The vector of worker characteristics in year t, $\overline{\mathrm{X}}_{\mathrm{it}}$, includes dummies for age (5-year intervals), education level (primary, secondary and collage), immigrant status (native, western immigrant, non-western immigrant) and gender. Regional and year fixed effects are represented by φ_r and ρ_t, respectively.[52] Industry times year fixed effects capture industry-specific trends and shocks ($\mu_s \rho_t$). a_0 is a constant, β is a vector of parameters and ε_{ijsrt} is an error term.

We are particularly interested in estimating the parameter a_3, which captures the difference in wage growth between treatment and control regions after the treatment regions change tax zone, compared to the pre-treatment period. We also adjust the above specified regression model to allow year-specific treatment effects.

Next, we look at the effect of lower payroll taxes on employment growth. To do this we use firm-level data, aggregated from our individual-level data and

[52] We use a measure of the municipalities' centrality. The index is measured according to distance to workplaces and service functions such as retail. Both the treatment group and the control group are represented in each of the centrality levels used. Controlling for municipality or economic region would be correlated with treatment, thus creating a problem for identification.

use the change in log firm size as dependent variable, measured as the number of workers in the firm. Thus, this approach deals with the extensive margin (hired/not hired), as opposed to the intensive margin (part-time/full-time or number of hours).[53] Our regression model is as follows

$$\Delta \ln size_{jsrt} = b_0 + b_1 T_r + b_2 P_t + b_3 T_r P_t + \varphi_r + \rho_t + \mu_s \rho_t + \varepsilon_{jsrt} \quad (4.2)$$

where $\Delta \ln size_{jsrt}$ is the change in log number of workers from year $t-1$ to year t for firm j in industry s located in region r, b_0 is a constant and ε_{jsrt} is an error term. Other explanatory variables are explained in relation to the wage equation above.
Our parameter of interest is b_3, which captures the difference in employment growth between treatment and control regions in the years after the payroll tax cut, compared to the pre-reform period. We also adjust the above specified regression model to allow year-specific treatment effects. Further, the firm level model will be applied with other dependent variables as well, namely the growth rates of number of hours worked by employees residing in the treatment and control regions, capital services and value added.

The regressions at firm level will be weighted with the level of the dependent variable to adjust for the fact that a given percentage change of the dependent variable has a different absolute effect on levels according to the size of the level. For example, a percentage change in the number of employees in a firm with 100 employees entails a different change in number of employees compared to what the same percentage change invokes in a firm with 10 employees.

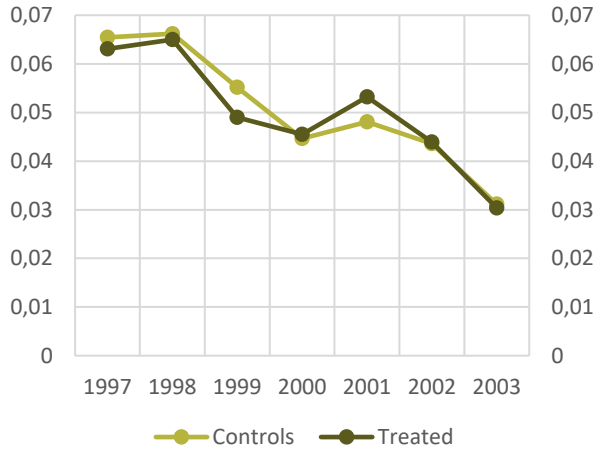
The difference-in-differences method hinges on an assumption of parallel trends, which means that the treatment group would follow the same trend as the control group in absence of treatment. This is called a counterfactual, since it is only hypothetical and cannot be observed. We cannot test for it empirically, but we can show some descriptive statistics and perform placebo checks[54] in our regressions to investigate the pre-treatment trends and group characteristics. We cannot be confident in the validity of the assumption of parallel trends if we find trends that are not parallel prior to treatment.
Figure 4.2 show average growth rates in hourly wages in both treatment and control regions. Notably, the wage growth rates in the groups are quite similar and declining in the pre-reform period, although the average growth over this period is slightly higher in the control group. In 2001 the average growth rate is higher in the treatment group than in the control group. Whether there is a statistically significant difference will be addressed in the regressions.

Figure 4.3 show average growth rates in employees residing in treatment and control regions. Employment growth (which we measure as growth in employees residing in either the control or treatment regions) is declining for both groups in the pre-reform period. On average, the two groups have a similar employment growth in the three-year period 1997-1999; the treatment group's average is 3.5 pct. and the control group's average is 3.4 pct. Post-

[53] We will also use hours worked as the dependent variable to investigate intensive margin effects.
[54] "Placebo" refers to the fact that we check whether there is a treatment effect before treatment occurs. If we find a treatment effect before the actual treatment occurs (i.e. a statistically significant placebo effect), then the two groups differ in terms of the dependant variable regardless of treatment, which invalidates the diff-in-diffs method.

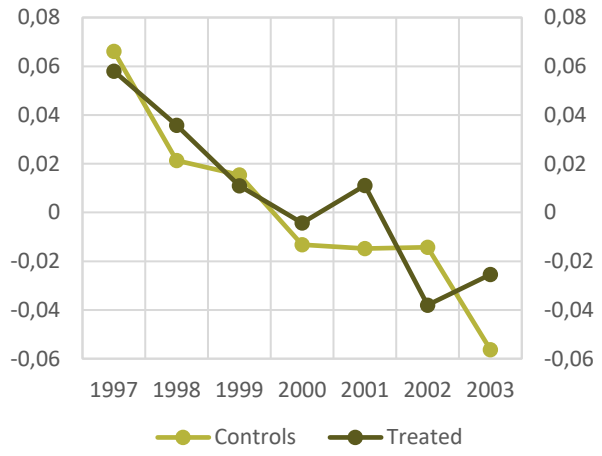
reform, the average growth rate is higher in employment of workers residing in treated regions.

Figure 4.2 Average annual nominal growth rate of hourly wages in treatment and control groups. 1997-2003



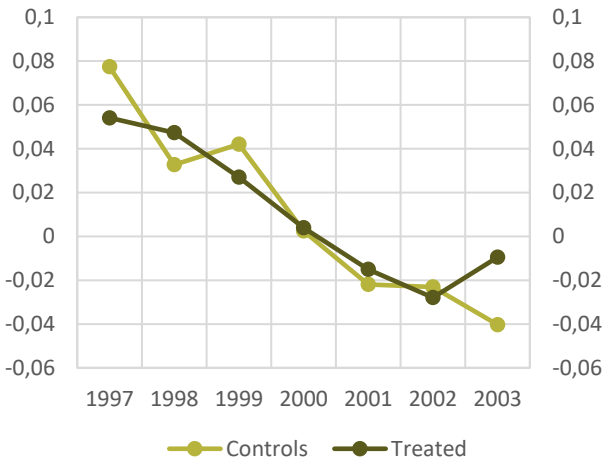
Note: Time series are calculated after making the same adjustments as done prior to estimation (see part 4.1.1).
Source: Samfunnsøkonomisk analyse AS

Figure 4.3 Average annual growth rate of employees in firms in the treatment and control groups. 1997-2003



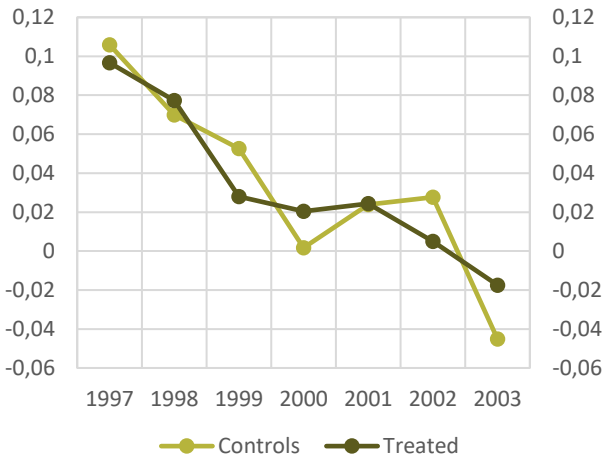
Notes: Time series are calculated after making the same adjustments as done prior to estimation (see part 4.1.1). Observations are weighted with the number of employees residing in the treatment and control regions.
Source: Samfunnsøkonomisk analyse AS

Figure 4.4 Average annual growth rate of hours worked in firms in the treatment and control groups. 1997-2003



Notes: Time series are calculated after making the same adjustments as done prior to estimation (see part 4.1.1). Observations are weighted with the number of hours worked by employees residing in the treatment and control regions.
Source: Samfunnsøkonomisk analyse AS

Figure 4.5 Average annual growth rate of value added in firms in the treatment and control groups. 1997-2003



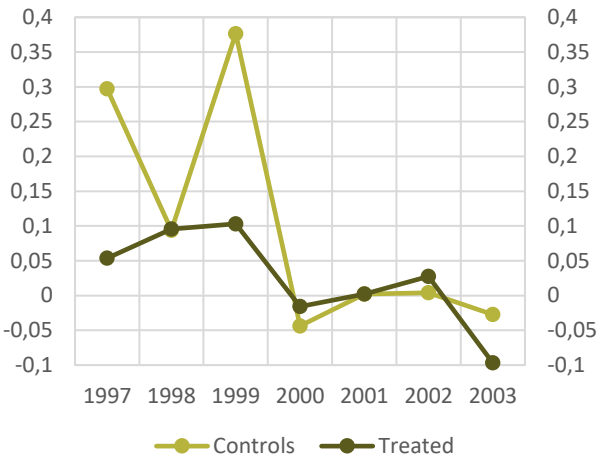
Notes: Time series are calculated after making the same adjustments as done prior to estimation (see part 4.1.1). Observations are weighted with the level of value added
Source: Samfunnsøkonomisk analyse AS

Using data on the annual number of hours worked per firm, we can estimate the effect of a reduction in the payroll tax rate on employment on the intensive margin. We let this variable define an annual number of hours of labour input in firms, again using our individual level dataset to calculate these hours only for workers residing in control and treatment regions. Figure 4.4 show average growth rates in hours worked by employees residing in treatment and control regions. The historical development is similar to that of the average growth rates of the number of employees.

Figure 4.5 show average growth rates in value added in firms in the treatment and control regions. The pre-reform trend is similar in the two groups. We test for common trend empirically by running a regression for growth in value added in the period prior to the reform on treatment, trend and an interaction between treatment and trend. The results lead us to dismiss common trend violation.

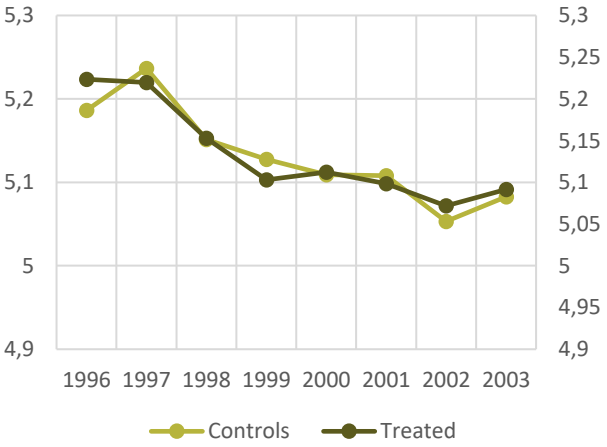
We also investigate the effect of the reduced payroll tax rate on capital. The ideal measure, capturing the economic contribution of capital inputs in a production theory context, is flow of capital services (see Draca, Sadun and van Reenen (2007)). Let the variable K be a measure of capital services, which are calculated based on the book values of a firm's tangible assets. Further, all assets are divided in two types: equipment (denoted by the superscript e) which include machinery, vehicles, tools, and transport equipment; and buildings and land (denoted by the superscript b). Then capital services $K_t = \sum_{j=e,b}(r + \delta_j)K_{jt}$, where the depreciation rates, δ_j, are 20 pct. for equipment and 5 pct. for buildings (Raknerud, Rønningen and Skjerpen 2007). The real rate of return, r, is the average real return on 10-year government bonds for the period 1999-2006, and equal to is 4.7 pct. (based on figures from the Norwegian Central Bank).

Figure 4.6 Average annual growth rate of capital services in firms in the treatment and control groups. 1997-2003



Notes: Time series are calculated after making the same adjustments as done prior to estimation (see part 4.1.1). Observations are weighted by the level of capital services
Source: Samfunnsøkonomisk analyse AS

Figure 4.7 Average annual log of capital services in firms in the treatment and control groups. 1996-2003



Notes: Time series are calculated after making the same adjustments as done prior to estimation (see part 4.1.1).
Source: Samfunnsøkonomisk analyse AS

Figure 4.6 show average growth rates of capital services in the treatment and control groups. We conduct the same pre-reform common trend test as we did with value added above and find that the trend is statistically different pre-reform at a 10 per cent significance level. If we only include the services sector in the test sample, we find that there is a common trend violation with an even stronger significance. Thus, we choose to estimate the treatment effect on the log level of capital services with fixed effects and a lagged level of capital services. Tests on the level of capital services leads us to accept the hypothesis of common trends, both overall and on the subsamples. Figure 4.7 plots the log level of capital services in the years 1996-2003 for the two groups. The development is similar for the two groups in the period prior to the reform in 2000.

Some of the growth rate plots bear witness of the business cycles that occurred in our evaluation period. The Norwegian economy left an upturn in 2001 and entered a downturn, effectuated by the dot-com bubble bursting and worsened by the Norwegian Central Bank's sharp increase in the interest rate, which had a large effect on the exchange rates. The latter had an adverse effect for exports and import competition, which meant worse times for manufacturing. As we saw in Table 4.6, the treatment group has relatively more activity in manufacturing, which could potentially be a problem for our identification of a causal effect of the reduction in the payroll tax rate. In the regressions, we include year dummies at industry level which should capture business cycle effects and common shocks to avoid problems from this composition problem.

4.1.3 Results from the wage regressions

Using the difference-in-differences approach described in the previous section, we estimate the effects of a reduction in the payroll tax rate on the growth in hourly wages. The results of five separate regressions of the impact of the 2000 reform on individual wages for the treatment group is presented in Table 4.7. The parameters of interest are those estimated for variables that are interactions between post reform years and treatment.

Column (1) presents the results from the regression restricting the treatment effect to be an average over the post reform years, 2000-2003. The point estimate of 0.005 on Treatment x Post 1999 means that the annual growth rate in hourly wages in the post-reform period is 0.5 percentage points higher in the treatment group than in the control group. The parameter estimate is statistically significant and relatively robust to model specifications with clustering at different levels and the log of individual lagged wage levels. The implication of this is a cumulative growth over the post-reform period of 2 pct. The total wage cost reduction on employees in the treatment group is 3.8 pct.[55] Thus, our average result in Column (1) implies that workers received over half (53 pct.) of the cost reduction from a reduced payroll tax rate.

Column (2) reports the year-specific effects. We see that only one post-reform year exhibits a statistically significant differing wage growth between the treatment and control groups, namely 2001. The point estimate in 2001 is 0.009. Thus, the difference in wage growth between the treatment and control groups is 0.9 percentage points over the post-reform period, which constitutes about 24 pct. of the

[55] Total wage cost is the sum of wage costs and the payroll tax, whereas labour cost is the sum of total wage costs and other personnel costs, where the payroll tax is not applicable. The reduction in the payroll tax rate of 4.2 percentage points can be shown to correspond to a 3.8 percentage points reduction in total wage cost. The initial level of the tax rate was 10.6 pct. (1.106-1.064)/1.106=0.038.

reduction in total wage costs following the payroll tax rate reduction. This is significantly lower than what the estimate in Column (1) implied. Including a lagged level-version of the dependant variable does not affect the results markedly. Before running the regressions in Table 4.7, we have dropped the top and bottom two percentiles of observations of the dependant variable. If we exclude another 2 pct. on both sides if the distribution, there are no statistically significant effects when running the same regression as in Column (2).

In Column (3) we adopt a more flexible model specification that controls for potential common trend violations pre-treatment by including interaction terms between pre-reform years and treatment. The point estimates from Column (2) are only marginally changed, but the statistical significance of the 2001-effect does not remain.

Column (4) reports the results of a regression using the same model specification as in Column (2), but only for the subsample of workers employed in the secondary sector, dominated by manufacturing. The point estimates are quite high in 2000 and 2002, and overall positive. A joint F-test of the sum of the four treatment estimates in Column (4) does not reject the hypothesis that the treatment effect is positive for the secondary sector and the treatment effect is in this case statistically significant at the 5

Table 4.7 Impact of payroll tax cut on individual wage growth

	Δ ln *w* Full sample	Δ ln *w* Full sample	Δ ln *w* Full sample	Δ ln *w* Secondary	Δ ln *w* Tertiary
	(1)	(2)	(3)	(4)	(5)
Treatment	-0.002	-0.002	0.001	-0.002	-0.002
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Post 1999	-0.045*				
	(0.019)				
Treatment x Post 1999	0.005**				
	(0.002)				
Treatment x 1998			0.001		
			(0.006)		
Treatment x 1999			-0.003		
			(0.006)		
Treatment x 2000		0.005	0.004	0.008	0.001
		(0.004)	(0.006)	(0.005)	(0.004)
Treatment x 2001		0.009**	0.080	0.006	0.011***
		(0.004)	(0.006)	(0.006)	(0.050)
Treatment x 2002		0.004	0.003	0.009	-0.001
		(0.004)	(0.006)	(0.006)	(0.004)
Treatment x 2003		0.004	0.003	0.004	0.004
		(0.003)	(0.006)	(0.005)	(0.005)
Observations	61,406	61,406	61,406	29,765	31,641
Obs. treatment	21,694	21,694	21,694	11,159	10,535
Obs. control	39,712	39,712	39,712	18,606	21,106

* p<0.1, ** p<0.05, *** p<0.01

Notes: The regressions include dummies for year, gender, age group, two categories of foreign countries of birth, two levels of education, industry times year and municipal centrality. The secondary sector is dominated by manufacturing and the tertiary sector is services. Standard errors clustered at firm level in parenthesis.

per cent level. If we drop one percentile more on each side of the distribution of our dependant variable, we find the 2002-effect to be statistically significant at the 10 per cent level.

Column (5) show the results of same regressions as in Column (2) and (4), but for the subsample of workers employed in the tertiary sector, meaning services. The results show that the effect found in 2001 in the overall sample regression in Column (2) comes from services, given that no effect is found for the secondary sector this year. Workers in services in the treatment group had a 1.1 percentage points higher hourly wage growth rate in 2001, compared to workers in services in the control group, implying that about 29 pct. of the wage cost reduction was shifted onto the workers.

The point estimates for both subsamples (Column (4) and (5)) are relatively robust to the inclusion of treatment-year interactions for 1998 and 1999, as well as the log of individual lagged wage levels. An alternative model specification of log level of individual hourly wages with fixed effects and a lagged dependant variable gives similar results as displayed in Table 4.7. If we only drop 1 pct. on each side of the distribution of our dependent variable, the point estimate in 2001 for the tertiary sector is marginally lower. The point estimate for the total sample in 2001 is not statistically significant. If we trim our sample by dropping 3 pct. on both sides of the distribution of the dependent variable, the effect for the secondary sector is statistically significant in 2002. Thus, the degree of tax shifting is quite sensitive with regards to trimming the tails of the distribution of the growth rate of hourly wages. The treatment effect found in 2001 for the tertiary sector is robust to these data considerations.

To conclude, we find that there is some effect in the secondary sector, but not as clear and robust as in the case of the tertiary sector. Our results are in line with Stokke (2016) and Bennmarker, et al. (2009) in terms of overall effects. However, we find smaller effects for the secondary sector and an effect in services which is not found in Stokke.

The relatively high share of unionised workers in the secondary sector, compared to services, may explain why we find smaller wage effects in the secondary sector than in services. This means the central wage formation in Norway is relatively more important in the secondary sector, implying less room for wage increases.

4.1.4 Results from the employment regressions

Using the difference-in-differences approach described in Chapter 4.1.2, we estimate the effects of a reduction in the payroll tax rate on the growth rates in firm sizes. The results are displayed in Table 4.8. Only firms located in the treatment and control regions are included.

Results from the regressions on firm size show a positive effect on the employment of workers residing in the treatment regions from the reduction in the payroll tax rate. Column (1) presents the regression results when restricting the treatment effect to be an average over the post-reform years, 2000-2003. The result indicates the annual growth rate in employees is 1.1 percentage points higher in the treatment group in the post-reform period than in the control group. The effect is not statistically significant.

In Column (2), we allow the treatment effect to vary over the post-reform period, by using year dummies instead of a step dummy interacted with treatment. The point estimate for 2003 is 0.031 and is statistically significant. This estimate indicates that employment growth of workers residing in the treatment regions was 3.1 percentage point higher than

the employment growth of workers residing in the control regions.

In Column (3) we include placebo checks for the pre-reform years 1998 and 1999. This increases the point estimates and makes the 2001-effect in Column (2) statistically significant. Thus, the passes the placebo test and the average positive employment effect across industries holds. The estimates in Column (3) suggests the employment growth of workers residing in the treatment regions was 7.6 (4.1) pct. higher than the employment growth of workers residing in the control regions, if we accept a statistical significance level of 10 (5) pct.

Column (4) reports the results of the same regression as in Column (2), but only for the secondary sector. As in the wage regression, there are no statistically significant effects to be found.

Column (5) reports the same regression only for the tertiary sector. We find a statistically significant effect in 2003. It seems the average effect across industries stems mostly from this part of the sample, as the point estimates are higher in Column (5) than in Column (2) for both 2001 and 2003 and there are no statistically significant effects found in the secondary sector. The point estimate for 2003 is 0.054 and is statistically significant at the 1 per cent level.

Table 4.8 Impact of payroll tax cut on employment growth. Number of employees

	Δ ln L Full sample	Δ ln L Full sample	Δ ln L Full sample	Δ ln L Secondary	Δ ln L Tertiary
	(1)	(2)	(3)	(4)	(5)
Treatment	0.002	0.002	-0.008	0.010	-0.003
	(0.008)	(0.008)	(0.015)	(0.012)	(0.011)
Post 1999	-0.167**				
	(0.035)				
Treatment x Post 1999	0.011				
	(0.010)				
Treatment x 1998			0.023		
			(0.021)		
Treatment x 1999			0.007		
			(0.020)		
Treatment x 2000		0.007	0.017	0.021	-0.006
		(0.016)	(0.02)	(0.023)	(0.022)
Treatment x 2001		0.025	0.035*	0.019	0.030
		(0.016)	(0.020)	(0.024)	(0.021)
Treatment x 2002		-0.021	-0.010	-0.033	-0.012
		(0.016)	(0.020)	(0.022)	(0.022)
Treatment x 2003		0.031**	0.041**	0.002	0.054***
		(0.015)	(0.020)	(0.024)	(0.020)
Observations	11,706	11,706	11,706	3,867	7,839
Obs. treatment	3,469	3,469	3,469	1,302	2,167
Obs. control	8,237	8,237	8,237	2,565	5,672

* p<0.1, ** p<0.05, *** p<0.01

Notes: The regressions include dummies for year, industry times year and municipal centrality. Estimates are weighted by total number of employees per firm. The secondary sector is dominated by manufacturing and the tertiary sector is services. Standard errors clustered at firm level in parenthesis.

The effect in 2003 for both the total sample and the tertiary sector are the most robust results with respect to trimming of the dependant variable.

An alternative model is a one estimating the treatment effect on levels of firm size in logs, using firm fixed effects. With this specification, we find a statistically significant treatment effect for both the full sample and the secondary sector in 2001. This effect is also statistically significant when including a lagged dependant variable in the regression. The point estimate is 0.045 for both the secondary sector and the full sample. The 2003-treatment effect is only statistically significant when including a lagged dependant variable in this model specification and has the same point estimate.

The significant effect in the tertiary sector only, could stem from an increase in wages in the treatment group, resulting in increased demand for goods and services in the treatment region. We found some tax shifting in terms of wages in Chapter 4.1.3, which gives weight to this argument.

Our estimated overall effect on employment indicates 177 more employees among firms in our treatment group than would otherwise be the case. To get an estimate on the cost of this higher employ-

Table 4.9 Impact of payroll tax cut on employment growth. Number of hours worked

	Δ ln H Full sample	Δ ln H Full sample	Δ ln H Full sample	Δ ln H Secondary	Δ ln H Tertiary
	(1)	(2)	(3)	(4)	(5)
Treatment	-0.007	-0.007	-0.016	0.008	-0.019
	(0.008)	(0.008)	(0.015)	(0.011)	(0.018)
Post 1999	-0.147**				
	(0.060)				
Treatment x Post 1999	0.016				
	(0.010)				
Treatment x 1998			0.018		
			(0.020)		
Treatment x 1999			0.008		
			(0.020)		
Treatment x 2000		0.020	0.029	0.031	0.010
		(0.014)	(0.019)	(0.022)	(0.019)
Treatment x 2001		0.011	0.019	-0.002	0.022
		(0.014)	(0.018)	(0.021)	(0.020)
Treatment x 2002		0.002	0.011	-0.016	0.017
		(0.014)	(0.018)	(0.021)	(0.019)
Treatment x 2003		0.037**	0.043**	0.016	0.050**
		(0.015)	(0.019)	(0.023)	(0.022)
Observations	10,215	10,215	10,215	3,349	6,866
Obs. treatment	3,006	3,006	3,006	1,115	1,893
Obs. control	7,209	7,209	7,209	2,234	4,973

* p<0.1, ** p<0.05, *** p<0.01

Notes: The regressions include dummies for year, industry times year and municipal centrality. Estimates are weighted by total number of contracted hours per firm. The secondary sector is dominated by manufacturing and the tertiary sector is services. Standard errors clustered at firm level in parenthesis.

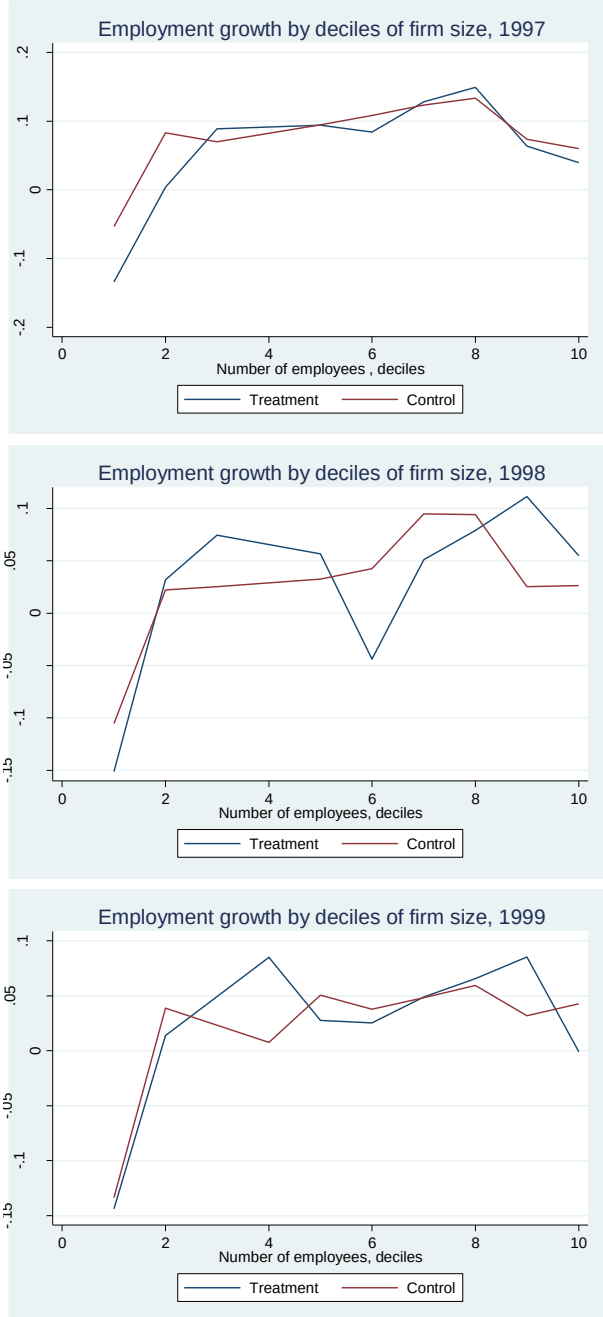
ment, we first take the difference between the labour costs the firms in our treatment group pay with the new (lower) payroll tax rate and what they would have paid with the old (higher) tax rate. Dividing this difference by the number of extra employees we find that the cost per employee was 880,000 (2000 prices). If we only consider the effect in the tertiary sector, the corresponding cost was 582,000.

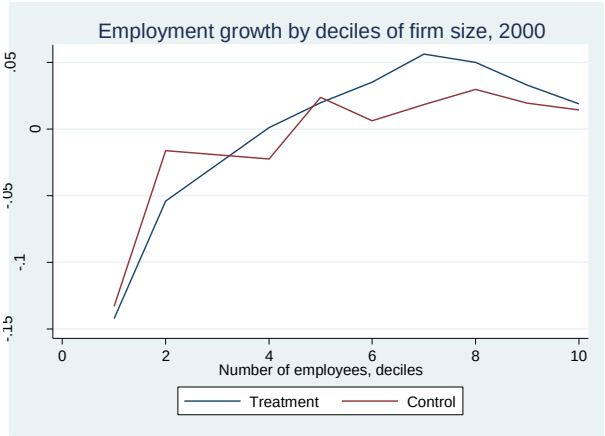
Note that the above calculated effects and costs are based solely on the marginal change in 2000 and only valid for the sample studied. It is plausible that larger changes in the payroll tax rate would lead to larger effects and that this relationship is non-linear, thus resulting in a larger employment effect per percentage point in changed payroll tax rate.

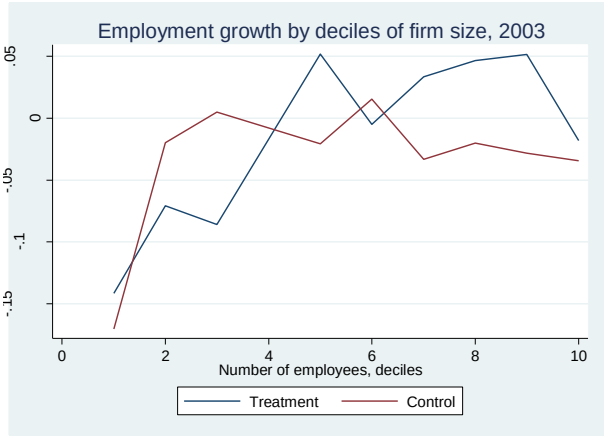
Table 4.9 reports the results from five separate regressions on the growth rates of the total number of hours worked at the firm level. The model specification is otherwise the same as in the regression commented above. We find a positive effect for the full sample (Column (2)) in 2003, which stems from the tertiary sector, reported in Column (5). The point estimate of 0.05 implies that the hours worked by workers residing in the treatment regions and working in the tertiary sector had 5 percentage point higher growth than that of workers in the same sector in the control regions. We do not find the same (weakly) significant effect in 2001, as found on the extensive margin (firm size).

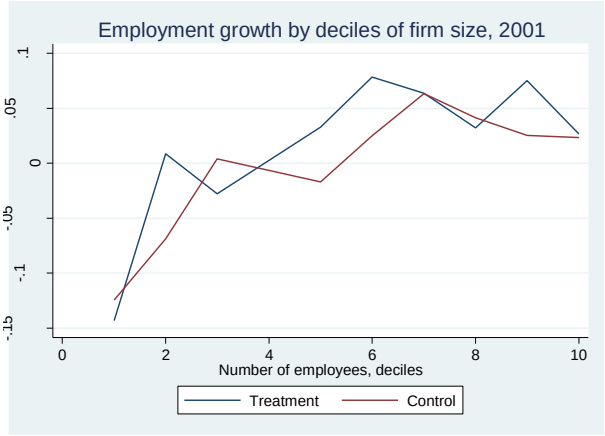
Figure 4.8 shows average growth in employment for firms in treatment and control regions, by number of employees (divided in deciles). It is apparent that the smallest firms experienced negative employment growth both before and after the change in 2000.Though negative, the growth rate was less negative among small firms in the treatment regions, compared to firms in the control region in 2001. It seems that the employment effects we have identified in 2001 and 2003 stems for higher growth among the larger treated firms.

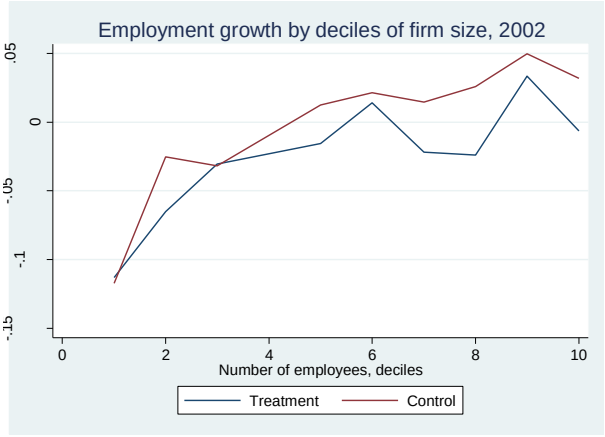
Figure 4.8 Average growth rates of employment of workers residing in treatment or control regions in firms by deciles of employees residing in treatment or control regions. 1997-2003











4.1.5 Results from value added regressions

In the following, we present estimated effects on value added. We restrict the analysis to firms with positive and non-zero value added. As before, only firms located in the treatment and control regions are included. As reported in Column (1), (2) and (3) in Table 4.10 we find no significant effects on value added for the full sample in the post-reform period. Column (3) includes a placebo check for the years 1998 and 1999, none of which are close to being statistically significant.

