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EVALUATION OF THE REGIONALLY DIFFERENTIATED SOCIAL SECURITY CONTRIBUTION SCHEME IN NORWAY – A FEASIBILITY STUDY

ABSTRACT

This report proposes a comprehensive methodology for evaluating the Norwegian *regionally differentiated social security contribution scheme (RDSSC scheme)*.

We recommend using Difference-in-Differences modelling on a full population both at an aggregated and municipality level. The evaluation should be supplemented by Regression Discontinuity Design and a matching procedure to identify proper, yet synthetic control groups.

Once the evaluator has identified the effect of the RDSSC scheme on important evaluation criteria, we recommend using existing regional models to study "ripple effects" of the scheme's main effects.

We estimate the total cost of the evaluation at NOK 6,600,000 including VAT.

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Foreword

This feasibility study is a collaboration between researchers and analysts from three institutions: Economic Analysis Norway (Samfunnsøkonomisk analyse), DAMVAD and Statistics Norway.

During our work on this report, we have had three meetings with a reference group consisting of representatives from the Ministry of Local Government and Modernisation, the Ministry of Finance, the Ministry of Trade, Industry and Fisheries, and the EFTA Surveillance Authority. We would like to thank the participants for their constructive comments in the meetings.

Special thanks go to the project coordinator at the Ministry of Local Government and Modernisation, Vidar Jensen.

As part of this project, we have explored the extent to which existing regional economic and demographical models are suitable for evaluating the regionally differentiated social security contribution scheme. In this work, we have had valuable help from different operators of these models. We would like to thank Arne Stokka at SINTEF for his help in describing PANDA and REMES. Thanks also to Annegrethe Bruvoll at Vista Analyse, and Leo Grünfeldt and Jens Fredrik Skogstrøm at MENON Business Economics, for their help in explaining NOREG.

7 April 2015

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Summary

This report proposes a comprehensive methodology for evaluating the Norwegian *regionally differentiated social security contribution scheme* (RDSSC scheme). The scheme was first introduced in 1975, with the aim of promoting business-driven growth in the northernmost parts of Norway. In the period from 1981 to 1991, the scheme grew to become a significant instrument for regional economic stimulus. Its original rationale was to rectify observed regional differences in employment caused by uneven labour productivity combined with a rigid, centralised wage-setting regime. Currently, the aim of the scheme is still to stimulate employment in rural areas, yet also more indirectly to stem demographic decline.

Since 1994, there have been regular negotiations about the design of the RDSSC scheme between Norway and the EFTA Surveillance Authority (ESA). Consequently, the scheme has been adjusted several times to adapt it to EEA rules for regional state aid. New EU guidelines on regional state aid entered into force on 1 July 2014. On 23 October 2013, the ESA adopted the new guidelines. These make provisions for operating aid in very sparsely populated areas, i.e. areas which have a population density below 8 inhabitants per square kilometre, to mitigate population decline. Yet the guidelines also contain provisions limiting the types of activities that may receive aid (sector restrictions). Norway customised the design of the RDSSC scheme and notified it for the period 1 July 2014 to 31 December 2020. The ESA approved the scheme under the condition that the Norwegian authorities conducted an impact evaluation in line with the EU Guidelines on Regional State Aid.

The evaluation will be carried out by external expert groups and will take place in three phases. The first phase consists of a feasibility study that proposes evaluation methods and data requirements for the actual evaluation. The second phase is a dialogue between the principal, expert groups and evaluation communities in order to discuss the recommendations in the feasibility study. The third phase is the actual evaluation. This report presents the feasibility study.

In the study, we have investigated two categories of approaches: econometric estimation and use of existing regional economic and demographic models. Our recommendations are based on a thorough discussion of whether the different approaches comply with the European Commission's evaluation criteria outlined in the Commission Staff Working Document, *Common methodology for State aid evaluations* (European Commission, 2014a).

The criteria state that the evaluation should address the objectives of the scheme, specifically identifying the direct effects, but also the indirect effects and effects of potential more efficient instruments. Most importantly, the evaluation must use methods that identify causal effects or the counterfactual development. The Commission Staff Working Document also

stresses the importance of evaluating the regional aid's distortive effects on competition and trade in relation to other EU member countries.

We recommend that the evaluation is conducted using three different variants of Difference-in-Differences (DD) econometric estimation. This is also consistent with recommendations in the Commission Staff Working Document. The DD method is established as well suited for policy evaluation, albeit not without its pitfalls. The main challenge is to find suitable control groups, which in turn is crucial for establishing the counterfactual development. Consequently, our analysis recommends using three different methods, capturing different delimitations of the population being measured. The models are as follows:

1. Using Difference-in-Differences modelling and adding explanatory variables to ensure that the parallel trends assumption is met. The models will build on a full population including all beneficiaries and non-beneficiaries, and will be estimated both at an aggregated and disaggregated (e.g. municipality) level.
2. Using Regression Discontinuity Design (RDD) as a way of identifying the proper control group and then measuring the effects by implementing a DD-model. The models will build on the population defined by the RDD.
3. Using a matching procedure to identify a proper, yet synthetic control group, based on observed variables. The population will build on a matching procedure.

The ESA approval of the scheme listed several result indicators that may measure the impact of the RDSSC scheme. Applying the above methods correctly, the evaluator should be able to identify causal effects of the RDSSC scheme on all of these. Indicators include labour market participation (total and by taxation zone); employment level and employment growth (total, by zone and by industry); wage income (total and by zone); disposable income; industrial structure; firm size distribution; education level of the population; and public finances (in particular central and local government incomes). We also recommend adding capital accumulation, use of intermediates and wage costs per hour to the list of indicators.

By controlling for alternative instruments in the DD estimation, the evaluator could also reveal the proportionality and appropriateness of the RDSSC scheme. Since the econometric models are based on micro-level data, it will be possible to delimit the population to a selected industry level and then estimate effects of the RDSSC scheme on employment, wages and other variables of interest. If the impact is strong on the EU-export oriented industries, one can argue that there are distortive effects on competition and trade with EU member countries.

The existing regional models for Norway are not suitable for evaluating the RDSSC scheme as such. There are no regional labour markets in the models, and important variables such as the social security contribution tax rates, wage costs, factor prices and product prices are not even listed in the models. The same can be said for alternative policy instruments, which are

underrepresented as variables in the models. Consequently, the direct impacts of the RDSSC scheme or other policy instruments are not possible to identify. Some regional economic relationships are represented in the models, but for the most part, they are accounting relationships or theoretical behavioural relationships by calibration.

That said, once the evaluator has identified the effect of the social security contribution tax on important evaluation criteria, we recommend using existing regional models to study "ripple effects" of the scheme's main effects. For example, demographics relate to employment and both PANDA and REGARD offer ample analytical opportunities. The regional general equilibrium models NOREG and REMES could illustrate long-term effects conditional on the assumption of full crowding-out effects in Norway as a whole.

The present report also lists the data needed for the proposed evaluation methodology. Statistics Norway will not provide any estimate of the costs of delivering these data. Nevertheless, data costs have been estimated based on available information on Statistics Norway's pricing policy and our own experience with ordering data.

When we sum up the costs for each stage in the proposed evaluation using DD estimation, and include data costs and costs for analysing ripple effects using existing regional models, we estimate the total cost for evaluating the RDSSC scheme at NOK 5,280,000 excluding VAT, and NOK 6,600,000 including VAT. Details are provided in the table below.

Estimated time, hours of work and costs of evaluating the RDSSC scheme using DD estimation

	Period	Hours of work	Costs excl. VAT based on NOK 1400* per hour
Establishing the analytical and logical approach	Oct. 2015 – June 2016	350	490,000
Ordering and collecting data	Dec. 2015 – July 2016	200	Data: 380,000 Work: 280,000
Preparing necessary databases	Oct. 2015 – Aug. 2016	600	840,000
Estimation and interpretation	Sept. 2016 – June 2017	1100	1,540,000
Analysis using regional economic and demographic models	April 2017 – Oct. 2017	400	560,000
Documentation	Nov. 2017 – Feb. 2018	500	700,000
Meetings, coordination and administration	Oct. 2015 – Feb. 2018	350	490,000
Total		**3500**	**5,280,000**

*Measured in 2015 prices/wages

1. Introduction

The regionally differentiated social security contribution scheme (RDSSC scheme) has for several decades been an important policy instrument, used by different governments to stimulate employment and economic activities in Norwegian rural areas. In its current form, the scheme implies that employers in rural areas pay lower social security contributions than the general rate of 14.1 per cent. The country is divided into geographical zones, and the rate in some areas is as low as zero.

The RDSSC scheme includes one general part which is state aid (tax relief for businesses that satisfy the enterprise concept, primarily private sector businesses), and one part which is not regarded as state aid (primarily public sector). According to the EEA Agreement, the EFTA Surveillance Authority (ESA) has to approve the RDSSC scheme, and the ESA should also be notified about any significant changes in the scheme.

The ESA re-approved the RDSSC scheme on 18 June 2014 for the period from 1 July 2014 to 31 December 2020. The ESA approved the scheme on condition that the Norwegian authorities conducted an impact evaluation in line with the Guidelines on Regional State Aid (RGA) published by the ESA.

The evaluation should encompass the entire scheme, including the exemption limit, but must separate the effects of the part that includes state aid, i.e. the part of the scheme that has been notified to the ESA.

The evaluation shall be carried out by external expert groups and will take place in three phases:

1. The first phase consists of a feasibility study in which a consultant proposes methods and data requirements and acquisition that can elucidate relevant issues in connection with evaluation of the RDSSC scheme.
2. The second phase consists of a dialogue between the principal, consultant, research communities and evaluation communities in order to discuss the consultant's proposed methodological approach to the evaluation of the RDSSC scheme.
3. The third phase is the main project and includes the actual evaluation of the RDSSC scheme.

Following a tendering process, the Ministry of Local Government and Modernisation assigned the feasibility study to a consultant group consisting of the companies Economic Analysis Norway (Samfunnsøkonomisk analyse), DAMVAD and Statistics Norway. This report documents the study.

The forthcoming evaluation has to be in line with the Guidelines on Regional State Aid (RGA) published by the ESA, which is also the basis for the feasibility study. The most recently updated methodology for state aid evaluations is outlined in the Commission Staff Working

Document, *Common methodology for State aid evaluations* (European Commission, 2014a). In the next chapter, before we turn to the description of the RDSSC scheme and possible evaluation methods, we comment briefly on the most important elements of the Commission Staff Working Document.

Chapter 3 discusses the common objective of the scheme and its historical background. Chapter 4 discusses further the intervention logic of the RDSSC scheme. In Chapter 5, we review relevant and feasible evaluation methods. Finally, in Chapter 6, we put forward our recommendations regarding the choice of evaluation methodology.

2. Evaluation criteria according to the European Commission

The Commission Staff Working Document, *Common methodology for State aid evaluations*, (European Commission 2014a), underlines the necessity for an evaluation of a state aid scheme to follow a comprehensive plan. The plan should consist of the following elements:

1. Objectives of the aid scheme to be evaluated
2. The relevant evaluation questions regarding possible
   a. direct impact of the aid on beneficiaries
   b. indirect impact of the aid scheme
   c. proportionality and appropriateness of the aid scheme
3. Result indicators that capture quantified information about results achieved by the state aid scheme
4. Methods: finding an appropriate basis for comparison of beneficiaries and non-beneficiaries
5. Data collection: using the best possible sources
6. Timeline of the evaluation
7. The body conducting the evaluation: ensuring independence and expertise
8. Publicity: facilitating the involvement of stakeholders

In this chapter, we highlight several important points regarding 1. – 4.

2.1 Definition of "contribution to a common objective"

The first stage in evaluating a scheme is to set out clearly the underlying "*intervention logic*" of the aid scheme. This includes describing the needs and problems the scheme intends to address, the target beneficiaries and investments, its general and specific objectives, and the expected impact. And finally, the main assumptions relating to external factors that might affect the scheme should also be mentioned.

The purpose of the RDSSC scheme is to contribute to enhancing employment in the selected municipalities, compared to what would otherwise have been the case. The basic premise of the scheme is that several municipalities are negatively affected by factors such as low labour productivity, so that nationally fixed wages have become incompatible with the target of a high degree of employment. Without the RDSSC scheme, employment may therefore be lower than is economically desirable. Differentiation of the social security contribution helps to reduce the gap between productivity and wages, and to increase employment. As a result of an assumed long-term positive correlation between regional employment change and regional population development, the regional employment effect will underpin an overall

policy goal in Norway: to reduce or prevent depopulation in very sparsely populated areas of the country.

Prior to the ESA approval of 18 June 2014, the Norwegian authorities explained that "the objective of the differentiated social security contribution scheme is to prevent or reduce depopulation in already sparsely populated areas by lowering employment costs for companies located in these areas, with the expectation that this will stimulate the local labour markets and lead to increased job opportunities and employment."[1]

To be in line with RGA the evaluation has to elaborate on this common objective of the RDSSC scheme. The methods in use must be able to answer whether the objectives have been achieved.

Chapter 3 of this report discusses the objective and the scheme's historical background in more detail. Chapter 4 discusses further the intervention logic of the RDSSC scheme.

2.2 The relevant evaluation questions: Identify direct effects

The Commission Staff Working Document emphasises that an evaluation should address a broad range of effects. The effects of the RDSSC scheme can be both direct and indirect. However, according to the working document, priority should be given to developing a method which is able to identify any *direct impact* on the beneficiaries. The working document mentions the following important evaluation questions:

- Has the aid had a significant effect on the course of action taken by the aid beneficiaries (incentive effect)?
- Has the aid had an effect on the situation of the beneficiaries? (For example, has its competitive position or default risk changed?)
- To what extent has the aid had the effects expected?
- Have beneficiaries been affected differently by the aid (for example, according to their size, location or sector)?

The working paper underlines the importance of identifying the direct impact by saying:

> *"In particular, where the aid provides no incentive effect, it can be assumed that the aid is distortive, in the sense that it provides the beneficiaries in question with windfall gains."*

Commission Staff Working Document, *Common methodology for State aid evaluations* (European Commission, 2014a).

[1] The EFTA Surveillance Authority (ESA) decision of 18 June 2014

2.3 Methods: finding an appropriate basis for comparison

The reliable identification of effects represents a difficult problem, and the Commission Staff Working Document carefully discusses alternative methods. The main problem is the estimation of how the beneficiaries would have evolved without the effect of the scheme, i.e. the identification of the causal effects of the scheme. In order to identify causal effects it is necessary to construct a counterfactual development, based on the development in most comparable firm(s) or a control group. The quality (relevance) of this control group is crucial for the validity of the evaluation.

The working document specifies that an evaluation cannot rely on a simple comparison between beneficiaries and non-beneficiaries, but must take into account the different characteristics of the two groups of firms, both those which can be observed and those which cannot.

The working document underlines that a specific problem emerges in terms of identifying a control group when non-beneficiaries have themselves decided to apply or not to apply for aid:

> *"For instance, if all firms are eligible (i.e. all firms who propose a project and apply for aid do receive some aid), then the firms who do not apply are likely to be those without projects. The firms' results may show that firms that did not receive aid performed worse in absolute and relative terms than those who did receive aid. This finding may however be entirely explained by the mere fact that the former group had no project to begin with, whereas the latter did, i.e. the management of the former group are lacking interest or creativity."*

Commission Staff Working Document (2014), *Common methodology for State aid evaluations*, European Commission, Brussels, 28 May 2014

Randomising the process of selecting beneficiaries would have solved the selection problem, but is practically impossible to implement in practice. In recent decades, other methods have been developed to evaluate the effects of a policy from an ex-post perspective. They aim to use exogenous variations of the environment in which firms operate, to create situations that are close to experiments (so-called natural or quasi-experiments). The working document presents the most common methodologies used to assess policy impact and underlines the following:

> *"Differences-in-Differences, Regression Discontinuity Design (RDD), Instrumental Variables (IV). These methodologies derive their validity from different assumptions and the best choice is normally driven by the context of the policy and the availability of data. (…) With the noticeable exception*

> *of randomised controlled treatments (…), there exists no technique superior to all the other ones in every aspect. The choice of a particular technique has to be guided by a careful analysis of the context of the measure and the available data."*

Commission Staff Working Document (2014), *Common methodology for State aid evaluations*, European Commission, Brussels, 28 May 2014

In Chapter 5 we elaborate on how the different methods can be used in the coming evaluation, and in Section 5.1 we discuss the three mentioned above in particular.

The chosen method should also have in mind that the selection problem related to the RDSSC scheme is not a result of non-beneficiaries themselves deciding not to apply for aid. The aid is assigned to firms within a geographic area. The geographical delimitation follows politically determined municipal boundaries. The selection problem will therefore to a certain degree be reduced. However, how to ensure sufficient data variation between similar municipalities will remain an important issue that evaluation has to overcome.

The ESA approval of the scheme also detailed several *result indicators* that may measure the impact of lowering employment costs through differentiated social security contributions. The ESA approval mentions explicitly:

a) labour market participation rates, total and by zone
b) employment growth (in both the public and private sector)
c) wage formation and household disposable income
d) industrial (sector) structure
e) educational level of the work force
f) municipal and state finances.

The evaluation should therefore identify the development in all these result indicators in the geographic areas affected.

2.4 The relevant evaluation questions: Identify indirect effects

Although the direct causal effects are of particular importance in an evaluation, it is also important to identify *indirect effects* of the scheme since such effects may also influence the result indicators above. Positive spillover effects as a result of the scheme may enhance potential positive direct effects. On the other hand, negative effects, such as crowding out investments in the same regions, may undermine the positive effects identified. Furthermore, it is useful to identify crowding-out effects by non-beneficiaries in other regions even though such effects are desirable in light of the common objective of the scheme.

The Commission Staff Working Document points out that measuring the indirect effects of a policy normally requires the use of different tools than direct effects, and also points out that

"it is more difficult to provide precise guidance on this type of exercise as it has to be tailor-made to the possible and expected positive and negative effects of the policy." The evaluation therefore has to carry out an independent analysis of the most credible way to measure or assess the indirect effects of the RDSSC scheme.

One specific negative side-effect mentioned in the Guidelines on Regional State Aid (RGA) and the working document potentially impacts competition and trade between member states.

The evaluation should therefore also try to measure aggregated effects on competition and trade. Identification of trade effects can rely on relevant result indicators. The evaluation plan should choose result indicators and explain why the chosen indicators are the most relevant for measuring the impact of this aid scheme.

The working document does not specify which indicators best capture the trade effects. However, some examples are given:

- If a scheme is biased towards a specific industry, it is regarded as a negative effect if the scheme has a multi-sector objective. Bias towards a specific industry can be measured directly.
- Correspondingly, it is problematic if schemes are biased towards loss-making firms or incumbents, or if they reinforce the market power of the beneficiaries. The population of loss-making firms can be defined on the basis of accounting data. Incumbents or enterprises with market power must be defined on the basis of a market analysis, especially if enterprises in the affected areas have significant market power in markets outside the affected areas.

As the examples show, the paper does not address export per se, but discusses trade effects more generally. The examples highlight unwanted and unintended results.

To conduct an adequate analysis of impact on competition and trade, the evaluation should identify when such effects may occur. One way is to identify whether firms covered by RDSSC are active in export markets or whether imports are a real alternative to the RDSSC firms' products. If so, the evaluation should investigate the extent to which the market is characterised by market dominance. If the dominant player is part of RDSSC, it is highly possible that RDSSC has a negative impact on competition and/or distorts trade. In Chapter 6 we suggest specific tools to identify situations where RDSSC may enhance firms' dominant market power, which reduces competition and distorts trade.

Negative trade effects should be understood as effects on trade that are disproportionate to the overall objective of the scheme. This can especially be the case if the scheme is disproportionately biased towards industries that mainly export to EU countries, and are part of the scheme.

2.5 Alternative instruments

The assessment should also assess the proportionality and appropriateness of the scheme. A crucial question in this regard is whether the same effects could have been obtained with less RDSSC aid, or with a different form of aid.

