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A cost-benefit analysis of Covid-19 response policies
A comparison of Sweden and Norway

Cajsa Dalne (24280) and Yohannes Hailom (23287)

Abstract. As the end of the Covid-19 pandemic is approaching, it is timely to assess different response policies. Utilizing the sweeping similarities between Sweden and Norway, the relative efficiency of their respective policies during the pandemic period have been assessed. A cost-benefit analysis was conducted using health economic methods to translate the health effects into monetary values. The benefit was expressed as relative QALYs lost in monetary terms and the cost in relative GDP performance. The results show that Sweden experienced a 4,5 times larger GDP per capita loss and a 5,3 times larger loss of QALYs per capita than Norway. This paper concludes that during the pandemic period, Sweden has lost 54 094 SEK per capita and Norway 11 395 SEK per capita. This implies a 4,7 times larger total net loss for Sweden compared to Norway. These results remain robust after conducting a series of sensitivity analyses testing the assumptions made in this paper. It is suggested that the main driver of these results was the responsiveness in the country's initial response policy.

Keywords: Covid-19, Cost benefit analysis, Health economics, Public policy, Stringency index

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Abbreviations

The following abbreviations are used in this paper.

CBA= Cost Benefit Analysis

EQ-5D= EuroQoL 5 Dimensions

GDP= Gross domestic product

NBHW= National Board of Health and Welfare (Socialstyrelsen)

NICE= National Institute for Health and Clinical Excellence

NIPH= Norwegian Institute of Public Health (Folkhelseinstituttet, FHI)

NPI= Non Pharmaceutical Interventions

OECD= Organisation for Economic Co-operation and Development

OxCGRT= Oxford Coronavirus Government Response Tracker Project

PHAS = Public Health Agency of Sweden (Folkhälsomyndigheten, FHM)

PPP =Purchasing Power Parity rate

QALY = Quality Adjusted Life Years

SSB= Statistics Norway (Statistisk SentralByrå)

SCB= Statistics Sweden (Statistiska CentralByrån)

TLV= The Dental and Pharmaceutical Benefits Agency

VSL= Value of Statistical Life

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1. Introduction

On the 24th of January 2022, WHO director for Europe Hans Kluge expressed that Omicron was moving the pandemic into a new phase and that the new variant could bring the pandemic to an end in Europe (AFP 2022). Denmark became the first country in the European Union to remove all their Covid-19 restrictions as of 1st of February (McLean, Doherty et al. 2022). The two Nordic countries Sweden and Norway followed swiftly announcing the repeal of their Covid-19 restrictions only two weeks later (Regeringskansliet 2022), (Norwegian Government 2022). After two years of Covid-19, the virus is becoming increasingly manageable. It seems as if Europe is preparing for a life post pandemic.

During these two years, different approaches have been observed to contain the virus. Sweden became notorious for relying on recommendations and not severe restrictions (Pickett 2021). Contrastingly, New Zealand committed to eliminate the virus through lockdown (Ministry of Health, N Z 2021). Since it is not a matter of *if* but *when* there will be another pandemic, policy makers need to understand the effects of Covid-19 and the response policy. An example of such evaluation is "Corona Kommissionen", a commission appointed by the Swedish government to understand how Sweden managed the pandemic.

In an effort to understand the implications of a chosen response policy, this paper studies a Nordic case. A region of countries known for their welfare states, strong trust in institutions and firm democratic beliefs. However, when the Covid-19 virus surged in Europe and WHO declared a pandemic, the Nordic countries did not act cohesively. While Denmark, Norway and Finland followed the rest of the world and implemented severe restrictions, Sweden relied on recommendations. Considering these countries' overall similarities and Sweden's singular approach to Covid-19, this Nordic case is rare. This set-up allows for an evaluation of corona response policies while minimizing differences and sustaining validity of the results.

This paper aims to evaluate the Covid-19 response policy of Sweden and Norway, using health economic methods in a cost-benefit analysis. More specifically, this paper aims to answer the following question:

Out of the two Covid-19 response policies, which one was the most efficient?

Before indulging in this matter, a general background of the Covid-19 virus, non-pharmaceutical interventions i.e. restrictions and the subject of health economics will be presented. Thereafter, a proper walkthrough of the theoretical concepts needed to understand a health economic cost-benefit analysis and associated tests of robustness. Finally, an exposition of the current state of the research field will be presented before the case, question and results of this paper are put forth.

2. Background

2.1 About SARS-CoV-2

The Covid-19 disease is an infectious disease caused by the Severe Acute Respiratory Syndrome Coronavirus 2, SARS-CoV-2. This name was chosen by the World Health Organization, WHO, because the virus is genetically related to the coronavirus responsible for the SARS outbreak of 2003 (WHO 2022b). In this paper, the virus is hereafter referred to as “Covid-19”.

The majority of infected people experience mild to moderate flu-like symptoms such as cough and fever. The majority recover without hospitalization or specific treatment. However, old people and people with underlying medical conditions such as cardiovascular disease, diabetes, or chronic respiratory disease are more likely to develop serious illness (WHO 2022a). The virus spreads through short-range aerosol transmission which implies either inhalation of virus particles that are released when an infected person speaks, coughs or sneezes or through direct contact with droplets containing the virus through the eyes, nose, or mouth. To prevent and slow down the spread, distancing and hygiene are the most important preventions (WHO 2022).

Covid-19 have a higher tendency to mutate than other types of viruses. The most recent variant, Omicron, which began to dominate infectious cases in the end of 2021, causes less severe disease but spreads more easily (R Bollinger, S Ray, L Maragakis 2022).

To slow down transmission, countries have chosen different approaches. However, essentially all of them include the implementation of non-pharmaceutical interventions.

2.2 Non-Pharmaceutical Intervention

When a society faces an outbreak of an infectious disease, there are primarily two methods to mitigate the spread, pharmaceutical drug treatments and non-pharmaceutical interventions (NPIs). NPIs are actions that individuals, groups or societies can implement to contain the spread. These interventions range from washing your hands more frequently or wearing a face mask to travel bans or curfew (CDC 2020). NPIs play a major role in reducing the pressure on public health services, until an efficient and affordable medical treatment is available. Hence, NPIs play a vital but somewhat complementary role in eradicating the disease (Aledort, Lurie et al. 2007).