In Column (4) we only include the secondary sector and find no statistically significant effects. In 2002, the effect is clearly negative, though not statistically significant. That year there was a downturn in the Norwegian economy, especially for manufacturing, and it might be that the treatment group is relatively more affected by this than the control group, although we control for common shocks through industry specific year dummies.

Column (5) reports results from a regression for the tertiary sector. We find significant positive effects in 2000 and 2003. This result is in line with the employment regressions, where we found significant effects for both hours worked and firm size in 2003. The point estimate in 2003 is about 0.05, meaning

treatment firms had a 5 percentage points higher growth in value added than the control firms in 2003. Prior to estimating the effects on value added, we drop the top and bottom two percentiles of growth rates in value added. However, if we drop two per cent more in both tails of the distribution, the results change somewhat. Doing this, we find positive and statistically significant effects on the full sample in 2000 and 2003, as well as a positive and statistically significant effect for the secondary sector in 2001.

The effects we found for the tertiary sector remains significant and have larger point estimates.

4.1.6 Results from capital regressions

With the same econometric approach as above, we estimate the effects of a reduction in the payroll tax rate on capital services. By dropping firms with no capital, we lose about 1,300 firm-year observations. Only firms located in the treatment and control regions are included in the sample. The results are presented in Table 4.11.

The overall effect across industries presented Column (1), (2) and (3) is positive and statistically significant. The placebo checks in Column (3) verifies our assumption of common pre-reform trends. When looking at the overall treatment effect in Col-

Table 4.10 Impact of payroll tax cut on growth in value added

	Δ ln VA Full sample	Δ ln VA Full sample	Δ ln VA Full sample	Δ ln VA Secondary	Δ ln VA Tertiary
	(1)	(2)	(3)	(4)	(5)
Treatment	-0.008	-0.008	-0.011	0.007	-0.027**
	(0.019)	(0.019)	(0.051)	(0.039)	(0.013)
Post 1999	-0.232				
	(0.187)				
Treatment x Post 1999	0.016				
	(0.020)				
Treatment x 1998			0.017		
			(0.057)		
Treatment x 1999			-0.009		
			(0.051)		
Treatment x 2000		0.028	0.031	0.021	0.038*
		(0.026)	(0.055)	(0.049)	(0.023)
Treatment x 2001		0.011	0.014	0.033	-0.007
		(0.024)	(0.050)	(0.043)	(0.02)
Treatment x 2002		-0.011	-0.009	-0.038	0.012
		(0.032)	(0.059)	(0.056)	(0.033)
Treatment x 2003		0.036	0.038	0.018	0.049**
		(0.023)	(0.049)	(0.038)	(0.024)
Observations	11,848	11,848	11,848	3,915	7,933
Obs. treatment	3,577	3,577	3,577	1,361	2,221
Obs. control	8,271	8,271	8,271	2,554	5,712

* p<0.1, ** p<0.05, *** p<0.01

Notes: The regressions include dummies for year, industry times year, lagged shares containing worker characteristics and municipal centrality. Estimates are weighted by total value added per firm. The secondary sector is dominated by manufacturing and the tertiary sector is services. Standard errors clustered at firm level in parenthesis.

umn (1), we find only weak significance, but the results in Column (2) show a strong and significant effect in 2003. However, this estimate is no longer significant when we introduce the placebo checks in Column (3), meaning it is not very robust.

Column (4) presents the results of a regression for the secondary sector only. We find only a weakly significant effect in 2002. Column (5) show the effects in the tertiary sector. There is only a statistically significant effect in 2003. This point estimate is in return quite a high, suggesting that treated firms, with positive capital, had a 10 percentage points larger increase in their capital level in 2003, compared to the untreated firms.

4.1.7 Effects on firm entry and exit

The estimated employment effects in Chapter 4.1.4 covers only employment in existing firms. However, changes in the payroll tax may also affect firm entries and exits. Thus, in this chapter we will provide a descriptive analysis of the employment effects from firm entry and exit.

It is reasonable to assume that lower payroll tax may affect the decision of where to establish a new firm. In addition, some firms that would have otherwise gone bankrupt may have survived due to the lower costs induced by the lower pay roll tax. Indeed, Bennmarker, et al. (2009) finds evidence of positive

Table 4.11 Impact of payroll tax cut on growth in capital services

	Δ ln C Full sample	Δ ln C Full sample	Δ ln C Full sample	Δ ln C Secondary	Δ ln C Tertiary
	(1)	(2)	(3)	(4)	(5)
Post 2000	0.114***				
	(0.029)				
Treatment x Post 2000	0.047*				
	(0.026)				
Log C_{t-1}	0.528***	0.529***	0.529***	0.516***	0.534***
	(0.018)	(0.018)	(0.018)	(0.026)	(0.023)
Treatment x 1998			0.011		
			(0.039)		
Treatment x 1999			-0.007		
			(0.041)		
Treatment x 2000		0.044	0.044	0.057	0.032
		(0.030)	(0.042)	(0.049)	(0.039)
Treatment x 2001		0.019	0.020	0.065	-0.010
		(0.030)	(0.042)	(0.047)	(0.039)
Treatment x 2002		0.064*	0.064	0.087*	0.053
		(0.035)	(0.046)	(0.049)	(0.049)
Treatment x 2003		0.072**	0.073	0.023	0.100**
		(0.036)	(0.046)	(0.053)	(0.048)
Observations	10,361	10,361	10,361	3,610	6,751
Obs. treatment	3,107	3,107	3,107	1,083	2,024
Obs. control	7,254	7,254	7,254	2,527	4,727

* p<0.1, ** p<0.05, *** p<0.01

Notes: The regressions include dummies for year, industry times year, lagged shares containing worker characteristics and municipal centrality. The secondary sector is dominated by manufacturing and the tertiary sector is services. Standard errors clustered at firm level in parenthesis.

effects on the number of firms from a payroll tax reform in Sweden. We use the same matched worker-employer dataset used in the previous sections and provide descriptive statistics on firm entries and exits and their impact on the employment in corresponding tax zones.

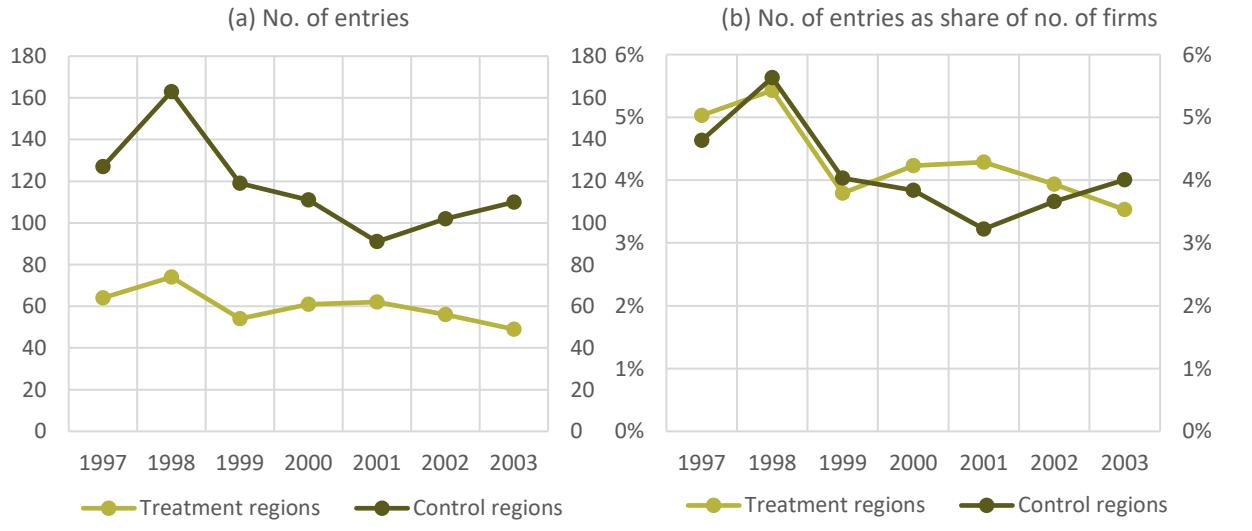
Since the control group is larger than the treatment group, the number of entries in the period 1997-2003 was larger in the control regions than the treatment regions (cf. Figure 4.9). However, looking at entries in terms of shares of the total number of firms, we see that the two regions were similar in the pre-reform period. In 1997, the share of new firms in the control group was slightly lower than in the treatment group, but in the two following years they were almost the same. From 2000 until 2002, the share of new firms was higher in the treatment group, suggesting there was a positive impact on firm entry from the reduced tax rate.

The impact of firm entries and exits on employment are more relevant indicators than firm entry and exit, i.e. how many jobs are created due to firm entries and disappear due to firm exits. In the following, we look at employment in full time equivalents.

We define firm exit as the situation when the firm disappears from accounting statistics for at least two years.[56] Thus, exit involves both bankruptcies and mergers and acquisitions.

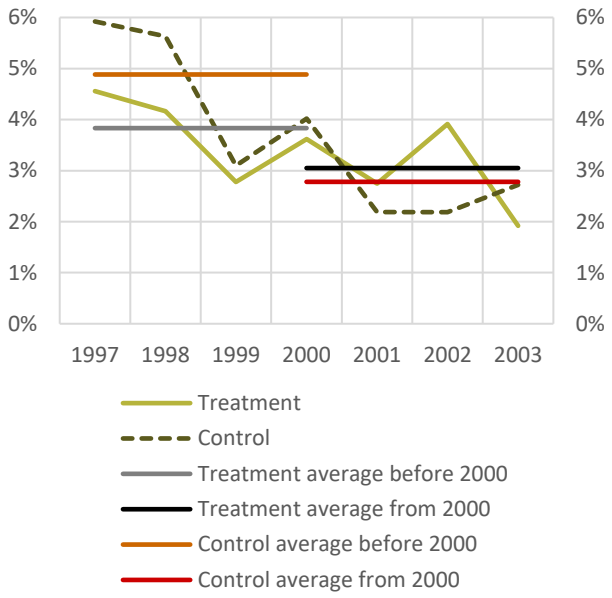
The pre-reform share of employees working in new firms was lower in the treatment regions than in the control regions but had a similar development over the years 1997-1999. In the post-reform period the two groups' order was temporarily reversed when the share was higher in the treatment regions in 2001 and 2002 (see Figure 4.10) and lower in 2000 and 2003. On average in the post-reform period, the treatment group had a higher share than the control group, which is the opposite of the situation in the pre-reform period. The level of both groups' shares was lower in the post-reform period, most likely due to macro conditions.

Figure 4.9 Descriptive statistics on firm entry



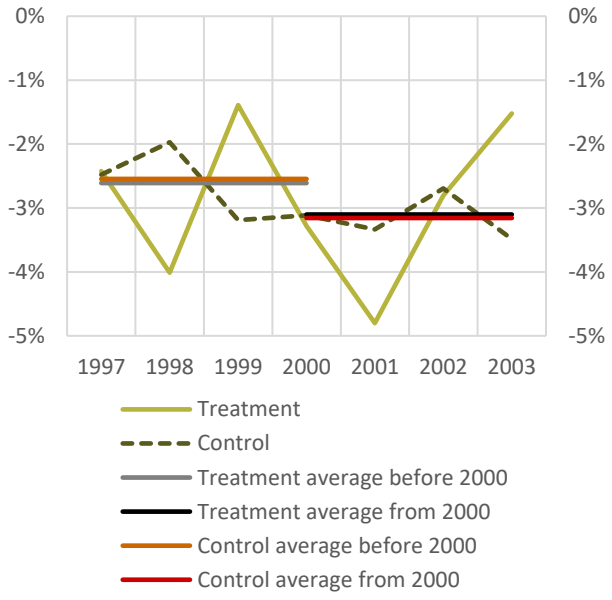
[56] By using this definition, we consider the cases of incomplete data when firms occasionally are not present in the data for one year. Further, we consider the scheme's industry exemptions by removing firms in these industries in our data after checking for exits.

Figure 4.10 No. of employees in new firms as share of total employment the previous year. Full-time equivalents. 1997-2003



Note: We have removed employees in new firms that were not present in the data the following year.

Figure 4.11 No. of employees in firms not in annual account statistics the following year as share of total employment the previous year. Full time equivalents. 1997-2003



Note: We have removed employees who find a new job the same year as the bankruptcy.

As we see from Figure 4.10, the payroll tax reform possibly increased entry to treatment regions relative to control regions. However, we cannot claim that the relative increase in treatment regions from 2000 was due to the reform, since our analysis is based solely on descriptive statistics.

The share of employees in firms that were not in annual accounting statistics the following year, relative to total employment the previous year ("exit share") varied a lot from year to year in the period 1997-2003, particularly among the treatment group. The control group experienced a decrease in the exit share over period, although the averages were almost the same as in the treatment group both in the pre- and post-reform periods (see Figure 4.11). The level of both the groups' shares was lower in the post-reform period, implying that exits are more influenced by macro conditions than by local conditions, including the payroll tax rate, as it was in the case with entries.

4.2 Evaluation of the reform in 2004

In this section we exploit several changes in the scheme in 2004 to identify effects of changes in the payroll tax. In 2004 the tax rate increased in Zone 2, 3 and 4, due to EEA regulations. While Zone 2 experienced an immediate increase to the general tax rate of 14.1 pct., a step-wise annual increase was implemented in Zone 3 and 4. These changes was reversed in 2007 (see Chapter 2.3).

We focus on the period 2000-2006, i.e. the period around the changes in the scheme in 2004 but after the change in 2000 and before the reversion of the changes in 2007.

At the same time as the tax rate was increased, the government implemented an annual tax deduction of NOK 270,000. That is, firms in the affected tax

zones only faced the higher tax rate on labour cost above a threshold.[57]

Table 4.12 Changes in tax rates and corresponding threshold for labour costs (NOK 1,000). 2004-2006

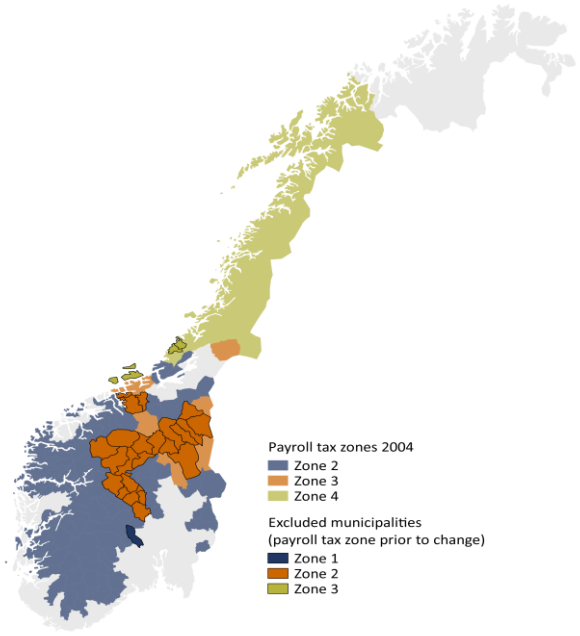
	Zone 2		Zone 3		Zone 4	
	Rate	Limit	Rate	Limit	Rate	Limit
2004	14.1	7,714.3	8.3	14,210.5	7.3	12,272.7
2005	14.1	7,714.3	10.2	7,105.3	9.5	6,136.4
2006	14.1	7,714.3	12.1	4,736.8	11.7	4,090.9
Prior to 2004[1]	10.6		6.4		5.1	

1) The same rate applied to wage costs below the threshold for the period 2004-2006. The thresholds are calculated as NOK 270,000/(new tax rate-old tax rate)
Source: Norwegian Tax Administration

In the empirical analysis we direct our attention to all municipalities in Zone 2, 3 and 4, except the municipalities that changed tax zone in 2000. The latter group is excluded from this part of the evaluation to minimise data noise. Our estimates in the previous section indicate effects on both wages and employment from a decrease in the payroll tax. Thus, it can be argued that firms affected by the changed in 2000 did not have the same development in 2000-2003 as firms unaffected by the 2000-reform.

Figure 4.12 shows which municipalities that are in Zone 2, 3 and 4 (as of 2004) and which municipalities that are excluded from the evaluation sample. Almost all municipalities in Zone 3 are excluded from the sample due to the 2000-reform. Thus, we only provide some results for Zone 3 in our empirical analysis and they must be considered as indicative. We are most confident in our results Zone 2 and 4. The part of the analysis that is highly data demanding is only conducted for the two latter tax zones (see Chapter 4.2.3).

Figure 4.12 Municipalities in Zone 2, 3 and 4. 2004



Note: Municipalities affected by the 2000-reform are marked with darker colours. These are excluded from the sample in the evaluation of changes in 2004.
Map: ©Kartverket

With an increase in the payroll tax labour becomes relatively more expensive. Thus, we expect effects on wages in the short run and on employment in the long run. More specifically, our main hypothesis is that employees in affected firms experienced lower wage growth than employees in unaffected firms.

Effects on wages and employment of the 2004-reform is studied at the firm level in Ku, Schönberg and Schreiner (2018). They find evidence that firms primarily responded to the increased payroll tax by reducing their demand for labour. They find little or no effect on wages. We add to this study by analysing effects on wages at the individual level (our entities are employees rather than firms).

[57] See Chapter 2.3 for how the threshold is calculated.

We apply two different methods; Difference-in-Differences (DiD) and Regression Kink Design (RKD). For both methods we construct a control and treatment group by dividing the population of firms into one group with labour costs above (treatment) and below (control) the thresholds presented in Table 4.12). We also check whether the common trend assumption is valid for these groups and find the test results satisfactory.

When evaluating the effects using DiD we include all firms in treatment and control groups. We also include all affected tax zones. This method gives us an indication on the direction of the effects. We cannot, however, claim that we find casual effects with this approach. Firms in the control group are, by construction of the two groups, smaller than firms in the treatment group in terms of wage costs and consequently in terms of numbers of employees. Using RKD we compare outcomes for firms right above and right below the threshold (and hence are very similar). This quasi-experimental inference gives us casual effects of an increase in the payroll tax rate on wages. RKD is a relatively data demanding and is therefore not applicable to evaluate the changes in Zone 3.

In connection with the discontinuation of differentiated payroll tax in the three zones evaluated in this section, it was decided that the affected municipalities should be fully compensated for additional expenses related to increased labour costs and increased private sector subsidies (St.prp. nr. 1 (2005-2006)). More than half of the compensatory funds can be said to be direct firm support, while the rest was given to what can be considered as common purposes, the largest of which is infrastructure investments. The latter may be assumed to only have indirect effects on firms (Hervik and Rye 2010).

Not nearly all firms affected by the increased payroll tax were compensated through direct firm support. In addition, no firms were compensated penny for penny. Thus, it is our opinion that we still can compare treatment and control groups within the same zone. However, it may be that the compensation (both direct and indirect) cause weaker effects than what we would have found without the compensatory measures. Our results should be interpreted as being on the lower boundary. Further, we believe that it takes longer to realise gains from municipal measures such as infrastructure investments than the immediate shock increased payroll taxes pose to the firm. Hence, we believe our estimated effects are unaffected by the compensatory measures in the short run.

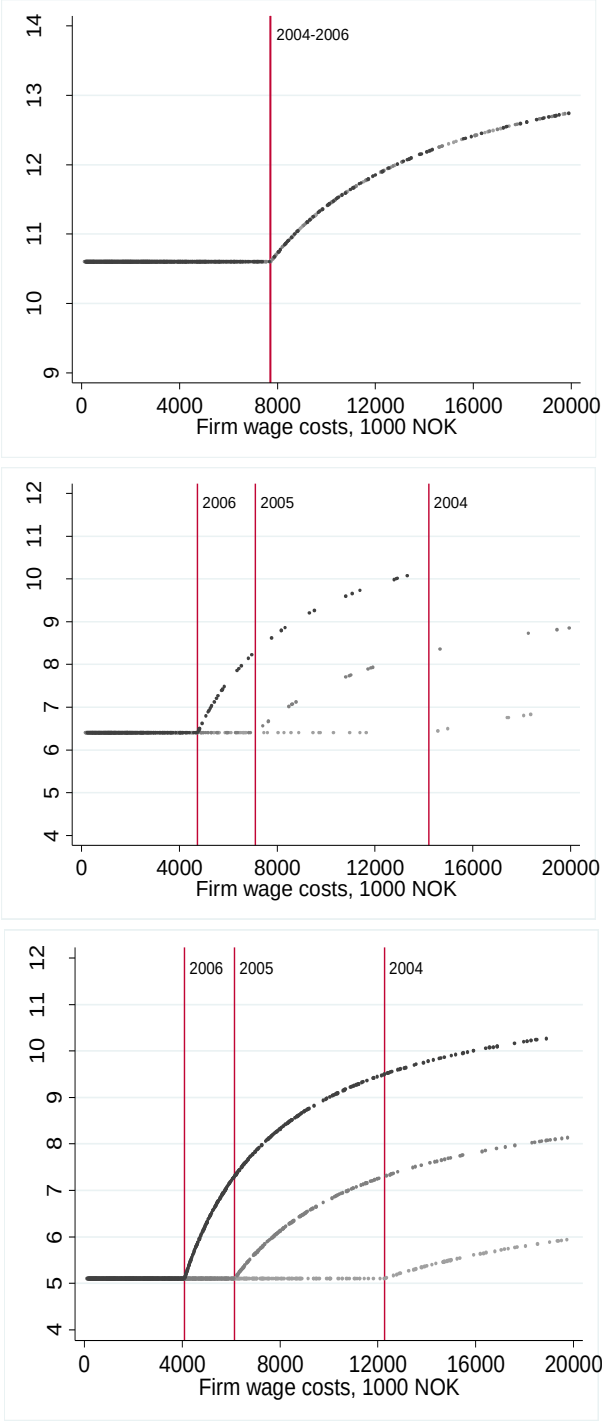
4.2.1 Sample construction and restrictions

As the evaluation period in this chapter (2000-2006) is partly overlapping with the period studied in the previous chapter (1996-2003), we apply a similar data trimming procedure. That is, we exclude the same sectors, employees earning more than 16G and those aged above 55 years. Further, we exclude individuals and firms with missing information on variables included in the regressions and we restrict our observations to include only those who are observed for at least three consecutive years (see Chapter 4.1.1).

In addition, we do some specific adjustments based on the key features of the 2004-reform. First, as mentioned earlier, we exclude municipalities that changed tax zones in 2000. Second, we only keep firms with at least 95 pct. of their man-hours performed by employees in the same zone as the firm is located. Information on wage costs and actual paid payroll tax is on firm level. Further, the tax-deductible amount (NOK 270,000) applies only to employees from the affected tax zones (Zone 2-4),

while a range of firms have a mix of employees from different tax zones.

Figure 4.13 Wage cost thresholds and effective payroll tax rate by tax zone. 2004-2006



Since we cannot identify which part of the firm's wage costs that should be compared to the thresholds applicable for the firm (see Table 4.12) we focus on this analysis on firms with almost all employees from the same tax zone as the firm.

The increased payroll tax rates in 2004 resulted in higher labour costs for firms with wage costs above the threshold. The larger the firm was in terms of employees, and hence wage costs, the more its total labour costs were affected by the 2004-reform (cf. Figure 4.13). In the period 2004-2006, these adjustments also made it more expensive to employ an additional worker for firms with wage costs above the threshold, compared to firms with wage costs below the threshold. Hence, for firms with wage cost above the threshold we expect to observe wage corrections through lower wage growth immediately after the reform. We study the effects on wage growth using individual-level data and we only include full-time employees.

While we use wage costs in nominal prices for comparing them to the threshold and dividing firms into treatment and control groups, we measure all monetary variables in 2015 prices in our estimations, adjusting for inflation using the consumer price index (CPI).

4.2.2 Estimating effects with a DiD approach

The difference-in-differences method is typically implemented in the literature in a situation with two periods, e.g. one with and one without the policy or one before the policy change and one after. While Zone 2 experienced an immediate increase in the payroll tax in 2004, Zone 3 and 4 faced a gradual increase (cf. Table 4.12). We can apply a simple difference-in-differences approach, as in the previous chapter, to evaluate the effect of increased payroll tax for firms in Zone 2 (where the same policy regime was valid for the whole post 2004-reform period).

In the case of Zone 3 and 4, where the tax rate changed annually, we need to apply a difference-in-differences approach where treatment is implemented at more than one point in time. We extend the model specification in Chapter 4.1.2 to the following specification

$$
\begin{aligned}
&Y_{it} \\
&= \gamma^0 \\
&+ \sum_{T \neq 0} \gamma^T G_i^T + \sum_T \tau^T D^T \\
&+ \sum_{T_0} \sum_{T_1 \geq T_0} \alpha^{T_0 T_1} G_i^{T_0} D^{T_1} g_{it} + \sum_j \beta^j X_{it}^j \\
&+ \varepsilon_{it}
\end{aligned}
\tag{4.3}
$$

Here, Y is the dependent variable by which we want to measure the effect of the policy change (e.g. changes in wage growth or probability to employ a new worker in our case), and X_{it}^j is a range of control variables. T is a categorical variable that is equal to 0, 1, 2, 3 given the total number of periods (i.e. 2000-2003, 2004, 2005 and 2006 correspondingly). $\mathrm{G^T}$ is an indicator variable for the generation of firms that were treated in period $T > 0$, where 0 remains for the period before the policy change in 2004. D^T is a dummy variable for period T, while $\mathrm{g_{it}}$ is a dummy variable that indicates whether firm i was treated in period t. T_0 represents the period just before the first treatment, and $\mathrm{T_1}$ any other period after this.

The parameters γ, τ, α and β are to be estimated. In equation 4.3, the γ parameters correct for differences between treated and untreated firms that already existed before the 2004-change, to the extent that these differences are not reflected in the set of variables X. Including multiple γ parameters enable us to distinguish between different generations of treated firms, i.e. larger firms that were treated in the start when the threshold for wage cost was very high in Zone 3 and 4, and smaller firms that were treated later (the smallest firms that never reached the threshold will have zero value for all Gs).

The τ parameters in equation 4.3 correct for differences between policy regimes that took place between policy changes. Finally, the α parameters measure the effect of the payroll tax changes. Instead of just estimating a single effect, we estimate one effect for each combination of treated firm generation (G) and period (T). For example, the parameter $\alpha^{1,3}$ measures the effect of the increase in the payroll tax in 2006 (period 3) on firms in Zone 3 and 4 from the first generation of treated firms (firms with wage costs above the 2004-threshold). A similar parameter (effect) is estimated for every possible combination of period and generation.

To illustrate the potential effects of the 2004-reform, we first present some graphical evidence. Figure 4.14 presents average growth rates in real hourly wages in both treatment and control firms by tax zone, for the years 2001-2006. We see that the two groups have similar development in the period prior to the change in 2004 in all three tax zones, although the average growth rate is slightly higher for the treated firms in Zone 2 and 3. In the period after 2004 (post treatment), the growth rates are remarkably lower in the treatment group compared to the control group in Zone 2 and 3.

We do not observe similar differences after 2004 in Zone 4. However, if we account for when the treated firms were treated, we observe that different generations of treated firms behave differently in the post-reform period (cf. Figure 4.15).[58] Firms treated in

[58] Due to too few observations for firms in Zone 3 we do not present the same figure for them.

2004 and 2005 experience decreasing growth rates immediately after the increase in the payroll tax, but not the firms that were treated in 2006. Moreover, average growth in all three groups is higher in 2006 than in the control group, possibly implying that firm anticipated the reversion of the 2004-reform that happened in 2007.

Figure 4.14 Average annual growth in real hourly wages in treatment and control groups by tax zone. 2001-2006

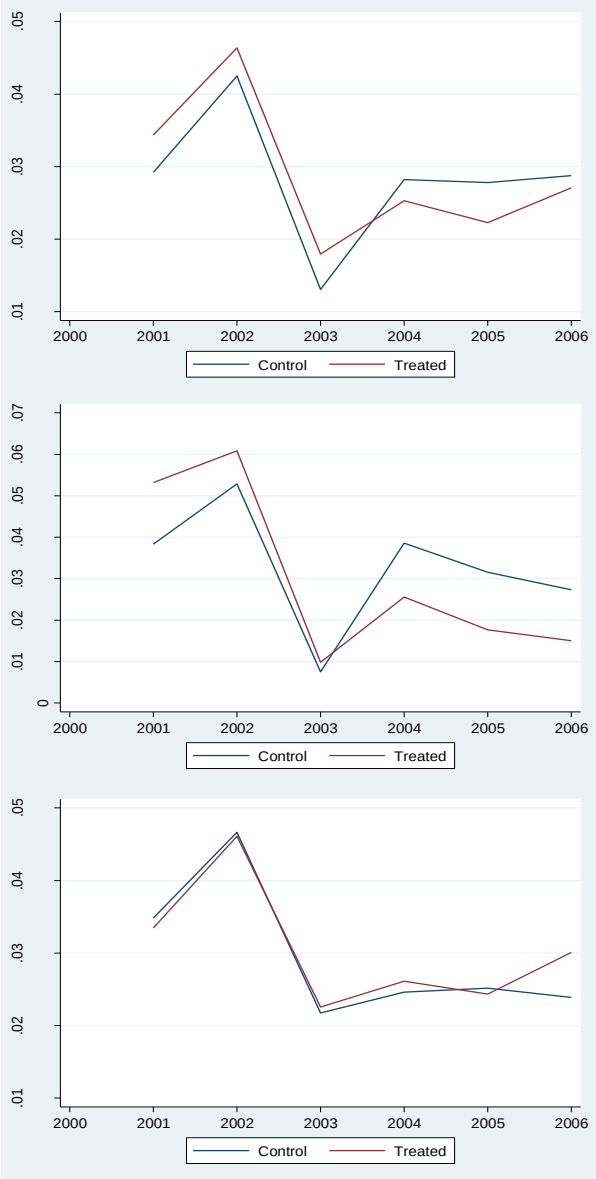
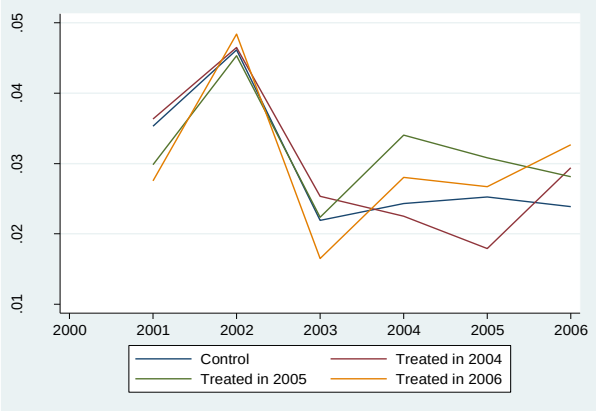


Figure 4.15 Average annual growth in real hourly wages in treatment and control groups in Zone 4 by timing of treatment. 2001-2006



In the following we will test whether the observed differences are statistically significant.

First, we estimate the effect of higher payroll taxes on wages by applying a simple difference-in-differences approach like the one presented in equation (4.1) in Chapter 4.1.2:

$$\Delta \ln w_{ijst} = a_0 + a_1 T_j + a_2 P_t + a_3 T_j P_t + \beta \bar{X}_{it} + \gamma \bar{X}_{j0} + \varphi_s + \rho_t + \varepsilon_{ijst} \qquad (4.4)$$

where $\Delta \ln w_{ijst}$ is the change in log hourly wage from year $t-1$ to year t for worker i in firm j in industry s, T_j is a dummy that equals 1 if firm j is in the treatment group, facing higher payroll tax (i.e. with wage costs above the threshold) in any of the post-reform years, and P_t is a dummy that equals 1 in the post-reform years (from 2004 onwards).

As in the model in equation 4.1, the vector of worker characteristics in year t ($\bar{X}_{it}$), includes dummies for age (5-year intervals), education level (primary, secondary and collage), immigrant status (native, western immigrant, non-western immigrant) and gender. In addition, we control for initial firm age $\bar{X}_{j0}$ (i.e. firm age in the first observation year). Industry and year

fixed effects are represented by φ_s and ρ_t, respectively, a_0 is a constant, β and γ are vectors of parameters and ε_{ijst} is an error term.

Table 4.13 presents the results from the regression for all zones involved the 2004-reform together and separately for each of the three tax zones. The parameters of interest are those estimated for the interactions between post reform years and treatment, which capture the difference in wage growth between treated and control firms after changes in the scheme in 2004. Column (1) for each regression show the results when restricting the treatment effect to be an average over the post reform years, 2004-2006. Column (2) show the results when we adjust the above specified regression model to allow year-specific treatment effects. All standard errors are robust and clustered at the firm level.

The results indicate that only firms in Zone 2, where the tax rate increased to the general level of 14.1 pct. and with no further changes in the period 2004-2006, responded with lower wage growth. The average effective tax rate for the treated firms in Zone 2 is equal to 12.9 pct. and implies on average about 2 pct. increase in their wage costs after the 2004-reform. [59] Thus, the interpretation of the results for Zone 2 is that an average 2.3 percentage point increase in the payroll tax rate generates on average 0.8 percentage point lower wage growth per year during the post-reform years 2004-2006.

Due to several changes in the scheme for Zone 3 and 4 (cf. Figure 4.13) and distinct characteristics of the treated firms in different periods regarding the labour cost thresholds, effective payroll tax rates and size of their labour costs, we cannot make any strong conclusions for employees in these firms based on the model in equation 4.4. We therefor continue with estimating the generalised difference-in-differences model with multiple treatment groups presented in equation 4.3. The results are presented in Table 4.14.