In Norway, various forms of state aid to promote regional businesses development (e.g. through innovation or investment aid) are used. Through the government body Innovation Norway, Norwegian enterprises have access to various types of loans, guarantees and grants, which are all regionally differentiated. The Research Council of Norway offers grants to research and innovation projects. The government body Siva funds activities which help enterprises connect to regional, national and international networks. It cannot be excluded that this different type of aid may have similar effects on employment as the RDSSC scheme.

Norway also provides different types of financial transfers to people who live in sparsely populated areas. Such measures may also have an indirect effect on employment in the targeted areas, through increases in local markets for local services.

The evaluation design should therefore be specified to make it possible to assess whether use of various other instruments can result in the same achievement of the common goal.

The impact of existing alternative instruments to RDSSC can be evaluated using similar methods as for RDSSC. It is therefore possible to include the effects of alternative instruments in the RDSSC evaluation designed. Thus, the evaluation may both provide an assessment of how alternative measures impact the effects of RDSSC and the effects of the alternative instruments themselves. We elaborate on how this can be done in Chapter 6.4.

3. Historical overview of the RDSSC scheme and its common objective

Regional differentiation of the social security contribution scheme was introduced in Norway on a relatively modest scale in 1975. It was extended from 1981 to 1991 to become a significant tool to achieve regional economic stimulus.

Its introduction was closely linked to a historically strong political goal of securing a balanced regional development in employment and population growth. Prior to the introduction, vast regional differences in unemployment were observed, which were only partly explained by people migrating to seek new employment opportunities. It was argued that when low geographical mobility in the labour market was combined with a centralised wage setting, the salary levels in regional labour markets did not reflect the geographical variation in labour shortages and productivity.

As we will see below, theoretical studies formed an important part of the rationale for the scheme.[2] The studies showed that labour subsidies would be better suited than capital subsidies to stimulate regional employment in an economy with high capital mobility and low labour mobility with centralised wage settlements. As a result, differentiated social security contributions were introduced to reduce labour costs in selected regions to a level that better corresponds to the levels of productivity and the market opportunities open to the firms in the different regions.

It is possible that the RDSSC scheme affects total employment in Norway by permanently raising employment in economically weak regions, lowering unemployment and possibly providing a higher supply of labour without crowding out employment elsewhere. The RDSSC scheme may also contribute to a redistribution of employment from central areas to the areas where the payroll tax is low, which is in line with scheme's objective. The effectiveness of the scheme will largely depend on how the Norwegian economy works.

Of particular importance in this context is regional wage formation. The RDSSC scheme was introduced as an alternative to subsidising other inputs in production, in particular capital, and has several attractive features. It is aimed directly towards the common objective of the scheme, namely employment, it is industry-neutral and easy to manage.

3.1 Some previous theoretical considerations

The introduction of the RDSSC scheme was theoretically justified by a basic market failure in the labour market. An important prerequisite was that the collective wage bargaining system did not reflect scarcity conditions in demarcated regional labour markets. Another

[2] See for example Leif Johansen (1965)

prerequisite was market failures linked to low labour mobility with (at the time) high unemployment in rural areas and low unemployment in urban areas.

Labour subsidies were considered to provide better employment effect than capital subsidies in situations of relatively immobile labour and partially mobile capital. The effect is influenced by how labour-intensive production is, and to what degree labour is alternative or complementary to production.[3]

Regional policy instruments have a long political tradition in Norway. Economist and the former Minister of Finance from 1945–1947, Erik Brofoss, was a mentor for the Northern Norway grants. In 1961, the Regional Development Fund (DU) was established, which in 1993 became part of the Norwegian Industrial and Regional Development Fund (SND) and in 2003 part of Innovation Norway (IN). With arrangements for credit provision and financial aid, first through the Northern Norway Fund and later DU, the financial size of SND and IN has grown significantly over time.

Another leading Norwegian economist in the last century, Leif Johansen, showed in an analysis of 1965 that labour subsidies would be the best regional policy instrument in an economy with high capital mobility and low workforce mobility combined with centralised wage formation (Leif Johansen, 1965). This would result in the best use of the most important resource, namely labour. The alternative cost of labour then becomes an important academic principle. Johansen (1965) distinguishes between mobile capital input as virtually free and transferable between regions and the less mobile local resources. He deduces what he calls the main rule for estimated price; estimated price must be such that public resources have the same estimated price in all regions, while regional resources in general have different estimated prices by region (although they were to be equivalent).

Labour is largely a regional resource. When central wage bargaining equalises regional wage differentials, an efficiency problem arises:

> *"The conclusion is of course not that wages actually paid to the workers in various regions must be different to satisfy the optimal requirements that we have derived."*

Johansen, 1965

What generally must vary from region to region is the estimated price of labour, "the calculated price/cost-price". "Based on an efficiency consideration it will therefore be wrong to subsidise public resources that should have equal price, when the problem lies in estimated price of labour." He recommends labour subsidies to compensate for the regional

[3] NOU 1975: 2 «Geografisk differensiert støtte til arbeidskraft» ("Geographically differentiated support to labour") and NOU 1976: 36 «Arbeidsgiveravgiften til folketrygden» ("Payroll tax to the National Insurance Scheme").

imbalance that occurs through central negotiations. “If there are vacant labour in a region, and if we disregard the possibility of moving this labour, the above provide justification for subsidising the use of labour”. A doctoral thesis by the economist Jan Serck Hansen supported the argument further (Serck Hansen, 1971).

The economist Victor Norman criticised Johansen’s analysis (Norman, 1972). Norman’s criticism was directed against one of the basic assumptions, namely factor mobility. If physical capital is assumed to be a mobile factor of production, the conclusion of Johansen’s analysis will no longer hold true due to the factor price equalization theorem. It may be more advantageous to subsidise capital. The important empirical question is then whether capital formation is so mobile that the prerequisites for the factor price equalisation theorem are fulfilled, or if capital formation in rural areas is less mobile because of market imperfections related to information problems and lower option value of capital.

In 1975, the RDSSC scheme was introduced in line with Johansen’s theory. Throughout the 1980s the RDSSC scheme escalated while capital subsidising became relatively less important. “Bygdeutvalget” (The Rural Commission) (NOU 1984: 21A) under the leadership of Bjørn Skogstad Aamo followed up the alternative cost principle that gave rise to the escalation of the scheme.

Here Jan Serck Hansen also contributed with an article from 1982 where he argued that the aim of the aid should be directly subsidised. He maintained that it becomes more expensive to achieve population growth by subsidising capital or transport than by subsidising labour. As long as there is substitutability between labour and capital, subsidising capital will promote the use of capital in production while subsidising labour will promote the use of labour in production. Subsidising transport will in turn promote the production of manufactured goods with large transportation costs.

3.2 The relationship between demand for labour and migration

Insufficient labour mobility is widely believed to contribute to higher regional disparities and overall unemployment, but few studies have compared mobility responses of different education groups to regional shocks.

Gross and net migration flows between regions are generally smaller in Europe than in the US (OECD, 2005; European Commission, 2008). Southern and Eastern Europe has the lowest mobility rates. Whereas migration is an important adjustment mechanism to regional shocks in the US, Australia and New Zealand, interregional migration flows respond slowly to regional shocks in Europe.

Unemployment rates are decreasing in educational attainment. In the EU19 area, the average unemployment rate of persons without upper secondary education is more than three times higher than that of persons with tertiary education (OECD, 2009).

Mobility between European regions depends on educational attainment. Persons with higher education relocate more often than less-educated individuals (see e.g. European Commission, 2008).

Many studies rely on cross-sectional variation between regions to identify migration responses to regional unemployment differentials. As pointed out by Murphy, Muellbauer and Cameron (2006), a methodological challenge of this approach is that omitted site-specific amenities may bias the estimated effects of local labour market conditions. Both location choices and local labour market conditions will in general depend on a wide variety of local amenities, including local public services, safety, private and public transportation, cultural and environmental amenities and neighbourhood quality.

In European migration studies, Murphy, Muellbauer and Cameron (2006) conclude that analyses that control for regional fixed effects generally produce more plausible estimates of effects of regional labour market conditions on mobility than studies that utilize cross-sectional variation.

An analysis by Carlsen, Johansen and Stambøl (2013) employs administrative registers covering the entire Norwegian population to compute annual time series from 1994 to 2004 of migration flows and regional labour market conditions by educational level for 90 travel-to-work areas. They find that regional disparities in unemployment rates are decreasing in education level, whereas the response of migration flows to regional unemployment shocks is increasing in education level. The results suggest that low regional mobility of low-educated workers may contribute to higher regional disparities and higher overall unemployment among the low educated.

However, the most remarkable phenomenon taking place in the Norwegian regional labour markets recently has been the increasing immigration of labour immigrants since the EU eastward enlargements in 2004 and 2007, spreading new immigrants to most parts of the country. Without net-immigration from abroad many regions would have negative net-migration due to negative balance in the domestic migration (See Stambøl, 2013). A new analysis in Skjerpen, Stambøl and Tønnessen (2015) has, however, detected a strong fall in the tendency among immigrants to emigrate from the least central municipalities of Norway since the turn of millennium and up to recently, while the emigration rates have increased from the most central municipalities.

These findings substantiate clearly the necessity that education and immigration are important factors to take into consideration when evaluating the effects on population by changes in the RDSSC scheme.

3.3 Adjustment to state aid rules in the EEA

The geographical and sectoral scope and associated rates in the RDSSC scheme have been adjusted several times. In 1990 the social security contribution was set to zero in the zone furthest to the north (Finnmark and North Troms). In 1993, overall tax was reduced from 16.7 to 14.3 per cent and since 1995 to 14.1 per cent. Reductions in all lower rates were reduced accordingly, except for the zero-rate area of Finnmark and North Troms, where it had been introduced two years earlier. The change was implemented as a package of measures against growing unemployment.

The tax was subsequently based on a classification of municipalities into five tax zones at the following rates for the payroll tax and an approximate indication of geographical zones:

- Zone 1: 14.1 per cent (from Sør-Trøndelag and south along the coast and major cities)
- Zone 2: 10.6 per cent (the rest of southern Norway with the exception of northern Oppland and Hedmark)
- Zone 3: 6.4 per cent (northern Oppland, Hedmark and southern Sør-Trøndelag)
- Zone 4: 5.1 per cent (northern Nord-Trøndelag, Nordland and Troms except Nord-Troms)
- Zone 5: 0 per cent (Nord-Troms and Finnmark)

The “internal devaluation” in 1993 thus reduced the regional differences, in that all rates above zero were reduced while the VAT rate was increased, so that revenue effect would be approximately zero.

After the founding of the EEA there was therefore a need for more systemic changes to adapt the scheme to the EEA state aid rules. Since 1994, there have been regular negotiations about the design of the scheme between Norway and the EFTA Surveillance Authority (ESA) and the scheme has been adjusted several times to adapt it to EEA rules for regional state aid.

Norway went through a transitional period from 2000 to 2003 to implement changes in sector delimitation. In the period 2004–2007, the scheme was further adjusted in that payroll tax for sectors covered by the EEA agreement had gradually to be stepped up to 14.1 per cent in zones 3 and 4, while zone 2 had 14.1 per cent from 2004 to 2007.

From 2007, however, Norway was granted approval for the reintroduction of large parts of the scheme, but with an important change. Whereas previously it was the employee's place of residence which determined the rate that should be used, the rate was now dependent on how business is conducted and recorded. In addition, 56 municipalities that previously had a reduced payroll tax rate were transferred to zone 1. Social security contributions are calculated from 2007 at the rate applicable in the zone where the employer is deemed to operate. The rates are the same as in 2003 except for the municipalities of Tromsø and Bodø,

which have received a slightly higher overall rate. The rates vary, however, as before from 14.1 per cent to 0 per cent given the following zoning:

Table 1: Rates of the geographically differentiated social security contributions

Zone	Ordinary industries	Agriculture and fisheries
I	14.1%	14.1%
Ia	10.6% (14.1% after allowance)	10.6%
II	10.6%	10.6%
III	6.4%	6.4%
IV	5.1%	5.1%
IVa	7.9%	5.1%
V	0.0%	0.0%

The new scheme from 2007, however, had fewer sector exceptions than the 2003 scheme and included the municipal and governmental sector. There were still some municipalities that did not reintroduce the scheme other than with regard to the de minimis aid rule.

3.4 New rules from 1 July 2014

The European Commission adopted new guidelines for regional state aid on 19 June 2013, and the ESA decided its policy on 23 October 2013. The new guidelines for regional aid in the EU and EEA make provisions for operating aid in very sparsely populated areas (less than 8 inhabitants per km^2), to prevent or reduce further population decline. However, the guidelines contain provisions limiting the types of activities that may receive aid (sector restrictions). Norway customised the policies for differentiated social security contributions and notified the scheme again for the period from 1 July 2014 to 31 December 2020.

All eligible areas before 1 July 2014 became participants in the re-established RDSSC scheme. In addition, the scheme was expanded to cover 31 new municipalities with a weak trend in population, employment or economic growth. Of these, 26 were part of the scheme prior to the change in 2004.

The differentiated social security contribution scheme from 1 July 2014 means that all or part of the following sectors can no longer use the scheme: Energy, transport, airports, steel sector, synthetics sector, financial and insurance sector, and head office functions and certain advisory services in corporate. Firms renting out labour to these sector activities must calculate the full social security contribution rate related to such work.

The notified scheme does not exclude the entire transport sector from the differentiated fee. Among others, taxi services, road transportation, pipeline transportation, warehousing and other related services to transport, and postal and courier services are included in the general part of the differentiated social security contribution scheme. Similarly, parts of the energy

sector that including mining and quarrying, and oil and gas, can calculate payroll at differentiated rates.

Enterprises with activities in agriculture, forestry and fisheries falls outside the EEA Agreement and can continue with differentiated rates in the same way as previously.

4. The effect of RDSSC in theory – the intervention logic

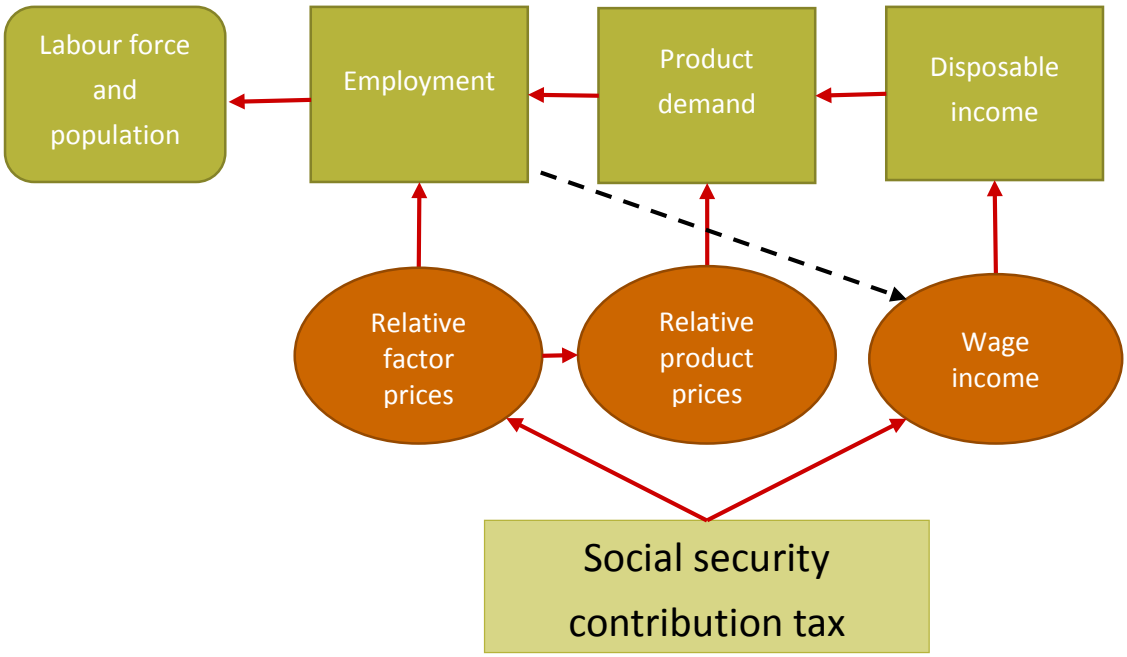
The previous chapter showed that the policy of regionally differentiated social security contribution in Norway was supported by economic analysis from the outset. Given that the policy target is to increase employment in regions with underemployment, it can be shown theoretically (given a set of assumptions) that it is more efficient to subsidise the cost of labour than to subsidise the prices of other factors of production. It is a main premise, therefore, that a reduction of real hourly wage costs (the relative price of labour) at a regional level will increase the demand for labour, while a reduction in the price of another input factor will only increase employment if labour is complementary (in production) to the factor that is being subsidised in the region.

Hence, according to theory, if the effect of a reduction in the social security contribution tax is a reduction in the real cost of labour per hour, then the effect of the policy will be an increase in employment (measured in hours worked, and most likely also in the number of employed persons), all other things being equal. However, in theory, and more so in practice, it is unlikely that the ceteris paribus clause will hold. Instead, "other things" will tend to change when the employment tax rate is reduced by policy. Some of these changes will strengthen the direct effects noted above; however, other changes may modify or significantly weaken the initial effect. This is illustrated in Figure 1.

The float diagram in Figure 1 reminds us that differentiated labour taxation is likely to be transferred to employment through relative prices, and that the "chain of effects" may (at some point in the process) also involve feedback loops, or simultaneous effects, that may strengthen or reduce the initial effects of tax rate reductions. For example, the primary effect of a reduction in the employment tax, namely the lowering of wage costs relative to the price of other inputs in production, depends on how wage earnings per hour are affected by the change in the tax rate. If the wage earnings per hour is unaffected by the policy, the premise of the policy holds, and wage cost per hour is indeed reduced as intended. If, on the other hand, the reduction in the tax rate is "rolled back" to the wage earnings level, the effect will be reduced. As a special case, the tax cut is wholly rolled back to the hourly wage earnings, and as a result there will be no effect on the relative price of labour.

It is easy to imagine that compensatory behaviour in wage formation may be weak immediately after the policy change (strong effect on the relative price of employment), but that it gains in strength over time (the intended effect of the policy on relative price of employment is weakened). Because of the dynamics of compensatory behaviour, it represents a special challenge for policy effectiveness assessment, since the results of the evaluation may realistically depend on the time perspective.

Figure 1: Effects of a change in the social security contribution tax



Strong effects may be likely in the short run. Weaker, or even no effect, may be the answer given by the long-run analysis. In practice, the value of the evaluation is reduced if the programme fails to be clear and concise about the short-run/long-run aspect of its evaluation method.

Even if there is no effect of wage costs per hour, because wage earnings per hour is increased one-for-one with the tax cut, it is still possible that total employment in the region can increase, because wage incomes for those already employed will increase and lead to a higher disposable income, cf. Figure 1. Some of the increased income may be used to buy the goods and services produced by the firms in the region, hence employment may benefit even if the main premise of the policy fails.

However, in the "normal case", when wage costs are lowered, but not one-for-one with the tax reduction, there may be additional positive effects on employment. For example, monopolistically competitive firms will lower the price of their products, so that relative product prices are adjusted in a way that increases product demand. According to economic theory, monopolistically competitive firms normally respond to increases in demand by increasing demand for employment and other inputs (it is only if demand is perfectly price-inelastic that this is not the case).

In order to formalise the line of thought in Figure 1 a little further, we may consider a stylised model of medium-term employment determination.

It may be useful to check the economic intuition that we have presented in Figure 1 by using a small model. For that purpose, we define the following variables:

N = employment. W = wage earnings per unit of employment. τ = employment tax rate. Q = price on the second input in production[4]. D = product demand. P = product price. $\bar{P}$ = price on competing products. Y = income. P_c = consumer price. O = transfers (alternative policy instrument).