The drawbacks of NPIs are the adverse effects on the well-being of the population, the economy and society as a whole (ECDC 2021). Depending on the stringency of NPIs, economic activity is decreased. NPIs that are of lockdown characteristics i.e., curfews, travel bans and limits on public gathering, naturally complicate people’s working lives. The economic effect will differ depending on the industry. Naturally the tourism industry will experience larger direct negative effects due to a travel ban than the television broadcasting industry. However, there are other negative effects that arise from economic uncertainty such as increased risk of mortality or mental illness (Bryan, Buajitti et al. 2021).

In the beginning of the pandemic, several countries implemented severe NPIs i.e., lockdown. A lockdown can be defined as “a temporary condition imposed by governmental authorities as during the outbreak of an epidemic disease in which people are required to stay at their homes and refrain from or limit activities outside the home involving public contact" (Merriam-Webster 2022). However, there is no formal definition of a lockdown expressed in terms of specific NPIs. Therefore, instead of treating Covid-19 response policy as a binary variable of lockdown, a stringency index is used in this paper to illustrate the sternness of the NPIs implemented.

2.2.1 Stringency Index

A stringency index depicts a country's Covid-19 response policy by presenting a composite measure of several NPIs. Using an index, a better understanding is attained of the sternness of countries' response policies. A commonly used stringency index is the Covid-19 Stringency Index, created by Oxford Coronavirus Government Response Tracker (OxCGRT) project. This index was calculated using nine metrics including school- and workplace closure and restrictions on internal movement. The index ranges from 0-100 where 100 implies literal lockdown. The following example illustrates the concern with a binary view on lockdown: Norway, France and New Zealand were considered to have implemented lockdown during April 2020. These countries experienced a stringency of 76, 87 and 95 respectively, indicating sternness but no cut-off level for lockdown (Hale, Angrist et al. 2021). This index will be the main depiction of a country's chosen response policy in this paper.

2.3 Health Economics

One of the main ideas of economics is decision-making with resource constraints. In society, assessments of different alternatives in order to maximize value within existing constraints are necessary. Policy evaluation thus becomes a significant task in all sectors of society. This concerns the health sector especially, as the demand for healthcare increases and the technology used becomes more complex and expensive (SBU 2021). A health economic analysis enables comparison of interventions that have different health effects and costs. However, healthcare policy evaluation is unique as policy makers have an ethical complexity in estimating the economic value of a human life (SBU 2020)).

2.3.1 Economic evaluation methods for Health Policy

In health economics, an evaluation of two possible interventions is conducted by a comparison of their respective health effects and costs. There are four primary methods of evaluation: Cost Minimization Analysis (CMA), Cost Effectiveness Analysis (CEA), Cost Utility Analysis (CUA) and Cost-Benefit Analysis (CBA). The first three methods are based on the same core methodology. The CBA is the only method that aims to monetize both the costs and health effects i.e., benefits (SBU 2020).

The CMA is used whenever two interventions, equivalent in terms of health effects, are compared. It aims to conclude what intervention is most affordable to implement (SBU 2020). The CEA compares the costs of an intervention with a one-dimensional measure of effect such as years of life gained. The CUA applies a multidimensional measure that combines years of life gained and the quality of life. One common measure that captures both these aspects is QALY – Quality Adjusted Life Years (SBU 2020).

The CBA could be described as a continuation of the CUA since the benefits are monetized, enabling a full comparison. However, there are practical and ethical difficulties in monetizing the benefits such as quality of life or welfare. Progress has been achieved in this area, but many questions remain unanswered (SBU 2020).

3. Theoretical concepts

In this section, different components in a health economic CBA are covered. The different approaches to measure and monetize benefits are explained and the alternatives of cost. Finally, the concept of a sensitivity analysis is presented to test the robustness of a CBA.

3.1 Benefit

There are many methods to assess the benefits of a policy. The ideal case would be to include all positive effects, both intended and unintended. However, all-encompassing measures of general welfare are complex and difficult to access. Different researchers have attempted to capture certain aspects of benefits of Covid-19 response policies. For example, Alfano and Ercolano (2020) study the intended effects of lockdown on spread of the virus measured by the reproduction rate. Gatti and Retali (2021) uses computerized modeling to predict the number of potentially saved lives due to Swiss lockdown. Other research focuses on unintended effects such as decreased levels of pollution in India (Becchetti, Conzo et al. 2022), positive effects on life quality in New Zealand (Jenkins, Hoek et al. 2021) or improved water quality in China (Liu, Yang et al. 2022).

Encountering the difficulties to measure total effects of a policy, the focus in this paper is the intended effects. Two alternative approaches to measure intended effects of Covid-19 response policies are number of Covid-19 cases and number of deaths due to Covid-19 infection. People that get infected but survive, mostly recover within a short time frame, thus the loss is temporary. However, people that get infected and eventually die, incur a permanent loss. Even though infection spread precedes death, the effect that is considered in this paper is the permanent loss i.e., death cases or mortality.

3.1.1 Mortality measures

Three common identification methods for Covid-19 related deaths are 1) a positive test result within a certain time frame from point of death, 2) Covid-19 reported as reason of death by health care personnel, and 3) excess mortality. Each method has positive and negative aspects. Different countries and authorities within each country use different methods.

The first method is defined as individuals who have received a laboratory-confirmed Covid-19 diagnosis and have been reported as deceased within 30 days of the diagnosis. This method is used by the Public Health Agency of Sweden (PHAS 2022) and Norwegian Institute of Public Health (NIPH 2022b). Both institutes conduct manual correction of the statistics to exclude false positives and false negatives. In this context, false positives are patients reported as deceased *due to* the virus but died *with* the virus. False negatives are patients with no laboratory confirmed infection within the specified time frame, but healthcare personnel determine Covid-19 as the cause of the death (NBHW 2021c). The second method implies that Covid-19 has been stated on the cause-of-death certificate issued by the doctor treating the deceased patient. This measure is used by The National Board of Health and Welfare (NBHW 2022) in Sweden. The third method, excess mortality, is defined as “the difference in the total number of deaths in a crisis compared to those expected under normal conditions” (WHO 2021). Excess mortality tells us all lives saved or lost due to Covid-19 and/or the policy chosen. Thus deaths are not necessarily caused by Covid-19 but the circumstances of the pandemic.

The correlation coefficients between these measures have been estimated to at least 0,91, indicating strong coherence (Kalischer Wellander, Lötvall 2021). Thus, these measures could be used interchangeably in a benefit-analysis of the Covid-19 response policies.

3.1.2 Quantifying benefit

To compare costs and benefits, both must be expressed in the same unit. Since the costs are expressed in Swedish krona (SEK), the benefits must be monetized. In the following section, the background for this conversion is explained.