Table 4.13 Impact of an increase in the payroll tax on individual wage growth, simple DiD

	Zones 2-4		Zone 2		Zone 3		Zone 4	
Variables	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Post2004	0.006	0.006	0.021**	0.022**	-0.006	-0.024	-0.003	-0.006
Treatment	0.003***	0.003***	0.004	0.004	0.01	0.01	0.003	0.003
Treatment x Post 2004	-0.002		-0.008***		-0.017		0.003*	
Treatment x 2004		-0.001		-0.007*		-0.023		0.003
Treatment x 2005		-0.003		-0.008**		-0.024*		0.001
Treatment x 2006		-0.001		-0.011**		0.003		0.007***
R^2		0.033		0.042		0.13		0.04
No. observations		78,147		35,392		1,289		41,466
No. individuals		175,55		7,932		284		9,339
No. firms		5,114		2,311		114		2,689

* p<0.10, ** p<0.05, *** p<0.01

Note: Clustered standard errors at firm level.

[59] The almost 2.3 percentage point increase in the payroll tax rate from 10.6 pct. to 12.9 pct. corresponds to 2 a pct. increase in wage costs: (1.129w-1.106w)/1.106w=0.02.

Only treated firms of type 1 (i.e. those with wage costs above the 2004-threshold) seem to have responded to the increased payroll tax in Zone 4, while treated firms of type 2 (i.e. those with wage costs above 2005-threshhold) responded in Zone 3.[60] However, from Figure 4.13 we can see that there are almost no firms of type 1 in Zone 3. In general, there are too few observations in Zone 3 to make any strong conclusions and robust calculations. Thus, in the following we proceed with interpretations of the results for Zone 2 and 4.

In Zone 2 the wage cost threshold remained the same throughout the period 2004-2006 (cf. Table 4.12) and, interestingly, only firms that initially had wage costs above the threshold responded to the increased payroll tax (firms of type 1 in Zone 2). For firms that reached the threshold in 2005 or 2006, possibly due to internal wage adjustments or employment growth despite of the increased payroll tax, we do not find any significant effect on wages after treatment (see the results for firms of type 2 or 3 in Zone 2).

As in the previous model, an average increase of labour costs of 2 pct. generates on average 0.8 percentage point lower wage growth per year during the post-reform years 2004-2006 in Zone 2. However, we only find a robust and strong effect in 2006, which is equal to a 1 percentage point lower wage growth for employees in the treated firms. compared

Table 4.14 Impact of an increase in the payroll tax on individual wage growth, generalised DiD

Variables	Zones 2-4	Zone 2	Zone 3	Zone 4
Post2004	0.008	0.021**	0.092	-0.003
Treated Type1	0.003**	0.002	0.055*	0.008***
Treated Type2	0.004**	0.001	0.036	0.005**
Treated Type3	0.001	-0.002	0.003	0.001
Type1 x 2004	-0.006**	-0.006	-0.01	-0.008**
Type1 x 2005	-0.008**	-0.008*	-0.019	-0.010**
Type1 x 2006	-0.005*	-0.010**	0.061***	0.003
Type2 x 2005	0	0.007	-0.051***	0.001
Type2 x 2006	-0.003	-0.013	-0.127***	0.004
Type3 x 2006	0.006*	0.006	0.018	0.009**
Log Initial employment	0.001	0.002*	0.023	0.002
Log Initial employment squared	0	0	-0.007	-0.001**
Log Initial firm age	-0.006***	-0.006***	0.007	-0.005***
Log Initial firm age squared	0.001***	0.001***	-0.002	0.001***
No. observations	78,147	35,392	1,289	41,466
No. individuals	175,55	7,932	284	9,339
No. firms	5,114	2,311	114	2,689
R^2	0.033	0.042	0.132	0.04

* p<0.10, ** p<0.05, *** p<0.01
Note: Clustered standard errors at firm level.

[60] Given average wage level in 2004, the size of treated firms of type 1 is about 40+ employees in Zone 3 and 35+ employees in Zone 4. The corresponding numbers for treated firms type 2 are 20-39 employees in Zone 3 and 18-34 employees in Zone 4.

to control group. This implies 50 pct. tax shifting on to the employees in Zone 2.[61]

As for the firms in Zone 4, the average effective payroll tax rate for the treated firms of type 1 (those with wage costs above NOK 12,272,727 in 2004) is equal to 6.0 pct. in 2004, which implies on average about 0.9 pct. increase in their wage costs from 2003 to 2004.[62] These firm have on average responded with a 0.8 percentage point lower wage growth in 2004, implying almost 90 pct. tax shifting on to employees in 2004.

The average effective payroll tax rate for the treated firms of type 1 in Zone 4 is equal to 8.3 pct. in 2005. This corresponds to an average increase in wage cost of about 2.2 pct. from 2004 to 2005.[63] These firms have responded by 1 percentage point lower wage growth in 2005, implying 45 pct. tax shifting on to employees in 2005.

Finally, the average effective payroll tax rate for the treated firms of type 1 in Zone 4 is equal to 10.5 pct. in 2006, which implies on average about 2 pct. increase in their wage costs from 2005 to 2006, but without any tax shifting on to employees in 2006. In total, treated firms of type 1 in Zone 4 experienced a 5.1 pct. increase in their wage costs during the period 2004-2006 and had a 1.8 percentage point lower wage growth in the same period, compared to what they otherwise would have had. That is, in Zone 4 the firms seem to have shifted 35 pct. of the tax increase on to their employees in total.

Overall, it seems that firms with the highest wage costs prior to the changes in 2004, and who therefore experienced the largest increase in their wage cost, also were the firms who had the strongest response to the changes. However, with this simple difference-in-differences approach we compare firms that differ in size. Despite their parallel trends in wage growth prior to the reform, they could differ a lot with respect to wage bargaining power, employment policy, growth possibilities, etc. which could influence their response. Hence, we cannot claim that the estimated effects are causal and are results of the 2004-reform alone.

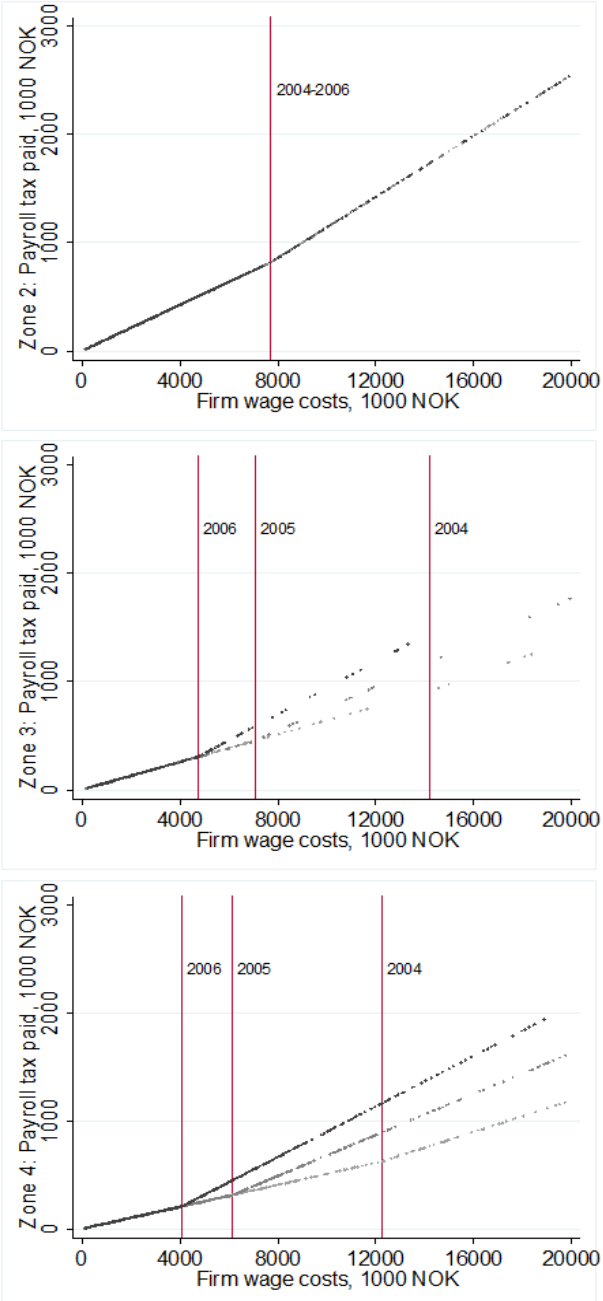
To cope with this challenge, we move on to evaluate the same changes in the scheme with an extension of the regression discontinuity approach called the regression kink design (RKD). This method is most appropriate when any threshold introduced by the policy leads to kinks in both the treatment and response variables (as we will show was the case in the 2004-reform).

4.2.3 Estimating effects with an RKD approach

The introduction of wage cost thresholds in 2004 and the gradual increase in payroll tax rates between 2004 and 2006 provide variation in the effective payroll tax rate both over time and between firms, i.e. the actual payroll tax paid depends on the firms' wage costs, tax zone and year. A firm's wage costs determine whether the firm is treated (facing a higher tax rate) or not. Whereas the regression discontinuity design exploits a discontinuity in the likelihood of being treated at some threshold point, the RKD exploits a change in slope at the likelihood of being treated at a kink point.[64]

[61] An average increase in wage costs of 2 pct. and a 1 percentage point lower wage growth for employees equals 50 pct. tax shifting.
[62] The almost 1 percentage point increase in the payroll tax rate from 5.1 pct. to 6.0 pct. corresponds to 0.9 pct. increase in labour costs: (1.060w-1.051w)/1.051w=0.009.
[63] The almost 2.3 percentage point increase in the payroll tax rate from 6.0 pct. to 8.3 pct. corresponds to about 2.2 pct. increase in labour costs: (1.083w-1.060w)/1.060w=0.022.
[64] See https://blogs.worldbank.org/impactevaluations/tools-trade-regression-kink-design

Figure 4.16 Paid payroll taxes above and below different wage cost thresholds by tax zone. 2004-2006



The kinks in the payroll tax schedules are presented in Figure 4.16. For wage cost below a given threshold (illustrated by red line) the firms pay taxes with one rate, while above the threshold they pay a higher rate on the amount above the threshold. In Zone 2 there is just one kink; firms faced a payroll tax rate of 10.6 pct. with wage cost below NOK 7.7 million and 14.1 pct. on wage costs above this amount. In Zone 3 and 4 we observe three kinks corresponding to the different thresholds and payroll tax rates in 2004, 2005 and 2006.

The basic idea with the RKD is to compare firms just above the kink (our treatment group) with firms just below (our control group) and see whether there is a change in the slope of the outcome variable at the threshold value. As the regression discontinuity design (RDD), RKD estimates the causal impact of the policy change as treatment is the only difference between the two groups (they are almost identical in other aspects).

Similar designs as the one with different tax rates for different levels of wage cost are present in a range of government policies. Simonsen, Skipper and Skipper (2015) exploit kinks in the Danish prescription drug reimbursement schedule to investigate how sensitive demand for prescription drugs is changes in drug prices.[65]

Another common example is unemployment benefits, which are often dependent on previous earnings, but with a maximum (and sometimes minimum) amount. With RKD it possible to study how long people stay unemployed as a function of the amount they receive in benefits (see Landais

[65] The subsidy in Denmark is based on the total prescription costs the individual has paid during the year; there is 0 pct. subsidy for the first DKK 500 in expenses, then 50 pct. subsidy once you have paid DKK 500 up to you have paid DKK 1,200, then 75 pct. subsidy, and eventually 80 pct. subsidy for expenses above DKK 2,800.

(2015), who exploits the effects of both benefit level and potential duration on the unemployment spells in the US; or Card, et al. (2015), who apply a fuzzy RKD to study the effect of unemployment benefits on the unemployment duration in Austria).

The main advantage of the RKD is that, in contrast to studies using regional or time variation in payroll taxation, the RKD holds market-level factors constant, i.e. we identify changes in the actual behavioural response, net of any market level factors that may change over time or across regions. The main disadvantage of this method, however, is that it is highly data demanding since we need to have enough observations around the kinks. Small samples would in general not exhibit enough statistical power to detect any effect with the RKD. That is why we only study effects of changes in the payroll tax in Zone 2 and 4.

Formally, the amount S_{jt} firm j pays in payroll tax in year t can be written as:[66]

$$S_{jt} = \begin{cases} \tau_0 W_{jt} & if\ W_{jt} \leq W^* \\ \tau_0 W^* + \tau_1 (W_{jt} - W^*) & if\ W_{jt} > W^* \end{cases}$$

or

$$S_{jt} = \begin{cases} \tau_0 W_{jt} & if\ W_{jt} \leq W^* \\ \tau_1 W_{jt} - (\tau_1 - \tau_0) W^* & if\ W_{jt} > W^* \end{cases} \quad (4.5)$$

where W^* is the wage costs threshold, τ_0 is the old payroll tax rate that remains applicable for firms with wage costs under threshold after the 2004-reform and τ_1 is a new (higher) payroll tax. Firms pay τ_1 on wage costs above the threshold. Values for τ_0 and τ_1 are presented in Table 4.12.

Following a sharp RK design we estimate the following polynomial regression:

$$E[y|\mathrm{W} = \mathrm{w}] = \mu_0 + \left[\sum_{p=1}^{P} \gamma_p (w-k)^p + \vartheta_p (w-k)^p \cdot D \right] \quad (4.6)$$

where $|w-k| \leq h$ with h being a bandwidth. W is the assignment variable (i.e. firm's wage costs) and $D = \mathbb{1}[w \geq k]$ is an indicator of whether wage costs are above the threshold or not. ϑ_1 measures the change in slope of the conditional expectation function of the outcome given the value of the assignment variable at the kink.

The causal effects of changes in the payroll tax rate can be by dividing the change in slope for the outcome by the change in slope for the treatment, where the former is estimated by equation 4.6 and the latter is deterministic and is described by equation 4.5[67]:

$$\hat{\alpha} = \frac{\hat{\vartheta}_1}{\tau_1 - \tau_0} \quad (4.7)$$

Identification of effects by RKD relies on two assumptions. First, the direct marginal effect of the assignment variable on the outcome should be smooth. Second, the density of the unobserved heterogeneity should evolve smoothly with the assignment variable at the kink. This local random assignment condition seems to be credible in the context of the Norwegian payroll taxation; high degree og centralised wage negotiations and strong protection

[66] This formula is applicable only in our case when we restrict the evaluation sample to firms with employees from the same tax zone as the firm. Firms with employees from various zones face different payroll tax rates and calculation of these firms is more complicated. This formula is also valid for all firms with similar restrictions after 2007, when the location of the firm and not the employees determines the tax rate.

[67] See explanation in Card, et al. (2012).

of employees prevent firms from perfectly manipulating their ex-ante position, i.e. planned wage cuts and downsizing.

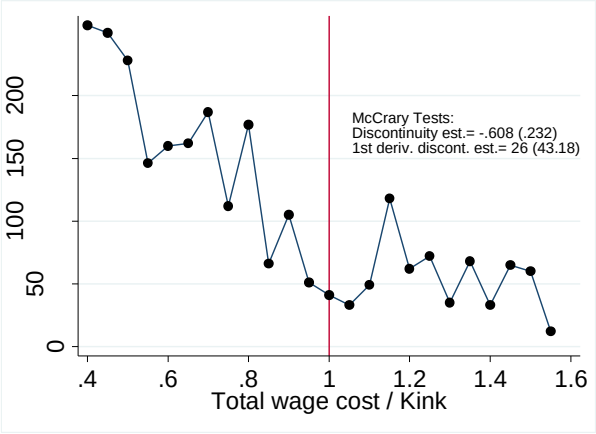
As mentioned above, we believe firms adapted to the 2004-reform by reducing wage growth rather than lower wages. In the following we provide empirical evidences of reductions in wage growth using the RKD.

First, we plot the probability density function of the assignment variable (wage costs) to detect potential manipulation of the assignment variable at the kink point. Figure 4.17 show the number of spells observed in each bin of firm wage costs, normalised by the kink (wage cost threshold set equal to 1) in Zone 2.[68] To test for discontinuity in the relationship between the number of spells and the assignment variable at the kink point we perform a McCrary tests (standard in the RDD literature). The test result is presented in the graph and confirm that we cannot detect a lack of continuity at the kink.

Following Landais (2015), we also extend the spirit of the McCrary test to test the assumption of continuity of the derivative of the p.d.f, as done in Card, et al. (2012). This test supports the assumption of a continuous derivative of the conditional density at the kink.[69]

Following the discussion in Card et al. (2012) on what is a key testable implication of the smooth density assumption underlying a valid RK design, we test whether the conditional distribution of any predetermined covariate evolve smoothly with the assignment variable around the kink point. This can be graphically tested by plotting the mean values of covariates in each bin of the assignment variable. We have done this test for all individual characteristics, i.e. age, gender, education and immigrant status, and found that all covariates evolved smoothly at the kink point supporting identification assumptions of the RK design.[70]

Figure 4.17 Probability density function of the assignment variable (wage costs) for the payroll tax schedule. Zone 2



The next key assumption of a valid RK design is that it is a change in the slope of the outcome variable. Figure 4.18 presents the relationship between the individual (log) hourly wage growth and the assignment variable, normalised at the kink point of the payroll tax schedules in Zone 2 and 4. We observe a visible change in the slope of this relationship for both tax zones. Thus, it seems that we can expect to find effects of changes in the payroll tax within the RK design.

However, when we split the whole post-reform period 2004-2006 into three sub-periods for observations in Zone 4, the observed changes in the slopes

[68] The choice of bin size (of 0.2) in our graphical analysis is done using both visual and formal tests of excess smoothing.
[69] The idea is to regress the number of observations N_i in each bin on polynomials of the average firm wage costs in each bin (centered at the kink) $(w-k)$ and the interaction term $(w-k)\cdot \mathbb{1}[w \geq k]$. The coefficient on the interaction term for the first order polynomial (testing for a change in slope of the p.d.f) reported in Figure 4.17 is insignificant, which supports our assumption.
[70] These graphs are not reported here but can be provided in the appendix.

are quite weak (cf. Figure 4.19). We test whether they are significant or not in the following regressions.

Figure 4.18 Log hourly wage growth by wage cost level (normalised to 1 at the threshold value). Zone 2 and 4. One post-reform period 2004-2006

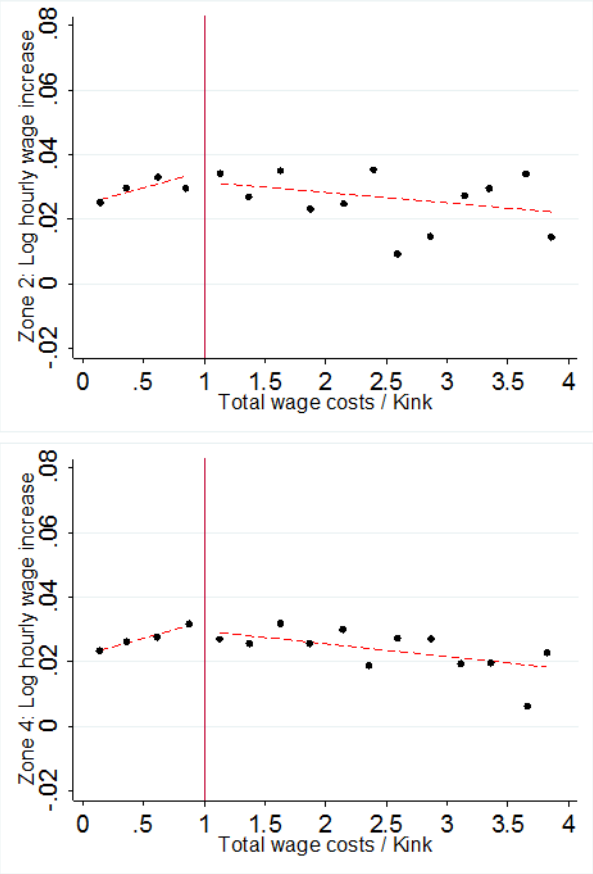
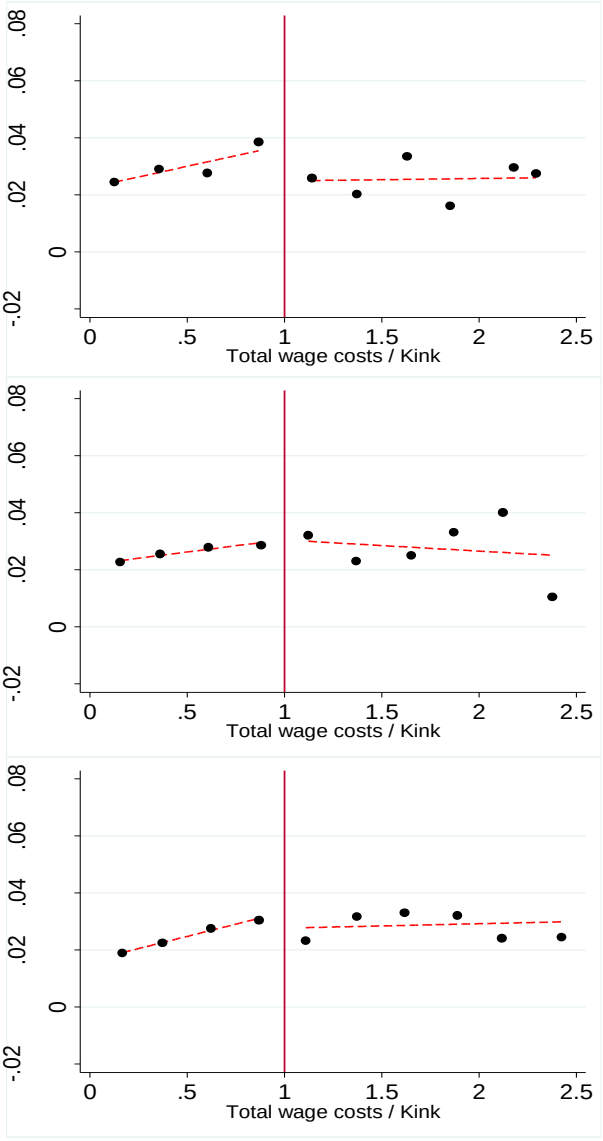


Table 4.15 presents the results of the RKD estimation of the effect of increased payroll tax rate on wage growth in Zone 2 for the whole post 2004-reform period. We have estimated the effect for five different bandwidths, i.e. five samples. A wider bandwidth includes more firms on either side of the wage cost threshold, but at the cost of less precise estimates (increasing difference between the firms). Table 4.16 presents the corresponding results for Zone 4 for each year in the post-reform period (2004-2006). We have estimated effects for different bandwidths each year. However, we only report results for the bandwidth with the highest levels of significance.

Figure 4.19 Log hourly wage growth by wage cost level (normalised to 1 at the threshold value) and pre-reform period. Zone 4. 2004-2006



In each column we report the weighted average treatment effect $\hat{\alpha}$ (calculated as in equation (7)), the elasticity of the individual wage growth with respect to the firm's wage costs, ε_w, the estimate of the preferred polynomial specification based on the Aikake Information Criterion (AIC) and number of observations.

We find that a smaller share of the increased payroll tax is shifted on to the employees, i.e. most of the tax burden resides with the employers, compared to the results in the previous chapters. The degree of tax shifting varies from 4 to 17 pct. in Zone 2 (see reported estimates for ε_w in column (1) to (5) of Table 4.15) and 0.5 to 4 pct. in Zone 4 (ε_w in Table 4.16). Our results indicate that labour demand is less elastic in Zone 4 (less of the tax is shifted on to the employees).

In our main specification in Chapter 4.1, we find that about 24 pct. of the tax incidence resides with the employees in the case of a reduction in the payroll tax. Compared with the estimated share of the tax burden residing with the employees in this chapter, it seems that there is an asymmetry in firm's adjustments to changes in the payroll tax.

Table 4.15 RKD estimates of the effect of increased payroll tax rates on wage growth. Zone 2. 2004-2006

	(1)	(2)	(3)	(4)	(5)
Bandwidth h	1,000	2,000	2,500	3,000	4,000
$\hat{\alpha}$	-0.019	-0.006	-0.010	-0.005	-0.001
	(0.010)	(0.003)	(0.008)	(0.016)	(0.001)
ε_W	-0.169	-0.050	-0.087	-0.040	-0.012
	(0.091)	(0.024)	(0.070)	(0.144)	(0.008)
Opt. polyoder	1	1	2	3	1
No. obs.	716	1,903	2,514	3,200	4,602

Notes: Wage growth is expressed by Δlog(hourly wages). $\hat{\alpha}$ is the RKD estimate of the average treatment effect of firm effective payroll tax rate on the outcome. Robust standard errors for the estimates are in parentheses. ε_W is the elasticity of the individual wage growth with respect to wage costs.

Table 4.16 RKD estimates of the effect of increased payroll tax rates on wage growth. Zone 4. 2004-2006

	(1)	(2)	(3)
Year	2004	2005	2006
Bandwidth h	6,000	4,000	1,000
$\hat{\alpha}$	-0.004	-0.001	-0.016
	(0.001)	(0.001)	(0.008)
ε_W	-0.033	-0.005	-0.041
	(0.008)	(0.003)	(0.020)
Opt. polyoder	1	1	2
No. obs.	1,880	1,410	905

Notes: Wage growth is expressed by Δlog(hourly wages). $\hat{\alpha}$ is the RKD estimate of the average treatment effect of firm effective payroll tax rate on the outcome. Robust standard errors for the estimates are in parentheses. ε_W is the elasticity of the individual wage growth with respect to wage costs.

4.3 Estimating long-run effects

A main question in the evaluation is whether a reduced payroll tax has a significant effect on the beneficiaries' behaviour, where the desired effect is an increase in employment (assuming this will reduce or prevent depopulation). With the quasi-experimental approaches used in the previous two sections, we find evidence that a change in the payroll tax affects both wages and employment. We do, however, find that most of the tax incidence resides with the employers.

As shown in the stylised model in Chapter 3.6, the effect on labour demand is largest when wages paid to the employees are unaffected. Thus, with little tax shifting on to the employees, which seems to be the case, we should expect a stronger direct effect on employment. In this chapter we will benefit from the stylised model in Chapter 3.6 to estimate the long-term effects of changes in the payroll tax. The idea is that if changes in the payroll tax lead to changes in wage costs (rather than a corresponding change in wages), and changes in wage cost affects the demand for labour, there is reason to claim that changes in the payroll tax affects the demand for labour.

Our empirical approach in this section follows, to some extent, the line of thought in Johansen and Klette (1997) and Gavrilova, et al. (2015)[71]. These analyses both use a panel of manufacturing plants to study how payroll taxes affect wages and demand for labour. Gavrilova, et al. (2015) exploit the variation in changes of the payroll tax rates for manufacturing sectors in Norway to estimate the incidence of the payroll tax. Johansen and Klette (1997) exploit the regional differentiated payroll tax and a regional subsidy scheme for capital in Norway to study how payroll taxes and investment subsidies affect wages and demand for labour and capital (elasticity of substitution).

Gavrilova, et al. (2015) use a two-stage least squares procedure to estimate the labour demand elasticity, where changes in the payroll tax serves as an instrument for changes in the wage cost rate. Compared to a reduced-form equation, where the payroll tax rate is regressed directly on labour demand, this approach distinguishes between whether no labour response is due to a labour demand elasticity of zero or that the tax incidence fully resides with the employees (Gavrilova, et al. 2015, 9).

Though we do not adopt the IV-approach, we do estimate the labour demand elasticity in to steps. Consider the following set of equations

$$N = N(W(1+t), X) \tag{4.8}$$

$$W = F\big((1+t), Z\big) \tag{4.9}$$

where W is a measure of real wages per hour, N is employment and labour cost per hour, WC, is defines as $W(1+t)$. X is a measure of product demand, set equal to value added, and Z is other factors typically included in wage bargaining models.

Taking the derivative of N w.r.t. $(1+t)$ we get

$$\frac{\partial N}{\partial (1+t)} = N_1 \left(\frac{\partial W}{\partial (1+t)} (1+t) + W \right) \tag{4.10}$$

which with some rearranging can be put in terms of elasticities:

[71] Working paper currently under revision.

$$\underbrace{\frac{\partial N}{\partial(1+t)}\frac{(1+t)}{N}}_{El_{1+t}N} = \underbrace{N_1\frac{WC}{N}}_{El_{WC}N\equiv\alpha_1}\left(\underbrace{\frac{\partial W}{\partial(1+t)}\frac{(1+t)}{W}}_{El_{1+t}W\equiv\beta_1}+1\right) \quad (4.11)$$

This allows us to first estimate the effect on wages of a change in the payroll tax. The expression on the right-hand side is largest when $El_{1+t}W = 0$, i.e. when wages paid to the employees are unaffected (the tax burden fully resides with the employer). Given the extreme case where $El_{1+t}W = 0$, or at least $El_{1+t}W \neq 1$, we would expect the employers to change their behaviour, as a response to increased wage costs. Thus, with a β_1 significantly smaller than 1 we would want to estimate the effect on labour demand from a change in wage cost per hour.[72]

4.3.1 Sample and variable definitions

This part of the evaluation is mainly based on accounting data on firm level. Accounting data contains information on gross wages, payroll tax paid and total wage costs, as well as employment, value added and operating profit. Information on contracted hours is added by aggregating number of hours per worker from individual data. Observing hours worked, we can calculate both wage rate per hour paid to the employees and wage costs (incl. payroll tax) per hour.

When the payroll tax increases this may reduce the wage per worker both because employers may shift their tax burden on to the employees, and because the number of contracted hours may decrease. Thus, without information on hours worked, the estimate on the incidence (tax burden) could be biased (Gavrilova, et al. 2015, 3).

When the payroll tax rate was determined by the residence of the employees, each firm's effective tax rate was a weighted average of all employees' tax rate. We can derive an approximate effective tax rate for each firm from the accounting data.[73] However, we lose a significant number of observations using this variable and the quality of the necessary variables seems to be relatively poor in the first years of the sample.

Using the statutory payroll tax, we limit our sample to firms with employees solely from the same tax zone as the firm is located to ensure that we assign the appropriate tax rate to each firm. By the same reasoning we have dropped firms with several establishments in different tax zones and firms operating in the sectors excluded from the scheme (see Chapter 2.2.2).[74] We further exclude public and primary sector as in the estimations above (see Chapter 4.1.1).

We measure all monetary variables in 2015 prices, adjusting for inflation using the consumer price index (CPI).

The main variables included in the estimations are described in Table 4.17. We define the gross wage rate as the ratio between total gross wages to the employees and the sum of contracted hours among all employees at the firm, whereas the wage cost rate is the ration between total wage cost (incl. payroll tax) per hour.

[72] Though β_1 is our parameter of interest in the first equation, we also estimate the effect on wage costs per hour directly.
[73] It is an approximation because we are not able to fully split reported labour costs into cost liable to tax and not.
[74] Some sectoral restrictions are determined based on firm characteristics not available in our data.

Table 4.17 Summary statistics. 2003-2014

Panel A Mean values				
	Mean	Std. Dev.	Min	Max
Gross Wage Rate[1]	269.9	105.2	84.5	898.5
Wage Cost Rate[1]	317.2	128.5	96.9	1,111.3
Statutory Payroll Tax	0.127	0.032	0	0.141
Effective Payroll Tax	0.126	0.034	0	0.216
Employees	9.4	17.5	0	1,636
Hours (thousands)	13.9	27.1	1.3	1,378.1
Value added[3]	5.7	19.8	-837.6	2,654.3
Panel B Share of obs. by tax zone				
	Pct.			
Zone 1	79.0			
Zone 1a[4]	3.1			
Zone 2	5.4			
Zone 3	2.0			
Zone 4	6.9			
Zone 4a[3]	1.6			
Zone 5	2.0			
No. of firms:	115,754			

1) Real wages (adjusted by CPI).
2) NOK million. Constant 2015-prices.
3) Tax zone introduced in 2007.

Almost 80 pct. of the observations in the main sample are observations for firms located in Zone 1 (not included in the scheme). Firms in Zone 1 and Zone 5 do not face changes in the statutory payroll tax during the estimation period (see Chapter 2.3). However, they contribute to variation in tax rates across firms (see Chapter 4.3.3).

The gradual increase in statutory tax rates between 2004-2006 in Zone 2, 3 and 4, and the reversion in 2007 provides us with longitudinal variation. Concentrating on these changes we limit our sample in this part of the evaluation to 2003-2014.

4.3.2 Empirical framework

Our parameter of interest is the elasticity of demand for labour. To estimate the elasticity of labour demand some of the incidence of payroll taxation must reside with the employer (firm), otherwise there is little, or no, reason to expect behavioural responses at firm level. If (some of) the tax burden falls on the employers, through increased wage costs, they may demand less labour. If some of the tax burden falls on the employees, through reduced wages, workers may supply less labour. The total effect depends on how sensitive employers and employees are to changes in prices (demand and supply elasticities as discussed in Chapter 3).

As pointed out by Johansen and Klette (1997), identification of elasticities requires good price data. There are at least two fundamental problems with existing price data. First, for some factors of production, prices can only be obtained at an aggregate level, and thus may not inhibit sufficient variation. Second, variation in prices across firms or over time may reflect differences in quality or other forms of heterogeneity, e.g. variation in mean hourly wage rates across firms may reveal little information about real cost differences if labour is not homogeneous. However, this difficulty can be overcome by using policy induced variation in factor prices (Johansen and Klette 1997, 5).

To estimate effects on wages of changes in the payroll tax rate we estimate the following wage equation[75]

$$\begin{aligned}\ln W_{jmst} = {} & \beta_1 \ln\left(1 + t_{jmst}\right) \\ & + \beta_2 \ln VAH_{jmst} \\ & + \beta_3 \ln AWR_{mst} + \mu_{st} \\ & + \eta_j + \epsilon_{jmst}\end{aligned} \tag{4.12}$$

[75] This is the same specification as in Johansen and Klette (1997). A similar specification is estimated in Gavrilova, et al. (2015).

where W is the gross wage per hour paid to workers in each firm, and t the payroll tax rate. To control for firm profitability, we include value added per hour, VAH. The alternative wage rate, AWR, is measured as mean wage in other firms in the same municipality and industry. We include time-fixed effects to account for wage and price growth. To control for sectoral shocks, like technological or preference shocks, we include industry-time fixed effects, μ_{st}.