A simple system of equations to match the float diagram in Figure 1 is:

$$N = N(W(1+\tau)/Q\,, D), \qquad N_1 \leq 0, \qquad N_2 \geq 0 \qquad \text{(A)}$$
$$D = D(P/\bar{P}\,, Y), \qquad D_1 < 0, \qquad D_2 > 0 \qquad \text{(B)}$$
$$Y = Y\big((W/P_c)\gamma N + O\big), \qquad Y_1 > 0 \qquad \text{(C)}$$

(A) is a conditional demand equation for labour, consistent with monopolistic competition as the reference assumption. Demand is therefore set equal to output. (B) is a product demand equation with conventional assumptions about the partial derivatives.

(C) is a simple functional relationship for aggregate income in the region we study. For simplicity, we only consider wage income and transfers (O). If we apply the framework to firm data, total employment in Norway is almost unaffected, hence we set $\gamma \cong 0$. Conversely, if N is regional employment, $\gamma \cong 1$.

Based on this framework the short-term effect of a reduction in the tax rate becomes

$$\frac{\partial N}{-\partial \tau} = \frac{-N_1\left(\frac{\partial W}{\partial \tau}(1+\tau) + W\right)\frac{1}{Q} - N_2 D_1 \frac{\partial P}{\partial \tau}\frac{1}{\bar{P}} - N_2 D_2 Y' \frac{\gamma N}{P_c}\frac{\partial W}{\partial \tau}}{1 - N_2 D_2 Y' \gamma \frac{W}{P_c}} \qquad \text{(D)}$$

The first term in the numerator represents the effect of relative factor prices on the conditional labour demand equation. 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 perhaps most realistic in the short-term analysis. If the tax change is rolled back on wage earnings, $\frac{\partial W}{\partial \tau} < 0$. In theory, this may for example 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 are demand effects. The second term is the effect that works through how product demand is affected by the reduction in product price level due to monopolistic firms' price adjustment: $\frac{\partial P}{\partial \tau} \geq 0$. The third factor in the numerator illustrates the fact that demand is increased if a tax change is rolled back on wage earnings, $\frac{\partial W}{\partial \tau} < 0$. Hence,

[4] In practice, of course, there may be more than two variable inputs in the model. 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.

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 employment by firms has a numerically significant effect on the region's total employment.

We see that all three terms in the numerator contribute to higher employment if $N_1 < 0$ (the direct price derivative in the labour demand function is negative), $\frac{\partial P}{\partial \tau} > 0$ (mark-up price setting) and $\frac{\partial W}{\partial \tau} < 0$ (tax rolled back on wage earnings). Conversely, even if there are negligible possibilities of substitution, $N_1 \approx 0$ (may be realistic in the short run), there can still be effects stemming from the two channels of increased product demand.

We conclude that a reduction in the employment tax is likely to have an effect on other variables than just employment. In fact, several of these other variables belong to the list of criteria that are to be assessed alongside employment, e.g. disposable income and labour force participation. However, a full representation of the relationships between the criteria requires a larger model than just (A), (B) and (C) above. Such a system of equations is set out in the next sub-section.

The discussion has also reminded us that a critical point of the analysis is how the relative price of employment (wage costs per hour relative to the price of other inputs) is affected. Although it has not been listed among the evaluation criteria, we believe that the relevance of the policy evaluation will be improved if the questions related to wage earnings response to the policy change are carefully answered by the evaluators.

For the individual firm, labour costs represent a large proportion of total costs. A reduction in wage costs may therefore be expected to influence medium- and long-term decisions such as geographical re-location and investment decisions. A lasting reduction in the employment tax rate may therefore also have a more gradual and long-term effect on employment and industry structure. Therefore, an evaluation should also include an analysis of long-term capital accumulation and business structure.

We will now list a set of economic and demographic relationships that should ideally be identified in order to properly evaluate the differentiated employers' labour tax scheme.

4.1 Empirical policy evaluation: Reduced form equations or structural models?

According to a letter from the Norwegian Ministry of Trade, Industry and Fisheries to the ESA of 21 May 2014, the evaluation criteria should include (at least):

1. Labour market participation, total and by employment taxation zone

2. Employment level and employment growth, total, by zone and by industry (minimum government and private)

3. Wage income, total and by zone

4. Disposable income

5. Industrial structure, e.g. employment share by industry; firm size distribution

6. Education level of the population, age group 17–70 years, (skilled and unskilled, may be more differentiated)

7. Public finances, in particular central and local government incomes

Table 2: A list of economic and demographic relationships that will cover most evaluation criteria – *j* is municipality, *i* is sector, *s* is skill or education, *a* is age and gender

$W_{j,i,s} = W(U_{j,s}, \rho_j, \tau_{j,i}, Z_{w,j,i}),$	(1)
$P_{j,i} = P\left(W_{j,i,s}(1+\tau_{j,i}), Z_{p,j,i}\right)),$	(2)
$N_{j,i,s} = N(W_{j,i,s}(1+\tau_{j,i})/Q_{j,i}, r_{j,i}(1-d)/Q_{j,i}, X_{j,i}),$	(3)
$K_{j,i} = K(W_{j,i,s}(1+\tau_{j,i})/Q_{j,i}, r_{j,i}(1-d)/Q_{j,i}, X_{j,i}),$	(4)
$V_{j,i,s} = V(W_{j,i,s}(1+\tau_{j,i})/Q_{j,i}, r_{j,i}(1-d)/Q_{j,i}, X_{j,i}),$	(5)
$X_{j,i} = X(D_{j,i}),$	(6)
$D_{j,i} = D(P_{j,i}/\bar{P}, Y_j, G_{j,i}),$	(7)
$DR_{j,i} = X_{j,i} - q_{j,i}V_{j,i} - N_{j,i}W_{j,i}(1+\tau_j),$	(8)
$Y_j = Y\left((1-\rho_j)\left[\sum_{i,s}(W_{j,i,s}/\bar{P})N_{j,i,s} + \sum_i (1-a_{j,i})DR_{j,i}\right] + O_j\right),$	(9)
$LF_{j,s,a}/POP_{j,s,a} = LF_a(U_{j,s}, W_{j,s}/PC),$	(10)
$POP_{j,s,a} = POP_a(N_{j,s}),$	(11)
$LOCAL\ REV_j = LOCAL\ REV(\quad),$	(12)
$STATE\ REV = STATE\ REV(\quad),$	(13)

As just noted, we advise that capital accumulation and wage costs per hour worked (or another operational and relevant measure of employment) should be added to the list of evaluation criteria. Table 2 lists all economic relationships needed to fulfil the evaluation criteria, except firm size distribution. The list contains other relationships as well, because the relationships form a structural model where the effect of the employers' labour tax operates

through other parts of the economy. When estimating the relationships, so-called reduced form equations may be used. For example, instead of estimating a demand equation and a production function separately, one might estimate the effect of variables by entering the demand equation directly in the production function.

In the equations in Table 2, $W_{j,i,s}$ is the nominal wage income level and $W_{j,i,s}\ (1+\tau_{j,i})$ is the corresponding wage cost level. Equation (1) represents a regional, sectoral and skill-specific wage curve linking the wage income per year (*W*) to the rate of unemployment, tax rates and other factors, *Z*, that are determinants of the wage earnings level. As noted above, the empirical effect of the payroll tax rate *T* is of particular relevance. If for example, wage earnings increase one-for-one with a reduction in *T*, one important channel for policy effectiveness is removed.

Equation (2) is intended to illustrate the fact that firms are found to set product prices as a mark-up on normal costs. This implies that prices will be responsive to increases in wage costs per unit of labour, and in principle also to increases in other variable factors of production, which are subsumed in the variable $Z_{j,i,s}$. The degree of responsiveness to wage-cost increases is, however, an empirical question, and the answer may depend on the degree of competition in the product markets. In principle, therefore, there is a connection between the price-setting equation given by (2) and the product demand (*D*) equation in (7). For example, finding strong mark-up behaviour in price-setting would not be congruent with estimating very large price elasticities in the product demand equations. In (7), the first argument is relative product price, *Y* is income and *G* is public demand. *Y* is determined in equation (9). Equation (6) determines production (*X*), and *DR* in (8) is operating profits.

Equations (3), (4) and (5) are conditional demand equations for labour, *N*, capital, *K*, and variable inputs, *V,* respectively. With three production factors there are two relative prices, and we have used the price of inputs *Q*, as the numeraire in equations (3), (4) and (5). The nominal user cost of capital is given as *r(1-d)*, where *d* represents a capital subsidy rate. If equation (4) is included, the perspective is taken to be long-run so that capital is indeed a variable factor. In the short-run analysis, only (3) and (5) are estimated, and there would be only one relative factor price to consider, between labour and material variable inputs.

The price of materials, *Q,* can be derived as industry weighted averages of *P* in equation (2), where the weights are based on production shares of intermediates. Alternatively, it can be modelled as a function of prices of manufactured goods from both within and outside the region. Prices from within the region will react to changes in wage costs per hour, but since *Q* also depends on foreign prices, the change in *Q* is not likely to be one-for-one with the change in wage costs per unit of labour. If *Q* is chosen as a modelled variable, and not only as a product of equation (2), the table should be extended by one more equation.

The remainder of the equations are the labour force participation rate (*LF/POP*) in equation (10), population (*POP*) in equation (11), and local and state revenues in equations (12) and (13), respectively.

In the following chapters, we will discuss the feasibility of identifying all the relationships in Table 2 at a municipal level. Data availability determines its feasibility.

One well-established policy evaluation method that can be used is based on Difference-in-Differences estimations of each evaluation criterion. A general challenge of this method is the construction of the counterfactual. However, since the counterfactual is always hypothetical, we see this as no different from other methods of policy evaluation; it can never be completely empirical, but has to be based on some type of statistical model and more or less formalised economic theories. As the discussion in the next section reveals, we see no principal reason why the usual problems of formulating a relevant counterfactual cannot be tackled in this project.

However, as the above analysis shows, it is highly likely that there are dependencies between the different criteria. Therefore, a sequence of Difference-in-Differences estimations that do not take the dependency into account cannot be an efficient evaluation method. It also runs the risk of logically inconsistent findings, for example finding an effect on the real cost of labour, but no effect on employment.

This dependency is an argument for anchoring the evaluation in a structural model approach, such as the system of equations in Table 2. Thereby the logical inconsistency problem of finding an effect of the policy in one variable (criterion) but not in another, though closely related, criterion would be avoided, at least ideally. In practice, it is easy to see that the structural approach will run into its own set of problems.

One of the typical problems for systems of equations is that, in the search for a complete model specification that represents all variables and dependencies, the system may become very large. As a result, identification (a theoretical problem) may become an issue, as well as estimation precision (statistical problem) if the number of parameters increases significantly relative to the number of observations.

However, some of these problems can be avoided by grouping the evaluation variables according to theoretical proximity or coherence. Evaluation criteria can also be grouped along the short-run, long-run dimension. For example, the short-term (1–2 year) analysis of employment effects among existing firms could probably be undertaken separately from the analysis of location effects and the effects on capital formation decisions (i.e. in the former, capital stock is conditioned upon).

Other compromises between the completely reduced form and the structural approach are also feasible in practice. For example, it would be helpful if the reduced form equations were

specified with reference to a common theoretical framework. After all, it lies at the heart of the reduced-form approach that the same set of variables affects the endogenous variables (i.e. the evaluation criteria).

5. Practical methods for evaluating the RDSSC scheme

In this chapter, we will review and discuss potential evaluation methods for the RDSSC scheme with particular emphasis on the criteria thoroughly debated in the Commission Staff Working Document (2014), which we discussed in Section 2.

We do this in two stages. First, in Section 5.1, we address the methods the commission recommended primarily for identifying the direct effects. These are various econometric modelling techniques. Then, in Section 5.2, we review whether existing regional economic and demographical models for Norway may be used in the evaluation, and in particular if they can be used to identify indirect effects.

5.1 Econometric modelling

The assessment of the impact of a scheme consists of two key parts. First, we wish to identify indicators that are robust measures of the outcome in question. Second, an impact assessment must be able to answer the question of causality. As the State Aid paper asserts, this is not a trivial task. The main problem is to estimate how the beneficiaries would have evolved without the effect of the scheme.

In the following, we will present possible ways of conducting the impact assessment in practice. This will include how to set up models that can address the question of causality. As this is a feasibility study, we will not complete the impact assessment, but we will outline suitable ways of constructing models. Further, we will outline suggestions for indicators needed to implement the impact assessment in accordance with the ESA guidelines.

The ESA outlines two overall approaches to setting up models for impact assessments. The first is to conduct randomised experiments. This approach encompasses the most favourable case since in principle there are no selection effects and thus no selection bias either, because the beneficiaries are selected randomly. However, it is difficult to argue for how to randomise the selection in the RDSSC scheme. This is also confirmed by the ESA who state that the method may be difficult to implement in practice, in particular for large existing schemes. As such, we conclude that conducting a randomised experiment is nugatory.

The ESA points to a second approach for conducting impact assessment called quasi experiments. With quasi experiments, it is possible to set up models that make it possible to estimate (or simulate) the counterfactual situation. By using quasi-experiment designs, we are able to use existing sources of exogenous variation in order to identify causality. The quality of the evaluation will crucially depend on how convincingly the models can establish the exogeneity of the control group. Here the ESA points at three different methodologies for completing quasi experiments:

1. **Instrument variables (IV)** use a linear econometric model in order to evaluate the effect of aid. Here, benefiting from aid can be seen as an endogenous explanatory variable in the econometric model and we can then use other variables that explain the probability of receiving benefits. These variables are called instrument variables.
2. **Regression Discontinuity Design (RDD)** essentially entails defining a control group that is closely related to the group of beneficiaries. For example, located on either side of an administrative boundary or other well-defined thresholds. The method imposes constraints on both treatment and control group. When the two groups are defined, it is straightforward to compare beneficiaries with non-beneficiaries and their development over time in order to assess the impact.
3. **Difference-in-differences (DD)** is a more sophisticated way of comparing two or more groups. One can use the full population or use various techniques to impose constraints on both beneficiaries and non-beneficiaries in order to identify relevant and robust control groups. With DD-modelling we consider the difference in outcome between beneficiaries and non-beneficiaries over time. The method compares the difference in performance between beneficiaries and non-beneficiaries before and after the RDSSC scheme. The method works over time if both treatment and control group are affected by the same factors that also affect performance, and if the level of impact is stable over time. This is known as the parallel trend assumption.

Assessing the three quasi-experimental models

All three models are only valid under the conditional independence assumption (CIA). The CIA implies that selection is based solely on observational factors and that all variables that influence the treatment decision and potential outcomes are simultaneously observed. The CIA is clearly a strong assumption and rules out the presence of unobservable characteristics affecting the treatment decision and potential outcomes. One way to oblige the CIA is to use rich, comprehensive and high-quality data. By exploiting the richness of data, all major factors that jointly influence both selections into treatment as well as potential outcomes are observed. However, the presence of unobservable factors cannot be completely ruled out, implying that the results should be interpreted with some caution. Unfortunately, the CIA is an untestable assumption (Gerfin and Lechner, 2002).

In the following we will assess the three quasi-experimental models individually.

Instrument variables are a classical way of dealing with the question of causality. The variable(s) explains the fact of being a beneficiary without having any correlation with unobserved determinants of the performance indicator. Thus, it explains all variance in the performance indicators as linked to being a beneficiary as opposed to a non-beneficiary. No test exists of the validity of exactly identifying instrument variables, thus one has to be very careful in choosing the variable. Therefore, one will need good economic arguments to assess

the validity of the evaluation. Further, the issue of weak instruments needs to be addressed. That is the case where instrument variables are weakly correlated with the indicator of being a beneficiary or not which will lead to imprecise estimates. In addition, there may be a temptation to use more instrument variables or even to create a vector of instruments, but again caution is needed in evaluating the instrument variable since many weak instruments do not add up to a solid instrument vector. Furthermore, there might be issues related to the joint correlation of the instruments, since they are imposed in the model at the same time.

Regression discontinuity design is a simple way of comparing beneficiaries with non-beneficiaries who are close to being beneficiaries. The ESA itself mentions that the eligibility of schemes can be linked to precise administrative boundaries, e.g. municipalities. This is a clear strength related to the evaluation of RDSSC scheme. Yet caution is called for when using this approach if not only the boundary, but many other aspects result in differences in performance. This will be the case particularly for observations far from the threshold, e.g. the administrative boundary. Another reason for caution is that non-beneficiaries, for example companies on the other side of the geographical boundary, may also be affected by the scheme in terms of increased demands in the market.

Difference-in-Differences is a third way to consider the difference in outcome between beneficiaries and non-beneficiaries over time. Pre-existing differences would be attributed to other factors than the RDSSC scheme. Only the change in these differences (the 'Difference-in-Differences') would be attributed to the scheme. The method compares the difference in performance between beneficiaries and control group before as well as after the aid and then attributes the change in the difference to the aid. The method can be implemented by either including the total population in a linear regression or by completing a matching procedure where the population is selected based on observable characteristics.

The problem with DD is that we must also be very careful to manage underlying trends, also known as the parallel trend assumption. Underlying trends are in this case economic forces affecting employment or economic activity. The problem arises when it is not possible to control for regional differences in such trends. There are in principle two ways of managing underlying trends. One is to include explanatory variables that explain differences in the underlying trends in the linear regression. Another approach is to use a matching procedure to define the population on the assumption that if beneficiary and non-beneficiary are alike, they will also be subject to the same influential factors. Balancing tests can test whether beneficiaries and non-beneficiaries are alike.

Thus, we can use DD on the entire population, but also on a subset defined by either RDD or a matching procedure. Hence, by using DD we are able to identify both the direct and indirect effect of the RDSSC scheme. This is a clear strength of DD and it provides the researcher with an excellent opportunity to test various model specifications and thus to test the robustness of the results.

The table below summarises the pros and cons for choice of models.

Table 3: Pros and cons of different evaluation methods

Model	Pros	Cons
Randomised experiments	The best way of establishing a proper control group and hence key to obtaining good and unbiased estimates of the effect	Not feasible with large existing schemes such as the RDSSC scheme.
Instrument variables	Well-known way of addressing causality and handling selection bias between beneficiaries and non-beneficiaries	Difficult to identify proper instrument variables. Furthermore, we cannot test whether or not we have identified good instruments
Regression discontinuity design	Easy to implement and works well with the RDSSC scheme as the scheme uses administrative boundaries to define beneficiaries and non-beneficiaries.	Should be used with caution since it does not control for other factors than geographical location. The model does not handle potential spillover from beneficiaries to non-beneficiaries. Furthermore, there is a need to address observations that are far from the threshold, both among beneficiaries and non-beneficiaries.
Difference-in-Differences	Intuitive and easy to manage. Flexible with regard to design, both in terms of linear regression with full population and of more advanced delimitation of population in matching procedures.	The parallel trend assumption is crucial and every model needs to address this by including observable variables. Tends to overestimate the statistical significance of the results.

5.1.1 Identifying contribution to a common objective – labour market and demography

The RDSSC scheme has two policy targets. The first is to increase employment. The second is to prevent depopulation of regional areas. As described in Chapter 3, there are several routes whereby it can affect factors that will have either a direct or an indirect impact on labour market and demography.

In this section, we will present possible ways of designing impact assessments to measure the policy impact of various performance indicators. The section focuses on three central elements:

1. First, we identify and list the performance indicators.
2. Second, we list potential control variables.
3. Third, we state how the impact assessment can be designed.