3.1.2.1 VSL and QALY

Different methods for monetizing health effects have been developed in the joint area of medicine and economics. When forming or evaluating public policy, Value of Statistical Life (VSL) is commonly used to determine the economic value of human life. To illustrate how VSL is calculated, consider the following example: if 100,000 people are each willing to pay 100 SEK to save one life, the VSL in this example is 10 million SEK. A widely referenced meta-analysis published by OECD in 2012 derives the value of VSL from surveys where people around the world have been asked about their willingness to pay for small reduction in mortality risks (OECD 2012).

Examples of authorities using VSL when assessing interventions to prevent accidents with deadly outcomes are the Swedish Transport Administration and the Swedish Environmental Protection Agency. To summarize, VSL is a statistical term that represents how much society would be willing to spend to prevent one accidental death (Hultkrantz 2020).

A common measure of health-benefits is QALY, a widespread measure within the medical field. For example, The Dental and Pharmaceutical Benefits Agency, TLV, bases their decisions for reimbursement of treatments on QALY calculations (TLV 2020). QALY measures the benefit of an intervention by combining the life years a patient might gain with the quality of remaining life years. QALY combines these two factors into a “QALY weight” ranging from 0 (death) to 1 (full health) for each year of the remaining life years. Another use of QALY is the estimation of lost life years due to a fatal accident. The lost QALYs express the lost life years having considered the quality of those life years. The lost QALYs due to the accident could therefore be expressed according to formula 1 below.

$$QALYs\ lost = \ QALY\ weight\ \times\ Lost\ life\ years \tag{1}$$

For example, two individuals suffer a fatal accident and lose 15 years of life but experience different qualities of life. The lost life years are multiplied with different QALY weights e.g., 0.6 and 0.8, which translates into 9 and 12 lost QALYs respectively.

3.1.2.2 QALY weight calculation

The above-mentioned QALY-weight can be calculated through direct or indirect methods (Bernfort 2012). In direct methods individuals evaluate different health-states by rating them on a scale from 0 to 1. The methods are used either directly on patients with a certain disease or a sample of the general population that rates hypothetical health-states.

The indirect methods rely on responses to questionnaires or "quality of life instruments" (examples of such instruments are EQ-5D, SF-6D och HUI-3). The responses are converted into QALY weights using a scoring system known as a "tariff", which in turn is obtained using one of the direct methods (SBU 2022). Thus, the respondent does not themselves estimate their health status.

The EQ-5D is a generic instrument that is widely used in research worldwide to estimate QALY weights (EuroQol Office 2022). It consists of a questionnaire where the respondent answers questions within 5 dimensions (5D): mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension is rated as: no problems, some problems, and extreme problems.

3.1.3 Translation into monetary value

A difference between VSL and QALY is that VSL is expressed in monetary terms by design while QALY needs to be monetized using different methods of valuing a human life. The final step in a health economic evaluation is to translate QALY into monetary values. The choice of method used as a basis to monetize QALY varies between countries and context thus there is no evident method to use (Santos, Guerra-Junior et al. 2017). Examples of basis to monetize QALY include VSL and GDP per capita.

In Sweden, there is an explicit VSL value of 40,5 MSEK expressed by the Swedish Transport Administration (Hultkrantz 2020). However, the value of a QALY is not explicit. A research group investigated TLV's historical decisions and estimated an implicit range of 0,75-1,3 MSEK (Santos, Guerra-Junior et al. 2017). In Norway, both the VSL value and QALY value are explicit. The VSL value is set at 37 MNOK and the QALY value is set at 0,7 MNOK (Government of Norway 2013). In Table 1 below, an overview of the valuation per VSL and QALY is shown for Swedish and Norwegian authorities.

Table 1.VSL and QALY values for Swedish and Norwegian authorities
Sources: Government of Norway 2013; Hultkrantz 2020; Santos, Guerra-Junior et al. 2017

Country	**VSL**	**QALY**
Sweden	40,5 MSEK Swedish Transport Administration	0,75–1,3 MSEK [1] TLV
Norway	37 MNOK[2] Norwegian Public Roads Administration	0,7 MNOK[3] Norwegian Directorate of Health

In the United Kingdom, the National Institute for Health and Clinical Excellence (NICE) proposes a range between 20,000 and 30,000 GBP per QALY (McCabe, Claxton et al. 2008). The NICE Citizens Council has concluded that interventions costing in excess of the upper limit of GBP 30,000 per QALY can be recommended in cases where the health condition is severe, and the intervention is of lifesaving nature (NICE Citizens Council, 2010). US health economists use values around $125,000 per QALY, a valuation over three times the NICE value (Goldstein, Lee 2020).

Further, the WHO proposes GDP per capita as a basis for QALY valuation. Interventions with a cost per QALY gained of less than GDP per capita are classified as "very cost effective". Interventions with a cost per QALY gained of between one to three times GDP per capita are categorized as "cost effective", while measures with a cost per QALY gained of more than three times GDP per capita are

[1] 700 000 SEK in 2017 prices corresponds to 745 814 SEK and 1,22 MSEK corresponds to 1,299.847 SEK in 2021 prices
[2] 30 million NOK in 2012 prices corresponds to 37,080,127.76 NOK in 2021 prices
[3] 500 000 NOK in 2005 prices corresponds to 705,438.76 NOK in 2021 prices

categorized as “not cost effective” (Rodgers, Vaughan 2012). The above-mentioned examples demonstrate the spread of QALY valuations between countries.

3.1.4 Discounting benefit

Discounting benefits implies a positive time preference for health. People value full health today and postpone getting sick (or die) into the future. However, since health benefits are difficult to value, it is a challenge to set the discount rate. Further, health benefits and monetary costs are discounted for different reasons and should therefore not necessarily be discounted by the same factor. These two difficulties have raised a debate of whether and how to discount QALYs (Bernfort 2012). On the other hand, if health-benefits are not discounted, it is assumed that the value of health benefits do not depend on when they occur. In Sweden, TLV recommends a discounting rate of 3 percent both for health benefits and costs when evaluating new interventions (TLV 2017).

3.2 Cost

Restrictions were implemented to stop the spread of Covid-19 and save lives. The costs every country had to bear were the negative impact of NPIs. These costs range from unemployment to the mental distress stemming from reduced social contact. Similar to the section discussing measures of benefit, in the optimal case the cost of NPIs would also be expressed using an all-including measure of welfare. Since that option is not easily accessible, a measure that capsulizes several negative effects is Gross Domestic Product, GDP.