The parameter of interest is β_1, the incidence-parameter. We estimate the effect on both wage cost per hour (incl. payroll tax) and the wage per hour paid to the employees (excl. payroll tax). Estimating the effect on the latter, we can derive the elasticity of gross wage rate w.r.t. the payroll tax rate $(1+t)$, i.e. $El_{(1+t)}W$ in equation 4.11

$$\frac{\partial \ln W}{\partial \ln(1+t)} = \beta_1$$

If some of the tax incidence resides with the firms, we can estimate the labour demand elasticity w.r.t. labour cost by the following equation

$$\begin{aligned} \ln N_{jmst} = {} & \alpha_1 \ln(W(1+t))_{jmst} \\ & + \alpha_2 \ln VA_{jmst} + \mu_{st} + \eta_j \\ & + \epsilon_{jmst} \end{aligned} \quad (4.13)$$

where N is firm employment and VA is total value added at firm level. Taking the derivative w.r.t. to $(1+t)$ we get

$$\begin{aligned} \frac{\partial \ln N}{\partial \ln(1+t)} &= \alpha_1 \frac{\partial \ln W}{\partial \ln(1+t)} + \alpha_1 \\ &= \alpha_1(\beta_1 + 1) := El_{(1+t)}N \end{aligned}$$

To obtain estimates on the long-run effects of changes in the payroll tax we further consider a dynamic model, including lags of the dependent variable (employment)

$$\begin{aligned} \ln N_{jmst} = {} & \alpha_1 \ln WC_{\mathrm{jmst}} + \alpha_2 \ln N_{jmst-1} \\ & + \alpha_3 \ln N_{jmst-2} \\ & + \alpha_4 \ln N_{jmst-3} \\ & + \alpha_5 \ln VA_{jmst} \\ & + \alpha_6 \ln VA_{jmst-1} + \alpha_t \\ & + \epsilon_{jmst} \end{aligned} \quad (4.14)$$

We apply a GMM estimator to obtain consistent estimates.[76]

4.3.3 Effects of the payroll tax on wages

First, we estimate the model in equation 4.12 on the pooled 2003-2014 cross section using OLS. The estimated effect on wage per hour and wage cost per hour is reported in Table 4.18. As specified in equation 4.12 we control for the alternative wage rate and value added per hour. Further, to control for labour heterogeneity across industries, we include interactions with time and industry dummies.

Our results suggest that a higher payroll tax rate has a negative effect on wages. The estimated coefficient of $\hat{\beta}_1 = -0.077$ implies that almost 8 pct. of the tax incidence resides with the employees. Or, conversely, 92 pct. on the employer. This is supported by the positive and significant effect on wage cost per hour, suggesting that 82 pct. of the tax incidence resides with the employer.

[76] As suggested by Arellano and Bond (1991).

Table 4.18 Gross Wage Rate and Wage Costs per Hour. Effects of changes in payroll tax. Pooled OLS. 2003-2014

	Log WRH	Log WCH
Log (1+SPT)	-0.077**	0.818***
	(0.032)	(0.032)
Log AWR	0.222***	0.237***
	(0.008)	(0.009)
Log VAH	0.400***	0.443***
	(0.010)	(0.010)
Dummies	Year x Industry	Year x Industry
R-Sq.	0.527	0.586
Obs.	408,540	414,058

* p<0.10, ** p<0.05, *** p<0.01

Notes: Estimates are weighted by total number of contracted hours per firm. Clustered standard errors at firm level in parentheses. WRH = Wage Rate per Hour, WCH = Wage Cost per Hour, SPT = Statutory Payroll Tax, AWR = Alternative Wage Rate, VAH = Value Added per Hour. VAH is instrumented with lagged value added per hour.

Controlling for other firm specifics, such as share of employees with higher education and share for foreign workers reduces the estimated effect on wages and increases the effect on wage cost. This may imply that we do not sufficiently correct for differences in labour heterogeneity and the endogeneity of the payroll tax rate (Johansen and Klette 1997).

Next, we estimate the wage regression in 4.12 with fixed effects, exploiting any longitudinal variation in the data. We also report the results from estimating the same specification using between variation (between effects). Comparing results from the pooled OLS, fixed effects and between effects it is apparent that our results, at least on wages paid to employees, are sensitive to estimation method. Further, it seems that the significant effect on wages paid to employees in the pooled OLS stems from the variation between entities in the data. Using fixed effects, the results are solely driven by firms located in Zone 1a to 4, due to lack of variation in the statutory tax rate in Zone 1 and Zone 5.

Table 4.19 Gross Wage Rate and Wage Costs per Hour. Effects of changes in payroll tax. Pooled OLS, Fixed Effects and Between Effects. 2003-2014

Panel A			
Log WRH	Fixed Effects	Between Effects	Pooled OLS
Log (1+SPT)	-0.084	-0.287***	-0.077**
	(0.123)	(0.029)	(0.032)
Log AWR	0.011**	0.255***	0.222***
	(0.005)	(0.005)	(0.008)
Log VAH	0.447***	0.377***	0.400***
	(0.019)	(0.002)	(0.010)
Dummies	Year x Industry	Year x Industry	Year x Industry
R-Sq.	0.113	0.486	0.527
Obs.	392,970	408,540	408,540
No. of groups	66,757	82,327	82,327
Panel B			
Log WCH	Fixed Effects	Between Effects	Pooled OLS
Log (1+SPT)	0.454***	0.588***	0.818***
	(0.120)	(0.030)	(0.032)
Log AWR	0.008**	0.262***	0.237***
	(0.004)	(0.005)	(0.009)
Log VAH	0.466***	0.404***	0.443***
	(0.015)	(0.002)	(0.010)
Dummies	Year x Industry	Year x Industry	Year x Industry
R-Sq.	0.227	0.526	0.586
Obs.	398,341	414,058	414,058
No. of groups	67,165	82,882	82,882

* p<0.10, ** p<0.05, *** p<0.01

Notes: Estimates are weighted by total number of contracted hours per firm. Clustered standard errors at firm level in parentheses. WRH = Wage Rate per Hour, WCH = Wage Cost per Hour, SPT = Statutory Payroll Tax, AWR = Alternative Wage Rate, VAH = Value Added per Hour. VAH is instrumented with lagged value added per hour.

Assuming the tax incidence must sum up to 1, we would interpret an estimated effect on wage cost per hour significantly different from 1, as evidence of some shifting of tax burden on to the employees. Estimating the effect on wage cost per hour using GMM with included lagged dependent variable as a last check, we get a point estimate of 0.905 and not

significantly different from 1. However, the Hansen p-value implies that this estimate is unreliable.

The presence of significant effects on gross wages when exploiting cross section variation in data and lack of effects only using longitudinal variations may be interpreted as support of zero effect on wages in a short-term analysis (see Chapter 3.6). Changes in tax rates for firms in Zone 2-3 in the period 2004-2006 were small in magnitude and only temporary, whereas tax rates vary from 0 to 14.1 pct. across firms in the sample and throughout the entire estimation period.

4.3.4 Effects of wage costs on employment

Regardless of specification and method, we find that most of the incidence of payroll taxation resides with the employers (firms). Thus, we proceed to the next step in the framework presented above and estimate the elasticity for labour demand. We measure labour demand at firm level as both number of employees and total number of contracted hours per firm.

Estimating the conditional demand of labour using fixed effects we find an elasticity of labour demand of -0.652 when number of employees is the dependent variable and -0.950 when estimating the effect on number of hours (cf. Table 4.20). Thus, a percentage increase in wage costs seem to reduce the demand for labour with little less than one per cent.

With wage cost per hour as our independent variable of interest, we do no longer lack longitudinal variation for firms in Zone 1 and 5. Nevertheless, we also report the results from estimations with between effects. When exploiting the cross-sectional variation, the estimated elasticity increases somewhat when estimating the effect on number of employees but remains almost unchanged when using number of hours as the dependent variable.

To check whether firms in different tax zones respond differently to changes in wage cost we have estimated the elasticity of labour demand for each zone with the fixed-effects approach. We do, however, not find significantly different effects between the different tax zones.

Table 4.20 Elasticity of labour demand. Fixed Effects and Between Effects. 2003-2014

	Log N FE	Log N BE	Log HRS FE	Log HRS BE
Log WCH	-0.652***	-0.976***	-0.950***	-0.986***
	(0.005)	(0.006)	(0.005)	(0.005)
Log VA	0.829***	0.864***	0.936***	0.887***
	(0.008)	(0.002)	(0.008)	(0.001)
Dummies	Year x Industry	Year x Industry	Year x Industry	Year x Industry
Obs.	431,833	447,758	431,835	447,761
No. of groups	71,511	87,436	71,511	87,437

* p<0.10, ** p<0.05, *** p<0.01

Note: Clustered standard errors at firm level in parentheses. WCH = Wage Cost per Hour, VA = Value Added, N = Number of employees, HRS = Contracted Hours. VA is instrumented with lagged value added.

Next, we include lagged employment and estimate the demand elasticity using a GMM estimator. The results are presented in Table 4.21. It seems that we should rely more on the specification with number of employees as our dependent variable (according to the Hansen p-value).

The coefficient estimates from the specification with number of employees as the dependent variable suggest a long-run elasticity of -1.102.[77]

[77]This is calculated as -0.389/(1-0.602-0.030-0.014). The estimated long-run elasticity lies within the 95-percent confidence interval [-1.40, -0.81].

Table 4.21 Long-run elasticity of labour demand. GMM. 2003-2014

	Log N	Log HRS
Log WCH	-0.389***	-0.350***
	(0.066)	(0.064)
Log VA_t	0.037	0.210***
	(0.066)	(0.025)
Log VA_{t-1}	0.100***	0.066***
	(0.016)	(0.015)
Log N_{t-1}	0.602***	
	(0.023)	
Log N_{t-2}	0.030***	
	(0.004)	
Log N_{t-3}	0.014***	
	(0.003)	
Log HRS_{t-1}		0.518***
		(0.034)
Log HRS_{t-2}		-0.009**
		(0.004)
Log HRS_{t-3}		0.021***
		(0.003)
Dummies	Year	Year
Obs.	220,268	220,383
No. of groups	50,153	50,162
Hansen p-value	0.130	0.008
No. of instruments	38	38
AR (1)	0.00	0.00
AR (2)	0.00	0.00
AR (3)	0.01	0.756

* p<0.10, ** p<0.05, *** p<0.01

Note: Robust standard errors at firm level in parentheses. The GMM estimates are all two step. WCH = Wage Cost per Hour, VA = Value Added, N = Number of employees, HRS = Contracted Hours. Estimated using xtabond2 (Roodman 2009)

4.3.5 Effects of the payroll tax on labour demand

Our results suggest that firms change their labour demand because of changes in wage costs. In addition, we show that wage costs are affected by changes in the payroll tax. There is no reason to believe that firms respond differently to changes in costs when the change is due to changes in the payroll tax than if there was another reason. Thus, our results imply that firms do respond to changes in the payroll tax by changing their demand for labour (as is also shown in the previous estimations in this chapter).

Considering the payroll tax, t, is a rate, we convert $El_{(1+t)}N$ to a semi-elasticity. That is, with some re-writing of the expression derived above, we get

$$\frac{\Delta N}{N} = \alpha_1(\beta_1 + 1)\frac{1}{(1+t)}\Delta t \qquad (4.15)$$

With this expression we can calculate the age change in labour from a one percentage point change in the payroll tax rate.

Table 4.22 Effects on labour demand from a one percentage point reduction in the tax rate

Tax zone	Mean tax rate	Fixed Effects	GMM
Zone 1	0.141	0.571	0.966
Zone 1a	0.107	0.589	0.995
Zone 2	0.106	0.590	0.996
Zone 3	0.065	0.612	1.035
Zone 4	0.052	0.620	1.048
Zone 4a	0.079	0.604	1.021
Zone 5	0.000	0.652	1.102

Notes: The mean tax rate in the tax zone is inserted as initial value for the payroll tax rate.

Estimating the elasticity of gross wage rate w.r.t. the payroll tax rate with fixed effects and GMM, we find that β_1 is insignificantly different from zero.[78] Using a fixed-effects approach we find a point estimate on the labour demand elasticity, α_1, of -0.652. The corresponding estimate using GMM is -1.102.

[78] Though Zone 1 and Zone 5 do not contribute to the estimation of effects on wages, we assume (based on our own and other results) that the tax incidence fully resides with the employers in these tax zones as well.

To calculate the total effect on labour demand we need an initial value for the payroll tax rate (tax rate prior to the change). Thus, we have calculated the effect for each tax zone, using the mean tax rate as the initial *t* (cf. Table 4.22). The increase in elasticity from Zone 1 to Zone 5 follows from the difference in the average tax rate inserted as the initial value.

With a long-run demand elasticity of -1.1, we get a total effect ranging from -0.97 to -1.1, i.e. a percentage point increase in the payroll tax rate leads to an approximately 1 pct. decrease in employment. This is in line with Ku et al. (2018), who finds that a one percentage point increase in the statutory tax rate reduces employment (measured as number of employees) by about 1.9 pct. for large firms and 0.3 for small firms (unweighted average of 1.1).

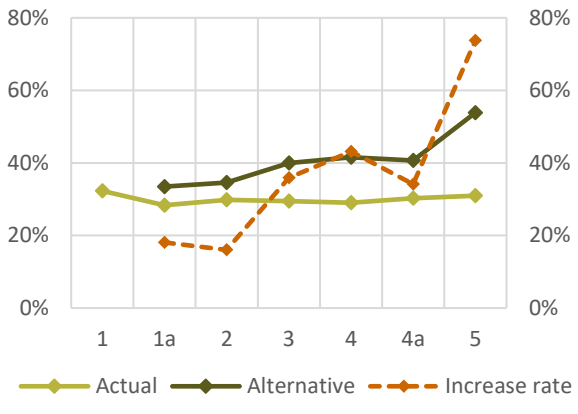
4.4 Analysis of larger shifts in the payroll tax

As explained above, our estimation results reflect that the changes have been relatively limited within our data period, making it more difficult to identify effects. This means we cannot conclude from our modest estimates that the impact of the scheme is small. We rather argue that the effects of changes are non-linear. A small change could be expected to have a small effect, as risk and costs related to reallocating resources reduce firms' incentives to change behaviour. Accordingly, for a large increase in the pay roll tax, we would expect substantial effects on employment. We elaborate on this issue by calculating the effect of an increase in the payroll tax on firms' operating profits in the different tax zones.

Figure 4.20 shows the actual share of firms with negative operating profits and the corresponding share if the pay roll tax was increased to 14.1 pct. in all tax zones. The share of firms with negative operating profits when facing the general tax rate increases almost proportionally with the change in the tax rate, i.e. almost no change in Zone 1a and 2 (where there would be a small change in the tax rate) and relatively large change in Zone 5 (going from 0 to 14.1 pct. In Zone 5, the share of firms with negative operating profits would increase by more than 70 pct.[79] if the tax rate increased to 14.1 pct., all else equal. However, negative operating profit is the immediate effect. In the longer run, some firms would manage to adapt to the increased tax rate and carry on, while others would reduce their activity or shut down their business completely, resulting in reduced employment.

Angell, et al. (2012) show that profitability is consistently lower in the Action Zone (Zone 5) than in other parts of the country, implying that an increase in the payroll tax could have particularly strong effects in this zone. This speaks for exercising caution in changing the payroll tax, especially in the Action Zone.

Figure 4.20 Share of firms with positive wage cost and negative operating profits by tax zone. 2014



[79] (0.54-0.31)/0.31=0.74

5 The dynamics of regional population growth

The question of whether people follow jobs, or jobs follow people have been widely discussed within regional science for the last fifty years. The direction of causality is not decisive for the relevance of RDSSC but shed light on the dynamic effects of such policy measures. A wide range of studies have analysed the interdependent processes of population and employment growth. Studies suggest that population and employment are subject to a dynamic adjustment process and are jointly determined. Aggregate studies support the hypothesis that people follow jobs. Evidence is found in both the US as well as the Nordic countries when looking across subgroups of both people and jobs. However, the literature has produced mixed evidence of the direction of causality for subgroups of people. The main lesson is that there is a strong bidirectional causality between jobs and population growth for subgroups. Despite varying evidence from the literature, aggregated studies suggest that stimulating job creation in the least populated regions of Norway can reduce, or prevent, depopulation in the eligible regions. Multiplicative effects on employment, consumption and population are, however, subject to thresholds. Hence, we expect RDSSC to have more impact in regions with developed local services and amenities compared to less populous regions with few or no local services or amenities.

5.1 Population growth through employment

The overall objective of RDSSC is to reduce or prevent depopulation in the most sparsely populated regions in Norway by stimulating employment. By stimulating the demand for labour through reduces payroll tax rates there is an underlying assumption that it will affect employment, and in turn stimulate population growth in the region.

It is, theoretically, possible to estimate the effect of RDSSC on population directly, within the frameworks presented in Chapter 4. There are, however, numerous reasons why we cannot estimate the effects on population growth directly.

Chapter 4 studied and discussed effects on economic factors such as wage and employment. The pitfalls and considerable challenges in estimating these effects are discussed in detail. While employment is directly influenced by the payroll tax rate through the price on labour, multiple factors can affect the population growth in the regions, e.g. birth- and death-rates, migration and other demographic factors, civil status, etc. All these factors must be considered when trying to extract effects of the payroll taxation.

We are not able to conduct an analysis in which all factors affecting population changes are considered in the scope of this project.[80] However, the previous chapters indicate that RDSSC to a certain extent contributes to higher employment and wage growth in zones with reduced tax than would otherwise have been the case. Economic literature has for a long time discussed the relationship between local employment and population growth. In our opinion, this is sufficient to determine whether RDSSC not only affects local employment but also population. The following sections discuss the literature on regional population growth in more detail.

[80] To estimate effects on population growth we would have to estimate effects on the municipality-level. This poses a challenge in finding a credible control group, given that municipalities with different tax rates differ in several characteristics determining their tax rate.

5.2 Urbanisation, productivity and regional development

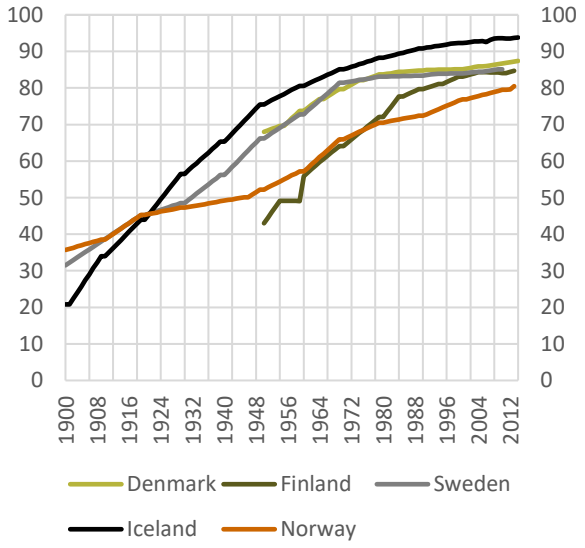
Most modern economies are characterised by an apparently increasing trend of urbanisation. Not all cities are growing, but high-income cities grow faster than their surrounding regions and other regions. Several factors explain this development. However, one main factor is thought to be higher productivity growth in cities than in rural areas (both employment per se and output per worker). The Productivity Commission discuss these mechanisms in a Norwegian context in NOU 2015:1, *«Productivity – Underpinning Growth and Welfate».* The following paragraphs are inspired by the discussion presented by the Productivity Commission.

The underlying processes of urbanisation is key in understanding the existence and emergence of cities and other densely populated urban areas as well as understanding population growth in less populated areas. The process of urbanisation in Norway diverges somewhat from our neighbouring countries during the 20th century (cf. Figure 5.1). Norway lags the share of population in urban settlements and had the lowest share as of 2014 compared to the other Nordic countries.

Nevertheless, almost nine out of ten Norwegians now live in urban settlements. The Norwegian population growth since 1966 has primarily taken place in our medium or large urban settlements. About 70 per cent of the population growth can be contributed to the four largest cities (Oslo, Bergen, Stavanger/Sandnes and Trondheim). For all these cities, the share of the population growth is higher than their share of the employment growth.

The urbanisation process can best be understood by discussing agglomeration effects, which is fundamental in understanding why cities exist (Duranton and Puga 2013). The emergence and growth of cities can be explained by density and variation of types of people which facilitate learning and collaboration (Glaeser, Kallal, et al. 1992). Collaboration and learning stimulate innovation, knowledge spill-over and the acquiring of knowledge. Hence, agglomeration effects give cities and large urban settlements economies of scale through larger markets, more suppliers of goods and services and a wider range of services and infrastructure as more people can share investment costs.

Figure 5.1 Percentage of the population in Nordic countries living in densely populated areas. Per cent. 1900-2014



Source: Statistics Norway, Statistics Iceland, Statistics Sweden, Statistics Finland and UN

An increasing amount of research suggests that amenities, entertainment and lifestyle considerations are important elements of the ability for cities to attract people and firms (Florida 2002, Glaeser, Kolko and Saiz 2000, Lloyd 2001, Lloyd and Clark 2001, Florida 2002). Increased population makes a region or city more attractive to firms in two ways. Firstly, a growing region represents an increasing pool of potential workers, especially for specialists with higher education (Puga 2010). Secondly, the

market for firms supplying goods and services to the population, such as wholesale, personal services and construction, increases.

Population growth is affected positively by increased quality of municipal services such as schools, kindergartens and cultural activities. Investments in infrastructure, housing development and attractive and functional public spaces are shown to have a positive effect on a region's attractiveness (Isdahl 2012).

Technological change, higher quality infrastructure and communications increase the degree of specialisation within the traditional industries (NOU 2015: 1). Specialisation concentrates headquarters and other administrative functions in cities, whereas production is located where land is less expensive and access to natural resources are better. Centralisation of administrative functions increase demand for supporting services such as accounting, legal advisors, marketing and other consultancy services, which in turn leads to a higher density of people with higher education within cities.

The literature suggests a strong correlation between educational level, wage level and population growth. People with high levels of education usually have high income, which in turn indicate high productivity (NOU 2015: 1), at least apparent in the private sector. High density of people with high educational levels leads to high productivity and wage levels in (large) cities (Rattsø 2014). There are, however, reasons to believe that these empirical results in a lesser degree apply to Norway than the US. A range of cities are in real competition of people and jobs in the US. This is not the case in Norway, which only have one large city (Oslo, ref. NOU 2015: 1).

Evidence from the literature does not indicate whether population growth is best stimulated through attracting people with more and better amenities, infrastructure and high-quality municipal services compared to pinpointed facilitation of jobs per se, and knowledge-based jobs more specifically.

5.3 The current settlement pattern mainly determined by historical events

Cities and urban settlements seem to grow partly on the expense of the most rural parts of Norway, as in other countries. However, Norwegian regional policy aims to slow this development by implementing various measures to stimulate population growth in their least populated areas. RDSSC is one example of such measures.

Regional policy measures still constitute a minor explanation of the current settlement pattern both in Norway as well as in other countries. The current settlement pattern is mainly a function of historical events. People traditionally settled along the Norwegian coastline due to access to fishery and trade, and in the mainland with productive land suitable for agriculture. Technology and peoples' preferences is constantly changing, but the settlement pattern consists. People tend to stay where their families have lived for centuries.

Regional policy measures in general, and RDSSC more specifically, can possibly influence peoples' decisions to stay or move, but historical events are the main explanation for today's settlement pattern. Available services, amenities and infrastructure can obviously affect people's decision to move or not in the long run, and future development can affect peoples' preferred residence.

The direction of causality between employment growth and population growth is not decisive for whether RDSSC stimulates population growth or not. In the following paragraphs we discuss evidence from the literature, which can shed light on the dynamics of population growth in general and how RDSSC affects population growth in the least populated areas of Norway.

5.4 Circular causation between population growth and employment growth

Urban researchers have for the last fifty years been discussing the fundamental causes of regional growth processes. One central question relates to whether people follow jobs, or jobs follow people. This is a chicken-or-egg question, i.e., which one comes first, demand or supply of labour? Does population growth stimulate the growth of employment (jobs), or does employment growth attract people and hence population growth?

In the context of the evaluation of RDSSC, does the creation of jobs in the least populated regions of Norway make net migration more attractive to these regions, or are the population growth (or depopulation) determined by other non-economic factors such as regional amenities or social networks?

Early studies of this question are the works of Borts and Stein (1964), Lowry (1966) and Muth (1971). Since then a wide range of studies have been conducted. A meta-analysis of studies using regional and dynamic adjustment models, as presented by Carlino and Mills (1987), are given in Hoogstra, et. al. (2005) and a quality review of the literature can be found in Bollinger and Ihlanfeldt (2001) and Sohn and Hewings (2000). Some of the newly published literature on the field, which also study our neighbouring countries, is Østbye, et. al. (2017) and Tervo (2016). The literature has produced mixed results.

The traditional view is that people follow jobs. People tend to move to regions giving access to income through interesting and relevant work opportunities. Theories supporting demand-driven employment argue that employment is exogenously determined and consequently determines population growth and migration. Population follow jobs as the region become more economically attractive, i.e., people migrate to regions where job opportunities exist. Regions which can generate employment growth will become more attractive to a larger group of people.

The early literature on demand-driven theories was based on export-based theory of regional growth, which states that differential rates of population growth are induced by differential growth in job opportunities or actual employment (Tervo 2016). Access to job opportunities are also a key finding when studying motives among Norwegians' decision to move or not (Sørlie, Aure and Langset 2012). However, a wide range of considerations affect individuals' decisions about moving or staying, and the individual preferences change over the course of time.

Some considerations are decisive only after securing the work-situation. When access to interesting work opportunities exist for the individual himself and a possible partner, other factors such as access to family and friends or other urban or rural amenities will become decisive in the decision on moving or staying.

The results discussed above support the 'people follow jobs' argument. However, it illustrates the complexity of the relationship between population and employment growth. In addition to the beforemen-

tioned arguments, societal trends such as urbanisation and personal preferences play key roles in the migration processes and regional development.

Although the arguments supporting the people follow jobs hypothesis are solid, there is a growing literature which support the opposite, i.e., jobs follow people. Borts and Stein (1964) was among early advocates for the importance of labour supply in stimulating population growth. Supply-driven growth gained traction in regional science following Richard Florida's book "*The Rise of the Creative Class: And How It's Transforming Work, Leisure, Community and Everyday Life*" published in 2004.

There are also reasons to believe that population and employment are subject to a dynamic adjustment process in which they are jointly determined (Carruthers and Mulligan 2008). When regions experience population growth, income will rise if employment (or other sources of income) increases. Increased income will in turn have a positive effect on demand for local goods and services. The increased demand will affect production, and hence demand for employees. This circular causation is also a main finding in many studies both at the aggregate and more detailed level as we discuss below.

The direction of causation, and to the relative magnitudes of the bidirectional causation, may have important policy implications. In cases where people follow jobs, one can argue that policies should target demand for labour, i.e., the creation of jobs. In this case RDSSC is a relevant policy measure. On the other hand, if jobs follow people, it can be argued that policy measures should stimulate investments in amenities or as direct economic aid to households. Examples of such policy measures can be reduced income tax, higher levels of tax deduction, child allowances or other individual benefits.

The direction of causality is not, however, decisive for the relevance of RDSSC. If employment and/or wage growth is higher than would otherwise be the case, positive effects on population growth of RDSSC can be reasoned.

There are reasons to believe that the multiplier-effect described above is subject to thresholds. Employment growth in large cities will most likely attract both knowledge-based firms and other firms, stimulating investments in amenities and local services. This may not be the case in small cities or settlements which have undeveloped local services and amenities. Such regions are expected to be less appealing as living and workplace to highly educated employees and firms, as they normally prefer developed amenities and services. Even in the case where there is a potential market for a knowledge-based firms, the investment may not be realised as the city cannot attract (enough) relevant employees.

Thresholds in the dynamics of regional development are relevant as RDSSC are applied to the least populated regions of Norway. Even if these theories cannot be generalised without care, some cities and regions where RDSSC is in effect can potentially benefit from such multipliers. One example is the city of Bodø. On the other hand, there are reasons to believe that small settlements around the country will not experience such multipliers. Stimulating employment in the hopes of affecting population growth in such regions through RDSSC may yield more limited results.

As we discuss in the following paragraphs, thresholds in the dynamics of regional development can help explain the mixed evidence from the literature as well as correlations between population and employment growth in various regions of Norway.

5.5 Mixed evidence from the literature

Since the early works of Borts and Stein (1964), Lowry (1966) and Muth (1971), studies using regional adjustment models has become the go-to research design after the work presented in Carlino and Mills (1987). A wide range of studies have analysed the interdependent processes of population and employment growth. Studies suggest that population and employment are subject to a dynamic adjustment process and are jointly determined. However, again, the empirical studies have produced mixed and rather unclear conclusions (de Graaf, van Oort and Florax 2012, Hoogstra, Florax and van Dijk 2005, Carruthers and Mulligan 2008). The following sections will discuss the varying results in more detail.

5.5.1 Positive correlation between population and employment growth in aggregate studies

Norwegian municipalities with positive population growth also experience positive employment growth as shown in Figure 5.2. The two statistics show a positive correlation for the last 16 years, both inside and outside the rural policy region. The regional policy region consists of the municipalities with challenges regarding population and/or employment growth, and hence are eligible for various rural policy measures.

The statistical correlation between population and employment growth is relatively high at 0.88 (0.85) within (outside) the rural policy region, which implies that almost 90 pct. of the variation in employment is explained by population growth and vice versa. Employment is measured by place of residence, which means that some of the observed statistical correlation can be explained by commuting. When allowing commuting between municipalities, by studying employment by place of residence, the correlation coefficient is significantly higher than would be the case if we had studied correlations between population growth and employment by place of work.

The relatively strong positive correlation does indicate that municipalities with high employment growth also experience high levels of population growth. Studying statistical correlation such as the ones above does not, however, give any causal relationship between population growth and employment growth. Statistical correlations are influenced by trends. Two time series such as the ones studied here, can converge or diverge over time. Two time series can obtain high levels of correlation because of a common trend and not because of interdependency or causality.

Characteristics of the labour market and the dynamics of regional development can also help explain the high correlation coefficients and why it is not even closer to one. Vacancies or increased demand for employees are not necessarily met with a supply of employees in all regions. Small cities or settlements with undeveloped local services and amenities will have trouble attracting relevant employees. This problem is expected to be especially high when considering highly educated and specialised labour. Even though, say an engineer, are offered a job in a small city or rural settlement, he or she may not consider moving there because of lacking amenities and/or available local services. Personal preferences and historical events may also affect people's choice to move or not move, explaining why the correlation coefficient between population and employment growth is not closer to one.

Correlations such as above does not contribute to answering the question of whether jobs follow people or people follow jobs, but it underlines the importance of job opportunities for migration and regional development. Studies of the correlation between employment growth in various sectors and

population growth in various age groups produce similar results. Such aggregate studies do, to some degree, support the hypothesis that people follow jobs. As we discuss below, the evidence is mixed when detailed research is undertaken.

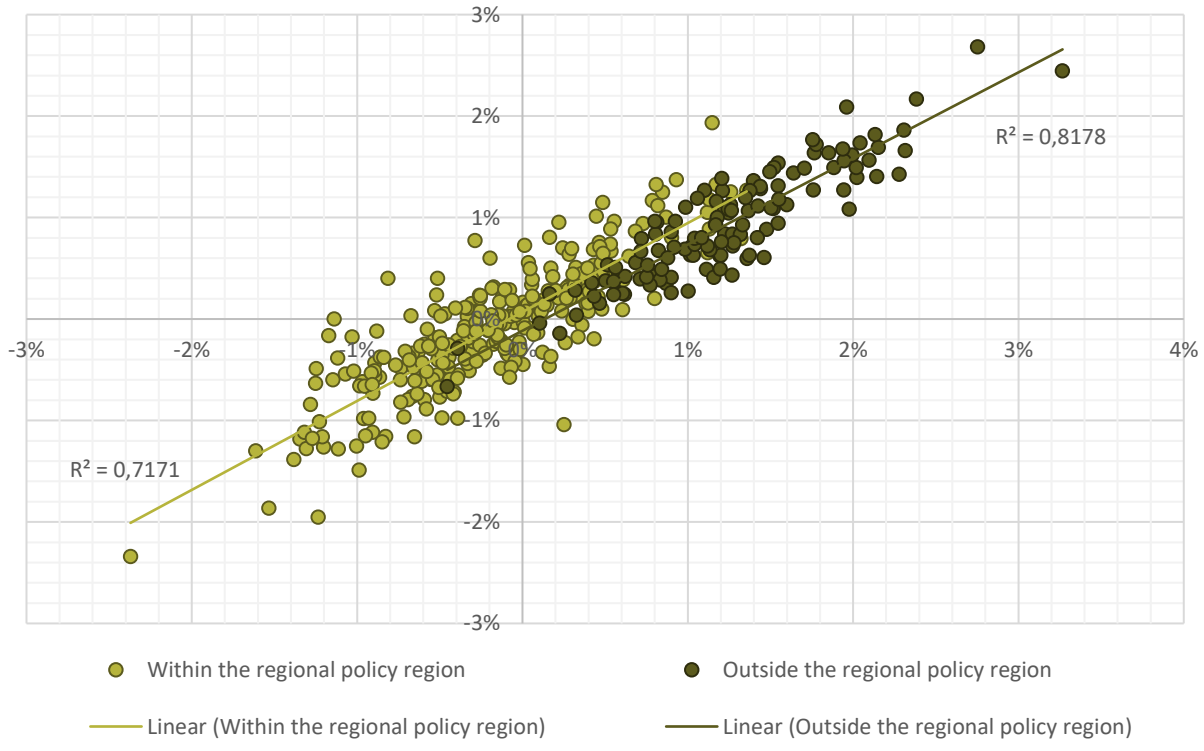
5.5.2 Ambiguous results in detailed research

The direction of causality may differ between subgroups with different kinds of education or skills. As presented and discussed by the likes of Moretti (2010), generating jobs in local economies attract additional jobs through increased demand for local goods and services. The multiplicative effect by one additional job will depend on the types of job and the educational level, and hence income, of the created jobs.