Performance indicators – common objective

The common objective of the scheme focuses on labour market and demography. Measuring effects requires identification of indicators on labour market and demography. We suggest a focus on the following indicators regarding labour market:

1. Labour force participation. This is the sum of employment and unemployment. It is possible to focus on an aggregate level as well as on a more disaggregated level, i.e. a municipality level. Normally, the labour force is seen in relation to the size of the population within the same age range. This measures the labour force participation rate. A higher labour force participation rate is attractive for any given region as it increases value creation and has positive socioeconomic effects.
2. The level and growth in employment rates. The indicator measures the proportion of a population that is employed. The population will consist of individuals of working age. It is possible to focus on an aggregate level as well as on a more disaggregated level, i.e. a municipality level, between sectors and between educational groups. As with labour force participation, an increase in employment is desirable as it increases value creation and has positive socioeconomic effects.
3. Occupational structure. Based on employment divided by sector, it is also possible to analyse changes in the occupational structure. It is possible to focus on an aggregate level as well as on a more disaggregated level, i.e. a municipality level. An increase in employment in the private sector as opposed to the public sector is desirable as it increases value creation in the private sector and thus improves public finances. It is also desirable to analyse the occupational structure between private sectors and groups of private sectors, e.g. production of tradable and non-tradable goods, primary sectors, service sectors etc.
4. Salaries and growth in salaries. Salaries are the compensation offered to an employee in return for work performed. It is possible to focus on both an aggregate level and on a more disaggregated level, i.e. a municipality level and between sectors. An increase in salaries may have both positive and negative effects for employment rates and growth. On the one hand, it increases spending power and demand; on the other hand increased wage costs lower the competitiveness of firms.
5. Net income and growth in net income. Net income is the amount of income left when taxes on salary are paid. This is also known as disposable income. As with other indicators, it is possible to focus on an aggregate level and on a more disaggregated level, i.e. at municipality level. An increase in disposable income will have derived positive effects for employment rates and growth, since it increases spending power.
6. Education level among the population. Education level is defined as the proportion of a population with a given education. Education is defined by NUS codes and is thus based on formal education level. We would recommend that the researcher apply an aggregated level of NUS at either 1-digit or 2-digit level.

7. Public finances, both in regional government and state sectors. Here we focus on the aggregated level of public finances. That is the total income including taxes, state transfers and others, minus total expenses.

With regard to the focus on changes in demography, the number of relevant indicators is somewhat smaller. Demography is a statistical study of human populations. It encompasses the size, structure and distribution of a population. We will focus on indicators aimed at reducing or preventing population decline:

8. Population size is simply the number of people living in a certain geographic area. In Norway there is a long tradition of registering each individual. Thus, population data are of high quality compared to Germany, for example, where the federal statistical office is not permitted to register individuals.[5] As we can track each individual, this indicator can be aggregated to any desired level.
9. Age distribution of the population is a common demographic indicator. Age distribution is a strong indicator for the future prospects of a population. A high proportion of young people and infants indicates an expanding population, whereas a high proportion of elderly people indicates a contracting population.
10. Net migration measures the difference between immigrants and emigrants. It is an indicator of the attractiveness of a given geographic location. As we can track each individual, this indicator can be aggregated to any level desired.

Control variables

Control variables are crucial to the impact assessment. They can be imposed directly into the DD model as covariates explaining variance in performance between beneficiaries and non-beneficiaries. Alternatively, they can be used to delimit population and define control groups.

We would suggest that the following groups of variables be included in the study:

- The zones of the RDSSC scheme. This will be central in identifying who are beneficiaries or non-beneficiaries, which is a basis for all three DD models. Further, the identification of zones is key to identifying the population in the RDD approach.
- Characteristics of the individual municipality. This includes a broad range of variables, but encompasses:
    - Characteristics of the business sector in the municipality including employment by sector, exports, capital stock, education level in businesses etc.
    - Characteristics of the demography in the municipality including population, net migration, density of population and age distribution.

[5] This is a legacy of the Stasi, as a result of which statistics on population in Germany are only an estimate.

- Characteristics of the labour market in the municipality including labour market participation, employment, wages, income and education level etc.

Depending on the specification of the model, there will be differences in which control variables should be included. The exclusion and inclusion will be an individual assessment for each of the models. Further, there are potential constraints in data access, particularly regarding the time dimension. For some variables it will not be possible to retrieve data for more than a 15-year period, whereas for others it will be possible to retrieve data from before the launch of the RDSSC scheme.

Implementing the impact assessment

Here we assess whether or not the econometric models can estimate the economic relationships put forward in Section 4.1. In the table below we have assessed whether or not it is possible to estimate the economic relationship as outlined in the theoretical discussion in Chapter 4.

All the performance indicators can be estimated econometrically in reduced form. This includes both indicators of labour market and preventing depopulation. Hence, we can estimate the following economic relationships from Table 2, which we have repeated in Table 4 and which follows the ESA guidelines (variables are defined in connection to Table 2 in Section 4.1):

- Equation (1) which focuses on wage
- Equation (3) which focuses on employment
- Equation (9) which focuses on income
- Equation (10) which focuses on labour force
- Equation (11) which focuses on population
- Equation (12) which focuses on the economy of the municipality
- Equation (13) which focuses on the economy at state level

Further, it is possible to estimate the following economic relationships:

- Equation (4) which focuses on capital or capital stock
- Equation (5) which focuses on use of intermediates
- Equation (6) which focuses on production
- Equation (8) which focuses on operating profits

Table 4: The list of economic and demographic relationships that will cover most evaluation criteria from Table 2 and whether they are possible to estimate econometrically; *j* is municipality, *i* is sector, *s* is skill or education, *a* is age and gender

Economic relationships		Reduced form	Possible to estimate econometrically
$W_{j,i,s} = W(U_{j,s}, \rho_j, \tau_{j,i}, Z_{w,j,i}),$	(1)	Into (3)	Yes
$P_{j,i} = P\left(W_{j,i,s}(1+\tau_{j,i}), Z_{p,j,i}\right),$	(2)	Into (3) and (7)	-
$N_{j,i,s} = N(W_{j,i,s}(1+\tau_{j,i})/Q_{j,i}, r_{j,i}(1-d)/Q_{j,i}, X_{j,i}),$	(3)		Yes
$K_{j,i} = K(W_{j,i,s}(1+\tau_{j,i})/Q_{j,i}, r_{j,i}(1-d)/Q_{j,i}, X_{j,i}),$	(4)		Yes
$V_{j,i,s} = V(W_{j,i,s}(1+\tau_{j,i})/Q_{j,i}, r_{j,i}(1-d)/Q_{j,i}, X_{j,i}),$	(5)		Yes, but depends on definition of *V*
$X_{j,i} = X(D_{j,i}),$	(6)		Yes
$D_{j,i} = D(P_{j,i}/\bar{P}, Y_j, G_{j,i}),$	(7)	Into (6)	-
$DR_{j,i} = X_{j,i} - q_{j,i}V_{j,i} - N_{j,i}W_{j,i}(1+\tau_j),$	(8)		Yes
$Y_j = Y\left((1-\rho_j)\left[\sum_{i,s}(W_{j,i,s}/\bar{P})N_{j,i,s} + \sum_i (1-a_{j,i})DR_{j,i}\right] + O_j\right),$	(9)		Yes
$LF_{j,s,a}/POP_{j,s,a} = LF_a(U_{j,s}, W_{j,s}/PC),$	(10)		Yes
$POP_{j,s,a} = POP_a(N_{j,s}),$	(11)		Yes
$LOCAL\ REV_j = LOCAL\ REV(\ \ ),$	(12)		Yes
$STATE\ REV = STATE\ REV(\ \ ),$	(13)		Yes

5.1.2 Identifying distortive effects on competition and trade

In order to assess potential distortive effects on competition and trade we must focus on industry sectors, as discussed in Chapter 2. The approach will include the following steps:

1. State whether there are any effects of RDSSC on defined markets, e.g. classified as product and service markets.
2. Assess whether these effects are related to industries that are subject to national competition.
3. Assess whether the identified industries are subject to international competition.
4. Assess whether there are effects on localisation.

Assessing the effect of RDSSC follows from the econometric modelling. The econometric models are based on micro-level data. Thus, one can aggregate to and analyse specific market segments divided by industry. One can delimit the population to a selection of industries, e.g. one can estimate effects exclusively on the manufacturing industry. It is possible to estimate effects of the RDSSC scheme on employment, wages or other variables of interest, e.g. equations from the table above. This is done by implementing constraints on the business included in the econometric modelling.

If RDSSC imposes an effect on selected markets, one can assess whether these markets are subject to national competition. This can be done by introducing two different measures. One is the Herfindahl-Hirschmann index, HHI. The HHI measures the sum of squared market shares of all companies in a delimited market, often delimited by NACE codes. Large indicator values (the EU states > 0,2[6] as a large value) indicate a relatively small number of companies with a large market share in a given market. This in turn can be interpreted as low competition. Then, it is possible to measure the development of the HHI over time. Depending on result, the interpretation here will state whether the competition has become more or less fierce and hence whether the effects of RDSSC are leading to more or less competition in a given market.

Another approach to identifying competition in a given market is to assess a measure for market entry. This is known as minimum efficiency scale and is a measure identifying the lower threshold of revenue in a market. The lower the threshold, the easier a market entry will be for any companies who wish to be located in a given market. This is one method of analysing localisation decisions.

In terms of international competition and trade, we focus on industries in markets with EU-oriented export. If the impact in the EU export-oriented industries is stronger than the impact determined in the overall assessment, it can be argued that there are distortive effects.

Focusing on industries that are exposed to international competition, the evaluation can assess whether or not these industries are more or less responsive to RDSSC. If the analysis shows that industries that are more exposed to international competition are more strongly impacted by RDSSC, it can be argued that there are distortive effects from the scheme.

RDSSC may also create incentives for the relocation of industries from outside to within the national geographic boundary of RDSSC. This may be regarded as a desired effect, unless relocation reduces competition or distorts international trade. The evaluation can measure relocation of enterprises by following where companies are located over time, using the municipality code for each company.

[6] See EU: Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings.

To test whether relocated enterprises create problems with regard to competition or trade distortions, the evaluation should examine whether the enterprises are in markets characterised by dominant players. If one of the dominant players is the relocated enterprise, RDSSC may have contributed to enhanced market forces through more favourable terms than previously.

5.1.3 Identifying effects of alternative instruments

One central part of the assessment is the question of the proportionality and appropriateness of the scheme. A central question here is whether the desired aim of the scheme could have been achieved at a lower cost by using other measures. This is a difficult question to answer since the other measures based on state aid may have other aims. Further, other measures could be constructed as other types of interventions in order to achieve the desired aim. Thus, the effect on the labour market of other performance indicators may only be indirect effects of the scheme in question.

One way of identifying the effects of alternative instruments is by including information on participation in other schemes. In the DD models, for example, one can include participation in other schemes as control variables. Hence, we use the information on participation in other schemes to explain variance in the chosen performance indicator. When the evaluation includes participation in other schemes as a control variable, it is possible to both eliminate the effects from the schemes in evaluating the RDSSC scheme and to evaluate the effect of other schemes on the performance indicators. If the evaluation still finds effects from the RDSSC scheme, these will be effects from social security contribution tax controlled for the effects that other measures have. Such an approach will include the following steps:

1. State whether there are any effects of RDSSC without controlling for the impact of other measures.
2. If RDSSC proves to have an impact, then include information regarding allocation of resources from other measures. This information should be presented by measure, the two categories of measures and as a total allocation of resources.
3. Assess whether or not the inclusion of additional information implies differences in the effects of RDSSC.

As stated in Section 2.5, we know that alternative measures fall into two categories: either measures aimed at households or investment schemes aimed at companies. Measures aimed at households are typically defined by geography. One example is the depreciation of student loans. In order to control for this, a control variable at municipality level should be included, stating whether there are measures focusing on transfers to households.

The other category focuses on companies. Here the evaluation needs to focus on company-level information and then aggregate the total amount of aid by municipality level. In order to

normalise the amount of aid, the evaluator should divide by the number of private full-time equivalent employees in the municipality.

If any observed effect diminishes when including information regarding other measures, the researcher should question the effect from the RDSSC scheme.

5.1.4 Data, duration, work requirements and costs

It is important that the evaluator should establish an analytical and logical approach thoroughly before conducting the estimation. This includes a theoretical analysis similar to that performed in Chapter 4, but in much more explicit form. In addition, the evaluator should specify the econometric specification in detail during this stage. It is advisable to do this before ordering data. We estimate the use of 350 hours of work for this part of the evaluation.

The data needed for conducting the analysis as described in Chapter 4.1 can be divided into three overall groups:

1. Performance indicators
2. Covariates or control variables
3. Key ID that can link individual companies and municipalities

Performance indicators data

Performance indicators can be implemented both at aggregated level, e.g. at national level, by zone or municipality level, and at a more disaggregated level, e.g. at company level. The performance indicators from Table 2 and Table 4 can be obtained from the following registers at Statistics Norway (SN):

- Wage income: can be found at the division for income and wage statistics. The indicator is available at individual level at SN. In the offset the data are available for the period 1993–2013.
- Employment level and hence employment growth: can be found at the division for labour market statistics at SN. The indicator is available at individual level. In the offset the data are available for the period 1990–2013.
- Fixed assets at companies: can be found at the division for accounting statistics at SN. The indicator is available at company level. The data are available for the period 1999–2013.
- Use of variable inputs at companies: can be found at the division for accounting statistics at SN. The indicator is available at company level. The data are available for the period 1999–2013.

- Production level or value added at companies: can be found at the division for accounting statistics at SN. The indicator is available at company level. The data are available for the period 1999–2013.
- Operating profit (earnings before interest and taxes): can be found at the division for accounting statistics at SN. The indicator is available at company level. The data are available for the period 1994–2013.
- Disposable income: can be found at the department of income and wage statistics. The indicator is available at individual level at SN. In the offset, the data are available for the period 1993–2013.
- Labour market participation: can be found at the division for labour market statistics at SN. The indicator is available at individual level. In the offset the data are available for the period 1990–2013.
- Population size and changes measured by municipality of residence: can be found at the division for population statistics at SN. The indicator is available at individual level but is aggregated to municipality level. The data are available for the period 1968–2014.
- Municipal finances: can be found at the division for public finances. The indicator is available at municipality level at SN. The data are available for the period 1991–2014 (municipal accounts from 1991 and KOSTRA from 2001).
- State finances: can be found at the division for public finances. The data are available for the period 1985–2014.

Control variables data

Many of the control variables will be reused from our performance indicators. In addition to the performance indicators, we would point out the following key data:

- Classification of municipalities in terms of population density, cultural services and administrative level. This can be obtained from various sources. We would suggest the index of centrality developed by NIBR since it is the most detailed. The index was published in 2013.[7]

In addition to the above-mentioned, indicators on general company characteristics must be included. This includes information regarding company size, sector and geographic location by municipality. Similarly, indicators on population characteristics must also be included. These include:

[7] The index is constructed by weighing figures against a number of relevant indicators of centrality, i.e. the number of inhabitants, number of employed, the number of persons commuting into the municipality, which services are available in the municipality, which public institutions are located in the municipality, and travel distance to service functions. See NIBR (2013).

- Educational level of the population, age group 17–70: can be found at the division for education statistics. The indicator is available at individual level at SN. The data are available for the period 1970–2013.
- Age distribution: can be found at the division for population statistics at SN. The indicator is available at individual level, but is aggregated to municipality level. The data are available for the period 1968–2014.

Data on key ID that can link individuals, companies and municipalities

The final point here refers to data that enable the researcher to link data between the various levels of interest. In the following we present data used to identify and link the various levels:

- Serial number for individuals. This is available across the different divisions at SN which will link information on the individual to either companies or municipalities. The data are available if the individual has a Norwegian personal identification number, since they are derived from this number.
- Serial number for companies. This is available across the different divisions at SN which will link information on the company to either individuals or municipalities. The data are available if the company has a Norwegian organisation number, since they are derived from this number.
- Identification of which zone a municipality belongs to. This information is available from government authorities.

Cost of data

The cost of data is based on the cost structure of SN. The researcher needs to access several registers at multiple departments at SN. Further, the researcher will need data covering a long time period. These are two costly determinants. Finally, it is vital that the researcher obtains a research contract for the evaluation in order for SN to accept the use of these microdata.

It has not been possible to obtain an estimate of the data costs from Statistics Norway. Hence, we need to conduct our own assessment of the cost of data. We know that we will need data from at least 12 different departments at SN. All these registers need to be harmonised. Further, we see that there is an issue regarding the long time period. Here we want information from 1975 if possible. The typical cost of data at Statistics Norway is defined by the following two points:

- Coordination and clarification of data order, including administration.
- Preparation of data, archiving and documentation.

In terms of this project, we would estimate the cost of data at Statistics Norway to be as shown below. The cost is calculated based on the expected number of hours that personnel at Statistics Norway expect to use, and using Statistics Norway's own price list. Here we use the cost of "group 2"personnel, i.e. researchers, counsellors and project managers[8]:

Task for Statistics Norway	Expected time spent	Price
Coordination and clarification of data, including administration.	151.5	NOK: 134 000
Preparation of data, archiving and documentation.	278	NOK: 246 000
Total cost excl. VAT		NOK: 380 000
VAT		NOK: 95 000
Total costs		NOK: 475 000

We estimate that the evaluator will use 200 hours of work when ordering data from Statistics Norway. This includes collecting necessary approvals, specifying a detailed order form, dialogue and re-specifications, and most probably meetings with Statistics Norway.

In addition to the costs of ordering data from Statistics Norway, we estimate the use of 500 hours of work with the evaluator, related to organising the data and collecting data from open sources and from various government bodies (social security contribution tax rates and income, and other instruments).

For the actual estimation, documentation and organisation of the project, we estimate a total of 1,950 hours of work. Table 5 summarises the costs of conducting a DD estimation for the evaluation. In the table, we have also indicated the duration of each stage of the evaluation, and the costs based on an hourly rate of NOK 1,400 measured according to 2015 prices/wages. In total, we estimate that the costs of the evaluation using a DD estimation amount to NOK 4,720,000 excl. VAT.

[8] See http://www.ssb.no/omssb/tjenester-og-verktoy/statistikk-paa-oppdrag/prising-av-oppdrag

Table 5: Estimated time, hours of work and costs of evaluating the RDSSC scheme using DD estimation

	Period	Hours of work	Costs excl. VAT based on NOK 1400* per hour
Establishing the analytical and logical approach	Oct. 2015 – June 2016	350	490,000
Ordering and collecting data	Dec. 2015 – July 2016	200	Data: 380,000 Work: 280,000
Preparing necessary databases	Oct. 2015 – Aug. 2016	600	840,000
Estimation and interpretation	Sept. 2016 – June 2017	1100	1,540,000
Documentation	Nov. 2017 – Feb. 2018	500	700,000
Meetings, coordination and administration	Oct. 2015 – Feb. 2018	350	490,000
Total		**3100**	**4,720,000**

*Measured according to 2015 prices/wages

5.2 Regional economic models

We will now turn to the feasibility of using existing, or expanded versions of existing regional economic and demographical models to identify the effect of the RDSSC scheme and other policy instruments on the performance indicators discussed in Section 2. Furthermore, as argued in Section 4.1, it is desirable that the evaluation model include the endogenous variables and variants of the modelled relationships listed in Table 2 in that section.

We have identified four possible regional models for use in the evaluation: the demand-driven models PANDA and REGARD, and the general equilibrium model NOREG. In addition, a regional equilibrium model called REMES is under development. PANDA was developed by SINTEF and is managed by the Panda Group, which represents the majority of counties in Norway. REMES is also under development by SINTEF. REGARD was created at Statistics Norway, and NOREG was developed jointly by Menon Business Economics and Vista Analyse.

In the table below, we repeat the list of desired endogenous variables from Section 4.1 together with information about whether they are endogenous, exogenous, determined by definitional relationships or calibration, or not included in the various regional modules of the models at all. REMES is not operative yet, and will be addressed separately below.

Table 6: List of desired endogenous variables for an evaluation of the RDSSC scheme from Table 2, and their main status in the regional modules of PANDA, REGARD and NOREG; *j* is municipality, *i* is sector, *s* is educational level or skill level, and *a* is age group.