3.2.1 GDP as cost-measure

GDP measures the monetary value of final goods and services produced in a country during a period. It counts all the output generated within the borders of a country. GDP is composed of goods and services produced for sale in the market and includes some non-market production, such as defense or education services provided by the government (Oulton 2012).

There are three main approaches to calculating a country’s GDP. *The production approach* sums all the added value at each stage of production. The value added is defined as the total sum of sales minus the input of production. *The expenditure approach* adds together all purchases made by final users such as household consumption of food and medical services. *The income approach* sums all income i.e workers’ salary and profit made by firms. If correctly calculated, all approaches result in the same GDP (Callen 2020a).

One of the main purposes of GDP as a measure is to assess the economic growth of a country. Since a country’s GDP is collected at prevailing prices, inflation must be accounted for to enable comparison across years resulting in real GDP. Since GDP commonly is expressed in local currency, conversion into a common currency is necessary for comparison. The conversion is based on a market exchange rate or a purchasing power parity (PPP) conversion rate. The market exchange rate is simply the rate that prevails at the foreign exchange market i.e., the rate that balances supply and demand of a certain currency. The PPP conversion rate is the rate at which the currency of one country would have to be converted into that of another country to buy the same amount of goods and services in each country. The PPP conversion rates compiled by OECD are based on a comprehensive basket of goods and services (OECD 2021). The proper choice of conversion method depends on the task at hand. For instance, if a GDP comparison across regions of the world is conducted, the financial flows occurring intra-regionally is considered by the market exchange rate. However, a comparison between countries might be distorted due to volatility in market exchange rates. The use of PPP conversion rate is appropriate whenever there is an aim to capture the level of livelihood in a country. However, a drawback of the PPP-method is that it is hard to compile, especially for countries with low levels of public administration. Finally, since countries vary in size of population, using GDP per capita allows comparison between all countries (Callen 2020b).

Using GDP as an approximate measure of welfare has advantages and disadvantages. A rise in the outcome of goods and services per person (GDP per capita) is viewed as the average person being better off. However, the GDP per capita growth does not reflect the negative side effects such as pollution. Furthermore, since GDP per capita is the ratio of aggregate GDP and the population, it does not take economic inequality into account (Callen 2020). Finally, GDP fails to consider non-market factors such as leisure, health and household production such as cooking and childcare. However, GDP per capita has been shown to capture the main component of welfare (Bannister, Mourmouras 2018) and to be highly correlated with other relevant factors such as infant mortality and life expectancy (Oulton 2012). To conclude, economic prosperity is closely tied to welfare which makes GDP an implicit indicator and a suitable cost measure in this paper.

3.2.2 Discounting cost

Discounting monetary values can be simply explained; an individual would prefer X amount of SEK today rather than X amount in the future adjusted for inflation. In the context of this paper, costs should be discounted in order to take the time value aspect into consideration. More specifically, if a net result is expressed as of end 2020, then all costs related to 2021 needs to be discounted to 2020.

3.3 Sensitivity analysis

All CBA are based on a set of assumptions. In order to test the robustness of the model, a sensitivity analysis should be performed. This illustrates how changes of an assumption affects the results. If the model is robust, these changes do not change the main conclusions. The simplest form of a sensitivity analysis is a one variable analysis. However, a multivariable analysis is possible to perform but more complex (Bernfort 2009).

The assumptions that should be tested in the sensitivity analysis depend on the CBA structure. Common assumptions to test in health economic models are the discounting rate for costs and benefits and different QALY valuations. For example, the Norwegian Knowledge Center for the health services proposed an NOK 100,000-1 million per QALY for sensitivity analysis purposes (Government of Norway 2013). Concerning GDP as a measure, it is crucial to test whether country-specific economic factors, such as the size or the growth of the economy, are assumptions that should be tested.

4. Literature review

The Covid-19 literature is in some respects extensive but in others highly uncharted. A quick overview indicated that most of the research concerns medical aspects. Single articles related to societal effects exist but literature of higher scientific quality such as systematic reviews are limited. A reason is that the world has to be at the end of the pandemic to assess the effect on society. To conclude, the literature relating to a CBA of Covid-19 response policies is scarce and characterized by reductionist approaches and modeling of counterfactual realities.

In this section, earlier research aiming to capture societal costs and benefits of the Covid-19 response policies is presented. Moreover, researchers' dependence on modeling to evaluate a lockdown will be discussed. Also, research utilizing the Nordic countries as a context to study Covid-19 due their sweeping similarities is presented, legitimizing the case in this paper. Finally, research on different Covid-19 response policies' effect on society is presented. Finally, the research gap will be illuminated and this paper's contribution to filling it.

4.1 Benefits and costs

Until recently, the papers that aimed to capture response policy's entailed costs and/or benefits have applied a reductionist approach. Many papers do not combine costs and benefits or they have captured a specific consequence of the policy. Capturing environmental effects of lockdown, Liu et al. (2022b) measured water quality in China before and after lockdown. They found a significant improvement in water quality. A paper by Stieger et al. (2021) aimed to assess the emotional toll of the pandemic and lockdown on Austrian adults. They found that more time spent in nature improved emotional well-being while excessive screen time had a negative effect. Other papers aim to capture effects tied to domestic violence (Bullinger, Carr et al. 2021) and economic uncertainty (Buajitti, Rosella et al. 2021). Papers examining specific costs or benefits are characterized by considering relevant but specific costs or benefits. Finally, these papers frequently lack a monetization element.

4.2 Modeling

Lockdown evaluation and optimal duration has been a common research topic during the pandemic. In the beginning, researchers relied on modeling to create counterfactuals. A systematic review of the modeling literature concludes the SIR-model (Susceptible, Infected, Recovered)[4] as the most utilized epidemiological model (Rezapour, Souresrafil et al. 2021). In a paper by Palma et al (2020), an extended version of the SIR-model was used to assess the health effects and economic costs of lockdown. It concludes that the net result of the Belgium policy was negative for low valuations of lives saved. The downside of modeling is the oversimplification and associated risk of distorting reality. A critical assessment of the Covid-19 lockdown evaluation literature revealed that reliance on modeling results in overestimation of benefits and underestimation of the costs of lockdown (Allen 2021).

[4] This model predicts disease spread and the duration of a pandemic. The model can be used to estimate the effect of different public health interventions.