Multiplicative effects will be decisive for the total effect of measures such as RDSSC depending on which industries increase their demand and what kinds of people they demand. It can also explain the varying results produced in the literature about the direction of causality in the question of whether jobs follow people or people follow jobs. Using aggregate data in such studies might conceal the existence of different patterns among subgroups (jobs or people) (Østbye, et al. 2017).

Recent evidence based on data for the Nordic countries support the hypothesis that people follow jobs at an aggregate level (Østbye, et al. 2017, Sörensson 2012). Tervo (2016) and Østbye, et. al.

Figure 5.2 Growth in population (y-axis) and employment (x-axis). Annual figures. Employed persons by place of residence. 2000-2016



Source: Statistics Norway

(2017) find no reverse causality, but Sörensson (2012) does.

Tervo (2016) and Østbye, et. al. (2017) study more detailed data, differentiating between educational level, time-periods (Tervo 2016) and industry (Østbye, et al. 2017). Both studies suggest that jobs follow highly educated people. The study of Finland (Tervo 2016) also finds temporal variations during the study period of 1990-2010 due to economic fluctuations. People did not follow jobs, nor did jobs follow people, during the deep recession in the early 1990s (Tervo 2016). Furthermore, the study suggests that the regional growth in the city regions of Finland were supply driven, which is in line with the theories presented by such as Glaeser, et. al. (2000).

Following the results from Finland, the author suggests that major city centres offer amenities attracting highly educated people. Jobs follow highly educated people, while less educated people follow jobs. Ultimately, population and employment growth affect one another (Tervo 2016). As suggested by the author himself, his result is in line with other studies of complex regional growth processes, and that they may take different forms in difference economic environments. Rather than a clear answer to the question of whether people follow jobs, or jobs follow people, Tervo (2016) stresses the fact that the answer may be multifaceted and dependent on time period and the development level of the economy. Hence, policy recommendations are troublesome.

Østbye, et. al. (2017) supports the findings in Tervo (2016), even though they add another dimension by allowing between-sector dynamics in addition to highly and less educated people. The study divides the economy into two sectors in line with Florida (2002), i.e., creative class jobs and other jobs.[81] Highly educated people are assumed to have creative class jobs, less educated people are assumed to have other jobs. In the three Nordic countries of Norway, Finland and Sweden, data suggest that there is a development towards lower (higher) equilibrium density of highly educated people in regions with low (high) density of other jobs (Østbye et. al., 2017).

The results suggest that people and jobs relocate in response to property prices. Evidence also suggest that there is a strong bidirectional causality between jobs in the two sectors. Creative class jobs (typically found in wholesale, health sector and education) follow other jobs (typically industry), and vice versa (Østbye, et. al. 2017). The authors launch the hypothesis that land-intensive 'main jobs' (traditional industry) does not follow creative class jobs.

Furthermore, Østbye, et. al. (2017), stresses the importance of the endogenous processes which will reinforce the initial stimulus through local demand for goods and services between firms and consumption from increased income to the population. Depending on the industry composition in the regions which receives the initial stimulus, the endogenous processes will create additional demand and employment as suggested by Moretti (2010). One additional employee in export-oriented industries will have a larger effect on local demand for goods and services than one additional employee in local services because of his or hers assumed higher income.

[81] Creative class jobs are defined by occupational nomenclature (ISCO-codes), and include the likes of physicists, mathematicians, statisticians, architects, engineers, nursing and midwifery professionals and so on. See an example of how creative class jobs are defined in Boschma and Fritsch (2009) and Østbye, et. al. (2017).

Studies of the Nordic countries allowing for between-sector and -people dynamics points towards a strong bidirectional causality between people and employment growth. Still, these studies indicate that job creation in non-service industries may be followed by jobs in services, which again may start an endogenous job-people-job processes.

5.6 Complex results call for complex policy measures

Evidence from aggregate studies support the hypothesis that people follow jobs. The hypothesis is also supported in studies of Norwegians' decisions about moving or not moving. Hence, there are reasons to believe that stimulating job creation in the least populated regions of Norway will reduce depopulation in these regions all else equal.

Ambiguous evidence follows from detailed studies of the relationship between population and employment growth. The results vary between educational level, time periods, countries and types of jobs. The endogenous processes of population and employment growth is therefore not fully understood.

The complex relationships, and the fact that the two determinants are mutually dependent, calls for multiple measures targeted towards various reasons for depopulation in rural regions. RDSSC, which is a broad and industry-neutral measure, fits the aggregate results, as it stimulates job creation. When we find effects on wages and employment, arguments can be made supporting population growth through increased demand for local consumption and hence employment.

The existence of multiplicative effects on employment, consumption and population are, however, subject to thresholds. Hence, we expect RDSSC to have more impact in regions with developed local services and amenities compared to less populous regions with few or no local services or amenities. Multiplicative effects are probably not present in small settlements in rural Norway to the same degree as in larger cities with well-developed local services and amenities. In small settlements population effects must depend on the direct employment effects of RDSSC.

In municipalities where the real obstacle to positive population development is not a lack of job opportunities but a shortage of social benefits or amenities to attract labour, shifting support from firms (through RDSSC) to municipalities may be an alternative. This would enable them to enhance the employment related to their tasks, invest in common goods in the municipality, enhance small municipal industrial funds or introduce individual measures to attract much needed labour as they see fit.

6 Alternative measures

The total annual support through RDSSC is close to NOK 14 billion. RDSSC is, thus, the single largest measure within the Norwegian rural policy. Norwegian rural and regional policy covers a wide range of measures. Economic theory and empirical studies indicate that the effects of capital subsidies, R&D grants and infrastructure investments on rural employment is uncertain and ambiguous. They are also more administratively burdensome than RDSSC. Further, existing alternative schemes are much smaller in scope than RDSSC and are expected to have a decreasing marginal return, as we assume that the best projects are realised first. Thus, we do not know whether the positive effects (if any) in terms of rural employment will prevail if they are inflated. In our view, RDSSC is the most suitable measure. However, RDSSC is so general in its design that the scheme is not suitable for compensating municipalities where the real obstacle to positive population development is not a lack of job opportunities but a shortage of social benefits or amenities. In such cases, shifting support from firms through RDSSC to municipalities may be an alternative. This would enable them to enhance the employment related to their tasks, invest in common goods in the municipality, enhance small municipal industrial funds or introduce individual measures to attract much needed labour as they see fit. However, such a transfer is likely to shift employment from the commercial sector to the public sector, which in the long run may weaken rural regions' abilities to develop new income opportunities.

The previous chapters have shown that employment may be increased directly by RDSSC reducing labour costs and indirectly through higher wages and increased demand. In this chapter, we discuss whether similar effects could be reached by alternative measures with the same amount of funds.

6.1 The single largest rural policy measure

Before assessing alternative measures, it is useful to compare the monetary size of RDSSC with other significant economic measures. When discussing economic measures for rural development one can make a distinction between the "narrow" and the "wide" rural policy. The term "narrow" rural policy covers a variety of measures administrated by the Ministry of Local Government and Modernisation, directly aimed at preserving the existing settlement pattern.

The "narrow" funds are mostly allocated to the county-level. Counties fund regional industry development measures through the likes of Innovation Norway and Siva (introduced below), municipal industrial funds or local development projects.

The term "wide" rural policy covers various rural policy measures, administrated by different ministries. The aim is to reach goals for which the various ministries are responsible for and to compensate for rural disadvantages. Wide policy measures are categorised as fiscal measures (such as RDSSC scheme), industry measures (mainly various grants for agriculture, forestry and fishery), infrastructure (e.g. covering internet, postal services, transport and road safety measures), measures supporting culture, environment and upbringing and various measures targeting the so-called Action Zone in the northern-most part of Norway.[82] The latter covers exemption from social security contributions, write-down of student loans, exemption from electricity

[82] The Action Zone includes all municipalities in Finnmark county, and seven municipalities in the northern part of Troms county.

tax on consumption, reduced income tax, higher income tax deduction and increased family allowance amongst others.

In 2016 the narrow funds totalled to about NOK 1.8 billion, whereas the “wide” funds totalled to about NOK 40 billion. The estimated cost of RDSSC was almost NOK 14 billion (see Chapter 2.2.3), about the same amount as the total cost of various measures targeting the fishery and agricultural sector. The latter does not cover national measures with rural and regional implications, such as investments in, or grants to, transport infrastructure, education, defence or health. Nor does it cover other indirect measures such as import restrictions on agricultural products.

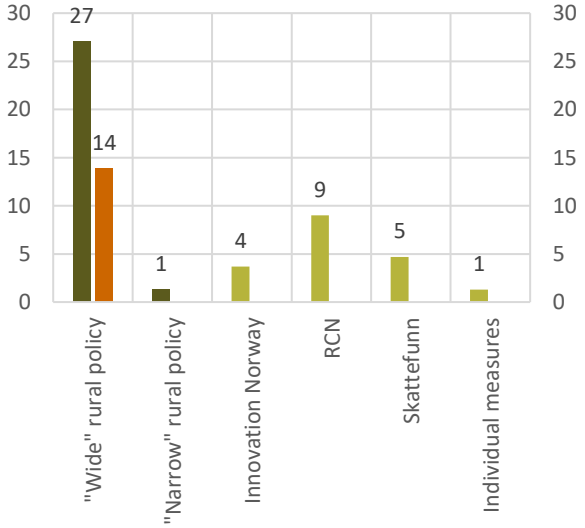
Norway has a large public sector. Provision of public services is based on the principle of equal welfare services and an equalising income system. This implies that the municipal funding scheme and provision of services plays an important role in maintaining the existing settlement pattern.

Gross operating revenue for the municipal sector was about NOK 425 billion in 2016 (Ministry of Local Government and Modernisation 2018). Municipal revenues consist of tax revenues, state funding, various grants and user payments. Kindergartens, primary and secondary schools and health and social services constitute about 70 per cent of municipalities' gross operating expenses.

Apart from the municipal funding, RDSSC is the single largest measure within the Norwegian rural policy (cf. Figure 6.1). The various measures are different with regards to funding, however, a simple comparison of the direct cost i 2016 indicate that RDSSC is a substantial economic measure in a national context.

Innovation Norway (IN) are responsible for various advisory services, network services, loans and grants, as well as rural development measures. Some measures are national and industry-neutral, whereas others are geographically differentiated and industry specific. Most measures target firms, but some target business networks and local communities. Funding is application-based, with innovation being a key criterion.

Figure 6.1 Rural and regional policy and important research and innovation measures. RDSSC is shown as the orange bar. NOK billions. 2016



Source: Statistics Norway, Ministry of Local Government and Modernisation (National Budget), NIFU, Innovation Norway

IN’s total budget for 2016 was about NOK 3.7 billion, only including grants, and NOK 6.7 billion including loans. About NOK 3.5 billion financed various activities within the agriculture and fishery sector, NOK 1 billion activities in rural areas and the remaining funded activities in other sectors and areas (Innovation Norway 2016).

The Research Council of Norway (RCN) finance basic and applied research, but also infrastructure for research and development. Support from RCN is generally not geographically differentiated. Some

programs are open for all disciplines, whereas other programs target specific disciplines or industries. The latter may be more important for some regions than others. Funding is in general based on application with research quality being a key criterion.
RCN's total budget for 2016 was NOK 9.2 billion, corresponding to about one quarter of all research and development funding in Norway (Research Council of Norway 2016).

In addition to the measures administrated by IN and RCN, an important measure administrated by the Ministry of Finance is SkatteFUNN. SkatteFUNN is a tax deduction scheme established with the objective of stimulating R&D investment in Norwegian firms. SkatteFUNN applies to all firm sizes, all industries and all types of business entities, irrespective of geographic location.[83] The estimated cost in terms of tax deduction was NOK 4.7 billion in 2016.

Total cost of RDSSC in 2016 equals the combined budget of RCN and SkatteFUNN and is four times greater than the total budget of Innovation Norway (excluding loans). Figure 6.1 illustrates the size (in terms of money) of RDSSC. The figure can however, not be used to summarise all industry relevant measures in Norway. First, not all industry development measures are included. Second, funding of measures targeting rural areas are reported both as "narrow" or "wide" measures and as a part of the funding for the various national agencies/measures.

The Norwegian taxation policy includes many individual oriented measures, such as income tax, income tax deductions and child allowances. Most individual oriented measures are nation-wide, however, as mentioned, a few measures target the Action Zone specifically. Such measure totalled to about 1,3 million NOK in 2016 (Ministry of Local Government and Modernisation 2017).

6.2 Economic theory suggests that RDSSC is the most effective policy measure

The following sections discuss alternative measures to RDSSC. As an experiment of thought, we can ask ourselves if transferring all funds from RDSSC to one or more alternative measures would be more effective in maintaining historical settlement patters. If no, RDSSC can be said to be the most appropriate measure.

6.2.1 Measures to change factor prices

Chapter 3 presented the theoretical justification of RDSSC. The objective of RDSSC is to reduce or prevent depopulation in the most sparsely populated regions in Norway by stimulating employment. By lowering the cost of labour, the aim is to stimulate a substitution effect that will replace some capital with labour (substitution effect) and increase production.

Other measures that reduce the price of (important) input factor(s) such as capital, transport, energy[84] and research will in theory have similar cost reducing effects.

However, as discussed in Chapter 3, economic theory predicts that a relative reduction in factor-prices increase a firm's use of this factor (substitution-effect). Capital subsidies allows for an adjustment in

[83] However, the scheme differentiates somewhat between SMEs and large firms. Large firms have the opportunity, through SkatteFUNN, to receive a tax deduction of up to 18 per cent on costs associated with R&D projects, whereas SME is entitled to a tax deduction of up to 20 per cent on their costs.

[84] Low electric prices have for long given Norwegian industry a comparative advantage. Interconnected electricity markets and international regulations have reduced this comparative advantage with time.

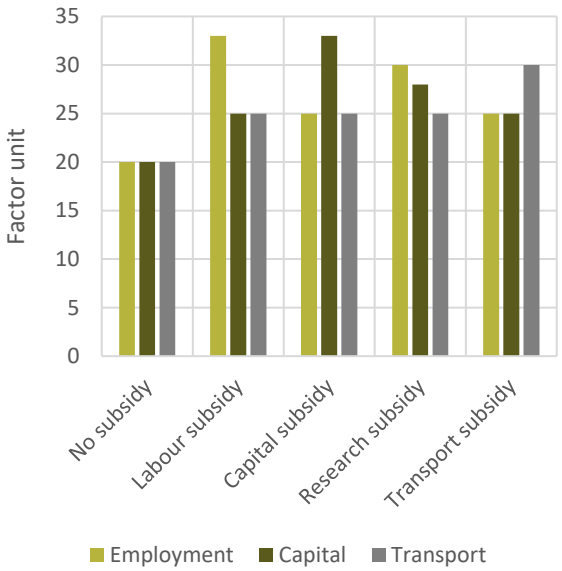
their input mix in favour of capital, if capital and labour are substitutes. Labour subsidies, such as RDSSC, allows for a substitution of labour for capital. In a case where production increase because of decreased product price, employment may rise if production expand sufficiently.

Similar theoretical arguments can be made for transport and research subsidies, but with different effects on employment. On firm level, research subsidies lower the cost of research (and with time possibly increasing productivity) leading to increasing employment of researchers (but to a lesser degree other types of personnel).

Direct transport subsidies or infrastructure investments can in theory also lower the total operating cost of firms by lowering transport time and transport cost.[85] Assuming no substitution or complementarity between transport and labour, such a measure will have no direct effect on employment. As before, the positive cost reducing-effect will (in theory) lead to increase in all factors including labour.

Figure 6.2 show a stylised model which summarise the firm effects. For simplicity, the illustration is based on a firm using labour, capital, research and transport as input factors in equal portion. The various factor subsidies will have similar cost reducing effect and thus rise in demand for labour (as well as other input factors). However, labour demand will also depend on the substitution effect in which labour demand will be somewhat higher in case of labour subsidy and research subsidy (but limited to researchers).

Figure 6.2 Stylized illustration: firm-level effect to change in factor subsidy prices



Notes: Illustration based on a simple model in which the factory subsidies in which a factor subsidy on capital, labour and transport increase the use of the specific factor by with 8 units (subsidy effects) and all factors with 5 (income effect). Subsidy effects in terms of a research subsidy use of personnel is assumed to increase with 5 units and capital with 3 units.
Source: Samfunnsøkonomisk analyse AS

Extending the simple analysis in which the firm not only rely on capital, labour, research and transport, but also on land, suggests that changes in factor prices will lead to changes in the industry mix assuming land is a limited resource.

When land is limited, a labour subsidy allows relative labour-intensive firms to out-bid capital intensive firms for land, whereas capital subsidies allow relatively capital-intensive firm to outbid the relatively labour-intensive firms. Economic theory thus suggest that capital subsidies can lead to a negative

[85] Such cost reductions are reflected in reduced lead times, improved safety, improved visual quality associated with transport systems (tourist roads, landscaping), reduced barrier effects, reduced operating costs for the means of transport, and by reducing noise and other contamination (Ministry of Finance 2014).

effect on regional employment with time (Lind and Serck-Hanssen 1972, Patrick 2017).

Similar reasoning suggests that transport-intensive firms (research-intensive) firms would out-bid labour-intensive firms in case of transport subsidy (research subsidy).

A potential "fear" of RDSSC alongside this reasoning, is that labour subsidies will lead to an industry mix consisting of labour-intensive firms (in stagnation) which in the long run will lower the productivity in rural areas more than would otherwise have been the case. This "fear" was considered not relevant when implementing RDSSC as rural areas have and must have a large number of labour-intensive firms to support local markets (agriculture, public sector, construction, services etc) (NOU 1975: 2 1975).

6.2.2 Measures to increase disposable income and the (local) economy

Our empirical investigations also indicate that RDSSC leads to an increase in wages and thus household's disposable income within target regions. Individual income transfers such as reduced income tax, higher tax deduction, child allowances or other individual benefits will also raise disposable household income. Price subsidies will also lower total household cost and thus raise disposable income. In theory, income transfer, subsidies and increased municipal funding thus represent possible alternatives to RDSSC with possible comparable effects on the economy.

Economic theory[86] suggests that changes in income tax rates and cost of consumption will affect the behaviour of individuals and businesses; see Chapter 3. Measures raising disposable income will be positive for those receiving the benefit, increasing their spending power. Higher regional spending power could in theory increase regional employment. Such a measure is most efficient in this regard if it raises consumption of locally produced goods and services.

Further, such measures could also raise the incentive to live within areas eligible for such grants. The effect in terms of labour supply will depend upon the measures ability to affect people's decision on where to live and work.

Transferring RDSSC to the municipalities directly is another alternative measure. Such a transfer would enable municipalities to enhance the employment related to their tasks directly, and indirectly through investments in common goods or municipal industrial funds where such are in place. Better municipal services or common goods can also help keep or attract labour.

Since some municipalities are experiencing challenges not covered by RDSSC, one could consider giving individual municipalities the freedom to choose whether they will carry on with RDSSC, or whether they want the same amount of support transferred in the form of separate free income for the municipality. This could, for example, take the form of a pilot scheme to test interest, but with the opportunity to revert to the previous arrangement.

6.3 Experience reveal pitfalls in measures to change factor prices

In the previous section, we discussed the theoretical effects of various types of alternative measures.

[86] See for example (Stiglitz 1988)

The actual employment effects of all measures will depend on a variety of factors such as the local labour market, competitiveness of local firms, individual preferences and wage formation. The scope of our study does not allow for empirical testing across measures, however, in the following section we will investigate empirical findings and practical consequences of a shift away from RDSSC towards measures affecting factor prices.

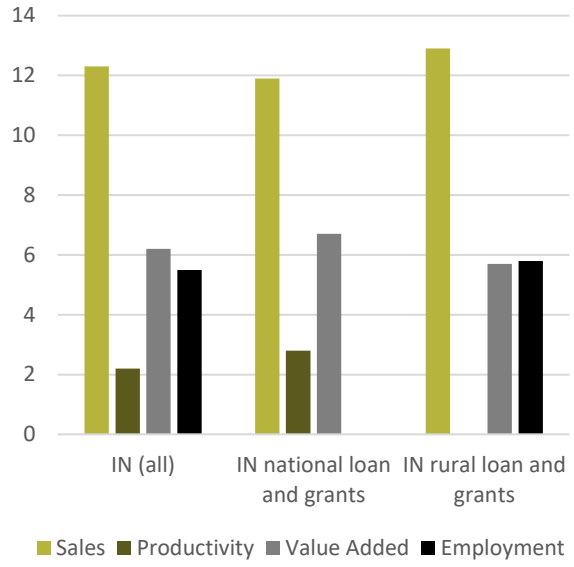
6.3.1 Unambiguous, and possible negative effects on job-creation of capital subsidies

Recent evaluations of national industry related capital measures suggest higher employment, profitability and value creation in firms with aid than for firms with no aid, see for example Cappelen, et al. (2015), Benedictow, et al. (2018) and Research Council of Norway (2016). However, the effects on ensuring rural habitation and employment is not investigated.

Cappelen, et a. (2017) have compared economic development for recipients of rural industry measures[87] with similar firms with no support. The study shows that firms with rural loan and grant on average have 5.7 pct. higher value added and 12.9 pct. higher sales than similar firms without such loan and grants. The effect in terms of sales and value added is at the approximately same level as for national loans and grants (cf. Figure 6.3).

Interestingly, national loan and grants through IN led to higher productivity, but no effects on employment. In the case of rural loans and grants, data reveals higher employment, but no effects on productivity. The study indicates a positive correlation between capital subsidies and employment but does not document causal relationships.

Figure 6.3 Output from firms with national and rural loans and grants from Innovation Norway compared to firms with no support. 2016



Source: Innovation Norway

Note: IN national loans and grants covers loans and grants under with the aim to increase innovation (as oppose to the loans and grants as a banking service).

In the study, employment is calculated based on a portfolio of firms fulfilling criteria for rural loans and grants, i.e. location of the firms at the time of application, and not where people work or live thereafter. Thus, we do not know the measures' effect in terms of rural job or habitants.

Although capital subsidies are widely used both in Norway and internationally, there are in fact little

[87] The report compares the development of performance indicators for limited liability firms (AS) that received support from Innovation Norway's various loan and grant schemes during the period 2001-2012, with the development of similar joint-stock firms that did not receive this support. The matching variables include industry classification (3-digit NACE), start-up size (total assets), geographic location and owner concentration. Results documented in IN's reporting to stakeholders (Innovation Norway 2017).

empirical studies on the effects on regional employment (and habitation). The few international studies on the topic, does however find that capital subsidies lead to no or even reduced demand for labour in line with economic theory. For example, Patrick (2017) empirically investigates the use of capital subsidies in America using the Incentive Environment Index constructed from state provisions that limit and structure capital aid and a county industry panel. The results indicate that increasing capital aid is associated with capital-labour substitution, decreased employment density and changes in the local industry mix in line with economic theory. Interestingly, capital subsidies induce more capital in both rural and urban areas. The effect is however higher in urban areas than rural areas. The employment effect is negative in both rural and urban areas.

According to Patrick (2017) empirical studies give no clear evidence as to what really happens with the net increase in capital but point to studies indicating that the net increase could be redirected from productive activities into overcapacity or non-productive activity such as additional rent-seeking activities because of increased aid availability. Net increase can also be used to increase labour productivity which again can increase wages which in turn will decrease demand for labour. The combination of these general equilibrium effects results in a theoretically ambiguous change in labour depending upon factor intensity, elasticities of capital-labour substitution, relative slope of labour demand and supply, wage formation, agglomeration effects and so forth.

The empirical findings reveal that even if sufficient access to capital is important for economic development, regional capital subsidies have an unambiguous, and possibly negative effect on rural employment.

6.3.2 Complex relationship between transport infrastructure and regional growth

Investment in transport infrastructure is also often launched as a measure for rural and regional development. The main argument[88] is that improved infrastructure gives regions improved accessibility, lower transportation costs and higher productivity, which allows for industry and inhabitants to remain in the region. Another argument in favour of regional infrastructure investments is that agglomeration theory suggests that efficient transport infrastructure may help to smooth down pressure in the labour market, housing market and traffic between different regions creating more efficient functioning labour markets, solving typical district issues, and possibly also allow for more specialisation, knowledge sharing, and innovation (Duranton and Puga 2004, Melo, Graham and Noland 2009, NOU 2015: 1 2015).

Both arguments are often put forward in rural development policies, even if transport economics indicate regional impact to be unclear.

Firstly, it is relevant to separate between intra and inter-regional transport investments. Investing in intra-regional infrastructure lower transport time and unambiguously improves the attractiveness of a region for both firms and people. Investing in interregional infrastructure, however, makes both exports

[88] The argument that infrastructure investments in rural areas leads to employment during planning, building and operation phase is also disregarded as this is a temporary effect. Transport infrastructure investment also create other types of positive and negative effect such as noise, safety, emission etc. neither considered here.

and imports cheaper and thus has a much more ambiguous impact (Oosterhaven and Knaap 2003). The net effect on regional economy and employment can be both positive and negative depending on comparative advantages of regional firms, preferences etc. If reduced transport cost will increase import, but not export, such an investment can have a negative impact on the regional economy.

Further, better infrastructure can also increase pressure and incentives to relocate to regions that are more central, with time resulting in a different geographical spread of industrial production. With sufficiently low transport costs, there are other considerations than proximity to the largest market that can be decisive for firm's location. The result can be a concentration of related firms both inside, but also outside of the region, or that head office moves to urban areas whereas the production facilities remain in the rural area (Bråthen, et al. 2003).

Empirical studies suggest that the relationship between transport infrastructure and regional development are quite complex and that there are many methodological challenges to measuring the economic effects of infrastructure projects. This is both due to various measurement problems and challenges identifying what would have been the case without an investment (Oosterhaven and Knaap 2003, Lian and Rønnevik 2010). Case studies indicate that some infrastructure projects have positive effects on employment, whereas others have not (Bråthen, et al. 2003, Lian and Rønnevik 2010).

Lian and Rønnevik (2010) investigated the ripple effects of 102 road investments in Norway during the period of 1993-2005. The statistical analysis indicated that size of the labour market is the most important factor for population growth (supporting agglomeration theory). Lian and Rønnevik (2010) did find a small effect of road investments on population, in which as an investment of 1.15 billion 2017-NOK would increase the population size of nearby municipalities by 1 pct. However, data did not reveal any effects on employment, income levels, commuting or industrial growth.

Another study on Norwegian data (Aarhaug and Gundersen 2017) also find that the effect in terms of population growth varies with the size of the labour market. The greatest effect of transport infrastructure projects is seen in small regions (defined as labour markets of less than 5,000 inhabitants) where infrastructure projects increase the regional labour market beyond a critical size (estimated to be around 10,000 inhabitants).

The study suggests that if the objective is to maintain or increase the population in rural areas, it is more important to invest in infrastructure, which increases the size of small regions with growth potential rather than increasing the size of already large regions. This contrasts to many cost benefit analyses, typically giving higher priority to infrastructure projects in the largest regions (Aarhaug and Gundersen 2017).

Studies also suggest that the worse condition on the current transport network, the greater the opportunities for such investments to create positive effects. Investments are especially beneficial if a central bottleneck disappears. Further, the region in question must have a clear development potential, including a reserve pool of well-qualified labour, an expansive business community with "entrepreneurial spirit" and a well-developed industrial and political environment that can help trigger the growth potential that may exist (Rietveld and Bruinsma 1998, recited in Lian and Rønnevik 2010).

Even if infrastructure can be considered an important imperative for economic development, and in some cases also have a positive impact on regional employment and population, the relationship between transport infrastructure investments and regional development is complex and transport infrastructure investment alone is no guarantee for rural habitation and development.

6.3.3 Research measure depend on existence of research community

Initially, we also launched research subsidies as a potential alternative to RDSSC. Although most R&D measures administrated by the RCN are national, the Council also have measures targeting certain regions. Research in North ("Forskningsløft i Nord") is one such program. The program was established in 2009 as a measure to increase research competence, research activity and cooperation between the research community and industry in the northern region of Norway. As of 2017, the program has ceased, and current projects are now a part of the larger program FORREGION which also has a regional focus (thus in the entire country). This program is just started, and an evaluation is currently in its early beginning.

Experience from Research in North, VRI (predecessor of FORREGION) and Strategic University Colleges projects targeting regional university colleges, indicate that regional research activities are important tools to mobilise and boost research activities in already existing private or public research communities. Funding is often used to finance employment of researchers, and thus potentially increase employment beyond a case with no support. (Tofteng, et al. 2015, Oxford Research 2012, Oxford Research 2013). Research quality is however in general considered to be lower than for national competitions and wider effects on the regional economy is not investigated in detail, mainly because they are not possible to track and/or expected to be minimal.

6.3.4 Decreasing marginal effect

Norway has a vast portfolio of rural measures, but also for industry development in general. For all schemes within the latter category, it is plausible to assume that best projects are realised first. For example, if the total funding of IN's schemes were to be inflated, there is reason to assume that there will be very little effect of "the last million". Generous availability of capital subsidies cannot create firms, business clusters or innovation alone. The drive for entrepreneurship or innovation must come from the actors themselves (Baumol 2002).

Similarly, a significant increase in available funds for research activities within the eligible regions for reduced payroll tax or for research themes relevant for firms within these regions will most likely not lead to a corresponding increase in the number of high-quality projects and employment. Universities, research institutes as well as research intensive firms are mainly located in urban areas. Upscaling available research funds and using geographical location as a selection criterion, is likely to shrink the pool of applications, and possibly also the research quality thus contradicting the overall objectives of Norwegian Research Policy defined in the long-term strategy for research and education (Ministry of Education and Research 2014).

Also, in the case of infrastructure investments, it is plausible to assume that the best projects are realised first and diminishing returns. According to Oosterhaven and Knaap (2003) the diminishing return on investment is reached at a lower level in rural areas than in urban regions.

It is difficult to believe that replacing RDSSC with infrastructure investments would give rural areas

priorities in future investment decisions (with higher cost benefit) unless funds are allocated to a "rural transport investment fund".

A transfer of funds from RDSSC to existing capital, research and infrastructure measure could lead to an increase in rural employment, however, the scope of the effect is highly uncertain, and it is plausible to assume a marginal declining effect regarding employment, but possible also regarding innovation, research quality or cost benefit and so forth.

Today, most capital and research subsidies are granted on a selection basis in which staff and external experts associated to Innovation Norway and NRC evaluate the applications. Infrastructure investment decision is also based on selection basis even if selection is partly based on professional and political decision-making procedures and includes a variety of stakeholders.

RDSSC, but also SkatteFUNN are right-based measures with relatively low administration costs. Capital, research and infrastructure measures however involve significant costs for applicants, funding agencies and so forth. Administrative cost corresponded to about 35 pct. of IN's total budget (not including loans) and 8 pct. of RCN's total budget in 2016. A transfer of RDSSC funding to alternative measures will most likely lead to a substantial increase in administrative costs.

RDSSC has other administrative advantages compared to the alternatives. Firstly, RDSSC can relatively easy be adjusted to different zones according to perceived disadvantages. Such mechanical targeting of the level of disadvantage and the level of support is more difficult (and costly) for other measures. There could be a need for a system to ensure that funding is conditioned on local employment.

Secondly, RDSSC link support to the actual localisation of the activity, whereas (existing) capital and research measures are linked to the location at the time of application. Although it is possible to make funding contingent upon local activity at the time of application, it is difficult (or costly) to ensure that activities will remain in the region in the foreseeable future within existing capital measures. Without funding being contingent upon local employment, a region with substantial access to available (cheap) capital (or research funding) will possibly attract capital-intensive firms (research intensive firms) with employment elsewhere.

Due to the monetary size of RDSSC, moving all regional support from RDSSC to the other schemes would most likely result in weaker effects and also require a radically change to all of them. Thus, replacing RDSSC with capital subsidies, research aid or transport infrastructure projects in rural areas does not stand out as suitable alternatives.

6.4 Individual measures and municipal funding can also prevent depopulation

In Chapter 6.2.2 income transfer, subsidies on services and increased municipal funding where introduced as possible alternatives to RDSSC, rising disposable income and household demand. In the following section we will shed light on the potential effects of transferring RDSSC to such measures.

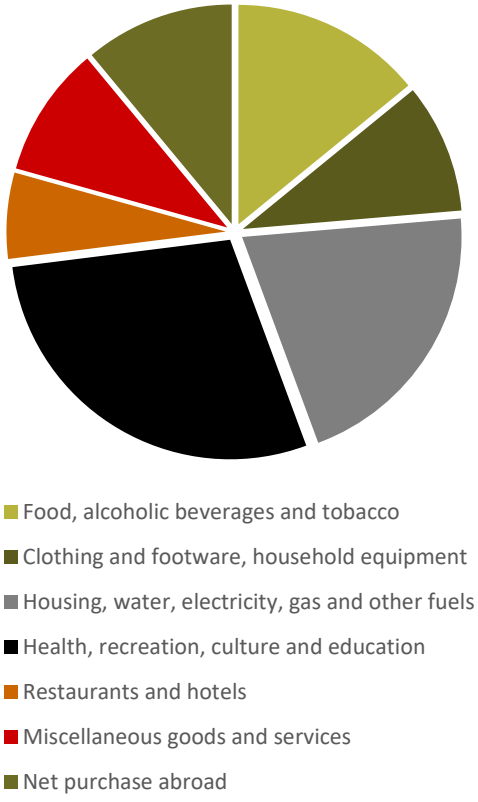
6.4.1 Individual measures to ease recruitment

The individual benefit increases disposable income and purchasing power, allowing for higher consumption of locally produced goods and services. Many consumer goods are generally imported from outside the region and even from other countries, whereas many services such as dining, recreation

and culture are produced locally. Sale and distribution of imported goods are generally consumed locally (Statistics Norway 2018).