			Estimated endogenous behaviour (A), determined by calibration or definition (R), exogenous (E), not included (-)		
	Variables	**Description**	**PANDA**	**REGARD**	**NOREG**
(1)	$W_{j,i,s}$	Nominal wages per hour or person	-	-	-
(2)	$P_{j,i}$	Prices	-	-	-
(3)	$K_{j,i}$	Capital, fixed price	E	-	R
(4)	$N_{j,i,s}$	Employment, working hours or persons	R	R	R
(5)	$V_{j,i,s}$	Use of intermediates in production, fixed prices	R	-	A
(6)	$X_{j,i}$	Production, fixed prices	R	R	R
(7)	$D_{j,i}$	Demand	A/R	-	R/E
(8)	$DR_{j,i}$	Operating surplus	-	-	-
(9)	Y_j	Disposable income	R	-	-
(10)	$LF_{j,s,a}$	Labour force	R	R/A	-
(11)	$POP_{j,s,a}$	Population	A/E	R/A	-
(12)	LR_j	Municipal tax revenues	-	-	-
(13)	SR	State tax revenues	-	-	R

In the following sections, we describe each of the regional models in more detail and comment on their feasibility for evaluating the RDSSC scheme.

PANDA

PANDA has two modules, one economic and one demographic. The economic module in PANDA is called REGNA, and is a demand-driven, fixed-price regional model, without other significant behavioural relationships at a regional level than a simple consumption function. This means that although the economic module that corresponds to determination of the variables in the table above consists of variables (1)-(9), only (7) is (partially) endogenous. Investments, represented by equation (3), are exogenous, except that maintenance investments in construction by definition equal depreciations. Also exports to other regions either in Norway or abroad, and public consumption are exogenous variables in REGNA.

The variables (4), (5), (6) and (9) are determined in REGNA as purely definitional relationships. Employment (4) follows production adjusted for an exogenous productivity trend. Wage costs are not included and have therefore no effect on employment. There is only one type of labour in PANDA, i.e. labour is not specified by skill or educational level. Use of intermediates in production (5) is determined by using fixed input-output tables distributing production in each industry to value added in all delivering industries within and outside the region (imports). Production (6) follows demand. Disposable income (9) equals the sum of industry income across all industries. Industry income follows as a fixed share of industry production.

This illustrates that PANDA is a demand-driven model. Shocks to the regional economy cause a corresponding effect on regional activity and the level of activity in other regions according to the fixed input-output relationships. However, it is only possible to run PANDA for one region at a time, so the effect on other regions follows only implicitly. That being said, a module of PANDA exists called multi-regional PANDA, which sums up trade effects between regions. As of now, this module does not describe trade effects on migration and commuting, but it is expected that this will be part of the model shortly.

There are no crowding-out mechanisms in PANDA or the multi-regional PANDA. Increased production in one region will not crowd out other types of production in the region or in any other region. Increased demand will in sum increase production accordingly (with a fixed import share).

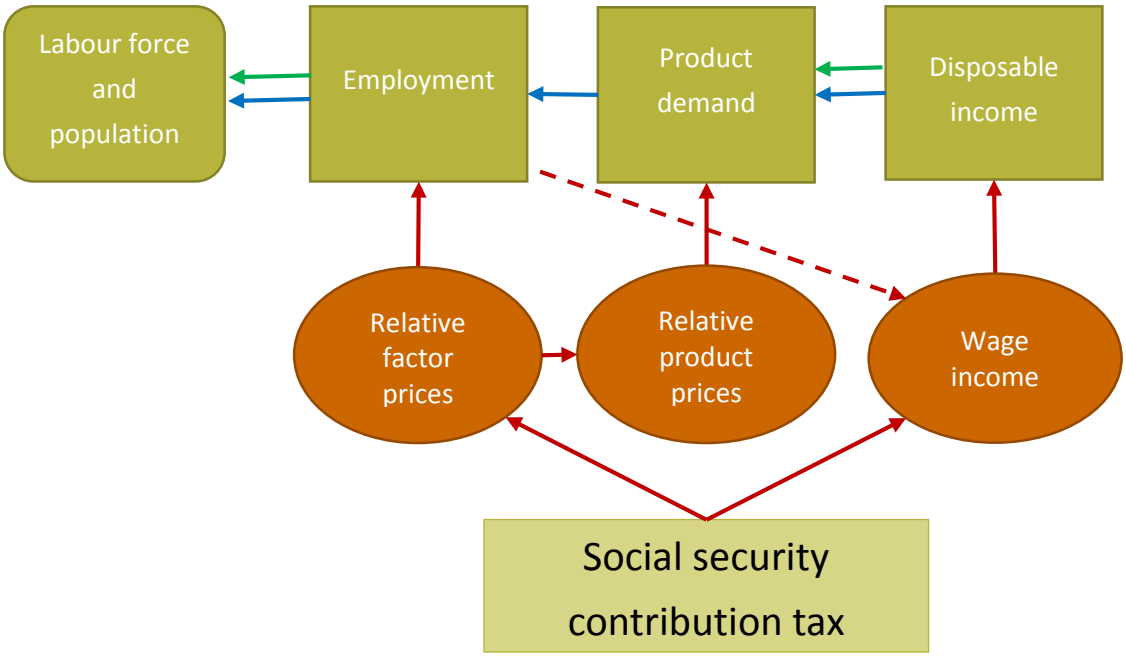
Wages (1), prices (2) and operating profits (8) are not represented in PANDA. Nor is the employers' contribution to social security. Local and state revenues, i.e. equations (12) and (13) in the table, are not included in PANDA either.

The demographic module in PANDA corresponds to equations determining variables (10) and (11) in Table 6, but with the exception of migration, they are not behavioural relationships. Population is determined by fixed fertility and death rates for each age cohort and by endogenous migration for each age cohort. PANDA assumes constant participation rates in each demographic group, or in some cases a fixed trend.

The model results that stem from PANDA can be given at municipality level, but in the economic module they are brought down from a regional level through the municipality's share of total employment in the corresponding region. Municipal private consumption is an exception. It is brought down from a county level using municipal data on disposable income.

Figure 2 sums up the relationships in PANDA using the same figure as in chapter 4, where we also indicate which relationships are represented and how. We see that RDSSC has no part in the model, nor have the channels it is possible it could work through. Employment, product demand and disposable income are in fact part of PANDA, but only consumption is endogenously determined by an estimated behavioural model. Migration is also determined endogenously. Other demographic variables and the labour force are fixed to trends in employment.

Figure 2: Effects of a reduction in the social security contribution tax using PANDA. Red arrows show relationships not included, blue arrows show accounting or calibrated relationships and green arrows show behavioural relationships



We now wish to illustrate how an analysis of a reduction in the social security contribution tax could be carried out using PANDA to analyse its ripple effects. We see from Figure 2 that we would have to shock three variables. First, we would have to increase employment due to a negative productivity shock, which might have been caused by a substitution of capital. This will not have any other effects in the economic module, but will increase labour force participation and the population through increased immigration. Second, we could increase disposable income due to an identified increase in the wage level. This will increase consumption, production and employment further. Third, we could also increase demand further, if from previous investigation we had found a negative effect on product prices. This causes a further increase in employment and immigration.

This shows that it is possible to use PANDA to illustrate the effect of the RDSSC scheme on municipal employment and population. However, the results build on assumed relationships rather than estimated relationships. Furthermore, indirect effects through trade and crowding out are ignored. Hence, the results only serve an illustrative purpose, and are not suited for evaluating the RDSSC scheme as such.

REGARD

REGARD is in many ways similar to PANDA. It also has two modules, one economic and one demographic. It is demand-driven and has no crowding-out effects. REGARD is modelled for seven regions of Norway. Variables at a regional level are disaggregated to county level using fixed weights. There is no further disaggregation to municipalities.

There is no input-output table distributing demand to production by industry. In turn production, value added, gross investments and employment are all parts of the model in each industry.

There are no regional behavioural relationships in the economic module. However, it can be linked to the large-scale national macro-economic models at Statistics Norway, MODAG, KVARTS and MSG. Although the social security contribution tax has significant effects on the total economy in the national models, regional differences have no effect in the current version of REGARD.

There is no regional demand determining regional production or employment. Regional production, value added and employment are merely a decomposition of the corresponding national values using constant regional shares in 28 industries. Furthermore, there is no income represented in REGARD. Nor are wages or operating surplus represented.

The module for demography is nevertheless rich. It determines labour supply, population and the number of workers commuting by gender, age and education. In addition, it also disaggregates employment from the economic module by gender, age and education.

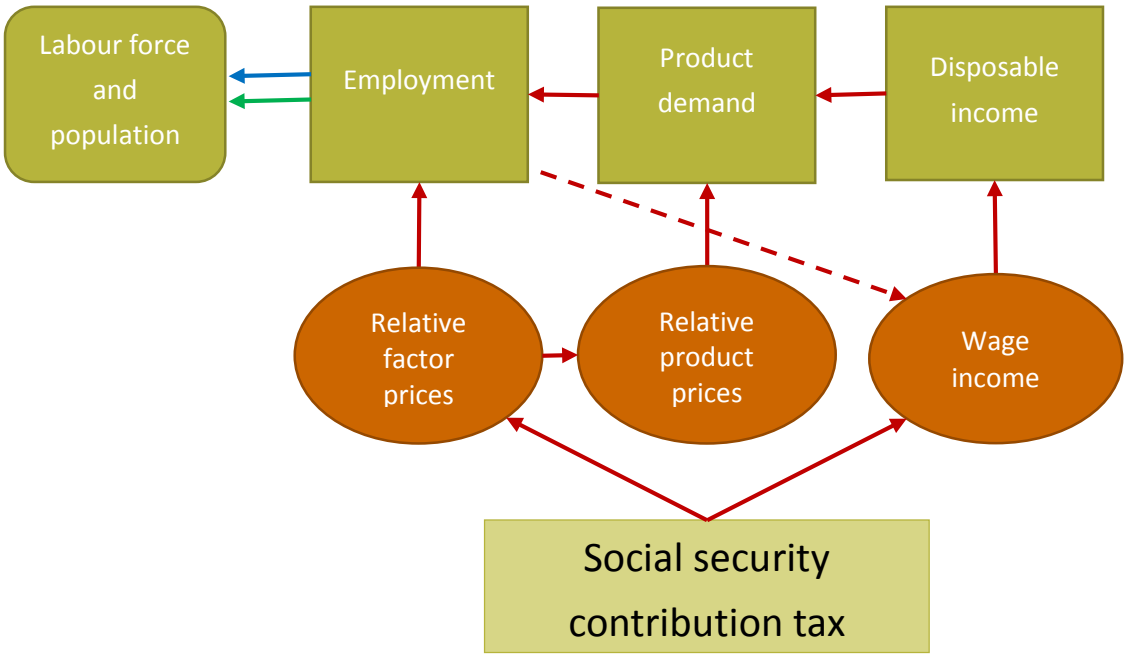
The population is determined as in BEFREG, the model used in Statistics Norway's official population forecasts. Regional migration is modelled as behavioural equations. Multinomial logit models determine migration probabilities between all pair of regions, where access demand for labour by gender, age and education in each region represents the most important explanatory variable.

There are constant labour force participation rates by gender, age and education. Similarly, commuting is determined by constant commuting rates by gender, age and education.

REGARD has the possibility to link the number of persons in each educational group to a national model called MOSART, which simulates educational attainment for each individual in the population by the individual's characteristics – mostly demographic characteristics.

To sum up, and focusing on the set of variables in Table 6, only varieties of equations (10) and (11) are included in REGARD. The endogenous variables in equations (4) and (6) are also included, but are, as described above, only disaggregates from national numbers using constant weights. Figure 3 summarises the relationships in REGARD.

Figure 3: Effects of a reduction in the employment tax rate using REGARD. Red arrows show relationships not included, blue arrows show accounting or calibrated relationships and green arrows show behavioural relationships



An older version of REGARD exists where the social security contribution tax enters explicitly in the determination of wage cost per man hour in manufacturing in each of the regions. Wage costs determine employment and the relationships are estimated using actual regional data. Furthermore, this version of REGARD has an explicit but exogenous representation of spillover effects to the wage level and households' disposable income. This version of REGARD could be a valuable part of an evaluation of the RDSSC scheme. However, the relationships have not been estimated since 1993. One would have to re-estimate a fairly large number of equations for the model to be operative. Even so, the relationships are only modelled for seven regions and employment in other sectors than manufacturing is not modelled.

NOREG

NOREG consists of a general equilibrium regional model for Norway as a whole and a subsequent module that distributes the effects on production to each of Norway's 19 counties. The distribution is based on a fixed industry structure. Hence, NOREG does not have 19 different general equilibrium regional models. However, value added is restricted to being equal to demand at a regional level at all times, which maintains the regional economies in equilibrium as well.

Regional employment follows value added in each region, adjusted for an exogenous productivity trend. Value added in a region is production minus the use of intermediates,

which again is determined by a matrix of product flows. The matrix is estimated using information from the Norwegian Institute of Transport Economics (TØI) and regional accounts from Statistics Norway about product flows and distances between the regions. It is possible to re-estimate the matrix after a shock affecting the industry structure in regions, resulting in different product flows in a reference scenario and alternative scenario.

The product flows are calibrated to be consistent with value added being in a fixed relationship to demand in each region each year. If the sum of value added across all industries exceeds demand in a region, the region is a net exporter, and vice versa. This works through the calculation of employment, since consumption in each region is determined by employment in the same region adjusted by a fixed factor to match actual consumption in the base year of the model. Other demand variables are exogenous at a regional level.

In an alternative scenario, one can, for example, analyse a positive shock to regional employment. It will increase regional demand and value added correspondingly. However, since production is determined from a fixed distribution of national production, the increase in value added lowers the net use of intermediates from other regions. Hence, an increase in regional employment crowds out employment elsewhere.

NOREG has two types of workers, those with high and low lvels of education, respectively, but the number of persons in either category is exogenously given from the supply side. It is possible to influence the level of education by exogenously investing in schooling.

There are no regional prices represented in the model. The regional labour force, which is not included in the model, is implicitly assumed as constituting a fixed proportion of the regional population (which is not included in the model either). However, migration is indirectly modelled, since regional employment reacts to shocks in the regional economy and the sum of employment in all regions is restricted to being equal to the national level of employment. Net immigration to Norway is exogenous.

In addition, the sum of value added, use of intermediates and consumption in the regions are restricted to being equal to the corresponding national levels.

The regional module determines production and use of inputs in 11 industries, similar to equations (10) and (12) in Table 6, but where demand *D* plays no role. Wage costs are not included in the regional module, which makes the present version unable to study effects of changes in the social security contribution tax. NOREG is suitable for analysing state aid to regional investments, but not to households or differentiated tax rates. The regional module of NOREG can be used to analyse the development in total employment and industry structure, but not labour force participation, wages, disposable income or level of education.

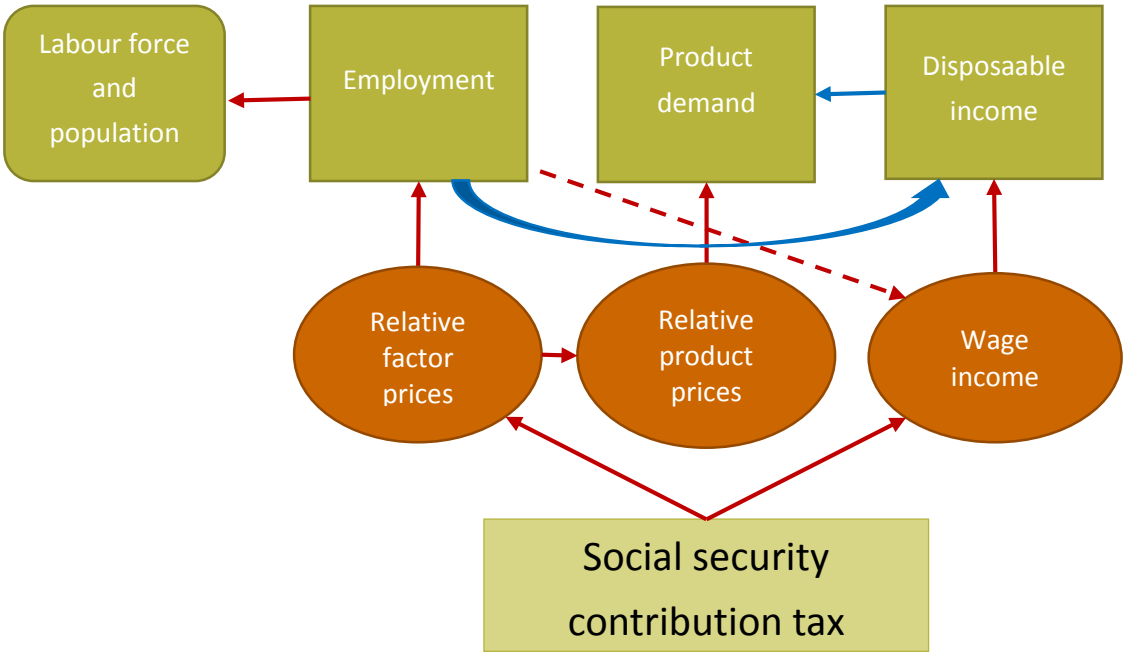
As we have seen above, a regional shock in NOREG could be analysed by a shock to regional demand. It could also be analysed by conducting the shock at the national level, distributing it

to regions, and then comparing it with a reference scenario (before the shock). The national model takes into account dynamic mechanisms through capital accumulation following the shock, which is subsequently distributed to each region.

The possible alternative scenario is one with an equal level on the social security contribution tax, but the effect on employment must be estimated separately prior to the analysis. Production (both before and after the shock) is then distributed to each region according to a fixed industry structure, regardless of where the shock initially originated. However, one could calculate a national equivalent to a regional shock, and then analyse it for the region that experiences the shock. If calculated correctly, the effect for the region in question should be of the correct magnitude. However, the economic mechanisms at a regional level would be the same as at the national level, and equal in all regions, but the region-specific industry structure and product flow imply different effects in each region.

At a national level, which by definition is also the sum of all regions, the shock will only have an effect through capital accumulation (migration to and from other countries are exogenous variables). Hence, net effects are often small because of crowding-out mechanisms. At a regional level, this might not be the case. If a region has a large industry delivering to consumption and a small industry delivering to other regions, a shock increasing consumption could potentially increase employment in that region significantly.

Figure 4: Effects of a reduction in the employment tax rate at a regional level using NOREG. Red arrows show relationships not included and blue arrows show accounting or calibrated relationships that are included. There are no behavioural relationships at this level in NOREG.



REMES

REMES is a regional equilibrium model for Norway under development at SINTEF. No complete documentation exists, and the model has not been used properly yet. We are therefore not able to give a very extensive description of it here.

REMES accounts for six regions, 47 industries, one national government, one representative household per region, taxes on goods, services and consumers, interregional trade, one Rest-of-the-World region which allows for international trade, transport and trade margins in domestic, interregional and international trade. The model is static. Stock changes and investments currently take a simplistic approach, though they are included in the model.

In REMES, households are characterised with both production and demand functions. Demand is determined by income from labour, capital and transfers. Production transforms this income to consumption production. Producers use intermediate products, labour and capital to produce domestic goods and services. Producers decide whether to sell the goods and services to the regional market, to ship them to other regions, or to export them to the rest of the world.

The government is national, but acts on a regional level by collecting taxes, buying goods and transferring money to households. All regions are assumed to be in equilibrium (money flows are balanced at a regional level). This implies also that the government for each region earns the same amount as it spends, i.e. being balanced itself.

An investment sector takes the savings of the local households and government, as well as the investment sent from abroad and enterprise investments, and buys investment products.

When solving the model, supply balances for labour and capital determine the outcome.

Since we have no experience with REMES, we will assume that eventually, when it is developed, it could be part of an evaluation of the RDSSC scheme. It will nevertheless be an equilibrium model, where employment and production determine demand, and regional shocks have close to complete crowding-out effects at a national level and usually also comprehensive crowding-out effects at a regional level. While crowding-out effects at a national level are in line with the RDSSC scheme's common objective, regional crowding out is not.