4.3 The Nordics

In the search for counterfactuals, the use of cross-country comparisons has been common. When inferring causality, the countries must be sufficiently similar in aspects other than the aspect being examined. The Nordic countries Denmark, Norway, Finland, and Sweden share similarities. However, regarding Covid-19 response policies, the Swedish government initially decided to rely on recommendations. Comparing Sweden to other Nordic countries allows researchers to compare different Covid-19 response policies while minimizing differences, sustaining the validity of the conclusions. Several researchers who used the Nordic case highlight these countries' similar profile in ethnic-, age-, and sociodemographic-distributions of the population. Further, the similar economic profiles and comparable health care systems and public health infrastructures is highlighted. Although some existing differences e.g., population density and culture, might have influenced each respective country's policy choices. The broader similarities enable useful comparisons to determine the impact of the differences in Covid-19 response policies (Conyon, He et al. 2020, Yarmol-Matusiak, Cipriano et al. 2021, Chen, He 2021).

A comparison of epidemiological indicators during February - July 2020 in Norway, Sweden, Denmark and Finland find the Swedish lenient initial response likely played a role in the severe impact of Covid-19 in Sweden. They found that Sweden had a higher incidence rate across all ages, a higher Covid-19-related death rate only partially explained by population demographics, a higher death rate in seniors' care and higher all-cause mortality (Yarmol-Matusiak, Cipriano et al. 2021).

With the aim to evaluate a lockdown effect, Born et al. (2021) creates a counterfactual lockdown scenario for Sweden. They constructed a synthetic control unit of European countries (Norway, Denmark and Finland included) that implemented lockdown during the period 15 March - 17 May 2020. They find that a 9-week lockdown in the first half of 2020 would have reduced Covid-19 infections and deaths by 75% and 38% respectively. Finally, compared to actual Swedish mobility adjustments, there was a substantial voluntary mobility change among Swedes but not as substantial as in the lockdown scenario.

4.4 Response policy

The negative relationship that exists between severe NPIs and economic activity is evident. However, changing levels of stringency imply dynamics that must be understood. In a paper by König and Winkler (2021), an analysis of two different strategies' effect on GDP growth is conducted. An elimination strategy is briefly explained as swiftly implementing severe NPIs to contain the virus and when the situation allows, immediately repeal them. A mitigation strategy implies that countries live with the virus as normal as possible. The authors find that countries pursuing an elimination strategy suffered less severe effects on the 2020 GDP growth than countries employing a mitigation strategy.

4.5 Existing health economic research

In the existing health economic literature, Miles et al. (2020) estimate how many lives that might be saved in a CBA of potential lockdown policies in the UK. They express these saved lives in monetized QALYs using NICE guidelines. These benefits are compared to estimated GDP loss, consequential of the policy. The paper concludes that continuing severe restrictions are undesirable and targeted measures should be considered. Yakusheva et al. (2022a) conduct a CBA of the US Covid-19 response policies during the first six months of the pandemic. The authors estimate the lives potentially saved by the policy and compare them to the lives potentially lost due to the economic downturn caused by the response policy. They conclude that the number of lives saved by the lockdown was greater than the number of lives potentially lost. However, when converting lives into QALYs, the net effect was ambiguous. The existing research that does apply a health-economic perspective remains questionable due to mentioned issues related to modeling and difficulties in using QALYs.

4.6 Research Gap and Contribution

The lack of a health-economic perspective together with dependence on modeling and a reductionist approach, summarizes the existing gap in the literature. First, this paper will contribute by studying the whole pandemic period of 2020-2021. This allows a holistic analysis compared to mentioned papers that have consequently studied periods of lockdown. Second, this paper will contribute by presenting empirical results. Third, this paper presents a CBA where costs and benefits are monetized and compiled in a net analysis. This facilitates policymaking as the monetized results are comparable to other interventions. Finally, these contributions are made possible using a valid case, Sweden and Norway.

5. Research question and scope

As mentioned, this study fills a gap in the literature by evaluating the Covid-19 response policy of Sweden and Norway, using health economic methods in a CBA. More specifically, this paper aims to answer the following question:

Out of the two Covid-19 response policies, which one was the most efficient?

In this context, comparing the two countries, efficiency implies achieving the superior net result.

The hypothesis is based on earlier research as described in the literature section. The hypothesis is the following: *A country with more responsive restrictions will result in lower death rates and a smaller economic burden for society than a country with more uniform restrictions.*

The scope of the research question is limited to evaluation of the intended effects[5] of Covid-19 response policies. As will be described in the section 7.1, the benefit is defined as the relative amount of lost QALYs due to lives lost during the pandemic period. Thus, other benefits such as preventing Covid-19 cases or preventing being hospitalized are not included in the scope. The cost only captures what is directly reflected by the relative GDP per capita performance during the period of examination. This implies that other measures of cost such as unemployment or sick leave are not explicitly expressed. Although GDP is related to other factors (as described in Section 3.2.1), the relative GDP performance expressed in this paper is intended to only reflect the direct economic effect of each country's Covid-19 response policy.

The paper includes data from 1st of January 2020 until 30th of December 2021[6]. This period is referred to as the *pandemic period* throughout this paper. The Covid-19 related restrictions were released in Sweden by the 9th of February (Regeringskansliet 2022) and the 12th of February in Norway (Regjeringen 2022). Therefore, it could be argued that the first period of 2022 should be included. However, the Omicron variant dominated the second week of 2022 in Norway (85.7%) and Sweden (61.5%) and it is not as fatal as the previous Delta variant in addition to the protection offered by vaccination (ECDC 2022). Further, reliable GDP data on the first months of 2022 was not accessible by the time the analysis in this paper was conducted which led to the decision to have similar period coverage on both costs and benefits.

[5] See section 3.1

[6] Data for 31st of December is not included in the paper since it is missing in INED-databases.

6. Case

6.1 Sweden and Norway

The two neighboring countries, Sweden, and Norway are comparable in many aspects. Both countries share geographical characteristics incl. climate and natural resources excl. Norway's oil and gas. Further, both countries are parliamentary constitutional monarchies and have comparable legal systems. Sweden's population is twice as large, but the countries share similar population pyramids, characterized by a majority of 25–54-year-olds and an aging population (CIA 2022). Both countries score amongst the top in the Human Development Index, an index created by the United Nations Development Programme (UNDP). It ranges from 0-1, indicating the level of welfare in a country where Norway is rated 0,957 and Sweden 0,945. The index compiles a vast and wide range of prosperity related measures (UNDP 2020). When observing the last 60 years of GDP development, it can be concluded that despite level differences, the countries have experienced similar economic growth, see Figure 1 below. The level difference is partly explained by Sweden's larger population.