Even if the measures does not increases disposable income it can boost the local economy; the main justification is the predicted effect in terms of increasing and stabilising labour supply, alone and in combination with other measures in the region (Angell, et al. 2012, Meld. St. 18 (2016-2017)).

Figure 6.4 Final consumption expenditure of households by expenditure. 2017



Source: Statistics Norway

The individual measures will undoubtedly be regarded as positive for those receiving the benefit, increasing disposable income and thus the incentive to live within the Action zone. However, the relevant question is whether the measure affects the decision on where to work or live and thus the long-run development of rural regions.

Pedersen and Andersen (2001) have studied the long-term effects of the measures using individual data about people who had their student loans written down between 1988 and 1998. They argue that individual oriented measures have had a stabilizing effect.

They also argue that the measures contributed to improved coverage in expert labour within the public sector (teaching, health, police, etc.). This is also a group that gains the greatest benefit from the measures through both write-downs of student loans, tax benefits and increased child allowance.

Similar results were identified in Angell, et al. (2012) arguing that the individual measures in Northern Norway had a particularly good effect for those with no geographical connection to the area, and that that those who benefit from two or three instruments are more likely to continue to live in the zone than those who only benefit from one measure, indicating that size of total benefit matters. Angell et al. (2012) also argues that the measures have made it easier to recruit new employees to the entire Action Zone, but most important for the central municipalities.
Experience with individual measures in Action Zone indicate that such measures do have a stabilizing and recruiting effect. Such measures can also be effective for other regions with similar challenges or to target special labour.

6.4.2 Increased municipal funding boost (public) employment

Transferring the support to the municipalities directly would enable them to enhance the employment related to their tasks, invest in common goods in the municipality, enhance small municipal indus-

trial funds or introduce individual measures to attract much needed labour as they see fit. Such measures can have direct effects on the economy, but also indirect effects by increasing the attractiveness.

According to economic theory, increased municipal spending is likely to increase employment both directly by hiring of public staff and indirectly via increased public and private consumption. The exact employment effect depends upon the use of the additional funding, wage formation, labour market, immigration etc.

Increased public spending and disposable income will bring further growth in the economy through the so called the multiplier effect [89]. Simulations of the Norwegian economy show that the multiplier for GDP Mainland Norway of a permanent increase in public consumption (public employment, intermediate inputs and consumer services from the private sector) is between 1.0 and 1.7 in the short and medium term. The long run multiplier is close to unity and indicates that crowding-out effects in the Norwegian economy are not particularly strong. One reason is that demand impulses will affect labour immigration and dampen the effects on Norwegian unemployment (Boug, Cappelen og Eika 2017).
It is very likely that an increased municipal budget would increase employment, although the full effects on the regional economy will depend on a variety of factors such as the regional industry mix and spending pattern.

6.4.3 Suitable measure in case of labour shortage

Economic theory and experience indicate that a shift toward increased municipal spending or individual benefits will most likely foster public employment, even if some growth in local private sector activity also may occur.

Individual benefits are relatively easy to implement and administrate, and the mix of measures can be scaled up or down and they can be directed towards all individuals or parts of the population given local challenges. Such measures may, for example, be relevant for regions with difficulties to attract skilled labour to the public as well as the private sector.
Experience also show that for individual measures to be effective, they must be widely known to the population and be of a sufficient magnitude to affect the decisions of individuals. Such measures should thus apply for a long period of time. Also increased municipal spending allows for development of a policy mix adjusted to local challenges.

A transfer towards municipal budgets allows for the municipalities to adjust their policy mix to their perceived, individual challenges. A pitfall of transferring the funds to the municipalities is that effectiveness will depend upon the single municipality's ability to priorities the best projects and not to spread the funding too widely. Røtnes, et al. (2016) did and empirical study on councils' development funds aimed at regional development (funded under the "narrow" rural funding). The study is based on a sample of projects from 2006-2014 with the average size of NOK 120,000 and found no statistically significant relationships between the use of development funds and population development.

[89] The multiplier effect refers to the increase in final income arising from any new injection of spending. The size of the multiplier depends upon household's marginal decisions to spend, called the marginal propensity to consume or to save, called the marginal propensity to save.

The absence of effects can be explained partly by the design of the instrument. The funds are distributed to many small projects and it takes long time from implementation of the projects until changes in terms of results and effects occur, making it difficult to identify in available data. It seems as if the funds are too small to be captured in population data at a municipal level, or that the municipalities are not able to prioritize the most effective projects in terms of their ability to affect population growth.

At the same time, the absence of effects may also be because the measure does not affect people's decision on where to live. Both of which, suggests that the funds allocated in this way do not have an impact on population growth in general.

Both measures can be effective in addressing a problem of depopulation, particularly when rural growth is restricted by shortages of labour, but to a lesser degree when cost of labour are too high.

In both cases, such a transfer away from RDSSC would lead to an increase in wage costs of local businesses, challenging to firms struggling with low profitability; see Chapter 4.4. Such a transfer is expected to weaken private sector in the long run and rural regions' abilities to develop new income opportunities.

7 Ripple effects

Our analysis of ripple effects shows that spillover effects to other regions are highest for the zones with the largest reduction in social security contribution. This is mainly because they have a less diversified industry structure than those in Zone 1 and need to import more from other zones for intermediate consumption and investment. While the zones inside the scheme (Zone 2 to 5) benefit from the direct effect of RDSSC, Zone 1 gain most of the ripple effects generated from the other zones in terms of employment. Such effects occur in all economic based support to rural regions.

The objective of the ripple effects analysis is to calculate and divide the total (domestic) effect on different types of indirect ripple effects. The effects are simulated by use of exogenous production (final demand) and income shocks in a fixed-price model (PANDA) with very little behaviour modelled.[90] The contribution from the ripple effect analysis is to decompose the total effects estimated in Chapter 4 into different components of ripple effects. Of special interest is the possibility to illustrate spillover effects (inter-regional effects) by using a multiregional input-output model.

The use of a such a model will not give a direct link between the differentiated social security contributions and the direct and indirect (ripple) effects. What is possible to achieve is to run the model with and without shocks together with different parameter settings to create contrasts representing various types of ripple effects.[91]

7.1 Ripple effects in the analysis

Ripple effects may be defined in different ways. Here we focus on the demand-driven effects related to possible changes in industrial production, income and private consumption due to the scheme.

Ripple effects is given different interpretations in the literature, depending both on the subject or phenomena one wants to describe, and on the method or principles used. The term "ripple effect" is used in different fields like sociology (social interactions), computer science (a complexity measure). Our use of the term is closely related to the term multiplier in macroeconomics.

In this analysis we are investigating economic ripple effects at the regional level by use of multipliers. Even this type of effects may be interpreted in different ways, due to different initial economic events or actions the effects are related to. Our analysis is based on a simulation of the aggregated ripple effects related to eligible industries in the different regions, and not specific impacts of certain firms or activities at the local level.

In the literature one finds mainly two types of economic ripple effect analysis: Input-output based analysis or econometric analysis. An example of the latter is the analysis of local multipliers (Moretti 2010). Moretti (2017) divides the industry in tradable and non-tradable sectors and find that jobs in the tradable sector creates relatively high multiplier values in the non-tradable sector.

[90] See a description of models and data in PANDA in Appendix 2.
[91] Analyses of population effects through the population model I PANDA is left out due to limitations in the model. A multiregional model to calculate interregional migration and commuting effects is not yet implemented in the multiregional PANDA-model.

The econometrically based analysis of ripple effects often gives higher multiplier values than input-output model-based analysis. There may be many reasons for different results in such analyses, for instance different regional delimitations, different division between exogenous (independent) and endogenous (dependent) industries, different time span (long versus short term perspectives) or that econometric analysis may capture other effects in addition to those calculated in the input-output models.

Another publication by Moritz, et al. (2017) is using the same econometric method as Moretti to estimate job multipliers related to the mining industry in Northern Sweden. They also compare the results with similar analysis made with a (multiregional) input-output model (rAps a model similar to PANDA). The econometric analysis gives somewhat higher multiplier values, but the authors conclude that the results are fairly consistent with the input-output studies in spite of the methodological differences.

We define ripple effects in this context to be additional effects in industries and households both inside and outside the treatment area, caused by industries defined to be covered by RDSSC.

The analysis carried out is a calculation of gross ripple effects. This implies that we do not consider production or employment resource limitations or crowding-out effects, nor alternative use of labour and capital in other regions. There are reasons to assume local mismatch between labour supply and demand at the regional level, which may be especially valid for beneficial regions within RDSSC. We do however calculate gross ripple effects in the rest of the country as well, and the presumptions mentioned above are therefore important.

Calculated components are:

- Production (final demand) ripple effects
- Direct effects in RDSSC region
- Indirect effects inside the actual RDSSC region
- Spillover effects to other regions in the country
- Feedback effects in the scheme area from other regions.

Direct effects are the primary effects in eligible industries covered by the scheme. Indirect effects inside RDSSC region are business-to-business effects through intermediate deliveries in the regional production. Spillover effects are business-to-business effects in other regions created by intermediate deliveries from businesses in these regions to businesses in RDSSC region. Feedback effects are business-to-business effects created in RDSSC region due to intermediate deliveries back to businesses outside the region, as a response to spillover effects.

Induced consumption ripple effects are:

- Induced effects related to direct and indirect effects inside the actual RDSSC region
- Induced spillover effects to other regions in the country
- Possible feedback effects (normally summed together with final demand created feedback effects).

Induced effects are effects generated through changes in household income and capital returns. creating both direct, indirect, spillover and feedback effects which correspond to production-generated effects. In this analysis we have limited the induced effects to changes in private consumption due to changes in household income.

The ripple effects are calculated as different kinds of demand-driven effects in fixed-price single and multi-regional input-output (I-O) models in PANDA. Even if the multiregional input-output model is quite simple, the ambition has been to shed light on the possible spillover effects between treatment regions, control regions and other regions. The multiregional model has no direct links between the regions, as the interaction between regions are handled by an extra national region or pool for interregional trade. Any trade between regions in the model thus passes to and from this common pool. One reason for keeping the model simple in this way, is the possibility for flexibility in the selection of number and delimitation of regions.

Ripple effects are calculated for two different regional aggregations within the nation:

- Five regions comprised by five different payroll tax zones.[92]
- 12 regions consisting of 1) the municipalities that was moved from tax Zone 2 to Zone 3 in 2000, called the DAGA region, 2) a Control region consisting of the municipalities in Zone 2 that did not change zone, and 3) the rest of the country divided in 10 regions.

Effects are simulated through a production (final demand) shock in a specific region within the scheme area, and ripple effects are calculated for different regional delimitations in the country. The result is presented as relative figures (multipliers). Since the model is (mainly) linear, the size of chosen shocks will have little influence on the values of relative effects calculated.

The ripple effects which we can calculate with the multi-regional model is limited to the supply/production and use/consumption of products as described by the national accounts, and the effects in the model given by the demand-driven flow of products. The main task has been to calculate and describe ripple effects that is possible to quantify through the model.

7.2 The PANDA models

The single region input-output model in PANDA is a Miyazawa (1976) type of industry-by-industry model extended with a household sector. The data is transformed from rectangular supply-use tables for counties (national accounts by county) to industry-by-industry input-output tables for the selected regions in the model. The regional specification is based on municipality data aggregations through rather comprehensive data pre-processing.

Production, value added, employment, different kinds of demand components, income etc. are calculated in the single region model, also when used as part of the multiregional model. All calculations are carried out for 50 industries.

The multiregional model combines the single region model for each region and a module for interregional trade. Interregional trade is specified as export and import between each region and a common national pool. The pool formulation may limit the precision as it does not take into consideration the distance between regions

The multiregional model has a free and flexible division of regions. It establishes growth paths for interregional exports and imports for each industry and

[92] Excluding Zone 1a and 4a for simplicity.

region and gives spillover and feedback effects between the regions.

A more formal description of the models and the estimation of trade coefficients is given in Appendix 2.

7.3 Ripple effects in the five payroll tax zones

We will first present some calculations of ripple effects in the multiregional model where the national economy is divided in five regions comprised by the municipalities within the different payroll tax zones. Ripple effects related to each zone (region) is simulated by shocking the economy in the zone with a change in exogenous final demand. The shock is set to 10 pct. of the output value in each eligible industry in the actual zone.

In 2010 eligible industries made up the shares of total output and employment in the different tax zones as presented in Table 7.1. Zone 5 has the lowest share of eligible industries related both to output and employment, while this zone has the highest share of employment in the public sector.

The public sector is not a part of our analysis I Chapter 4, so eligible industries as part of industries in the private sector may be a more relevant measure. Zone 1 has still the highest share of eligible industries, while Zone 5 now has a higher share than Zone 2 and 3.

The distinction between eligible and non-eligible industries in RDSSC scheme goes down to a rather detailed industry level and is also related to firm size within certain industries. We are here limited to make this distinction based on PANDA's 50 industries and this may not give a sufficient precision in all distinctions. The distinctions between eligible and non-eligible industries is given in Table 1 in Appendix 2.

The targeted share of the employment seems to be lowest in the zone where the need for RDSSC support is supposed to be highest.

Ripple effects related to eligible industries in the five zones are presented in Table 7.2. Zone 5 is the zone with lowest internal ripple effects (0.2767), while Zone 1 has the highest level (0.8577). Zone 1 has no reduced social security tax. It consists of all the main city regions and have the most diversified industry structure. It is no surprise this zone is very important to the other zones and has high spillover effects from them. On the other hand, Zone 1 has very little spillover effects to the other zones, only 0.068 out of a total ripple effect of 0.9258

Table 7.1 Eligible and non-eligible industries' shares in the five payroll tax zones. 2010

	Zone 5	Zone 4	Zone 3	Zone 2	Zone 1
Output 2010					
Eligible industries' share of all industries	36.8 %	44.5 %	47.3 %	45.8 %	47.8 %
Employment 2010					
Eligible industries' share of all industries	35.3 %	40.1 %	40.0 %	41.4 %	51.4 %
Local and central government's share of all industries	42.0 %	39.0 %	29.5 %	30.2 %	27.1 %
Primary industries' share of all industries	6.6 %	5.5 %	12.3 %	8.4 %	1.5 %
Eligible industries' share of industries in private sector	60.8 %	65.8 %	56.8 %	59.3 %	70.4 %

The other zones have higher spillover effects to Zone 1 than their indirect effects in own zone.

The main conclusion to be drawn from this is that the zones inside the scheme (Zone 2 to 5) can benefit from the direct effect of RDSSC, while Zone 1 gain most of the ripple effects generated by eligible industries in the other zones. The ripple effects for each zone is also illustrated in Figure 1 in Appendix 2.

7.4 Ripple effects of the 2000-reform

In this chapter we present calculations of ripple effects more in detail related to the DAGA region. The effects are calculated for employment, value added and income, and we divide the ripple effects between eligible and non-eligible industries.

We have calculated different ripple effects simulated by a production shock in eligible industries in the 23 municipalities where the tax zone was changed from Zone 2 to Zone 3 in 2000. In addition to the region consisting of these municipalities we have included the Control region used in the econometric analysis. The rest of the country is divided in ten regions representing different county groups. The regions are listed at the end of this chapter. These ten regions are summed together in the presentation and presented as "Rest of Norway".

Table 7.2 Ripple effects on employment from a change in final demand in eligible industries in the five payroll tax zones

	Ripple effect in zones					
	Zone 5	Zone 4	Zone 3	Zone 2	Zone 1	Total ripple effect
Zone 5						
Direct effect	1					
Indirect effects	0.2767	0.1005	0.0140	0.1162	0.4705	0.9778
of this feedback	0.0140					
Zone 4						
Direct effect		1				
Indirect effects	0.0129	0.3534	0.0128	0.0972	0.4115	0.8877
of this feedback		0.0603				
Zone 3						
Direct effect			1			
Indirect effects	0.0150	0.0923	0.3152	0.1105	0.7249	1.2579
of this feedback			0.0147			
Zone 2						
Direct effect				1		
Indirect effects	0.0138	0.0849	0.0138	0.4869	0.5206	1.1200
of this feedback				0.1033		
Zone 1						
Direct effect					1	
Indirect effects	0.0043	0.0253	0.0044	0.0340	0.8577	0.9258
of this feedback					0.1007	

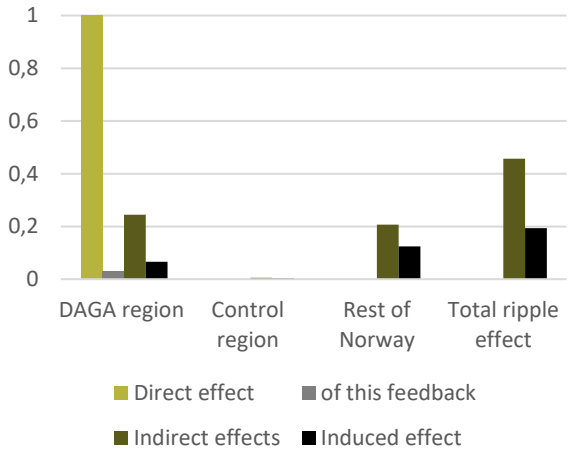
The municipalities are spread on four different counties, and form five municipality groups. These are merged together into one region, partly without common borders, called the DAGA region.

We have also made model runs with the five small regions separately instead of the aggregate region. The disaggregated runs did not differ much from the aggregate runs, and we have used the aggregate region in the runs presented here. As in the case with the five RSDDC zones, the exogenous shock is 10 pct. of the production value in eligible industries in the region. The different ripple effect figures are presented in the table below.

The exogenous final demand and induced private consumption effects sum up to 65 pct. (0.6505) in indirect effects. These are almost evenly distributed on intra-regional effects in the DAGA-region (0.3100) and spillover effects to the rest of Norway (0.3316). The total indirect and induced intra-regional effects in the DAGA region is 35 pct., so the total national multiplier related to the shock in economic terms is therefore 1.75.

The spillover effects to the control region are very small (0.0089 of the direct effect in the DAGA-region altogether).

Figure 7.1 Employment ripple effects from a change in final demand in eligible industries in the DAGA region (industries in municipalities that moved from Zone 2 to 3 in 2000)



The indirect output effects in the DAGA region are larger than the spillover effects to the Rest of Norway. For the induced private consumption effects,

Table 7.3 Employment ripple effects from eligible industries in municipalities that moved from Zone 2 to 3 in 2000

		DAGA region	Control region	Rest of Norway	Total ripple effect
Production output effects from exogenous final demand					
	Direct effect	1			
	Indirect effects	0.2443	0.0057	0.2068	0.4568
	of this feedback	0.0295			
Induced private consumption effects					
	Induced effects	0.0656	0.0033	0.1249	0.1938
Total ripple effects					
	Direct effect	1			
	Indirect effects	0.3100	0.0089	0.3316	0.6505
	of this feedback	0.0295			

the picture is opposite. The induced effects are larger outside the DAGA region than inside.

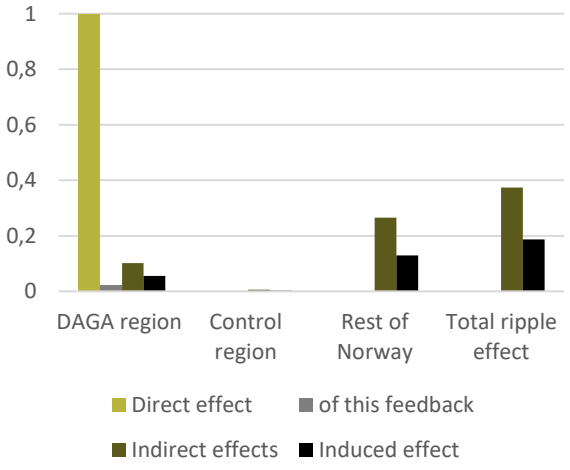
The total spillover effect to the rest of Norway is higher than the internal ripple effect in the DAGA region, which also is in line with the results presented in the previous chapter. But the analysis of the DAGA region shows that the internal output-generated effects are higher inside than outside the region, while it is opposite for induced consumption effects. The spillover effects are twice as large as the internal ripple effects.

7.5 Value added effects

The ripple effects related to value added are presented in the table below. Contrary to the picture for employment, the value-added ripple effects in the DAGA region is less than half of the effect related to employment (0.1019 against 0.24443). On the other hand, spillover effects for value added to the rest of Norway is higher compared to the effect for employment (0.2655 against 0.2068).

For the induced private consumption effects, the picture is the same in both cases, the effect outside the DAGA region is twice as high as the effect inside the region. The total ripple effect is 0.5609 related to value added, while it is 0.6505 related to employment.

Figure 7.2 Value added ripple effects from a change in final demand in eligible industries in the DAGA region



Measured in value added terms, the picture is quite opposite compared to the employment effects. The spillover effects to the rest of the country is two and a half times as large as the internal ripple value in the region. This may also be caused by higher value-added levels in general in the rest of the country compared to the DAGA region.

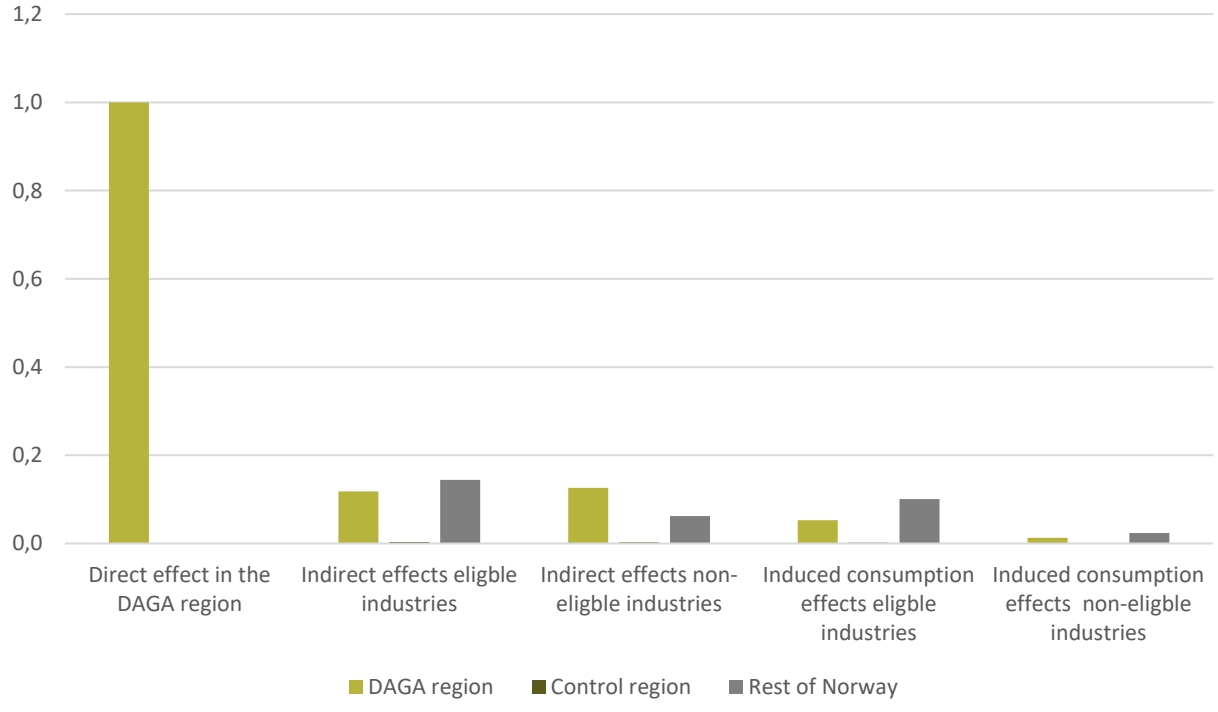
Table 7.4 Value added ripple effects from a change in final demand in eligible industries in the DAGA region

	DAGA region	Control region	Rest of Norway	Total ripple effect
Production output effects from exogenous final demand				
Direct effect	1			
Indirect effects	0.1019	0.0059	0.2655	0.3733
of this feedback	0.0228			
Induced private consumption effects				
Induced effect	0.0552	0.0030	0.1294	0.1876
Total ripple effects				
Direct effect	1			
Indirect effects	0.1570	0.0090	0.3949	0.5609
of this feedback	0.0228			

Table 7.5 Employment ripple effects from a change in final demand in eligible and non-eligible industries in the DAGA region

	DAGA region	Control region	Rest of Norway	Total national effect
Production output effects from exogenous final demand				
Direct effect in the DAGA region	1.0000			1.0000
Indirect effects eligible industries	0.1184	0.0031	0.1444	0.2659
Indirect effects non-eligible industries	0.1259	0.0025	0.0624	0.1908
total indirect effect	0.2443	0.0057	0.2068	0.4568
of this feedback eligible industries	0.0140			
of this feedback non-eligible industries	0.0155			
Induced consumption effects				
Induced consumption effects eligible industries	0.0527	0.0024	0.1008	0.1559
Induced consumption effects non-eligible industries	0.0129	0.0009	0.0241	0.0379
Total induced effect	0.0656	0.0033	0.1249	0.1938
Total effects				
Direct effect	1.0000			1.0000
Total ripple effects eligible industries	0.1711	0.0055	0.2452	0.4218
Total ripple effects non-eligible industries	0.1389	0.0034	0.0865	0.2287
Total effects	0.3100	0.0089	0.3316	0.6505
of this feedback	0.0295			

Figure 7.3 Employment ripple effects from a change in in final demand in eligible and non-eligible industries in the DAGA region



7.6 Ripple effects in eligible and non-eligible industries

In the Table 7.5 and Figure 7.3, all ripple effects in eligible and non-eligible industries are presented, and a figure showing only the indirect effects is also presented. What is interesting here, is that the eligible industries have a higher indirect effect outside the DAGA region than the non-eligible industries.

The ratio of outside ripple effects (Rest of Norway) compared to the inside ripple effects (the DAGA region) is presented in Table 1 in Appendix 2. The exogenous final demand shock is the same as the shock used in the tables and figures presented in this chapter. The ratio varies between the industries. One reason for that, is the different representation of each industry in the two areas. Because the DAGA region is an inland region the magnitude of for example the ship-building industry (no. 29) is very small compared to the Rest of Norway. The similar reason explains the figure for industry no. 3 Fishing.

7.7 Income and consumption effects

Income and consumption effects appear in the model in two different ways, either as a) an exogenous income change, or b) induced income effects from a production change. In the first case the economy is shocked with a change in income independent of the production level. In the latter case the income effects are related to a production change and is calculated as a part of the total ripple effects from a production change. In both cases income spillover effects is calculated as a part of the income ripple effects.

7.8 Income effects

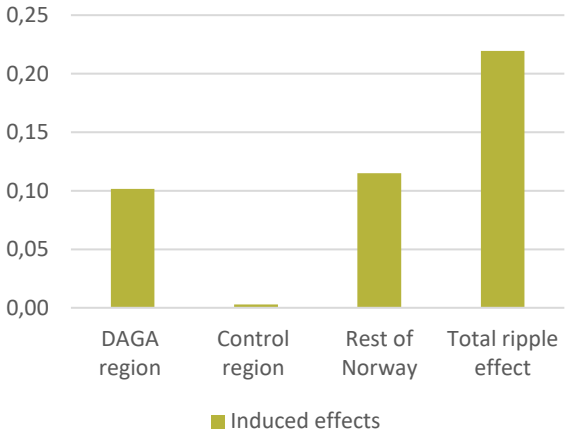
We have also made simulations of income effects by shocking the DAGA region with an exogenous transfer shock set to 10 pct. of the wages in the eligible industries.

Table 7.6 Effects from an exogenous income shock (in income values)

	Daga region	Control region	Rest of Norway	Total ripple effects
Direct effect	1			
Induced effects	0.1017	0.0028	0.1149	0.2194

Indirect effects from this exogenous income shock appear through induced private consumption effects in the DAGA region and spread to the other regions through spillover effects from the regional production of consumption products. These indirect effects amount to about 22 pct. all together where 10 pct. appears in the DAGA region and 11 pct. appears in the rest of Norway.

Figure 7.4 Induced income effects



The picture is approximately the same as for the ripple effects from a shock in exogenous final demand: the ripple effect in the Rest om Norway is approximately of the same magnitude as the ripple effects in the DAGA region.

8 Impact on competition and trade

State aid that limit competition are prohibited by the EEA agreement. However, state aid facilitating the development of economic areas, where such aid does not adversely affect trading conditions to an extent contrary to the common interest, may be considered compatible with the functioning of the EEA Agreement. RDSSC compensate firms in more rural areas for having competitive disadvantages through larger distances and inefficiently high wages. In line with the scheme's objective, we find that RDSSC does enhance beneficiaries' competitiveness domestically. Most firms receiving aid from RDSSC are offering services locally, which reduces the potential impact on international competition and trade. We also find that the proportion of export-oriented firms is not significantly higher within the zones with reduced rates. Furthermore, the exporting firms tend to be capital intensive, thus gaining relatively little from a tax scheme reducing the relative cost of labour. Moreover, we find that very few of the exporting beneficiaries receives support above the limit of de minimis aid. We are not able to quantify the scope of import competition due to lack of data. However, we argue that the fact that the economy is small and specialised in industries where Norway has a comparative advantage and the relatively low extent of intra-industry trade in Norway limits the scope of import competition. We conclude that there is little evidence of RDSSC having a distortive impact on competition and trade to an extent contrary to the interest of the EEA Agreement.

Several countries have considerable economic disparities across regions. To reduce regional inequalities, governments often use regionally differentiated policies to generate employment and productivity in selected regions. The policies include favourable tax rates (for example payroll taxes), subsidies and other benefits given to incentivize firms to locate in disadvantaged regions. Differentiated tax schemes exist between the states of Australia, the EU and the US. However, differentiated social security contribution across regions within a country is not common.

The scheme has a positive impact on employment in regions with scattered settlement through:

1. Creating a geographic bias towards regions with scattered settlement
2. Decreasing the cost of labour relative to capital

RDSSC takes on a societal cost to achieve the political goal of preventing depopulation in scarcely populated areas. Hence, the objective is not to counteract a market failure in contrast to many other schemes, like for instance SkatteFUNN which compensates for underinvestment in R&D.

Schemes that limit competition are prohibited by the EEA agreement, unless they are targeted at specific objectives of EU interest and distortions of competition and trade are kept at an acceptable level.[93] RDSSC compensates firms' larger distances between producer and consumer and the cost of transport and for inefficiently high wages in rural areas due to the centralised wage-setting system. It is important that a measure preventing depopulation actually brings about a higher level of inhabitants in sparsely populated regions than would otherwise occur. At the same time the scheme must ensure that the positive demographic effects outweigh the

[93] According to Article 107(1) of the Treaty on the Functioning of the European Union (TFEU). The Treaty places the responsibility for the control of State aid in the hands of the European Commission.

potentially negative impact on international competition.

The social security rates that firms are subject to in Norway mainly depend on the firm's geographical location. Furthermore, there are certain industries which are excluded from the scheme of differentiated rates, irrespective of their location.[94]

RDSSC has been notified to the EFTA Surveillance Authority (ESA) for the period 2014 to 2020, in accordance with the provisions of the EU regulation, pursuant to Article 1(3) of Part I of Protocol 3. In Decision No 225/14/COL, ESA approved the renewal of the notified aid scheme for another 7 years. It was concluded that by alleviating the cost of employment in disadvantaged areas, the scheme aims at a regional policy objective of common European interest and is an appropriate policy instrument in this respect.

The characteristics of the scheme implies that the Norwegian authorities are obliged to conduct an impact evaluation in line with the European Commission Staff Working Document, *Common methodology for State aid evaluations*.[95] An important aspect of this evaluation is to assess the potential impact on competition and trade.

To analyse the possible distortions on competition and trade we consider several factors, pointed out by the European commission in their guide evaluating the impact of state aid.[96]

We have not found international studies measuring the impact on competition and trade due to geographical differentiated payroll tax schemes. However, several studies on general payroll taxes has found a significant impact on wages and employment (Gruber 1997, Holmlund 1983, Egebark og Kaunitz 2014, Schreiner, Schönberg og Ku 2018, Stokke 2016, Bennmarker, Mellander and Öckert 2009). The impact on competition has not been examined thoroughly.

We assess the impact RDSSC may have on the domestic and the international competitive environment in the following.

8.1 Impact on domestic competition

To favour certain domestic regions is a political choice. Thus, finding an impact of the scheme at all implies that there is a distortive impact on domestic competition favouring these regions. But this distortive impact is wanted.

Given our findings in Chapter 4, our main conclusion when it comes to RDSSC's impact on domestic competition is that it does enhance beneficiaries' competitiveness. We estimate significant, but small, direct and indirect effects on employment in eligible regions and increased profitability for firms.[97] This is in line with the objective of the scheme. However, our results from Chapter 7 indicates that ripple effects reduce the domestic distortive effect of RDSSC somewhat as they generate an "import leakage" through increased demand to surrounding and central zones.