5.2.1 Possible extensions of the regional models

In principle, it is possible to expand and improve all regional models. It is a question of resources and usefulness, and there are important practical limitations regarding such extensions. New modelled relationships are often very resource-intensive, as the new relationships have to be modelled at the same aggregation level as before, the same variables

are used in many other parts of the existing models and new variables are often introduced that ideally should be endogenous as well, or exogenous values must be set for them. The larger the model, the more complexity and issues of consistency arise.

It is less problematic to replace existing calibrated or definitional relationships with estimated relationships. The relationships would have to be estimated. This is in many ways the same task and requires the same data as described in Section 5.1, but involves further work to incorporate the identified relationships into the model. If effects are found of variables not included in the model in the first place, these must be included and treated as exogenous. This is still no small task, since the databases must be expanded and updated regularly with the new data.

For NOREG it would be particularly problematic to include estimated relationships, especially demand effects, since it is restricted to being a supply-driven model.

In the following, we will use the lack of endogenous relationships identified in connection to Table 6 to discuss possible extensions, which make the regional models more suitable for evaluation of the RDSSC scheme.

PANDA and REGARD

According to Table 6, PANDA and REGARD need new relationships that identify the effect of the social security contribution tax on relative factor prices and relative product prices. PANDA and REGARD are fixed price models today, so this means extensive changes to the models. Alternatively, it should be sufficient to estimate reduced-form relationships connecting the tax to conditional factor demand by industry and total product demand. The identified effects are then only implicitly caused by relative price changes. Equations for nominal wages at an industry level should nevertheless be included. It should thereby be fairly easy to specify operating profits at an industry level by subtracting wage income from value added in each industry.

Furthermore, the definitional relationships in PANDA and REGARD should be re-specified on the basis of estimation results. This means estimating regional production functions by industry and labour force participation by age and gender, in addition to the conditional factor demand equations and product demand equations.

The task of including employment and labour supply by education in PANDA seems large, but it should be possible to estimate the conditional factor demand equations at an industry level for workers with both a high and low level of education. The same could be done when estimating labour force participation equations.

The lack of municipal input-output matrices makes changing the regional level of REGARD too large a task. However, PANDA works at a regional level down to a municipality level through a

prior processing that generates regional accounts, including regional input-output coefficients. PANDA is also for that reason better suited for an evaluation than REGARD.

It is important to include alternative instruments in the estimated relationships. Instruments that are aimed at stimulating demand should be included in the demand equations. Examples of such are public investments or subsidy to private investments.

NOREG

If NOREG is used to evaluate the RDSSC scheme, it too should have regional labour markets embedded in the model framework. This implies including conditional factor demand equations and wage equations by industry at a regional level. In order to evaluate the long-term effects of the scheme, NOREG should include possible effects on labour force participation by region as well. Although unemployment is by definition zero in general equilibrium models, labour force participation rates are affected by the wage level. The social security contribution tax may affect the regional wage level. Furthermore, migration should be included to model population and crowding-out effects elsewhere explicitly.

However, if NOREG opens for regional labour markets and endogenous labour supply, it seems impractical or even impossible to keep the relationship between the results from the national model and the regional implications as they are in today's model. Currently, production is determined at a national level and spread out to the regions using fixed shares. Regional value added and employment are determined by endogenous product flows between regions. If regional production is fully endogenous, each region should be modelled as a general equilibrium economy, similar to the GTAP model[9]. MENON informs us that this is a very extensive task. We believe it is unrealistic within the timeline and funding possibilities of the RDSSC scheme evaluation to perform this. For reasons we will return to in Chapter 6, it is also questionable whether it will be useful for an evaluation at all.

As of today, NOREG is specified for Norway's 19 counties. MENON informs us that it might be possible to establish a similar product flow matrix on a municipal level by assuming the same product flow matrix as on the corresponding county level, although it would be very unrealistic for some municipalities. However, MENON has produced a municipal distribution of the national accounts that includes value added, wages, operating profits and employment in 16 industries. This could then be used to distribute the county effects to municipalities.

[9] The GTAP (Global Trade Analysis Project) is coordinated by a team at the Center for Global Trade Analysis (CGTA), based in the Agricultural Economics Department at Purdue University. The team maintains a global computable general equilibrium model, which uses a database produced by a global network of researchers.

MENON estimates that such a sub-model to bring the county results down to a municipal level requires 1 to 2 work months.

5.2.2 Numerical specification of the model

There are in principle two alternative ways to numerically specify the regional models, estimating and calibrating the parameter values. An estimation implies the use of historical data for the same regions and variables that the model is specified for, and an econometric estimation the parameter values.

The alternative is to calibrate the model using preset parameter values. This is useful either if you lack sufficiently good data or methods for estimation, or if you want the model to be driven by theory. In a theory-driven model the parameter values may still be empirically estimated, but not necessarily using data for your particular region. Similarly, the model specification may also be empirically motivated in a theorydriven model, since empirical results from other studies are used to select between competing theories. However, a calibrated model, although it may have nice properties theoretically, is particularly vulnerable to misspecification because it is not numerically specified with the properties of the economy it is intended for.

One might argue that an empirically specified model is similarly vulnerable, because it will be used to study a counterfactual development that is not represented in the data used for estimation of the parameter values. The strength of the model to produce correct results relies on the quality of the data and the methods used. In practice, there are often data or methodology issues that may cause misspecifications. Sometimes it is therefore preferable to rely on theory instead, particularly if the theory has been supported by empirical evidence elsewhere.

The decision as to whether to use empirical estimation or calibration depends on the data availability and data quality. Often both procedures must be used in one and the same model.

5.2.3 Level of regional aggregation

In addition, when it comes to a choice of which level of regional aggregation to use when specifying the model numerically, data availability is essential. It is particularly important if you want to estimate the parameter values. It is easier to choose aggregation at municipal level in a calibrated model, since you do not need municipal time series for estimation. However, even in a calibrated model you need municipal data in order to match the levels of the variables, i.e. the population size, employment, industry structure etc.

In Norway, we have a national account at a county level, which makes it easy to use this particular aggregation level in estimating the relationships between variables in the model. The results can then be disaggregated to a municipal level. Since the employer's contribution

tax varies between municipalities, the average tax rate must be calculated within each county prior to estimation.

5.2.4 Identifying contribution to a common objective

From the evaluation criteria discussed in Section 2, the RDSSC scheme must first and foremost increase employment and thereby population in the selected municipalities, compared to what would otherwise have been the case. This is the common objective of the scheme. With minor adjustments and extensions, can the existing regional economic models we have looked at above identify such effects and document whether they are in fact causal?

The answer is no. Neither PANDA, REGARD, NOREG nor REMES have embedded regional labour markets. Wages do not even enter as a variable, far less the social security contribution tax rate. Hence, it is impossible to document the direct effect of the tax rate on conditional employment through factor substitution or on product demand through product substitution or income effects using the models without these being expanded extensively. However, once these direct effects have been identified, the models could be used to analyse interesting ripple effects from them. Nevertheless, because most of the relationships in the models are either calibrated or accounting relationships, the results of any ripple effect analysis are not necessary causal either. Furthermore, they do not cover all indirect effects. PANDA and REGARD disregard crowding-out effects both regionally and nationally, and NOREG and REMES assume no increase in total employment.

One exception to this might lie in the fact that employment determines migration and hence the size of the population in PANDA and REGARD. The relationships are estimated so that these models might be suitable to identify the counterfactual development, given an effect on employment. While PANDA allows for such an analysis on municipal level, REGARD includes estimated relationships between employment and migration at a more aggregated regional level. The relationship between product demand and employment is nevertheless based on several accounting relationships in both models, and hence is of less value for an evaluation.

The relationships between regional employment and other variables in NOREG are purely calibrated or accounting relationships. Although product flows are endogenous and represented by estimated parameters, the sums are restricted by the more or less fixed supply of labour and capital.

PANDA and REGARD are demand-driven models, where a regional demand shock affects regional production correspondingly. No crowding-out effects are included. Hence, they are incomplete in terms of analysing indirect effects and effects on total employment. The problem with using NOREG and REMES is the complete opposite. There, the crowding-out effect after a regional shock is complete at a national level, leaving no room for demand

effects for Norway as a whole. This is not unduly problematic for evaluating the RDSSC scheme, since it is in line with its common objectives. However, the crowding-out effects at a regional level might also be extensive. This is particularly problematic since part of the motivation for the RDSSC scheme is an observed difference in employment across regions.

The regional models could increase their value for an evaluation by incorporating estimated relationships between income and demand, where actual data for the regions are used. There are no such estimated relationships in REGARD today. In PANDA, consumption is linked to the sum of industry income and transfers, but the relationships are not estimated at a municipality level.

In addition, the labour force participation rates could be estimated without problems and with only few resources. In the current version, these rates are exogenous.

In order for the demand-driven models PANDA and REGARD to illustrate the full counterfactual development, they would have to be able to take into account indirect effects through multipliers and crowding-out effects as well. They do not. Nor do the equilibrium models NOREG and REMES. Increased employment would typically increase demand towards other regions, which will increase income there, and then demand towards the region we initially looked at. This is a typical multiplier effect and might be embedded in PANDA and REGARD to a certain extent, but not in NOREG and REMES. On the other hand, one might believe that it would also crowd out other economic activity within the regions, at least partly, because both capital and workers are scarce,. These effects are not present in PANDA and REGARD at all.

5.2.5 Identifying distortive effects on competition and trade

All of the regional models we have described above are able to show results at a relatively detailed industry level. This means that the effect on regional employment and production after a shock stemming from changes in the social security contribution tax can be illustrated for different types of industries. Hence, as discussed in Section 2, the models might illustrate the distortive effects on competition and trade by measuring the effects the RDSSC scheme has on typical export industries. If a lower tax rate is associated with a large increase in employment in typical export industries, it could be concluded that the distortive effects on competition and trade are vast. On the other hand, if employment is mostly affected in sectors delivering to domestic demand, the distortive effects are probably quite small.

When interpreting the industry structure as distortive effects on competition and trade, the analysis should be supplement by knowledge about the extent to which each industry exports to EU countries. If a large effect on employment in typically EU-exporting industries is found, a more thorough analysis should also be conducted to identify which companies within these industries that are actually located in the municipalities in question.

Of course, the problems that we identified and discussed above regarding the use of these models as evaluation methods still apply. Hence, care is advised when interpreting the model results. Irrespective of which model is used, many indirect effects are suppressed, relationships may not be causal and they are nevertheless based on actual estimation.

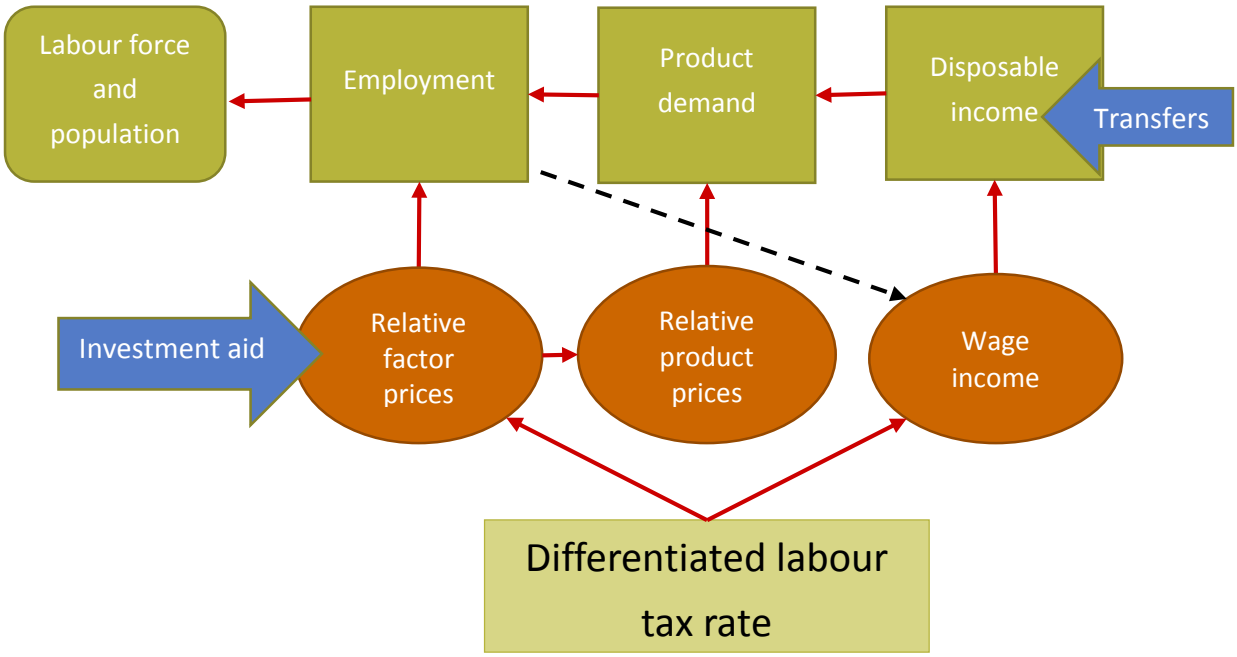
5.2.6 Identifying effects of alternative instruments

As discussed in Section 2.5 the evaluation should address the proportionality and appropriateness of the RDSSC scheme, i.e. whether the aim could be achieved by less state aid using other measures. In order to do that using regional models, the alternative instruments would have to be included in the models with the same thoroughness as the social security contribution tax.

In Section 2.5 we saw that the alternative instruments for stimulating the regional economy in Norway fall into two main categories: several investment aid schemes to firms and various forms of transfer to households.

Figure 5 illustrates how the two types of regional aid affect employment in the region. Transfers increase households' income, raising their product demand for goods and services, which increases local employment if the products are produced locally. All the regional models include transfers in the determination of regional income, so the models are suitable for analysing the effect of this instrument.

Figure 5: Effects of alternative instruments to stimulate employment



Various types of aid for regional investments include subsidy of the use of capital in the production function of firms, lowering the user cost on capital. Hence, it affects relative factor

prices. If capital and labour are complementary factors, it will increase the use of both capital and labour. This should be the case. However, some investments may be aimed at rationalising the production, in which case capital and labour might be substitutes. Therefore, in an evaluation, the various forms of investment aid must be specified and tested separately.

As discussed above, none of the regional models includes factor prices. Investments are in fact exogenous or simple breakdowns of national values at the regional level in all models. The analysis could be conducted by shocking regional investments, but the results will be the same regardless of the form of investment aim.

In NOREG, all instruments aimed at increasing regional demand financed by the state are represented. These instruments affect the regional economy in the same way as an exogenous increase in employment, which would be the way to study the effect of the social security contribution tax as well, since regional demand follows employment exactly in NOREG. Furthermore, it is worth mentioning that it is possible to analyse the number of skilled vs. unskilled workers in a region by state investments in regional schooling.

Although we have identified various ways to analyse the effects of alternative instruments in the regional models, the same drawbacks as we have discussed earlier using these models apply. The relationships are not based on estimation using actual regional data. This makes the results questionable and predefined. Furthermore, the demand models PANDA and REGARD disregard crowding-out effects, and the equilibrium models NOREG and REMES have only small possibilities for an overall increase in employment within the regions in question. These particular model properties limit the value of model analysis used for evaluation.

5.2.7 Data, duration and work requirements and costs

As we have seen, four regional macro models exist in Norway, PANDA and REGARD, which are demand-driven, and NOREG and REMES, which are general equilibrium models. Instead of estimating new relationships as described in Section 5.1, we have described in this section the degree to which these models capture the equations (1)–(13) in Table 2 in section 4.1, which we consider to be optimal when evaluating the RDSSC scheme. Unfortunately, none of the four models includes the social security contribution tax, nor any variables capturing wage costs. Furthermore, they lack economic and demographic behaviour from estimation at a regional level. Instead, the relationships are accounting relationships, or based on calibration. Some of the necessary relationships do not exist at all.

This means that the models are not suitable for evaluating the RDSSC scheme without significant extensions and econometric work. However, as we have discussed above, all four models could be used to analyse the ripple effects of a pre-identified effect of a given change in social security contribution tax on employment and demand. Even though the ripple effects

would be merely accounting relationships, the models can illustrate the net effects within a common framework that are consistent with national and regional aggregates.

Once a reduction in the social security contribution tax is identified at a regional level and for various industries, the ripple effect analysis could easily be conducted using existing operative regional models or with only a few extensions and modifications. Furthermore, it might be preferable to recalibrate the accounting relationships as well. We cannot see any data that retrieves costs in order to conduct such ripple effect analysis using the existing models. However, those who operate the models and conduct the adjustments and model simulations must be compensated for this work and for documenting the results. We estimate these costs to amount to about 400 hours of work, or NOK 560,000 excluding VAT.

As we have discussed in Section 5.2.1, and although we question the usefulness of doing so, it could in theory be possible to expand and improve the regional models extensively for an evaluation of the RDSSC scheme. Since this would imply estimation of basically all of the relationships listed in the optimal model in Table 2 in Section 4.1, which was explored in Section 5.1, we estimate that the data requirements and costs of doing this correspond to the estimates in Section 5.1.4. In addition, the estimated relationships must be formalised within a model framework, databases must be expanded and updated, software must be compatible with the extended models, and so on. This additional work is estimated to require several work years and the cost may amount to as much as NOK 10 million. We do not explore this any further, since none of the institutions operating the potential models recommend using them in this way when asked explicitly.

6. Our recommendations for methods evaluating the RDSSC scheme

As stated in Chapter 4 and recommended by the Commission Staff Working Document (European Commission, 2014), a well-established way of conducting policy evaluations is through Difference-in-Differences (DD) estimation. In Section 5.1 we explored this and other econometric evaluation models in detail. We now argue why DD is the preferred model tool for evaluating the RDSSC scheme, even though there are other possibilities. Further, we will argue for the feasibility of implementing DD models. This includes arguments on how to handle the challenge of establishing the counterfactual situation that should be the offset of implementing the DD models. The DD models do not take account of the potential dependencies between the performance indicators. As discussed in Section 3.2 there will be pros and cons linked to this approach and this section will not add to this discussion. For an evaluation of the RDSSC scheme, we believe the conclusions do not depend on the scale of these dependencies.

A regional economic model could show the relationships between the various performance indicators. However, as is evident from the previous section, existing regional models for Norway are not suitable for evaluating the RDSSC scheme as such. In fact, they lack nearly all the necessary behavioural relationships identified in Section 4.1. Most importantly, the tax rate, wage costs and many alternative instruments are not represented in the models. Some of the relationships from Section 4.1 are represented in the models, but mostly as pure accounting techniques or by calibration.

However, once the effect of the social security contribution tax on important evaluation criteria has been identified using our recommended DD technique, the existing regional models could be used to study its ripple effects on regional demographic variables in more detail. These are richly specified in PANDA and REGARD. Furthermore, NOREG and REMES could be used to illustrate long-term effects conditional on the assumption of full crowding-out effects in Norway as a whole.

However, due to the complexity of the models and limitations in software infrastructure, it seems to be a near-impossible task uncertain outcome to include all structural relationships that identify dependencies between the performance indicators and indirect effect. Nor is it necessary. The effects could be carefully estimated in reduced form models separately, and estimated using DD with data that are suitably aggregated. As discussed in Section 2, this is in principle what the ESA recommends as well.

Because of the extraordinarily good quality of Norwegian microdata, and the fact that selection of beneficiaries of the RDSSC scheme enables us to overcome important methodological obstacles, we believe DD estimation as described in Section 5.1 is sufficient to

meet all the evaluation criteria from Chapter 2. Both direct and indirect effects can be identified, and with high hopes of uncovering the counterfactual development. Hence, we see no need for analysing further effects of the RDSSC scheme using regional economic models.