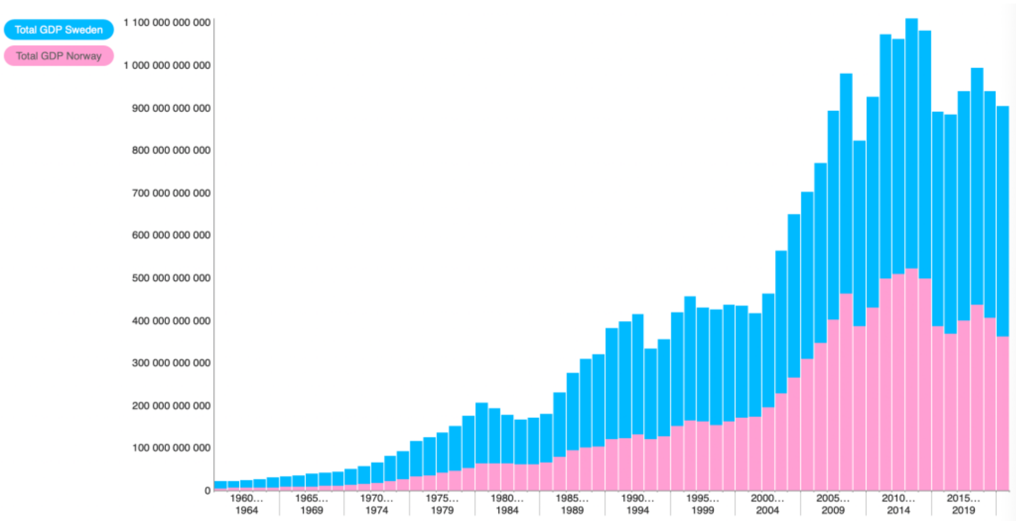

Figure 1. Total GDP for Sweden and Norway from 1960-2019 in current US dollars
Source: World bank, 2022

The economic resemblances are clear also when observing each country's key indicators incl. debt, import/export (Statista 2021). Further, from a cultural and social standpoint, Sweden and Norway are positioned high on Secular and Self-Expression Value on The Inglehart-Welzel World Cultural Map (World Values Survey 2020). Further, the two countries share the same health care structure which is worth highlighting during the pandemic period (NOMESCO 2021, Einhorn 2019). The similar health care structure has also been reflected in how registration of Covid-19 related death cases has been conducted. The two Nordic countries have comprehensive and centralized national population registers and causes of death registers which are the main registers the data from national authorities relies on (NBHW 2021).

6.2 Government response policy

Using the Covid-19 Stringency Index, the response policies for both countries are presented below. In Figure 2 below, Sweden (blue) and Norway (pink) government responses are presented using the stringency index. During the first year of 2020, there are discrepancies in how the two different countries respond to the Covid-19 pandemic. Norway rised rapidly, reaching an all-time high of 79.63 by the end of March and later relaxed the restrictions down to a level of 32.41, ending the year by rising to a level of 73.15. Sweden did not respond as rapidly, they eventually settled on a level of circa 60 at which they remained until November. In December, Sweden rose to their all-time high of 69.44. During 2021, it can be concluded that the two countries co-moved at a high level. To summarize, Norway was quicker to respond and experienced distinct highs and lows. Sweden was slower to respond and remained on a steady level of stringency. Therefore, Norway's response policy could be described as relatively more responsive while Sweden's response policy as relatively more uniform.

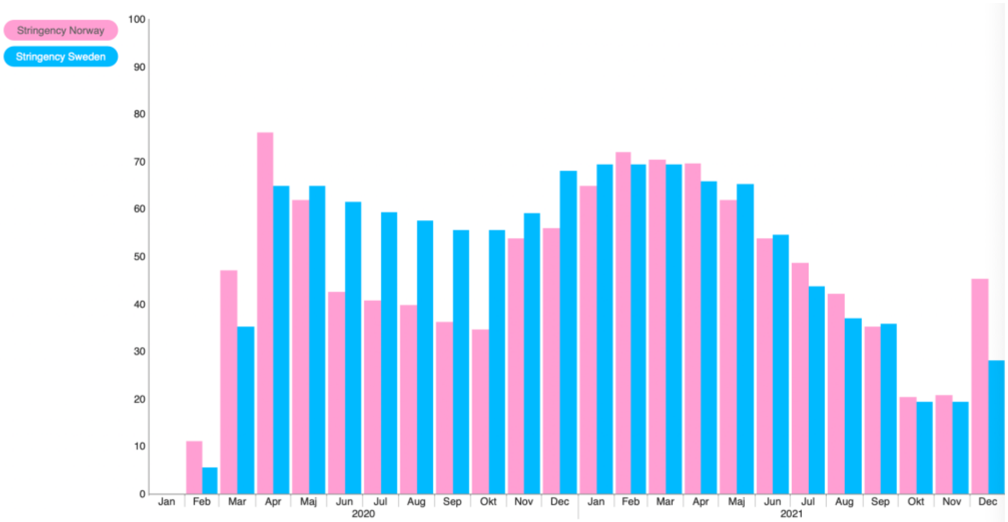

Figure 2. Covid-19 Stringency Index for Sweden and Norway
Source: Hale, Angrist et al. 2021

In order to better understand how these two countries differed in stringency, Figure 3-6 represents some of the indicators that constitute the index. In summary, the individual indicators reflect the overall pattern in the stringency index. In most cases, Norway experienced more variation and reached higher tops than Sweden that has been more uniform in their stringency.

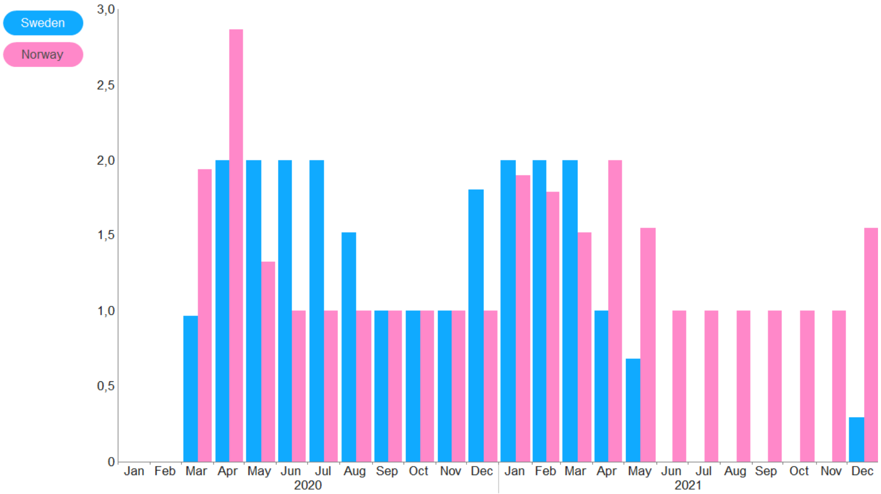

Figure 3. School closure. 0 = No Measure, 1 = Recommended, 2 = Required (Only at some levels), 3 = Required (All levels)
Source: Hale, Angrist et al. 2021