[94] Between 2002 and 2007 there was also a reduced rate for firms hiring individuals above 62 years (Ellingsen og Røed 2006).
[95] According to Article 61(1) of the EEA Agreement, as interpreted by the EFTA Court, a measure will constitute 'state aid' if four cumulative conditions are met: (i) there must be an intervention by the State or through State resources; (ii) that intervention must confer an advantage on the recipient; (iii) it must be liable to affect trade between EEA States; and (iv) it must distort or threaten to distort competition.
[96] See Common principles for an economic assessment of the compatibility of State aid under Article 87.3. The overall objective of a State aid evaluation is to assess the positive and negative effects of a scheme.
[97] We argue that the estimates are conservative due to little variation in data, see Chapter 4.4.

We argue that RDSSC enhances overall competition between firms in Norway by lowering the costs of firms that initially had a competitive disadvantage.

8.1.1 RDSSC contributes to reduce a competitive disadvantage

The Norwegian economy is characterised by a national collective wage bargaining system, leading to a relatively high degree of wage equalisation between geographical regions. In remote areas with small labour markets and/or a one-sided industrial base, this could typically result in higher wages and lower employment than what would have been the case in a fully competitive market. Under such circumstances, RDSSC helps offsetting the gap between tariff and market wages in rural areas. This in turn increase competition by reducing a competitive disadvantage of firms in rural areas.

Furthermore, payroll taxes in general create a bias towards use of capital, which is counteracted in rural areas by decreasing the cost of labour.

As explained in Chapter 3, employment may be increased directly by RDSSC reducing labour costs relative to regions without reduced rates. The lower cost of labour will allow firms to increase their employment, reduce product prices or enhance product quality, and thereby gain market shares. In Chapter 4, we find that a percentage point increase in the payroll tax rate leads to an approximately 1 pct. decrease in employment.

RDSSC may also contribute to increased employment indirectly, if part of a tax reduction is shifted to workers through higher wages. Higher wages will in turn lead to increased demand, activity and employment in the economy, cf. Chapter 3. In Chapter 4, we find that about 30 pct. of the reduction in labour costs contributes to higher wages.

8.1.2 Several countries use differentiated SSC to reach political objectives

Across countries, the social security contributions differ substantially in design, from a lump sum tax in Denmark, to a progressive rate in France of up to 50 pct. of the salary[98], to a percentage-based scheme with payment caps in Germany.[99]

There are several options of designing a differentiated social security scheme. For example, in Sweden the payroll tax was lower for young individuals until 2016 (Bennmarker, Mellander and Öckert 2009). Today the social security rate is lower for older individuals and firms in the north-west (stödområde A). In France it is lower when hiring individuals without formal education (Karmarz og Philippon 2000).

The schemes mentioned above are all intended to increase employment by making firms with certain characteristics (e.g. located in rural areas or hiring younger or older individuals) more competitive. Comparably, RDSSC makes firms suffering from geographical locational disadvantages more competitive. When firms in the eligible zones provide goods or services in competition with firms falling outside the zone, the first group of firms will benefit from an advantage compared to the former. Thus, competition between firms will be distorted and the competitive disadvantage of firms in more rural areas will be reduced. Based on the empirical results

[98] The rate depends on industry, firm size, the type and status of the job, and the level of the remuneration. The employer rates are also lower on wages on or around the minimum wage, or for part time employees.

[99] Data from the KPMG online database of tax rates.

from Chapter 4, we conclude that RDSSC has a distortive impact on domestic competition, in line with the scheme's objective.

8.2 Impact on international competition

In addition to the impact on domestic competition, the scheme may also have an impact on competition and trade within the internal market of the EU. To achieve the objective of the scheme, there must be a domestic distortive impact on competition bringing about a clear positive demographic effect in the rural areas, but without strong adverse effects on international competition.

The EEA-agreement restricts the government's ability to freely adapt various discriminative subsidy schemes if beneficiaries are competing in international markets and there is a potential for a distortive impact on international markets.

Our analysis on international competition indicates that such distortive impact is very modest. A large share of beneficiaries is part of the "sheltered sector" and thus will not have an impact in international trade. Furthermore, the aid received by the great majority of firms is far below the limit for *de minimis aid* and the share of exporting firms benefitting from reduced social security contribution is lower than the share for firms without a reduction.

Norwegian firms have been subject to regionally differentiated rates of social security contribution for almost half a century. Despite being active for a long period, we do not see that the proportion of export-oriented firms is significantly higher within the zones with reduced tax rates than outside, rather vice versa.

The scheme's moderate impact on employment does not seem to be driven by employment growth in export industries. The export industries that are relatively important employers in zones with lower rates, are partly based on natural resources, such as fish and abundant power supply (the metal industry). In general, the Norwegian export industries are capital intensive, and this is to a larger extent the case in the regions with lower rates (Nordvik and Grytten 1994).[100] A high capital intensity implies that a reduced cost of labour relative to capital will not have as large an impact on the firm's decisions, as if the firms was labour intensive.

8.2.1 Necessary conditions for an international distortive impact

If a firm gains an advantage through lower costs, it will also be a competitive advantage in international markets, given that the firms' activities are oriented towards international markets.

For RDSSC to have a negative impact on international trade, beneficiaries must be exporting or strengthen their competitiveness in the Norwegian market compared with foreign suppliers.[101]

In addition to being active in the international market, the amount of aid granted must be such that it

[100] In most western countries, the export industry is typically relatively capital intensive. However, due to the compressed wages in Norway the incentive to utilize machinery instead of low educated labour higher than in other countries.

[101] Note that the tax policies are developed at the national level. The individual states' tax systems are however required to comply with the basic principles set out in the EU treaties on free movement of goods, persons, services and capital, on freedom of establishment and on non-discrimination, regardless of whether secondary legislation has been adopted. Tax rules must also be in accordance with the rules on state aid. Because RDSSC is defined as state aid its impact on competition within the internal market of the EU must be evaluated. The rate of social security contribution, in itself, is however not relevant in this evaluation. It is still important to note that Norway has a significantly lower rate of social security contribution, compared to other countries in Europe. See Statista (2018) Payroll taxes of 100 euros gross earnings in member states of the European Union.

likely will affect the firm's market access at the expense of firms in other countries (cf. Chapter 8.3.3). We do not have access to the international firm level data necessary to estimate the impact of RDSSC on international firms. Hence, we cannot not conclude for certain on the aggregated impact on international competition and trade.

We do, however, have access to information about the industries of firms benefitting from RDSSC, their export activity and the amount of support received through RDSSC. This, in conjunction with the limit of de minimis aid[102], is used to give an indication of the impact.

8.2.2 More than half of the beneficiaries are in sheltered industries

To give an indication of the potential distortive impact on competition and trade, we conduct a descriptive analysis of the size and industry of beneficiaries. The objective is to shed light on the industrial differences between firms in the various zones. Differences can give an indication of distortion if the beneficiaries are concentrated in a few industries oriented towards the international market.

There are certain industries where the potential distortions to competition and trade could be particularly high, such as in the energy industries covered by the scheme. Hence, it is important to keep the industries where the potential for distortion is particularly high in mind when assessing the appropriateness of the instrument, in line with point 55 of the RAG.[103]

We find that the firms subject to reduced rates to a large extent is part of the “sheltered sector”, and not exposed to international markets. The industries in the sheltered sector include construction, wholesale and retail trade, transport and storage, accommodation and food service activities and education.

Figure 8.1 illustrate the total forgone tax revenue due to a reduced social security contribution in the sheltered sector and three other industry aggregates.

We define export-oriented industries as industries where demand is determined from outside the region (both international and national). This is also to some extent the case for knowledge intensive industries. The development in these industries depends on technological and market conditions nationally and internationally and the local prerequisites for such industries (Moretti 2010, Moretti og Thulin 2013). Export-oriented industries include manufacturing, shipping and accommodation. Whereas the aggregate defined as the knowledge intensive industries include professional, scientific and technical activities, financial and insurance activities and information and communication.

The firms defined as export-oriented industries are typically active in international markets, either as exporters or competing with international firms exporting to Norway. In 2014, about 20 per cent of the firms categorised as export-oriented were exporting internationally.

A common characteristic of (internationally) exporting firms in the zones with reduced SSC is that they are partly based on input from natural resources, such as fish and abundant power supply. The firms within these industries are typically small and highly specialised, but of great importance to regional

[102] Aid below this limit is defined as not distortive cf. Chapter 8.3.

[103] RAG is the EFTA Surveillance Authority's Guidelines on regional state aid. Click here for more information.

value chains. More importantly, these industries are located close to the natural resources necessary for production. Therefore, we view it as highly unlikely that RDSSC can affect the location of these firms.

In Zone 5, there is a relatively high share of exporters in the manufacture of food products (mainly processing and preserving of fish), rubber and plastic products and electrical equipment industries.[104]

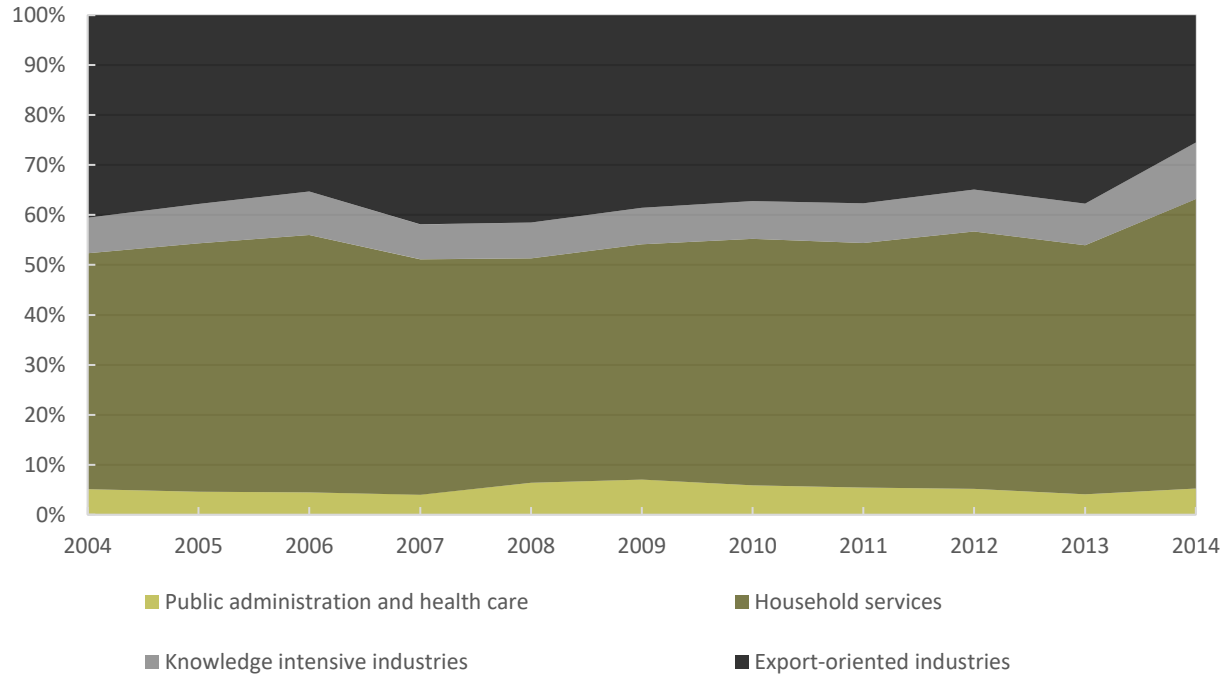
In Zone 3, the share of employees working in exporting firms are lower than in the other zones. Exports within manufacturing of wood and of products of wood (except furniture) is, however, high relative to the other zones.

In Zone 2 and 4, manufacturing of basic metal employs a relatively large share of the region's population, as compared to other exporting industries. In Zone 2, manufacturing of transport equipment is also relatively important for regional employment.

We are not able to quantify the scope of import competition, as we do not have data for the share of Norwegian firms competing with international firms in the Norwegian market. However, the relatively low extent of intra-industry trade in Norway, relative to otherwise comparable countries, indicates that a large share of imported goods to Norway are goods not produced in Norway.

The Norwegian economy is small and specialised in industries where Norway has a comparative advantage. It follows that the share of import competing firms is low. Furthermore, a large share of import competing firms are within the agricultural and fishing sectors, which are exempted from the EEA

Figure 8.1 Total forgone tax revenue due to reduced social security contribution by industry aggregate



Source: Samfunnsøkonomisk analyse AS

[104] NACE 10, 25 and 28.

agreement, and therefore not relevant in the discussion of distortive effects on competition and trade (EFTA 2018).

Local industries, i.e. public administration, health care and household services, are determined by demand within the region, hence the citizens' income (Borge, et al. 2017). Hence, developments in local industries depend on the regional market potential. More than half of the forgone tax revenue accrues to local industries.

We find that the activities of the large exporting beneficiaries are relatively evenly spread across industries. Indicating that the scheme does not seem to distort any single industries.

Furthermore, firms operating in the steel[105], synthetic fibres[106], transport[107], airports[108], energy[109], financial and insurance activities[110] and head office and consultancy activities[111] are not eligible for aid (reduced tax rate) under the scheme.[112] Firms in these industries are subject to 14.1 per cent in social security contribution regardless of geographical location.

A relatively high share of firms in these industries are exporters, and this restriction of RDSSC imply that the potential distortive impact of the scheme on international competition within the internal market of the EU is lower than the aggregate data above suggest.

Exports per employee by zones is another measure of export intensity which can provide an indication of how labour intensive the beneficiaries are. Our export data show that the exported value per employee amongst firms in Norway is NOK 865,000, on average. However, the high average is driven by a relatively few large exporters. The median exported value per employee is only NOK 4,500.

In general, the Norwegian export industries are capital intensive. Furthermore, the capital intensity is relatively high in the resource-based export industries, which is more common in the regions with a lower social security contribution.

A high capital intensity implies that a reduced cost of labour relative to capital will not have as large an impact on the firm's decisions as if the firms were labour intensive.

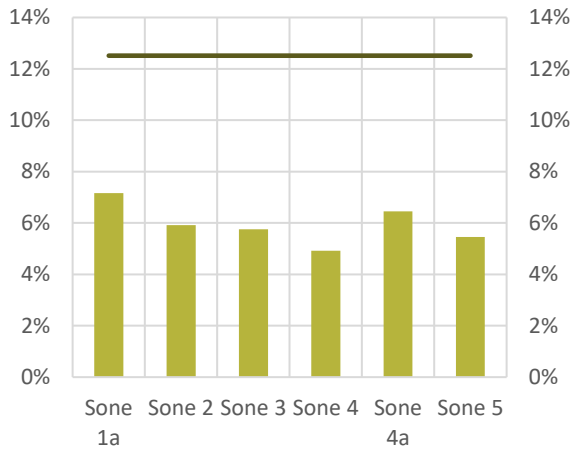
8.2.3 International exporters among beneficiaries

In this section we use export-data to give insight into the beneficiaries' activity in international markets. Figure 8.2 illustrate that the share of firms exporting in each zone, is much lower than the share of exporting firms in Zone 1, i.e. the zone without a reduced rate of social security contribution. The share of exporters between 2004 and 2014 was 13 pct. of firms in Zone 1, but only about half in the zones with reduced social security contribution. We do not know whether the share of exporting firms in the zones with favourable rates would have been lower without the scheme. However, the relatively low

[105] As defined in Annex IV of Guidelines on regional State aid for 2014-2020 (p. 43). For the purpose of the evaluation we have defined the steel sector as NACE Rev. 2 group 24.1.
[106] As defined in Annex IV of Guidelines on regional State aid for 2014-2020 (p. 43). For the purpose of the evaluation we have defined the synthetic fibres sector as NACE Rev. 2 groups 13.1, 13.2 and 13.3.
[107] NACE Rev. 2 classes 49.100, 49.200, 49.311, 49.312, 49.391, 49.392, 49.393, 49.410, 50.101, 50.102, 50.109, 50.201, 50.202, 50.203, 50.204, 50.300, 50.400, 51.100, 51.210
[108] See Guideline on regional State aid for 2014-2020 (p. 3).
[109] NACE Rev. 2 division 35
[110] NACE Rev. 2 division 64, 65 and 66 (Section K)
[111] Undertakings performing intra-group activities and whose principal activity fall under NACE Rev. 2 classes 70.10 or 70.22
[112] As of 1 January 2018, firms operating within the transport and energy sector are eligible for reduced tax rates.

share of exporters indicates that the scheme's impact on international markets is modest.

Figure 8.2 Share of exporting firms by zone. 2004-2014



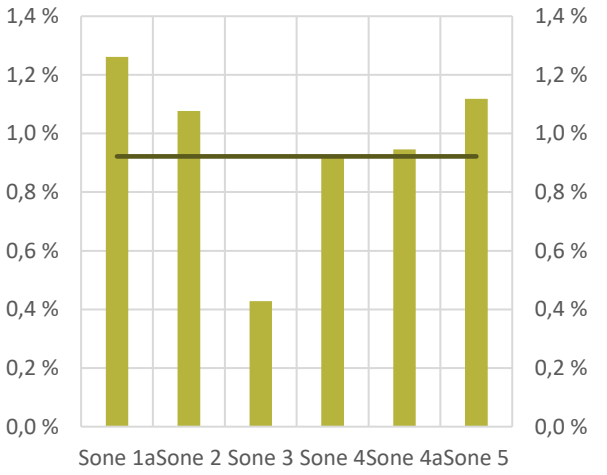
Note: The dark green line represents the share of exporting firms in Zone 1.
Source: Samfunnsøkonomisk analyse AS

In Figure 8.2, the criteria for being an exporter is that the exported value between 2004 and 2014 is more than zero. However, to have a distortive impact on competition and trade in the internal market of the EU the exported value must be of a certain size.

Limiting the definition of exporter to firms with at least one employee, an exported value of more than NOK 1 million (to exclude firms with insignificant exports) and having an export to revenue ratio of more than 25 per cent (export intensity)[113], the number of exporting firms is reduced significantly. Figure 8.3 shows that under this, stricter definition the share of firms exporting is down to around 1 per cent or lower in all zones.

An issue with export data is that the exported value is registered on the firm, although the export might be conducted by sub-units. To take this "headquarter-effect" into account we make a further restriction on our sample by excluding firms with sub-units.

Figure 8.3 Share of large exporters by zone. 2004-2014



Notes: Large exporters defined as firms with export intensity above 25 per cent, exported value above NOK 1 million and more than one employee. The dark green line represents the share of exporting firms in Zone 1.
Source: Samfunnsøkonomisk analyse AS

When excluding firms with sub-units, the share of exporters, in general, is lower. When excluding exporters with sub-units among firms with a reduced social security contribution the share of exporters is almost halved for all zones, both when using the strict and the broad definition of exporter. The relative share of exporters with and without a lower rate does not change, but there is a larger share of exporters with sub-units among those that do not benefit from the scheme.

[113] 25 per cent is indicates that exports are a significant part of the firm's activity and is used as a benchmark also in earlier studies, see for example Mellbye, Amble and Fjose**Invalid source specified.**.

8.2.4 The limit of de minimis aid as an indication of distortive effects

In the subsections above we find that firms with a reduced SSC rate does not seem to be more active in international markets, compared to firms in Zone 1. Rather, the opposite seems to be the case. This is based on the industrial composition in the zones and reported values of export.

So far, we have not considered the size of the aid received by different firms. According to EU regulation, aid received by a firm amounting to below € 200,000 for a three-year period is deemed as not large enough to have an impact on trade and competition within the internal market of the EU and not to distort or threaten to distort competition (de minimis aid).[114] Support above this limit does not necessarily have an impact on trade, but it might.

The € 200,000 for a three-year period is equivalent to slightly less than NOK 640,000 per year.[115] 97 pct. of firms with a reduced rate of social security contribution receive support below this limit (cf. Figure 8.5).

Table 8.1 gives an overview of the threshold for a firm's wage costs that will keep the costs below the limit for de minimis aid and the share of firms receiving more than this limit, by zone. On average, about 3 pct. of the firms receive aid through RDSSC above the limit. However, among the firms receiving aid above the limit for de minimis aid, the median aid is almost NOK 1.3 million in 2014.This means that there is just a small share of firms receiving aid above the de minimis limit, but that several of these receive aid substantially above the limit. However, that some firms receive more than the limit is to be expected of a scheme with no upper boundary.

Table 8.1 Yearly threshold for wage costs to fall below the limit of de minimis aid, average aid and share of firms above limit, by zone. NOK. 2014

Zone	Tax rate	Annual limit of wage cost. Mill.	Average aid received in	Share of firms above de minimis
1a	10.6 %	12,857.1	75,000	0 %
2	10.6 %	18,571.4	141,000	3 %
3	6.4 %	8,441.6	294,000	6 %
4	5.1 %	7,222.2	255,000	7 %
4a	7.9 %	10,483.9	309,000	9 %
5	0 %	4,609.9	377,000	9 %
Average				3 %

The firms receiving more than de minimis aid is primarily located in the industry of household services or export-oriented industries. On a more disaggregated level, the six industries receiving most support in 2014 is mining, construction of roads and railways, processing and preserving of fish, manufacturing of basic pharmaceuticals and chemicals and retail of specialised goods.

The potential distortive impact would be caused by the export-oriented industries. The median aid received by firms, receiving more than de minimis aid, in export-oriented industries was about NOK 1.4 million in 2014.

The high support received in these industries are driven by a few very large firms. Large firms do naturally have higher labour costs, and thus the value of the aid becomes larges for these firms. Firms within mining, processing and preserving of fish and manufacturing of basic pharmaceuticals are typi-

[114] See the Official EN Journal of the European Union for more information. The period of three years to be taken into account should be assessed on a rolling basis so that, for each new grant of de minimis aid, the total amount of de minimis aid granted in the fiscal year concerned and during the previous two fiscal years needs to be taken into account.

[115] Based on the exchange rate of Euro to NOK of 9,54 as of 18th of September 2018.

cally active in international markets. This could potentially have an unwanted distortive impact on trade within the internal market of the EU.

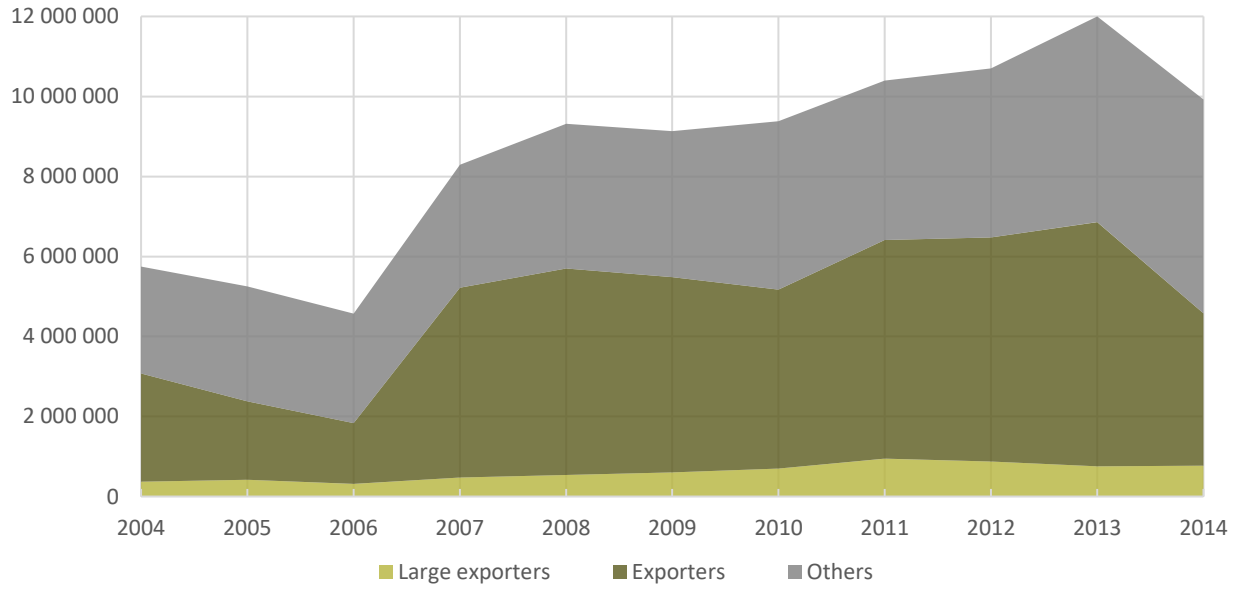
To have a negative impact on international competition, a necessary condition is that the aid received is above the limit for de minimis aid. This is however not a sufficient condition. The beneficiaries must also be active on the international market. As explained above, firms categorised within export-industries are not necessarily active in international markets. To analyse the potential impact on competition, we utilize data on the scope of the beneficiaries' export in conjunction with data on the scope of received aid.

Due to lack of data on competition in the import market we cannot conduct an analysis on the degree of import competition. However, the relatively low extent of intra-industry trade in Norway limits the potential extent of import competition, as explained above.

To have an impact on international trade, the exported value must be of a certain size. In Figure 8.4 and 8.5 we therefore include the strict definition of exporting firms. Named large exporters in the figures. This is firms with an export intensity of at least 25 pct., an exported value of at least NOK 1 million and more than one employee.

Figure 8.4 illustrate the total forgone tax revenue accrued by firms in zones with a lower rate, in the form of reduced social security contribution. The median aid received is about NOK 65,000 per year in the period from 2004 to 2014. The median for firms defined as large exporters was about NOK 500,000 for the same period. The average for large exporters is

Figure 8.4 Total estimated forgone tax revenue due to reduced social security contribution by export activity. NOK (1,000). 2004-2014



Notes: Large exporters are defined as firms with an export intensity above 25 per cent, exported value of above NOK 1 million and at least one employee. Exporters are firms with an exported value above NOK 0. Others are firms with no export activity.
Source: Samfunnsøkonomisk analyse AS

volatile, as there are only a few firms in this category, and, thus, we report median values.

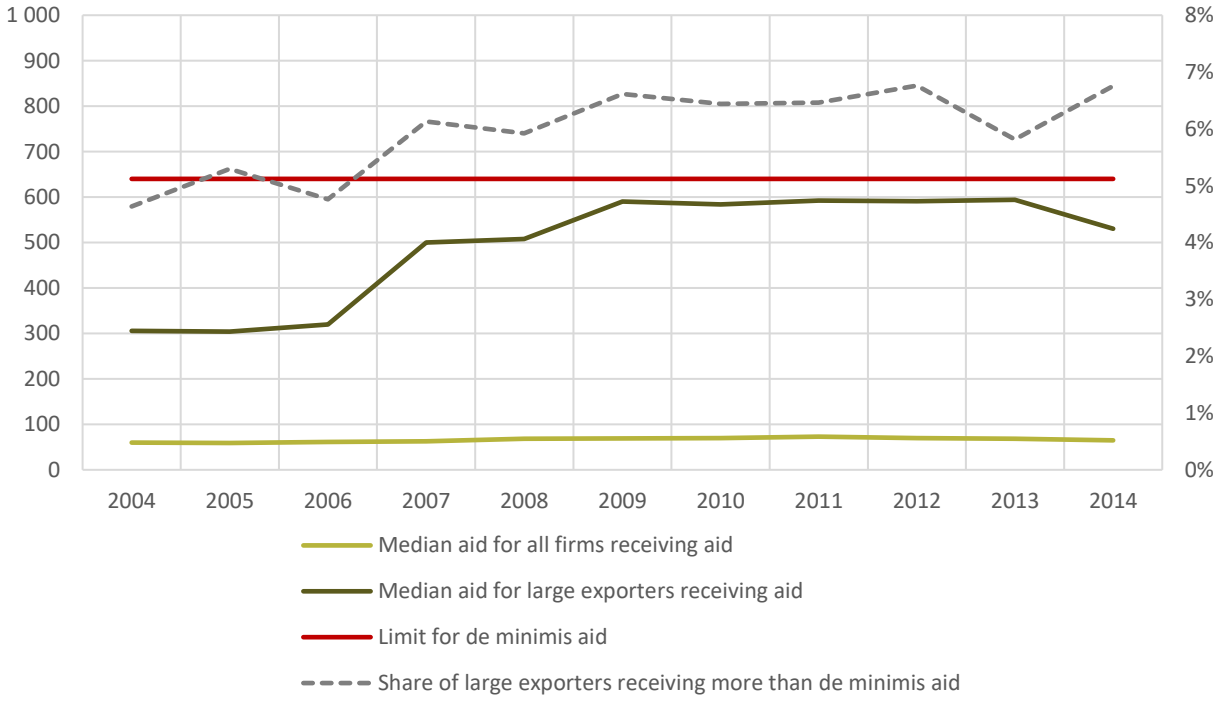
Figure 8.5 illustrates that the median aid received by large exporters is below the limit for de minimis aid (the red line) for all years, except from 2011 when it was slightly above the limit. The share of large exporting beneficiaries receiving support above the limit for de minimis aid is about 8 pct. for the period from 2004 to 2014, cf. Figure 8.5. This amounts to slightly less than 90 firms per year, which is about 0.4 pct. of all firms benefitting from a reduced social security contribution.

The low share of aid to exporters indicate that the benefit received due to the scheme mainly goes to firms oriented towards the Norwegian market.

Whether activities performed by the exporting firms receiving state aid above the limit has an impact on trade and competition is uncertain. Nevertheless, we view it as unlikely that there is a significant impact on international trade due to the low share of beneficiaries receiving aid above the limit of de minimis aid.

It is important to note that the total amount of de minimis aid granted to a single undertaking shall not exceed EUR 200,000 over any period of three fiscal years. This implies that firms getting a reduced payroll tax worth less than NOK 640,000 times three for a three-year period, but that is receiving state aid from other sources can potentially exceed the limit for de minimis aid.

Figure 8.5 Median support for all firms and large exporters receiving aid in NOK (1,000) to the left and share of exporters receiving more than de minimis aid to the right. 2004-2014



Notes: Large exporters are defined as firms with an export intensity above 25 per cent, exported value of above NOK 1 million and at least one employee. The red line represents the limit for de minimis aid.
Source: Samfunnsøkonomisk analyse AS

Aid under the scheme may be cumulated with other forms of aid, but not of the same eligible costs under other schemes. Aid for labour costs granted provided by any other scheme must consider the aid granted under the scheme for regionally differentiated social security contributions. Reduced payroll tax cannot be cumulated with de minimis aid for labour costs, if the de minimis-limit is exceeded.[116]

When evaluating RDSSC's impact on international competition and trade, we argue that the relevant question is whether firms receiving aid through RDSSC, isolated, receive more than the limit for de minimis aid. If not, then RDSSC does not have a distortive impact on international trade and competition. It is not relevant that a firm might have a distortive impact due to a cumulation of aid from different schemes.

The analysis above indicates that only a small share of firms receive aid through RDSSC above the limit for de minimis aid, thus we consider the potential for a distortive impact on competition in the internal marked to be limited.

[116] The aid recipients are required to give statements confirming that these rules are respected. For more information see (EFTA Surveillance Authority 2006).

9 Concluding remarks and recommendations

The main objective of this evaluation has been to assess the extent to which the Norwegian scheme of regionally differentiated social security contributions (RDSSC) has made a positive contribution to regional employment and population in eligible regions. The evaluation has been carried out according to the Guidelines on State Aid (European Commission 2014).

In line with guidelines and the objective of the evaluation as stated by the Norwegian Ministries of Finance and of Local Government and Modernisation, the evaluation has tested and analysed several data sets to assess whether RDSSC 1) has a well-defined objective of common interest, 2) is designed to achieve the objective of common interest, 3) is appropriate and correctly proportioned for achieving these targets and 4) has a distortive impact on competition and trade.

In this chapter we summarise our findings and provide our recommendations on how RDSSC – in combination with other regional policy instruments – can contribute to stable settlement patterns in eligible regions.

9.1 The objective of the scheme is well defined

Since its introduction in 1975, RDSSC has been part of a broad regional policy to preserve the distinctive features of Norwegian settlement patterns. The policy has very broad political support and thus may be said to be of common interest.

The specific aim of RDSSC has been to increase employment in eligible regions. The reasoning for supporting employment is based on the assumption that enhanced regional employment also increases settlement in the same region.

Several studies support the assumption that regions with employment increase also experience growth in population. However, the direction of causality is not clear. Do people follow jobs, or do jobs follow people? In Chapter 5 we discuss this further. Although there is varying evidence from the literature, overall, studies suggest that stimulating job creation in the least populated regions of Norway will contribute to reducing or preventing depopulation.

When the RDSSC scheme was introduced, the differentiation of tax rates was justified by a situation with a strong reduction in employment in primary industries in rural areas. This situation, combined with low labour mobility between regions and nationally determined wages, could create “hidden” unemployment; see Chapter 2. This may still be the case, but the arguments for stimulating rural employment have changed over the years. Today it is much more important to stimulate rural employment to avoid depopulation.

There may still be a lack of labour mobility between regions in the short run, and migration data support this (see Chapter 2). But in the long run (across generations), agglomeration forces create urban amenities rural firms must compensate for one way or another in order to attract workers; see Chapter 5.

Two potential developments can undermine the political objective of stable settlement patterns:

- Weak access to urban amenities reduces the ability of rural regions to attract sufficient labour even though there are work opportunities.
- Depopulation may slowly reach a level that reduces the attractiveness and productivity of the remaining firms.

The latter may be the result both of reduced economies of scale for local services and increased transaction costs because of longer distances between partners and customers.

Avoiding depopulation appears today to be the most urgent argument for stimulating employment in rural regions, which is the aim of RDSSC scheme.

RDSSC brings down the calculation price of labour. In this way, RDSSC may help rural firms both to compete for labour in the long run and/or to expand production by lowering costs. In both cases, rural employment will be higher than would otherwise have been the case.

Overall, the objective of the scheme of reducing or preventing depopulation in the most sparsely populated regions in Norway is clear and easily understood and is sought accomplished through theoretically convincing means. We therefore conclude that RDSSC addresses a well-defined objective of common interest.