Nevertheless, we still believe that the evaluation should be supplemented by regional model analysis. The reason for this is that the results may elucidate important ripple effects and constraints at low costs, since several models are already operational. However, we do not recommend significant extensions or modifications to existing regional economic and demographical models.

If we should restrict the model analysis recommendation to existing model versions, we recommend using both PANDA and NOREG. These are operational at municipal and county level, respectively. However, REGARD and REMES are also potential alternatives. Therefore, we will not point towards specific models, but we recommend using a demand-driven model that is able to study a given effect of increased employment on a rich number of demographic indicators at a municipality level. Hence, results from REGARD must be disaggregated further than is possible today. Furthermore, we recommend using an equilibrium model that can illustrate the effect of a given increase in municipal demand on municipal employment. NOREG should capable of this task with only small extensions. REMES may also shortly be capable of this.

The various regional models are described in detail in Section 5.2. There we also provided descriptions of how to use them as supplementary analysis of the RDSSC scheme. Since we do not see how regional model analysis can play a crucial role in an evaluation of the RDSSC scheme, we will not describe them further in this chapter. Below we instead describe in more detail how to conduct the DD estimation, list the data requirements and estimate their costs. The discussion below supplements the description in Section 5.1.

6.1 Difference-in-Differences (DD) estimation

As we have seen from Chapter 2, the ESA points at four different methodologies for evaluating regional state aid:

1. **Randomised experience (RE)**
2. **Instrument variables (IV)**
3. **Regression Discontinuity Design (RDD)**
4. **Difference-in-Differences (DD)**

The last three are all forms of quasi-experiments, as opposed to randomised experience.

There is no way to select beneficiaries randomly, so we disregard RE. Because of the discussion in Section 5.1, we will argue not to pursue the IV methodology either. The choice of instrument variables is far from straightforward, and hence it is probably too difficult to identify and assess valid instrument variables.

Despite our words of caution regarding RDD methods, we would recommend pursuing this approach, using administrative boundaries as a way to identify control groups. We would recommend using RDD as a way of establishing a population of beneficiaries and non-beneficiaries that can be compared. Then we would recommend that the comparison be completed with DD models, but with the modification that there is a need to take the parallel trend assumption into consideration.

The table below summarises the pro and cons attached to each method from Section 5.1, as well as our recommendation on choice of models.

Table 7: Pros and cons of different evaluation methods, and our recommendations

Model	Pros	Cons	Recommendation
Randomised experiments	The best way of establishing a proper control group and hence key to obtaining good and unbiased estimates of the effect	Not feasible at all with large existing schemes as in the case of the RDSSC scheme.	As the model is not feasible to implement, we would not recommend this approach.
Instrument variables	Well-known way of addressing causality and handling selection bias between beneficiaries and non-beneficiaries	Difficult to identify proper instrument variables. Further, we cannot test whether or not we have identified good instruments	We would not recommend the use of instrument variables due to the cons of the approach.
Regression discontinuity design	Easy to implement and works well with the RDSSC scheme as the scheme uses administrative boundaries to define beneficiaries and non-beneficiaries.	Should be used with caution since it does not control for other factors than geographical location at the outset. The model does not handle potential spillover from beneficiaries to non-beneficiaries. Further, there is a need to address observations which are far from the threshold, both among beneficiaries and non-beneficiaries.	We would recommend the use of this model, but only as a way of identifying population. The estimation of effects will be completed through DD models.
Difference-in-Differences	Intuitive and easy to manage. Flexible in terms of design both in terms of linear regression with full population and with more advanced delimitation of population in matching procedures.	The parallel trend assumption is crucial and every model needs to address this by including observable variables. Tends to overestimate the statistical significance of the results.	We would recommend the use of DD models. In order to test the robustness of models and results we would recommend the implementation of three different DD models. The difference in these models depends on the choice of control groups and includes 1) a full population, 2) population defined by RDD and 3) a population defined by matching procedures.

In the following, we present how to design econometric models. We would recommend three different models in our feasibility study. The difference in these models is based on the delimitation of population. The models are as follows:

1. Using Difference-in-Differences modelling and adding explanatory variables to ensure that the parallel trends assumption is met. The models will build on a full population including all beneficiaries and non-beneficiaries, and will be estimated both at an aggregated and disaggregated (e.g. municipality) level.
2. Using RDD as a way of identifying the proper control group and then measuring the effects by implementing a DD model. The models will build on the population defined by the RDD.
3. Using a matching procedure to identify a proper, yet synthetic control group, based on observed variables. The population will build on the matching procedure.

We describe each model below.

DD including explanatory variables.

In the model, we include explanatory variables to control for observable differences between the treatment and control group. We define the Difference-in-Differences model as:

$$y_{jt} = \beta_0 + \beta_1 D_j + \beta_2 D_t + \beta_3 D_j D_t + \bar{\alpha}_1 \bar{X}_{jt} \varepsilon_{jt} \qquad \text{(i)}$$

Where y is the performance indicator, β_0 is the constant, D_j is a dummy with value 1 if the municipality j is in a region that is part of the scheme and 0 otherwise. β_1 is the corresponding coefficient. D_t is a dummy variable for the time dimension and has the value 1 if it represents the time after implementing the scheme and 0 otherwise. Vector $\bar{X}_{jt}$ consists of covariates relevant for estimating the performance indicator y_{jt}. The dummy variable $D_j D_t$ captures possible differences between our treatment and control groups prior to the scheme change, thus β_3 is the coefficient of interest. The Difference-in-Differences estimate then becomes

$$\widehat{\beta_3} = (\hat{y}_{1,1} - \hat{y}_{1,0}) - (\hat{y}_{0,1} - \hat{y}_{0,0}) \qquad \text{(ii)}$$

In the above-mentioned model, we do not impose any constraints on the control group. Thus, we assume that the explanatory variables explain all variation in performance not caused by the scheme. This is one feasible way of estimating the policy effects.

DD based on RDD to identify proper control group.

Regression Discontinuity Design exploits the existence of a variable that has a discontinuing impact on the selection of beneficiaries. This threshold can be defined by different measures,

but as we are focusing on a scheme that divides beneficiaries and non-beneficiaries by geographic location, the use of administrative geographical boundaries as the decisive measure is self-evident. As focus in the impact assessment changes, so will the potential control group. Including a focus on alternative measures will for example potentially lead to establishing new control groups. It is important to bear in mind that the control group is not a fixed group of non-beneficiaries, but instead serves as the alternative outcome in the counter factual situation.

Of course, one should be aware of the potential drawbacks of the approach. First, there is a question of whether or not the non-beneficiaries are a solid control group for beneficiaries of the policy scheme. To decide whether the control group constitutes a good match with the treatment group, we would suggest the use of balancing tests. A balancing test is a diagnostic tool designed to test whether two or more groups are significantly different on a set of objective parameters. Such a test provides useful insights into whether we have a solid control group and thus whether a plausible counterfactual situation has been established. More precisely, the analysis employs a test to investigate whether the treatment and control group are in balance with regard to each of the covariates. Hence, the following property is investigated:

$$Treatment \perp X|p(X) \qquad \text{(iii)}$$

The second question is somewhat more difficult to assess. That is the question of non-beneficiaries who will also be affected by the policy scheme and cause us to underestimate the effects of the scheme. Addressing this problem will rely on economic arguments and other types of economic analysis. One way of analysing this is by analysing the development of the control group. If a catch-up effect is identified in the control group in the period after our treatment group enters RDSSC, it can be argued that there is a spillover effect. Spillovers that are more permanent can be identified by local or regional input/output analysis. Here the coherence between two regional economies, and hence any increased effect from RDSSC on a regional economy can be analysed.

In order to estimate the effect of the scheme on performance indicators, we follow the approach from equation (i) and (ii). The difference is that population in D is defined by the RDD.

DD based on matching procedure to identify proper control group

A third approach is to create a synthetic control group. The idea is in principle identical to the RDD but here we design our “neighbouring” municipalities. So, we create the municipality best suited as control observation based on observed characteristics. For example, the synthetic municipality may consist of average values from 10 or 15 municipalities. This

approach is very well described in the literature[10], yet it is by no means straightforward to implement. We will describe the overall setup. However, the implementation of the model requires real data to test how appropriate the model is and how well the control group matches the treatment group. This can only be implemented when data is available.

The overall setup of the model is the following. We switch the neighbour municipalities with a designed control group, but otherwise follow the same Difference-in-Differences approach. Here we create a so-called counterfactual situation in which a synthetic control group simulates a situation in which the treated municipalities did not receive the treatment. There are various approaches to creating this counterfactual situation, all based on propensity score matching. They are all based on logistic regressions. With this method, we match on observed characteristics that distinguish treatment and control groups in order to make the groups more similar.

Matching ensures that any differences between the treatment and the control groups are not a result of differences in the matching variables. The disadvantage is that the effects of the matching variables on the outcome cannot be studied and that we assume that all relevant covariates have been measured and are included in the model. The regression can be expressed as:

$$p(X) \equiv \mathrm{Prob}(participation = 1|\mathrm{X}) \qquad \text{(iv)}$$

The matching procedure can follow many different approaches. This includes nearest neighbour matching. In this method, the absolute difference between the estimated propensity scores for the control and treatment groups is minimised. Another example is N:N matching. In this method, control and treatment subjects are randomly ordered but the first n treatments are matched to n control subjects with the closest propensity score. The commonly used matches are 1:1, 1: N or N: 1 matches. A third example is kernel matching. Here every treated subject is matched with the weighted average of the control subjects. The weights are inversely proportional to the distance between the treated and control group's propensity scores from the logistic regression.

In order to test whether or not one have identified a solid control group, one could implement balancing tests as stated in equation (iii). In order to estimate the effect of the scheme on performance indicators, one can follow the approach from equation (i) and (ii). The difference is that population in *D* is defined by the propensity score matching method. In

[10] See World Bank (2011) *Handbook on Impact Evaluation*, Mark et al. (2015) *Measuring the Economic Effects of Companies Collaborating with a Research Intensive University*, DASTI (2014) *Central Innovation Manual on Excellent Econometric Evaluation of the Impact of Public R&D Investments* or OECD (2006) *Evaluation of SME Policies and Programmes*

addition, in this case the control groups will differ depending on the focus of the impact assessment. Hence, it is expected that models including and excluding alternative measures will lead to differences in the control groups. Again, it is important to bear in mind that the control group serves as the counter factual situation.

6.2 Identifying contribution to a common objective – labour market and demography

The objective of the RDSSC scheme is to prevent depopulation in regional areas by increasing employment in these areas. As described in Chapter 3, there are many ways in which it can affect factors that will have either direct or indirect impact on labour market and demography. In Section 5.1.1, we listed these three elements of designing the impact assessments when measuring the policy impact:

1. First, we identify and list the performance indicators.
2. Second, we list potential control variables. These variables can be used in all three specifications of the DD model.
3. Third, we state how the impact assessment can be designed, based on our three different approaches.

In this section, we repeat the description we gave in Section 5.1.1 for the first two elements, and add a detailed explanation for the third element.

Performance indicators – common objective.

The common objective of the scheme focuses on labour market and demography. Measuring effects requires identification of indicators on labour market and demography. We suggest a focus on the following indicators regarding labour market:

1. Labour force participation. This is the sum of employment and unemployment. It is possible to focus on an aggregate level as well as on a more disaggregated level, i.e. a municipality level. Normally, the labour force is seen in relation to the size of the population within the same age range. This measures the labour force participation rate. A higher labour force participation rate is attractive for any given region as it increases value creation and has positive socioeconomic effects.
2. The level and growth in employment rates. The indicator measures the proportion of a population that is employed. The population will consist of individuals of working age. It is possible to focus on an aggregate level as well as on a more disaggregated level, i.e. a municipality level, between sectors and between educational groups. As with labour force participation, an increase in employment is desirable as it increases value creation and has positive socioeconomic effects.
3. Occupational structure. Based on employment divided by sector, it is also possible to analyse changes in the occupational structure. It is possible to focus on an aggregate

level as well as on a more disaggregated level, i.e. a municipality level. An increase in employment in the private sector as opposed to the public sector is desirable as it increases value creation in the private sector and thus improves public finances. It is also desirable to analyse the occupational structure between private sectors and groups of private sectors, e.g. production of tradable and non-tradable goods, primary sectors, service sectors etc.

4. Salaries and growth in salaries. Salaries are the compensation offered to an employee in return for work performed. It is possible to focus on both an aggregate level and on a more disaggregated level, i.e. a municipality level and between sectors. An increase in salaries may have both positive and negative effects for employment rates and growth. On the one hand, it increases spending power and demand; on the other hand increased wage costs lower the competitiveness of firms.
5. Net income and growth in net income. Net income is the amount of income left when taxes on salary are paid. This is also known as disposable income. As with other indicators, it is possible to focus on an aggregate level and on a more disaggregated level, i.e. at municipality level. An increase in disposable income will have derived positive effects for employment rates and growth, since it increases spending power.
6. Education level among the population. Education level is defined as the proportion of a population with a given education. Education is defined by NUS codes and is thus based on formal education level. We would recommend that the researcher apply an aggregated level of NUS at either 1-digit or 2-digit level.
7. Public finances, both in regional government and state sectors. Here we focus on the aggregated level of public finances. That is the total income including taxes, state transfers and others, minus total expenses.

With regard to the focus on changes in demography, the number of relevant indicators is somewhat smaller. Demography is a statistical study of human populations. It encompasses the size, structure and distribution of a population. We will focus on indicators aimed at reducing or preventing population decline:

8. Population size is simply the number of people living in a certain geographic area. In Norway there is a long tradition of registering each individual. Thus, population data are of high quality compared to Germany, for example, where the federal statistical office is not permitted to register individuals.[11] As we can track each individual, this indicator can be aggregated to any desired level.
9. Age distribution of the population is a common demographic indicator. Age distribution is a strong indicator for the future prospects of a population. A high proportion of young people and infants indicates an expanding population, whereas a high proportion of elderly people indicates a contracting population.

[11] This is a legacy of the Stasi, as a result of which statistics on population in Germany are only an estimate.

10. Net migration measures the difference between immigrants and emigrants. It is an indicator of the attractiveness of a given geographic location. As we can track each individual, this indicator can be aggregated to any level desired.

Control variables

Control variables are crucial to the impact assessment. They can be imposed directly into the DD model as covariates explaining variance in performance between beneficiaries and non-beneficiaries. Alternatively, they can be used to delimit population and define control groups.

We would suggest that the following groups of variables be included in the study:

- The zones of the RDSSC scheme. This will be central in identifying who are beneficiaries or non-beneficiaries, which is a basis for all three DD models. Further, the identification of zones is key to identifying the population in the RDD approach.
- Characteristics of the individual municipality. This includes a broad range of variables, but encompasses:
    - Characteristics of the business sector in the municipality including employment by sector, exports, capital stock, education level in businesses etc.
    - Characteristics of the demography in the municipality including population, net migration, density of population and age distribution.
    - Characteristics of the labour market in the municipality including labour market participation, employment, wages, income and education level etc.

Depending on the specification of the model, there will be differences in which control variables should be included. The exclusion and inclusion will be an individual assessment for each of the models. Further, there are potential constraints in data access, particularly regarding the time dimension. For some variables it will not be possible to retrieve data for more than a 15-year period, whereas for others it will be possible to retrieve data from before the launch of the RDSSC scheme.

Implementing the impact assessment – an example using labour market participation

We suggest that the impact assessment should run along three different lines. These include: a DD model based on full population, a DD model based on RDD and finally a DD model based on matching procedure. In this section, we will give an example of how models can be implemented based on a performance indicator. Since the approach is the same for other performance variables, we will only do this for one example. We will select labour market participation.

Labour market participation must be examined both by taxation zone and in total. This gives us a fine opportunity to show the flexibility of the DD model. If we set out with the full

population, the model will be defined in equation (i). We will use the information on zone classification to define the population. D_j is a dummy with value 1 if the municipality j is part of the scheme and 0 otherwise. Our control variables will be a vector $\bar{X}_{jt}$ that have explanatory power in estimating the performance indicator y_{jt}. In principle, all types of control variables are relevant. The researcher can perform a sequential reduction of control variables according to their explanatory power, starting with the variables without explanatory power.

In order to estimate the effect by taxation zone, we redefine D. Now D_j is a dummy with value 1 if the municipality j is in a given zone and 0 otherwise. We can then test each group and compare it to others. Alternatively, we can arrange the different zones into new groups and test the impact of these, e.g. test zone I, Ia and II against zone III, IV and IVa and against zone V. Again, the researcher will choose control variables.

Implementing RDD as a means for establishing a control group is also relatively straightforward and can be implemented both at the overall level and by zone. Here we identify and delimit the treatment and control group by municipalities on either side of a zone. Here we can put forward a long list of DD models, all with different populations, so that now D_j will depend on RDD. In order to assess whether RDD provides us with a proper population, we can test the treatment group against the control group using a balancing test that follows from equation (iii). It can be implemented as a probit regression. As previous, the researcher must choose control variables that can be included in the DD model when estimating the effects.

The last approach identifies the population by a matching procedure. The choice of matching procedure must be well reasoned by the researcher. We would recommend the use of propensity score matching based on a probit model. The propensity score matching refers to pairing the treatment and the control units with similar values on the propensity score and possibly other covariates, and discarding all unmatched units (Rubin, 2001). Propensity score matching addresses both selection bias and causal inference (Dehejia and Wahba, 2002). Furthermore, we calibrate the matching by imposing a tolerance level on the maximum propensity score distance. The matching procedure can follow many different approaches as stated earlier. The approach will be the choice of the researcher.

Propensity score values are dependent on a vector of observed covariates associated with the receipt of treatment. Generally, if a treated subject and a control subject have the same propensity score, the observed covariates are automatically controlled for. Therefore, any differences between the treatment and control groups will be accounted for and will not be because of the observed covariates. The researcher will choose covariates from the list of control variables. Again, the evaluator can test the groups by using a balancing test.

With well-established treatment and control groups it is straightforward to estimate the potential impact on labour market participation in a DD model, see equations (i) and (ii).

Implementing the impact assessment – in general

The above section describes how to implement the impact assessment on labour market participation. In principle, the approach can be replicated to all of the performance indicators mentioned. Thus for each of the performance indicators defined earlier in this section, it would be feasible to implement an impact assessment. For each of the performance indicators, the researcher can exploit the three different approaches in setting up a DD model.