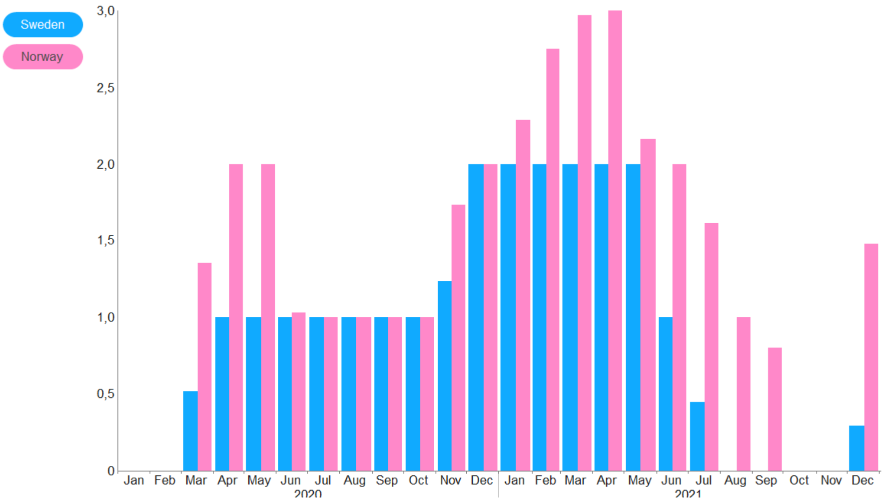

Figure 4. Workplace closure. 0 = No measure, 1 = Recommended, 2 = Required for some, 3 = Required for all but key workers
Source: Hale, Angrist et al. 2021

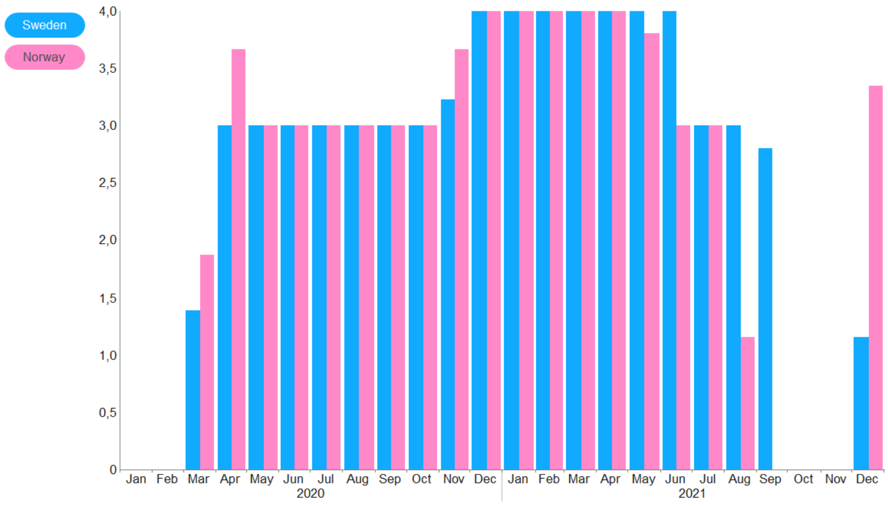

Figure 5. Public gatherings. 0 = No restrictions, 1 = > 1000 people, 2 = 100 -1000 people, 3 = 10 – 100 people, 4 = <10 people
Source: Hale, Angrist et al. 2021

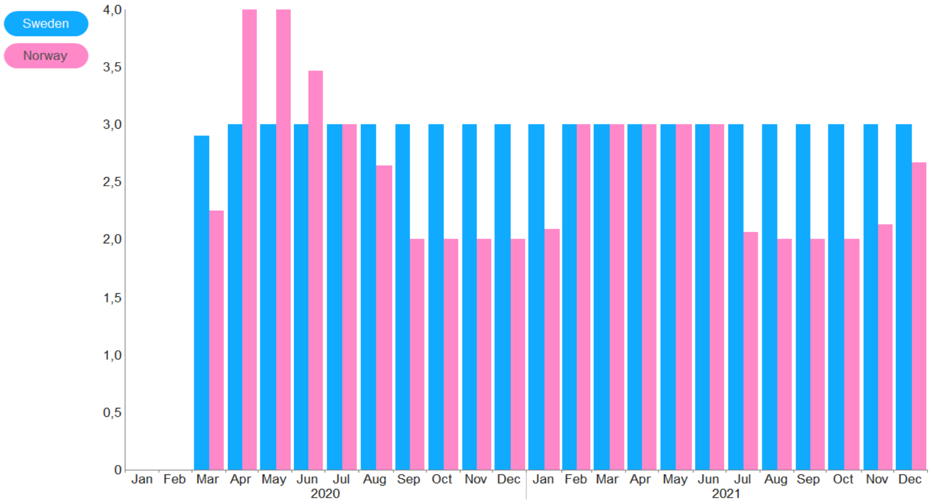

Figure 6. International travel controls. 0 = No Measures, 1 = Screening, 2 = Quarantine from high risk regions, 3 = Ban on high risk regions, 4 = Total border closure
Source: Hale, Angrist et al. 2021

7. Method

In previous research, estimations of potential lives saved due to the Covid-19 response policy have represented benefits in the CBA. Correspondingly, GDP loss has represented costs and illustrated the negative relationship between NPIs and economic activity. This setup allowed for an illustration of the dynamics that exist between saving lives, the economy and NPIs. This paper conducts a comparison of Sweden and Norway; thus, it is their relative performance that constitutes the net analysis of this CBA. This CBA is structured as follows: Benefit - relative Covid-19 related deaths and Cost - relative GDP performance. This structure is exemplified with the following fictitious example; if Sweden's Covid-19 response policy has resulted in fewer Covid-19 related deaths relative to Norway, Sweden experiences a *relative benefit.* Further, Sweden's response policy has resulted in a larger GDP loss relative to Norway. Thus, Sweden experiences a *relative cost.* If the GDP loss is larger than the benefit, the net result is negative. This paper's CBA structure and comparison of two countries will still allow for the aforementioned dynamics to be analyzed. In this section, a detailed description of the benefit and cost will be presented. Further, the net analysis is described and lastly the method of the sensitivity analyses.