9.2 RDSSC increases employment in eligible regions

The basic idea behind RDSSC has been that the scheme should increase employment in sparsely populated regions. This may be achieved directly by RDSSC reducing firms' wage costs. The assumption is that lower wage costs allow firms to reduce their product price, increase production and gain market share. It is this direct effect that explicitly justifies the choice of RDSSC as a policy instrument.

However, RDSSC may also contribute to increased employment when affected firms do not reduce their product prices. This may be the case, for example, when firms sell their products in small local markets (local services) or are effectively restricted by access to other input factors (as firms limited by natural resources may be).

Nevertheless, firm revenue will increase because of cost reductions. Over time, it is reasonable for wage bargaining to help to distribute this increased income between employees (wages) and owners (profit). When income increases for employees and owners living in eligible regions, demand for all consumer goods will increase, typically household-based services produced in the region. As a result of higher local production of consumer goods, income transfer via RDSSC will also contribute to increased regional production.

In Chapter 4 we have tested whether it is possible to identify significant direct and indirect employment effects in detailed employment and firm data. We have also tested the extent of wage increases as a result of RDSSC.

Our main identification strategy is to use variation induced by different changes in the scheme, so-called exogenous shocks. There have been several changes in the scheme since the introduction of differentiated payroll tax rates in 1975. We exploit the three reforms of the scheme that took place in the period 2000-2007: (i) we use difference-in-differences to study effects of a lower tax rate for firms in municipalities that changed tax zone in 2000; (ii) we use both difference-in-differences and a regression kink design to evaluate effects of increased payroll taxes in the period 2004-2006; (iii) we exploit all variation in the tax rates following the reform in 2004 and its reversion in 2007 to estimate long-run effects on the demand for labour using a GMM estimator.

Our analyses confirm significant effects, both direct and indirect, on employment in the eligible regions.

Employment increases directly through reduced labour costs, allowing firms to reduce product prices and thereby increase production and gain market share. The scheme also contributes indirectly to increased employment by shifting some of the tax reduction onto workers through higher wages, which increases household demand for goods and services. The estimation results indicate that both indirect and direct effects are modest.

An obvious interpretation of the above results is that a repeal of RDSSC as a policy instrument would result in increased centralisation. Over time, firms would reduce their investment and production in the (currently) eligible regions and expand elsewhere.

When interpreting the size of the identified effects it is important to consider that we have not been able to test the effect of the scheme where the scope is greatest, in Finnmark and northern Troms (Zone 5).

Although the total annual support through RDSSC is close to NOK 14 billion, changes to the scheme has been relatively limited within our data period. Our estimation results reflect this limited data variation, which makes it more difficult to identify effects. It is reasonable to assume that the effects of changes are not linear. A small change could be expected to have a small or zero effect because the risk and costs associated with reallocating resources reduce firms' incentives to change their behaviour. But if the payroll tax had increased from 0 to 14.1 per cent in Zone 5, for example, we would expect substantial effects.

In Chapter 4.4 we show that such an increase would increase the share of firms with negative operating profit by 70 per cent in Zone 5. The share of firms with negative operating profits would increase in proportion to the change in the tax rate. This indicates a potential for substantial effects on employment.

9.3 Alternatives to RDSSC are costlier and less appropriate

Total annual support through RDSSC has a financial scope similar to Norwegian agricultural policy support (NOK 14 billion). However, it should be noted that implicit support (reduction in payroll tax) increases over time as a result of the scheme's design. Because the social security contribution is calculated on the basis on employer-paid payroll tax, the difference between high and low tax rates will grow in monetary terms in line with the general wage level and employment.

To assess the proportionality and appropriateness of the scheme, it is useful to consider 1) what would have happened without the scheme and 2) what alternative schemes are available.

Abolishing the regional differentiation of social security contributions within a tax-neutral framework would have resulted in lower employment and settlement in the low-rate zones and higher employment and settlement in Zone 1. This follows directly from the results discussed above.

It is also worth noting that the results of a tax neutral change would not necessarily result in the same employment increase in Zone 1 as the decline in the zones with a reduced rate. This follows from our empirical results, indicating that the negative effects on employment of a tax increase might be greater than the positive effects of a tax reduction.

Thus, a tax-neutral repeal of the regional differentiation of social security contributions is no alternative when there is a need for schemes which contribute

to positive population development (or reduce depopulation) in rural areas.

Could transferring the funding from RDSSC to alternative schemes be an option? In Chapter 6 we saw that RDSSC in monetary terms is by far the most important scheme in the rural and regional development policy mix. Moving all implicit regional support from RDSSC to other schemes will radically change all other schemes. This raises a serious question about appropriateness.

Public instruments designed to influence the behaviour of individuals and businesses normally have a diminishing effect. Especially if a targeted scheme multiplies in size, it can be reasonably assumed that "the last million" will have very little effect.

An alternative to RDSSC could be to increase capital and innovation support in eligible regions to promote employment. Norway has several such schemes under the auspices of Innovation Norway and the Research Council. Evaluations indicate that such schemes increase employment to almost the same extent as RDSSC. However, these schemes are much smaller in scope than RDSSC, and we do not know whether the effects would persist if all the implicit support through RDSSC was transferred to such schemes. In particular, this would be the case in Zone 5, where abolishing RDSSC would increase the social security contributions most and where alternative schemes would have to increase by a relatively large amount in order to achieve the same effect. Our assessment is that there is little to be gained by such a reorganisation.

Increasing income support to households, as Norway already does in Zone 5, might also be an alternative. Increased income support might boost regional settlement in two ways. First, through the same income-employment effect as higher wages through RDSSC, and second, by making it more attractive to live in the eligible regions. It is nevertheless difficult to see that income support to households per se would be more effective than the implicit increase in income that follows from RDSSC. A significant increase in regional income transfers to households might also go to both "needy" and "non-needy", which may be difficult to defend in terms of fairness.

Regional employment could also be supported by moving the implicit support to firms through RDSSC to the eligible municipalities themselves. Municipalities are the main provider of care services, primary education and local community development. Transferring the support to the municipalities themselves would enable them to support employment where needed, invest in common goods in the municipality or boost small municipal industrial funds where these exist. This might be a realistic alternative to RDSSC as it is today.

One public employee cost approximately NOK 700,000[117], compared to our estimated cost of an extra employee through reduced payroll tax rate of NOK 1,200,000.[118] However, it is important to bear in mind that our estimation results reflect the fact that changes in the scheme have been relatively limited in our data period, as explained above, and probably underestimate the effects of larger changes. In other words, our estimate of NOK 1,200,000 is probably too high. The effect of a major

[117] Based on man-year expenses in the Norwegian municipal sector in 2016 (Statistics Norway).

[118] In Chapter 4.1.4 we show that the cost per extra employee was 880,000 in 2000 prices (estimating effects of the 2000-reform). This is equivalent to approximately 1,200,000 in current prices.

change in the scheme could be substantially larger, and thus the cost substantially smaller. Further, we have not considered possible costs related to tax distortions from collecting funds to finance public employment.[119] However, if the cost of one extra municipal employee is not too far from one extra employee as a result of RDSSC, moving regional support from RDSSC to the municipalities might be an appropriate alternative solution to local employment challenges. However, such a move would also shift employment from the commercial sector to the public sector, which in the long run might weaken rural regions' ability to develop new income opportunities.

Strengthening municipal finances might be an interesting alternative in municipalities with untapped income opportunities and where the challenge is to attract residents. Better municipal services or communal goods might be factors that help to keep or to attract labour. In such municipalities, higher state funding could be an alternative to RDSSC.

Our assessment is that totally abolishing RDSSC would clearly reduce the possibility of achieving regional policy objectives. The effects of abolishing the scheme would be clearly strongest in Zone 5. We do not consider that there is any complete alternative to RDSSC. RDSSC appears to be an appropriate instrument in an ambitious regional policy alongside other schemes aimed at balancing the settlement pattern. However, it may be necessary to consider whether some municipalities might be better off with a different mix of policy instruments.

9.4 Small effects on competition and trade

Schemes that constrain competition are prohibited by the EEA agreement, unless they are aimed at specific objectives of EU interest and distortions of competition and trade are kept at an acceptable level. In Chapter 8 we discussed whether RDSSC distorts competition and trade, i.e. whether it distorts competition among firms, nationally or internationally.

In line with the scheme's objective, we find that RDSSC does enhance beneficiaries' competitiveness domestically.

Most firms receiving aid from RDSSC are offering services locally, which reduces the potential impact on international competition and trade. We also find that the proportion of export-oriented firms is not significantly higher within the zones with reduced rates. Furthermore, the exporting firms tend to be capital intensive, thus gaining relatively little from a tax scheme reducing the relative cost of labour. We also argue that the scope of import competition is limited by a high level of specialisation and low intra industry trade.

Furthermore, the evaluation finds that the vast majority of exporting firms receive support that is under the threshold for de minimis aid, and thus is not defined as distortive state aid according to the EEA agreement.

We conclude that there is little evidence of RDSSC having a distortive impact on competition and trade to an extent contrary to the intent of the EEA agreement.

[119] If the general cost of 20 øre per additional krone is applied, the cost of a public employee would be approximately NOK 840,000.

9.5 Recommendations

Based on an extensive empirical review of RDSSC, we recommend that the scheme be continued. The scheme appears to work in accordance with the intention of counteracting depopulation in the rural areas of Norway. We find evidence of modest direct effects through higher employment and indirect effects through wage shifting and increased demand in zones with lower tax rates. We also argue that the actual effects are probably larger than indicated by our estimation results, as the variation in rates within the data period is small and does not reflect the magnitude of the scheme.

We do not believe similar effects could be achieved by distributing RDSSC funds across the considerable number of alternative schemes with similar objectives. They are significantly smaller in scale and more targeted and therefore more subject to decreasing returns than RDSSC, which is a general measure directed to all firms in the zones with reduced tax rates.

However, RDSSC is so general in its design that the scheme is not suitable for compensating municipalities where the real obstacle to positive population development is not a lack of job opportunities but a shortage of social benefits (amenities). Such a situation may apply to both small municipalities with long distances to larger centres and municipalities with such a low population density that it is demanding to develop local service businesses. Such municipalities are at risk of depopulation even if there are local income opportunities. Strengthening the finances of such municipalities may, in principle, help to increase the population and the customer base for some local services.

Shifting support from firms to municipalities may also be an alternative for municipalities with real commuting opportunities from municipalities in Zone 1. This will apply to municipalities in Zone 1a and 2, zones with such small differences in tax rates from Zone 1 that the effects of RDSSC on firm behaviour are limited. In the case of such municipalities, more financial transfers may boost municipal service production or the development of common goods, which in turn could be important for population growth.

Thus, to account for the fact that some municipalities are experiencing challenges not met by RDSSC, we suggest that the relevant ministries consider giving individual municipalities the freedom to choose whether they will carry on with RDSSC or whether they want the same amount of support transferred in the form of separate free income for the municipality. This could, for example, take the form of a pilot scheme over a period of time sufficient to test interest and evaluate the effects, but with the opportunity for the municipalities to revert to the previous arrangement or for the authorities to prolong or cancel the experiment at the end of the trial period.

The RDSSC scheme should also consider that the population pattern in sparsely populated regions may change and vary over time, due either to successful policies or to altered external factors. It can therefore be assumed that the need for RDSSC will also change over time. This might call for occasional reassessment of the zoning. However, it must be borne in mind that it is important for business investment decisions that tax rules are not changed frequently. To take account of both these considerations, zone borders should be reviewed at long intervals. This could be done using the existing procedure, as described in Chapter 2.4.

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Appendix 1: Data

The econometric analysis in this evaluation is based on data from several administrative records from Statistics Norway, linked by anonymous firm- and person specific serial numbers. An overview of the records and their characteristics are presented in the table below. Main variables used in our estimations are described in Chapter 4.

In addition to records from Statistics Norway, we have linked municipal-specific data from publicly available in Statistics Norway's StatBank, e.g. time series on payroll tax rates, centrality and population.

Data sources and characteristics

Record	Person ID	Firm ID	Establishment ID	Years	Notes
The Establishment and Enterprises Register (Virksomhets- og foretaksregisteret (VoF) in Norwegian)		X	X	1995-2014	
The Employer-Employee Register (Aa-registeret in Norwegian)	X	X	X	1995-2014	
Wage statistics	X	X		1997-2014	Missing firm ID 1997-2002
Matched population, education and income statistics (incl. Certificates of Pay and Tax deducted (LTO in Norwegian))	X			1993-2015	
Register based employment statistics	X	X		2000-2015	
Firm accounts		X		1993-2015	
Capital statistics from structural statistics		X		1993-2014	Only for industries in manufacturing
Trade statistics		X		2004-2015	

Appendix 2: Models and data in PANDA

The single region model

The input-output model in PANDA is a Miyazawa (1976) type of quadratic Input-output model extended with a household sector. The data in the model is transformed from rectangular supply-use tables for counties (national accounts by county) to a quadratic form in the model.

The extended model has the following solution:

$$\begin{bmatrix} \boldsymbol{x} \\ DR \end{bmatrix} = \begin{bmatrix} (\boldsymbol{I}-\boldsymbol{A}) & \cdots & -\boldsymbol{c} \\ \vdots & \ddots & \vdots \\ -\boldsymbol{w}' & \cdots & \mathbf{1} \end{bmatrix}^{-1} \cdot \begin{bmatrix} \boldsymbol{y} \\ DR^{ex} \end{bmatrix} = \begin{bmatrix} \boldsymbol{\alpha} & \boldsymbol{\beta} \\ \boldsymbol{\gamma} & \boldsymbol{\delta} \end{bmatrix} \cdot \begin{bmatrix} \boldsymbol{y} \\ DR^{ex} \end{bmatrix}$$

Where $\boldsymbol{x}$ and $\boldsymbol{y}$ are vectors of production and final demand respectively, and $\boldsymbol{c}$ and $\boldsymbol{w}$ are private consumption and wage coefficient vectors. $\boldsymbol{A}$ and $\boldsymbol{I}$ are intermediate input coefficient and unit value matrices, respectively. *DR* and DR^{ex} are scalars of total disposable and exogenous income.

$\boldsymbol{\alpha}, \boldsymbol{\beta}, \boldsymbol{\gamma}$ *and* δ are multiplier matrix and vectors related to the extended model, where:

$\boldsymbol{\alpha} = [\boldsymbol{I} - \boldsymbol{A} - \boldsymbol{c} \cdot \boldsymbol{w}']^{-1}$

is a multiplier matrix describing the effects on output (production) from changes in exogenous final demand. This is the inverse Leontief matrix extended with a household sector, which gives the effects on production included private consumption effects.

$\boldsymbol{\beta} = \boldsymbol{\alpha} \cdot \boldsymbol{c}$

is a multiplier vector describing the effects on production (output) from changes in exogenous income.

$\boldsymbol{\gamma} = w' \cdot \boldsymbol{\alpha}$

is a multiplier vector describing the effects on income from changes in final demand.

$\delta = 1 + \boldsymbol{w}' \cdot \boldsymbol{\alpha} \cdot \boldsymbol{c}$

is a multiplier (scalar) describing the effects on income from changes in exogenous income.

The solution of the model becomes:

$$\boldsymbol{x} = \boldsymbol{\alpha} \cdot \boldsymbol{y} + \boldsymbol{\beta} \cdot DR^{ex} = \boldsymbol{\alpha} \cdot [\boldsymbol{y} + \boldsymbol{c} \cdot DR^{ex}] = [\boldsymbol{I} - \boldsymbol{A} - \boldsymbol{c} \cdot \boldsymbol{w}']^{-1} \cdot [\boldsymbol{y} + \boldsymbol{c} \cdot DR^{ex}]$$

$$DR = \boldsymbol{\gamma} \cdot \boldsymbol{y} + \delta \cdot DR^{ex} = \boldsymbol{w}' \cdot \boldsymbol{\alpha} \cdot [\boldsymbol{y} + \boldsymbol{c} \cdot DR^{ex}] + DR^{ex} = \boldsymbol{w}' \cdot [\boldsymbol{I} - \boldsymbol{A} - \boldsymbol{c} \cdot \boldsymbol{w}']^{-1} \cdot [\boldsymbol{y} + \boldsymbol{c} \cdot DR^{ex}] + DR^{\boldsymbol{ex}}$$

When the model is shocked with a change in final demand production, we get the following effects in the first hand:

$\Delta \boldsymbol{x} = \boldsymbol{\alpha} \cdot \Delta \boldsymbol{y}$

and:

$\Delta DR = \boldsymbol{\gamma} \cdot \Delta \boldsymbol{y} = \boldsymbol{w}' \cdot \boldsymbol{\alpha} \cdot \Delta \boldsymbol{y} = \boldsymbol{w}' \cdot \Delta \boldsymbol{x}$

A shock in exogenous income, ΔDR^{ex}, gives the following effects:

$\Delta \boldsymbol{x} = \boldsymbol{\beta} \cdot \Delta DR^{ex} = \boldsymbol{\alpha} \cdot \boldsymbol{c} \cdot \Delta DR^{ex}$

and:

$\Delta DR = \delta \cdot \Delta DR^{ex} = [1 + \boldsymbol{w}' \cdot \boldsymbol{\alpha} \cdot \boldsymbol{c}] \cdot \Delta DR^{ex}$

The effect on production (output) is directly transformed to private consumption demand and is relatively higher than the effect on income since the last effect is down-scaled with the wage parameters (***w***) in addition to the private consumption parameters (***c***).

But these changes also initiate changes through the interregional transactions, and the initial final de-

mand or income shock creates an additional exogenous final demand change in the interregional exports, EXI, see next chapter.

The multiregional Input-output model

In the single-region model a regional purchase coefficient rpc is estimated for the intra-regional deliveries (intermediate PI, consumption C, Investments J, and special activities A) of each product, *p*, in each region, *r*. The rpc values may vary with the kind of utilisation.

Inter-regional import of each product is calculated as the (1-*rpc*) part of these deliveries and summed over all regions:

$$IMI_{p,t}^{N} = \sum_{r} \left[IMIPI_{p,t}^{r} + IMIC_{p,t}^{r} + IMIJ_{p,t}^{r} + IMIA_{p,t}^{r} \right]$$

Interregional export of product *p* from each region is calculated in an iterative process where interregional export appears as a constant (fixed) part t_p^r of the national sum of interregional import:

$$EXI_{p,t}^{r} = t_p^r \cdot IMI_{p,t}^{N}$$

where t_p^r is an interregional trade coefficient.

The solution in the multiregional model requires that the national sum of interregional export equals the national sum of interregional import for each product:

$$\sum_{r} EXI_{p,t}^{r} = IMI_{p,t}^{N}$$

Changes in production thus initiate in the interregional transactions, and both the initial final demand change and the income change get an additional change through the interregional exports, EXI. This is the spillover effect in the delivering industries, which is calculated as an endogenous change in demand in the multiregional model but appears as an exogenous change in the single region model.

The total exogenous final demand change in the single region model is therefore:

$$\Delta \boldsymbol{y} = \Delta \boldsymbol{ACT} + \Delta \boldsymbol{EXI}$$

ΔACT is the primary (general) change in exogenous final demand, and ΔEXI is the added secondary change in final demand through interregional exports

A similar interregional effect also occurs in addition when the model is given an exogenous income shock.

Data - Estimation of trade coefficients

A crucial parameter when calculating regional ripple effects is the estimation of regional trade and regional trade patterns. The coefficients are here expressed as the division of trade between industries in each region (intra-regional trade) on one hand and trade between these regions and a common national trade pool on the other (multiregional trade). The latter may also be named interregional trade even if this term is usually limited to trade specified directly between regions and not via a common pool.

Since the results from the calculations are strongly dependent on the trade coefficients, we will here give a description of the method used.

Estimation of regional trade coefficients is usually a challenge, and this is no exception in this case. These coefficients are not usually recorded or observed and must be estimated by means of different estimation methods. Several methods are reported and tested in the literature (the gravity function, the Round and Flegg methods, location quotients etc.).

Ripple effects are in general dependent on the level of trade coefficients estimated in the I-O model. The level of the (intra-)regional trade coefficients is dependent on several factors, but rather important is the industry and demand structure in the region on the one hand, and the level of the regional production and supply in each industry compared to the national level on the other. The size of the actual region will therefore be important to the level of the intra-regional trade coefficient and ripple effects. Since the national levels of the trade coefficients are given (=1), the value of the aggregate interregional trade coefficients can be calculated as a residual as soon as we have estimated the intra-regional trade coefficient.

The kind of trade parameter which is normally estimated in regional I-O models is the so-called self-sufficiency ratio, which gives the region's own supply of each product as a ratio of either total or domestic demand for this product. This is often referred to as the regional purchase coefficient - RPC. In PANDA, the output RPC coefficients for deliveries of all kind of use are given as ratios of total domestic (national) demand for each specific product, estimated for each industry and region.

For intermediate deliveries an input RPC coefficient reflecting the sum of regionally delivered inputs in each industry as a part of total domestic input in this industry. The elements in the domestic intermediate table for each county are then justified by use of a so-called RAS method to estimate the regional RPC values in each direction.

The calculations of RPC values start with the estimation of counties values outside the model. This estimation is based on different sources, such as vendor surveys, purchaser's ledgers, commodity flow surveys and synthetic methods (mainly use of Flegg estimators). In the last step the elements in the county tables are justified by use a RAS-routine.

These pre-estimated RPC values for counties are used as benchmark values in the estimation of actual RPC values for regions in the model. When data for the chosen region(s) are pre-processed in PANDA, the trade coefficients are estimated in two alternative ways, depending of the size and composition of the region

Regions less than a county:

- The estimation of regional intermediate element values is based on direct (down)justifying of county values by comparing the demand for and supply of this specific product in the region compared to that in the county. RPC values are thereafter deducted.

The estimation of intermediate deliveries for small regions is as follows, where the least of the two values from comparing demand and supply shares, respectively, is chosen as the regional intermediate delivery:

$$PIR_{pq}^{r} = Min \begin{cases} PIF_{pq}^{r}(q), & demand\ share \\ PIF_{pq}^{r}(p), & supply\ share \end{cases}$$

where:
$PIF_{pq}^{r}(q) = n_{q}^{r} \cdot PIF_{pq}^{f}$ is the regional receiving industry's (q) share of the county receiving industry's intermediate delivery between industries p and q.

$PIF_{pq}^{r}(p) = n_{p}^{r} \cdot PIF_{pq}^{f}$ is the regional supplying industry's (p) share of the county supplying industry's intermediate delivery between industries p and q.

n_{q}^{r} and n_{p}^{r} are regional industry q and p shares of the county industries, respectively.

PIF_{pq}^{f} is the intermediate delivery from industry p to industry q in county f, limited to the intra-county level.

Regional purchase coefficients are calculated as follows:

$$rpc_p^r = \sum_q PIR_{pq}^r \Big/ \sum_q PI_{pq}^r$$

And:

$$rpc_q^r = \sum_p PIR_{pq}^r \Big/ \sum_p PI_{pq}^r$$

These represent the region's own supply of intermediate deliveries as parts of the region's national supply of such deliveries, summed over the supplying and demanding industries respectively.

Regions consist of more than one county or of two or more county parts:

- The estimation of RPC values is then based on a general function weighting the influence of regional production as a share of national production together with regional demand for the single product as part of the national demand for the same product. A discussion of an earlier version of this estimator is given in Vik and Stokka (2000)

$$rpc_p^r = \sum_{k \in r} [rpcfl_p^k + \cdot \left(bal_p^r - bal_p^k\right) + (1 - k_p^k) \cdot (prdand_p^r - prdand_p^k)] \cdot \frac{prdand_p^k}{prdand_p^r}$$

Where:
$rpcfl_p^k$ is the regional purchase coefficient at the county level representing municipality k.

k_p^k is a trading factor representing industry p and county f.

$$k_p^k = \frac{rpcfl_p^k - prdandf_p^k}{balf_p^k - prdandf_p^k}$$

bal and $prdand$ are balancing and production ratios respectively, calculated in the following way:

$$bal_p^r = \frac{NPRD_p^r}{ND_p^r} = \frac{PRD_p^r - EXU_p^r}{ND_p^r}$$

$$prdand_p^r = \frac{NPRD_p^r}{NPRD_p^N} = \frac{PRD_p^r - EXU_p^r}{PRD_p^N - EXU_p^N}$$

(similar for k and N)

$NPRD$ is the domestic directed output (production) from the municipality (k), region (r) or the whole nation (N) respectively, ND is the demand for domestic supplied products in k, r or N. PRD and EXU is output (production) and interregional exports from to the same geographical units.

These two estimation methods are calibrated to give the same values when the region is a county.

The regional input coefficients are calculated as:

$$a_{pq}^r = \frac{PIR_{pq}^r}{PRD_q^r}$$

Where the a_{pq}^r elements forms the $\boldsymbol{A}$ matrix in the model and PRD_q^r forms the $\boldsymbol{x}$ vector.

The 12 regions in the analysis of ripple effects

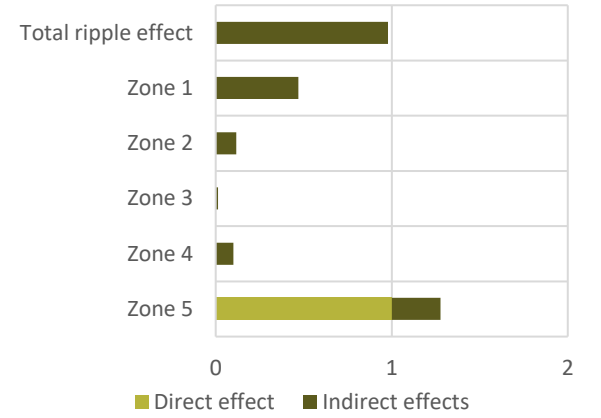
Daga region 2000	0432 Rendalen 0436 Tolga 0437 Tynset 0438 Alvdal 0439 Folldal 0441 Os 0511 Dovre 0512 Lesja 0513 Skjåk 0514 Lom 0515 Vågå 0517 Sel 0540 Sør-Aurdal 0541 Etnedal 0542 Nord-Aurdal 0543 Vestre Slidre 0544 Øystre Slidre 0545 Vang 1566 Surnadal 1567 Rindal 1571 Halsa 1640 Røros 1644 Holtålen
Control region 2000	0516 Nord-Fron 0519 Sør-Fron 0520 Ringebu 0615 Flå 0616 Nes 0617 Gol 0618 Hemsedal 0619 Ål 0620 Hol 0826 Tinn 0828 Seljord 0829 Kviteseid 0830 Nissedal 0831 Fyresdal 0833 Tokke 0834 Vinje 0935 Iveland 0937 Evje og Hornnes 0938 Bygland 0940 Valle 0941 Bykle 1401 Flora 1413 Hyllestad 1428 Askvoll 1429 Fjaler 1430 Gaular 1431 Jølster 1432 Førde 1433 Naustdal 1438 Bremanger 1439 Vågsøy 1441 Selje 1443 Eid 1444 Hornindal 1445 Gloppen 1449 Stryn
Other	The rest of Sogn & Fjordane and Møre & Romsdal The rest of Trøndelag Østfold and Vestfold Oslo and Akershus The rest of Agder and Rogaland Hordaland Nordland Troms and Finnmark The Continental shelf and Svalbard The Rest of Norway

Table 1 Leakage of ripple effects in eligible and non-eligible industries in the DAGA region. Ripple effects in detailed eligible and non-eligible industries and ripple effects in the Rest of Norway as per cent of the ripple effect in the DAGA-region

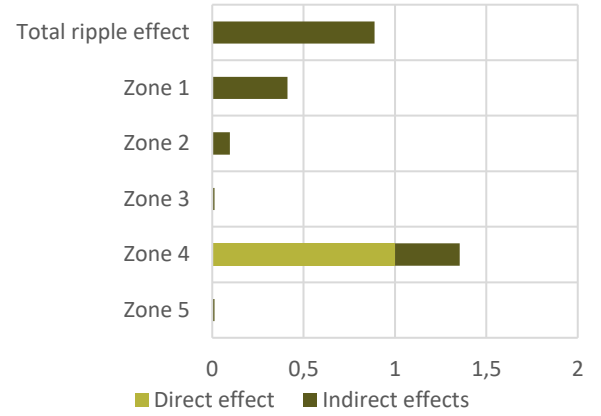
	Eligible industries	Non-eligible industries
01 Crop and animal production, hunting and related service activities		15 %
02 Forestry and logging		86 %
03 Fishing		27,568 %
04 Aquaculture		29 %
05 Oil and gas extraction, transport via pipelines		0 %
06 Mining support activities		0 %
07 Mining and quarrying		99 %
08 Manufacture of fish products	27 %	
09 Manufacture of food products, beverages and tobacco products	14 %	
10 Manufacture of textiles, wearing apparel and leather products	7 %	
11 Manufacture of wood and wood products, except furniture	2 %	
12 Manufacture of paper and paper products	0 %	
13 Printing and reproduction of recorded media	12 %	
14 Refined petroleum, chemical and pharmaceutical products	341 %	
15 Manufacture of rubber and plastic products	9 %	
16 Manufacture of other non-metallic mineral product	15 %	
17 Manufacture of basic metals		488 %
18 Fabricated metal products, except machinery and equipment	22 %	
19 Manufacture of computer, electronic and optical products and electrical equipment	29 %	
20 Building of ships, oil platforms and modul		1303 %
21 Manufacture of motor vehicles, machinery and equipment n.e.c.	25 %	
22 Manufacture of furniture	1 %	
23 Repair and installation of machinery and equipment	76 %	
24 Electricity, gas, steam and air conditioning supply		56 %
25 Water collection, treatment and supply, sewerage	16 %	
26 Construction		2 %
27 Wholesale and retail trade and repair of motor vehicles	12 %	
28 Wholesale trade, except of motor vehicles	54 %	
29 Retail trade, except of motor vehicles	14 %	
30 Freight and passenger ocean transport, supply and other sea transport offshore services	24 %	
31 Freight and passenger coastal transport	47 %	
32 Land transport, except transport via pipelines, air transport		68 %
33 Warehousing and support activities for transportation	61 %	
34 Postal and courier activities	44 %	
35 Accommodation and food service activities	6 %	
36 Publishing activities, motion picture and video programme production, broadcasting	56 %	
37 Telecommunications, computer programming and related activities		582 %
38 Financial service and insurance activities		128 %
39 Real estate activities	13 %	
40 Prof., scientific and technical activities (excl. scientific research and development)	27 %	
41 Scientific research and development	302 %	
42 Rental and leasing activities, employment activities	197 %	
43 Travel agency and tour operator reservation service	25 %	
44 Security and investigation activities, other service activities	29 %	
45 Repair of computers and personal and household goods	12 %	
46 Private sector education	51 %	
47 Private sector human health activities and social work activities	9 %	
48 Arts, entertainment and recreation	21 %	
49 Local public administration, education, human health care and social work activities		109 %
50 Central public administration education, human health care, social work activities and defence		104 %

Figure 1 Ripple effects on employment from a change in final demand in eligible industries in the five tax zones included in the analysis

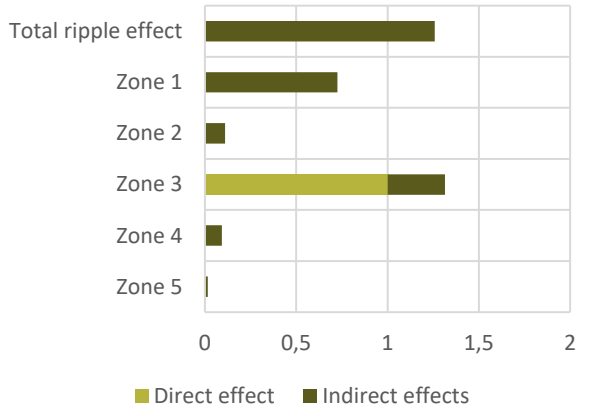
Zone 5



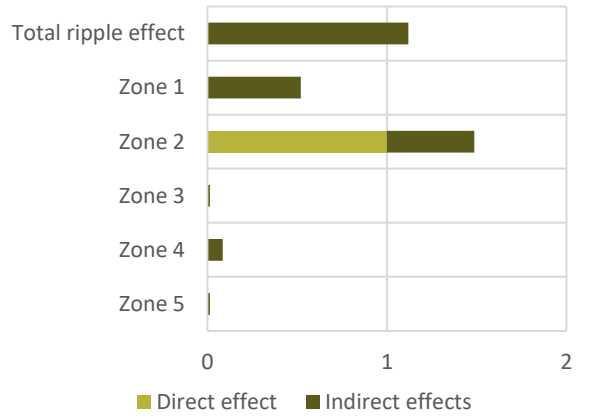
Zone 4



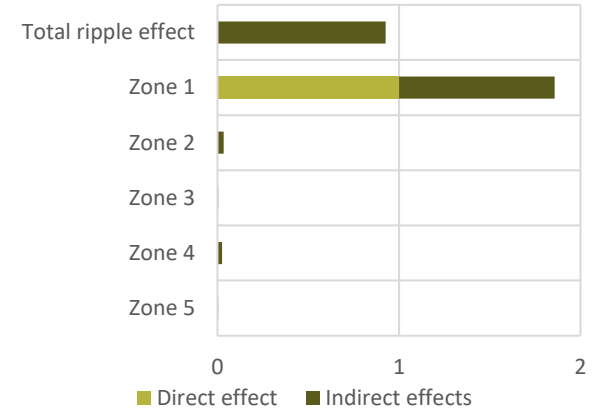
Zone 3



Zone 2



Zone 1



SAMFUNNSØKONOMISK ANALYSE

BORGGATA 2B
N-0650 OSLO

POST@SAMFUNNSOKONOMISK-ANALYSE.NO

PHONE:+47 970 43 859
VAT NO.: NO 911 737 752