Table 8: The list of economic and demographic relationships that will cover most evaluation criteria from Table 2 and whether they are possible to estimate econometrically; *j* is municipality, *i* is sector, *s* is skill or education, *a* is age and gender

Economic relationships		Reduced form	Possible to estimate econometrically
$W_{j,i,s} = W(U_{j,s}, \rho_j, \tau_{j,i}, Z_{w,j,i}),$	(1)	Into (3)	Yes
$P_{j,i} = P\left(W_{j,i,s}(1+\tau_{j,i}), Z_{p,j,i}\right),$	(2)	Into (3) and (7)	-
$N_{j,i,s} = N(W_{j,i,s}(1+\tau_{j,i})/Q_{j,i}, r_{j,i}(1-d)/Q_{j,i}, X_{j,i}),$	(3)		Yes
$K_{j,i} = K(W_{j,i,s}(1+\tau_{j,i})/Q_{j,i}, r_{j,i}(1-d)/Q_{j,i}, X_{j,i}),$	(4)		Yes
$V_{j,i,s} = V(W_{j,i,s}(1+\tau_{j,i})/Q_{j,i}, r_{j,i}(1-d)/Q_{j,i}, X_{j,i}),$	(5)		Yes, but depends on definition of *V*
$X_{j,i} = X(D_{j,i}),$	(6)		Yes
$D_{j,i} = D(P_{j,i}/\bar{P}, Y_j, G_{j,i}),$	(7)	Into (6)	-
$DR_{j,i} = X_{j,i} - q_{j,i}V_{j,i} - N_{j,i}W_{j,i}(1+\tau_j),$	(8)		Yes
$Y_j = Y\left((1-\rho_j)\left[\sum_{i,s}(W_{j,i,s}/\bar{P})N_{j,i,s} + \sum_i (1-a_{j,i})DR_{j,i}\right] + O_j\right),$	(9)		Yes
$LF_{j,s,a}/POP_{j,s,a} = LF_a(U_{j,s}, W_{j,s}/PC),$	(10)		Yes
$POP_{j,s,a} = POP_a(N_{j,s}),$	(11)		Yes
$LOCAL\ REV_j = LOCAL\ REV(\ \ ),$	(12)		Yes
$STATE\ REV = STATE\ REV(\ \ ),$	(13)		Yes

In Table 8, we have assessed whether or not it is possible to estimate the economic relationship as outlined from the theoretical discussion in Chapter 4.1. All the performance indicators can be estimated econometrically in reduced form. This includes both indicators on

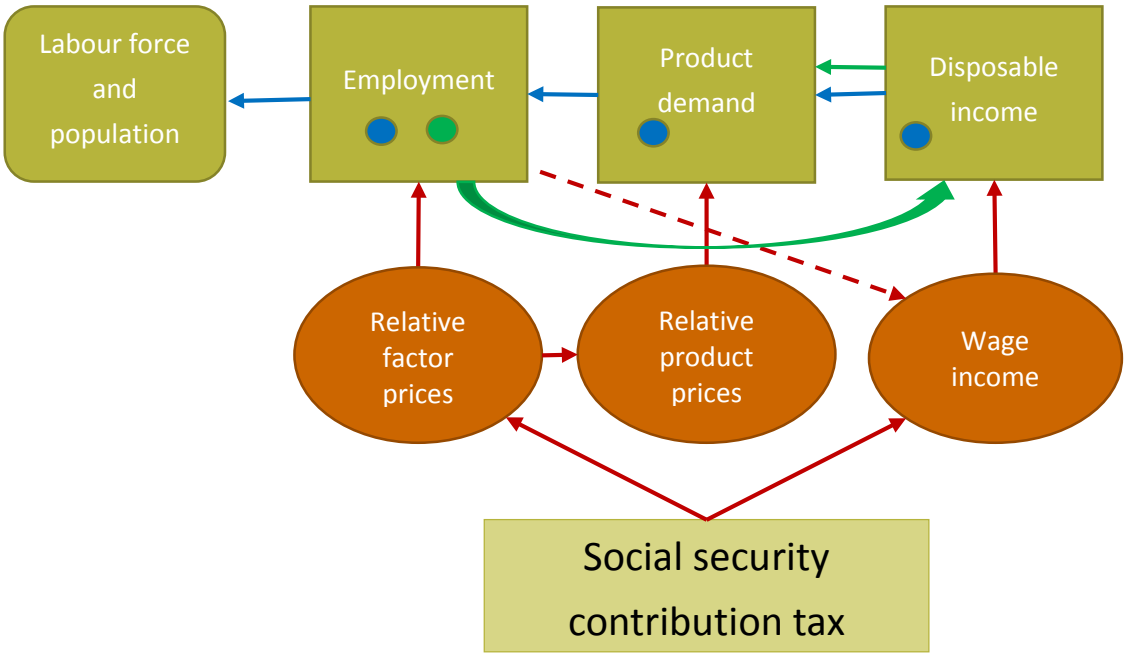
labour market and preventing depopulation. Hence, we can estimate the following economic relationships following ESA guidelines:

- Equation (1) which focuses on wage
- Equation (3) which focuses on employment
- Equation (9) which focuses on income
- Equation (10) which focuses on labour force
- Equation (11) which focuses on population
- Equation (12) which focuses on the economy of the municipality
- Equation (13) which focuses on the economy at state level

Further, it is possible to estimate the following economic relationships:

- Equation (4) which focuses on capital or capital stock
- Equation (5) which focuses on use of intermediates
- Equation (6) which focuses on production
- Equation (8) which focuses on operating profits

Figure 6: Effects of a reduction in the employment tax rate using our recommended procedure. Red arrows show estimated effects in reduced form equations using DD estimation, blue dots show where, for example, PANDA variables can be changed, green dots show where NOREG variables can be changed, blue arrows show relationships calculated using PANDA and green arrows show relationships calculated using NOREG.



Finally, in Figure 6, we summarise by using the float diagram from Chapter 4 once again, where we include relationships estimated using our three DD methods outlined here, as well

as the supplementary analysis using regional economic and demographic models. We have used PANDA and NOREG as examples in the figure, because these are currently operational.

6.3 Identifying distortive effects on competition and trade

In order to assess potential distortive effects on competition and trade we focus on the following steps:

1. State whether there are any effects of the RDSSC on defined markets, e.g. divided by product and service markets.
2. Assess whether these effects are related to businesses that are subject to national competition.
3. Assess whether the businesses identified are subject to international competition.
4. Assess whether there are effects on localisation.

The econometric models are based on micro-level data. Thus, an evaluator can aggregate to and analyse specific market segments divided by industry. It is possible to delimit the population to focus only on a selection of industries, e.g. it is possible to estimate effects on only specific manufacturing industries.

If the evaluation identifies that firms covered by RDSSC are active in export markets or imports are a real alternative to the RDSSC firms' products, the market situation should be investigated, as pointed out in Chapter 2.4.

There are several ways of calculating market dominance. The most direct is market share. However, the influences of customers, suppliers, competitors in related industries, and government regulations must be taken into account. Although there are no rules governing the relationship between market share and market dominance, EU and ESA guidelines on the assessment of horizontal mergers point to a 20 per cent market share of a company, brand, product, or service as a large value.[12]

Market shares within an industry might not exhibit a declining scale. There could be only two firms in a duopolistic market, each with a 50 per cent share; or there could be three firms in the industry each with a 33 per cent share; or 100 firms each with a 1 per cent share. The concentration ratio of an industry is used as an indicator of the relative size of leading firms in relation to the industry as a whole. One commonly used concentration ratio is the *four-firm concentration ratio*, which consists of the combined market share of the four largest firms, as a percentage, in the total industry. The higher the concentration ratio, the greater the market power of the leading firms.

[12] See EU: Guidelines on the assessment of horizontal mergers under the Council Regulation on the control of concentrations between undertakings.

Alternatively, there is the Herfindahl index (HHI). This is a measure of the size of firms in relation to the industry and an indicator of the amount of competition among them. It is defined as the sum of the squares of the market shares of each individual firm. As such, it can range from 0 to 1, moving from a very large number of very small firms to a single monopolistic producer.

The HHI is defined as:

$$HHI_i = \sum_{k=1}^{N} R_{k,i}^2$$

Where *i* is market, which can also be delimited geographically, *k* is company and $R_{k,i}^2$ is the company share of total revenue in market *i,* squared, $\frac{revenue_{k,i}}{revenue_i}$. *N* is the total number of companies within the market.

Decreases in the Herfindahl index generally indicate a loss of pricing power and an increase in competition, whereas increases imply the opposite.

If the use of HHI indicates that RDSSC includes companies with market power, it is necessary to conduct additional analyses to define the market for the companies. The most common method of market definition is the SSNIP test (Small but Significant Non-transitory Increase in Price). SSNIP tests of individual products show a loss of customers after a price increase. The method requires thorough market analysis, which we assume falls outside the evaluation of RDSSC. The evaluation should therefore be restricted to indicating whether RDSSC creates competition problems that must be analysed separately.

Another approach is the minimum efficiency scale, i.e. what is the entry revenue to a market. This measures the minimum demand for revenue in order for a company to operate efficiently in the market. Here we suggest setting a threshold, following Graversen and Mark (2003), to the lower decile of logarithm to revenue.

Assessing the international competition, the evaluator may assess whether or not businesses in export industries are more or less responsive to RDSSC. If the analysis shows that businesses that are more exposed to international competition are more strongly impacted by the RDSSC scheme it can be argued that there are distortive effects from the scheme.

RDSSC may also create incentives for relocation of businesses from outside to within the national geographic boundary of RDSSC. This may be regarded a desired effect, unless relocation reduces competition or distorts international trade. Relocation of enterprises can be measured by identifying the municipality of the individual enterprise. Following the enterprise over time allows identification of any changes in its location.

To test whether relocated enterprises create competitive problems or trade distortions, the evaluation should examine whether the enterprises are in markets characterised by dominant

players. If one of the dominant players is the relocated enterprises, RDSSC may have contributed to enhanced market powers through more favourable terms than previously.

6.4 Identifying effects of alternative instruments

One central part of the assessment is the question of the proportionality and appropriateness of the scheme. A central question here is whether the desired aim of the scheme could have been achieved at a lower cost by using other measures. This is a difficult question to answer since the other measures based on state aid may have other aims. Further, other measures could be constructed as other types of interventions in order to achieve the desired aim. Thus, the effect on the labour market of other performance indicators may only be indirect effects of the scheme in question.

One way of identifying the effects of alternative instruments is by including information on participation in other schemes. In the DD models, for example, one can include participation in other schemes as control variables. Hence, we use the information on participation in other schemes to explain variance in the chosen performance indicator. When the evaluation includes participation in other schemes as a control variable, it is possible to both eliminate the effects from the schemes in evaluating the RDSSC scheme and to evaluate the effect of other schemes on the performance indicators. If the evaluation still finds effects from the RDSSC scheme, these will be effects from social security contribution tax controlled for the effects that other measures have. Such an approach will include the following steps:

1. State whether there are any effects of RDSSC without controlling for the impact of other measures.
2. If RDSSC proves to have an impact, then include information regarding allocation of resources from other measures. This information should be presented by measure, the two categories of measures and as a total allocation of resources.
3. Assess whether or not the inclusion of additional information implies differences in the effects of RDSSC.

As stated in Section 2.5, we know that alternative measures fall into two categories: either measures aimed at households or investment schemes aimed at companies. Measures aimed at households are typically defined by geography. One example is the depreciation of student loans. In order to control for this, a control variable should be included at municipality level stating whether there are measures focusing on transfers to households.

Alternative effects from households can be assessed by including information on the level of household subsidies in equation (i) in $\bar{X}_{jt}$. Further, the information can be included in equation (iv) and again it will be in vector *X*. Thus we control for the impact that other measures aimed at households have on the selected performance indicator.

The other category focuses on companies. Here it is necessary to focus on company-level information and then aggregate the total amount of aid by municipality level. In order to normalise the amount of aid, the aid level should be divided by the number of private full-time equivalent employees in the municipality.

In order to analyse the effects, it is possible to include information on other aid measures in equation (i) in $\bar{X}_{jt}$. Further, the information can be included in equation (iv) and again it will be in vector *X*.

If any observed effect diminishes if information regarding other measures is included, the researcher should question the effect from the RDSSC scheme.

If the evaluation include full information regarding all alternative industry-oriented support schemes in Norway, the work will in principal lead to a full impact assessment of Norwegian funding system. As for the moment, the Statistics Norway is conducting this kind of analysis of the most important industry-oriented support schemes, except the RDSSC scheme. Evaluating all industry-oriented schemes might not be the intension of evaluating the RDSSC scheme, which is the present focus. The scope of the evaluation of other support schemes than the RDSSC scheme and the use of ongoing evaluations of industry-oriented schemes is primarily a question of the scope of the RDSSC scheme evaluation. This scope question should be determined before the evaluation start. Because the evaluation is taking into account the impact of alternative measures when estimating the effect of RDSSC, we recommend that the evaluators use knowledge from other works, including the ongoing work by Statistics Norway, when discussing if alternative policy instruments can provide the same result as RDSSC.

The level of public support in various measures may lead to diminishing returns to scale. Whether or not this is the case will be an empirical question and will probably be discussed in the aforementioned work at Statistics Norway. Because the use of alternative support schemes are particularly extensive within the RDSSC area, questions about diminishing returns will be particularly relevant in the discussion of alternatives to RDSSC. The evaluator must therefore address this question in particular when assessing whether or not alternative policy instruments can replace RDSSC.

6.5 Data, duration and work requirements and costs

The data needed for conducting the analysis as described in Chapter 5.1 can be divided into three main groups:

1. Performance indicators
2. Covariates or control variables
3. Key ID that can link individual companies and municipalities

For all groups we intend to identify as long a time series as possible. For several of the indicators the immediate time series runs from 2000 to 2013. This does not mean that data on the indicator cannot be obtained from before 2000. It simply means that the current active indicator covers this time series. In order to obtain older data there is a need for closer dialogue with Statistics Norway.

The evaluator should also chain different data series in order to obtain as long time series as possible for the evaluation.The RDSSC scheme was introduced as early as 1975. Throughout the years, there have been both large- and small-scale changes. It is possible to retrieve high quality data for the entire period. At least since 1993 the evaluator will have access to a very diverse and rich set of data. With stable and high quality data, this implies that changes in the measure can be seen as natural experiment giving the evaluator the strongest offset to conduct the impact assessment.

Performance indicators data

Performance indicators can be implemented both at aggregated level, e.g. at national level, by zone or municipality level, and at a more disaggregated level, e.g. at company level. The performance indicators from Table 2 and Table 4 can be obtained from the following registers at Statistics Norway (SN):

- Wage income: can be found at the division for income and wage statistics. The indicator is available at individual level at SN. In the offset the data are available for the period 1993–2013.
- Employment level and hence employment growth: can be found at the division for labour market statistics at SN. The indicator is available at individual level. In the offset the data are available for the period 1990–2013.
- Fixed assets at companies: can be found at the division for accounting statistics at SN. The indicator is available at company level. The data are available for the period 1999–2013.
- Use of variable inputs at companies: can be found at the division for accounting statistics at SN. The indicator is available at company level. The data are available for the period 1999–2013.
- Production level or value added at companies: can be found at the division for accounting statistics at SN. The indicator is available at company level. The data are available for the period 1999–2013.
- Operating profit (earnings before interest and taxes): can be found at the division for accounting statistics at SN. The indicator is available at company level. The data are available for the period 1994–2013.
- Disposable income: can be found at the department of income and wage statistics. The indicator is available at individual level at SN. In the offset, the data are available for the period 1993–2013.

- Labour market participation: can be found at the division for labour market statistics at SN. The indicator is available at individual level. In the offset the data are available for the period 1990–2013.
- Population size and changes measured by municipality of residence: can be found at the division for population statistics at SN. The indicator is available at individual level but is aggregated to municipality level. The data are available for the period 1968–2014.
- Municipal finances: can be found at the division for public finances. The indicator is available at municipality level at SN. The data are available for the period 1991–2014 (municipal accounts from 1991 and KOSTRA from 2001).
- State finances: can be found at the division for public finances. The data are available for the period 1985–2014.

Control variables data

Many of the control variables will be reused from our performance indicators. In addition to the performance indicators, we would point out the following key data:

- Classification of municipalities in terms of population density, cultural services and administrative level. This can be obtained from various sources. We would suggest the index of centrality developed by NIBR since it is the most detailed. The index was published in 2013.[13]

In addition to the above-mentioned, indicators on general company characteristics must be included. This includes information regarding company size, sector and geographic location by municipality. Similarly, indicators on population characteristics must also be included. These include:

- Educational level of the population, age group 17–70: can be found at the division for education statistics. The indicator is available at individual level at SN. The data are available for the period 1970–2013.
- Age distribution: can be found at the division for population statistics at SN. The indicator is available at individual level, but is aggregated to municipality level. The data are available for the period 1968–2014.

Data on key ID that can link individuals, companies and municipalities

The final point here refers to data that enable the researcher to link data between the various levels of interest. In the following we present data used to identify and link the various levels:

[13] The index is constructed by weighing figures against a number of relevant indicators of centrality, i.e. the number of inhabitants, number of employed, the number of persons commuting into the municipality, which services are available in the municipality, which public institutions are located in the municipality, and travel distance to service functions. See NIBR (2013).

- Serial number for individuals. This is available across the different divisions at SN which will link information on the individual to either companies or municipalities. The data are available if the individual has a Norwegian personal identification number, since they are derived from this number.
- Serial number for companies. This is available across the different divisions at SN which will link information on the company to either individuals or municipalities. The data are available if the company has a Norwegian organisation number, since they are derived from this number.
- Identification of which zone a municipality belongs to. This information is available from government authorities.

Estimates on total costs and duration

The cost of data is based on the cost structure of SN. The researcher needs to access several registers at multiple sections. Further, the researcher will need harmonised data covering a long time period. These are two costly determinants. Finally, it is vital that the researcher obtains a research contract for the evaluation in order for SN to accept the use of these micro-data.

It has not been possible to obtain an estimate of the data costs from Statistics Norway. Hence, we need to conduct our own assessment of the cost of data. We know that we will need data from at least 12 different divisions. All these registers need to be harmonised. Further, we see that there is an issue regarding the long time period. Here we want information from 1975 if possible. The typical cost of data at Statistics Norway is defined by the following two points:

- Coordination and clarification of data order, including administration
- Preparation of data, archiving and documentation

In terms of this project, we would estimate the cost of data at Statistics Norway and use of existing regional economic and demographic models to be:

Task for Statistics Norway	Expected hours spent	Price in NOK
Coordination and clarification of data, including administration.	151.5	134 000
Preparation of data, archiving and documentation.	278	246 000
Total cost excl. VAT		380 000
VAT		95 000
Total costs		475 000

We estimate that the evaluator will use 200 hours of work when ordering data from Statistics Norway. This includes collecting necessary approvals, specifying a detailed order form, dialogue and re-specifications, and most probably meetings with Statistics Norway.

In addition to the costs of ordering data from Statistics Norway, we estimate the use of 600 hours of work with the evaluator, related to organising the data and collecting data from open sources and from various government bodies (social security contribution tax rates and income, and other instruments).

It is also important that the evaluator thoroughly establishes an analytical and logical approach before conducting the estimation. This includes a theoretical analysis similar to that performed in Chapter 4, but in much more explicit form. In addition, the evaluator should specify the econometric specification in detail during this stage. It is advisable to do this before ordering data. We estimate the use of 350 hours of work for this part of the evaluation.

For the actual estimation, documentation and organisation of the project, we estimate a total of 1,950 hours of work.

Finally, we have included a sum equivalent to 400 hours of work for regional model analysis. In this sum, we have estimated 150 hours of work for small adjustments to the existing models in order for the models to match the specific issues concerning the RDSSC scheme.

Table 9 summarises the duration of the various stages, the hours of work needed and their costs measured in 2015 prices/wages. In total, we estimate the use of 3500 hours of work. At an hourly rate of NOK 1400, and adding the costs of ordering data from Statistics Norway, the total cost of evaluating the RDSSC scheme is estimated at NOK 5,280,000 exclusive of VAT, or NOK 6,600,000 inclusive of VAT.

The proposed timeline is based on estimated duration of each stage of the evaluation process, where each stage builds successively on the work from the previous stage. The total evaluation period stretches over two and a half years. Hence, there is a need for communication between the principal, the evaluator and other expert groups during the period. In the timeline, we have taken into account that the evaluator presents preliminary findings in meetings, seminars, workshops or milestone reports. In particular, we recommend arranging a seminar during the second quarter of 2017, where the evaluator presents the results from the DD estimation and where methodological issues are discussed with other expert groups.

Table 9: Estimated time, hours of work and costs for evaluating the RDSSC scheme using DD estimation

	Period	Hours of work	Costs excl. VAT based on NOK 1400* per hour
Establishing the analytical and logical approach	Oct. 2015 – June 2016	350	490,000
Ordering and collecting data	Dec. 2015 – July 2016	200	Data: 380,000 Work: 280,000
Preparing necessary databases	Oct. 2015 – Aug. 2016	600	840,000
Estimation and interpretation	Sept. 2016 – June 2017	1100	1,540,000
Analysis using regional economic and demographic models	April 2017 – Oct. 2017	400	560,000
Documentation	Nov. 2017 – Feb. 2018	500	700,000
Meetings, coordination and administration	Oct. 2015 – Feb. 2018	350	490,000
Total		**3500**	**5,280,000**

*Measured in 2015 prices/wages

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