7.1 Benefit - Relative Covid-19 related deaths

The first method to measure mortality as described in section 3.1.1 is used in this paper; "individuals who have received a laboratory-confirmed Covid-19 diagnosis and have been reported as deceased within 30 days of the diagnosis" hereafter referred to as "Covid-19 related deaths". Then the following steps were conducted to calculate total QALYs lost per capita for each country:

1. Data on the total number of Covid-19 related deaths was extracted for separate age groups; interval of 10 years between 40-89. Individuals under 40 years constitutes one age group and above 90 one age group.
2. Data on life expectancy for the different age groups was extracted. Having multiplied the number of Covid-19 related deaths in each age group with the respective life expectancy, lost life years per age group was attained[7], see formula 2. The same life expectancy data was used for both Sweden and Norway in order to cancel out the effect different life expectancies could have on the result.

$$Number\ of\ deaths \times\ Life\ expectancy = Lost\ life\ years \qquad (2)$$

[7] The available data on life expectancy is reported for every one year age group while the analysis in this paper uses age group intervals of ten years. For each interval, the median remaining life expectancy is used. For example, for the age group 40-49, the remaining life expectancy for 45 year olds is used. For the <40 group, the remaining life years for 25 year olds is used since death cases among young people <10 years were rare. For the age group 90+ the average life expectancy is used for 90-106 year olds (106 is the upper limit of the data).

3. The lost life years per age group were multiplied with QALY-weights representative for the different age groups in the general population - resulting in QALYs lost for each age group[8], see formula 3. By using QALY-weights representative for the general population, it is implied that the deceased individuals were representative for society as a whole.

$$Lost\ life\ years \times QALY\ weight = QALYs\ lost \tag{3}$$

4. The final step calculating benefits was conducted according to formula 4 below by dividing the QALYs lost by the population for each country, resulting in QALYs lost per capita for each country.

$$\frac{QALYs\ lost}{Country\ population} = QALYs\ lost\ per\ capita \tag{4}$$

7.2 Costs - Relative GDP performance

The aim of the cost calculations was to bring forth an estimation of what the two countries gained or lost in terms of GDP per capita that is due to Covid-19 and the respective country's choice of response policy. Sweden and Norway have different population sizes, currencies, and inflation rates. To allow for comparison, these differences were adjusted for. The following steps were conducted to adjust the GDP to enable comparison:

1. Total GDP in constant 2015 prices and local currency from 2015-2021 was extracted.
2. Adjustment was made for inflation. The aim was to have all GDP numbers currently expressed in 2015 prices to be expressed in 2021 prices. First, the compound inflation rate for Sweden and Norway was calculated respectively according to formula 5.

$$Inflation\ rate\ 2015 \times Inflation\ rate\ 2016 \times \ldots \times Inflation\ rate\ 2021 = Compound\ inflation \tag{5}$$

The respective country's GDP for each year from 2015 until 2021 was multiplied with the compound inflation to have them all be expressed in 2021 prices. Formula 6 below exemplifies the calculation for 2015 GDP.

$$2015\ GDP\ in\ 2015\ prices \times Compound\ inflation = 2015\ GDP\ in\ 2021\ prices \tag{6}$$

3. Currency conversion for Norwegian GDP for each year 2015 until 2021 was performed using PPP conversion rates (NOK/SEK) in order to express Norwegian GDP in SEK. Formula 7 below presents calculations for 2015 GDP.

$$\frac{Norwegian\ 2015\ GDP\ in\ NOK}{PPP\ conversion\ rate} = Norwegian\ 2015\ GDP\ in\ SEK \tag{7}$$

[8] The QALY weights used in this paper are based on table 2 in the paper by Burström et al (2001) that examines health-related quality of life in the population using EQ-5D. Since the paper lacks a QALY weight for the age groups <40 and 90+, the QALY weight for 30-39 year olds is used for the age group <40 and the 80-88 is used for the age group 90+. Note that the age group 80-88 range over 9 years compared to other age groups that range over 10 years in the paper.

4. In the final step, differences in population size were accounted for by dividing GDP for each year by the respective country's population. In this paper, the population size of 2021 was used regardless of the year of GDP in order to exclude any differences stemming from differences in population growth. Formula 8 below exemplifies the calculation for 2015 GDP.

$$\frac{2015\ GDP\ in\ 2021\ in\ SEK}{Country\ population} = 2015\ GDP\ per\ capita \qquad (8)$$

Finally, once the above-mentioned adjustments were made, the following GDP-measure will be used as the basis of comparison: *GDP per capita in SEK, constant prices (reference year 2021), constant PPP conversion rates (reference year 2021).* From here on in this section, the adjusted GDP-measure will simply be referred to as GDP.

Continuing, to estimate respective country's GDP loss or gain the following steps were taken:

1. The GDP data for 2015-2019 was used to calculate annual growth rates for Norway and Sweden respectively. These annual growth rate for subsequent years 2015-2019 were calculated through formula 9 exemplifying the annual growth rate between 2015-2016

$$\frac{(GDP_{2016} - GDP_{2015})}{GDP_{2015}} \times 100 \qquad (9)$$

This formula is applied for every two-year period between 2015-2019. The resulting four annual growth rates are used to calculate an average growth rate for the whole period for each country respectively according to formula 10.

$$\frac{Ann\ growth\ rate\ 2015{-}2016 + \ldots + Ann\ growth\ rate\ 2018{-}2019}{4} = Avg\ annual\ growth\ rate\ 2015 - 2019 \qquad (10)$$

2. The predicted GDP for 2020 and 2021 for Norway and Sweden respectively are calculated by multiplying last year's GDP with each country's average annual growth rate according to formula 11 and 12.

$$GDP\ 2019 \times Average\ annual\ growth\ rate = Predicted\ GDP\ 2020 \qquad (11)$$

Predicted $GDP\ 2020 \times Average\ annual\ growth\ rate = Predicted\ GDP\ 2021$ (12)

3. Finally, the predicted GDP estimates are compared to the actual GDP for 2020 and 2021 according to formula 13 and 14 below.

$$Actual\ 2020\ GDP - Predicted\ 2020\ GDP = Gain/Loss\ in\ GDP\ 2020 \qquad (13)$$

$$Actual\ 2021\ GDP - Predicted\ 2021\ GDP = Gain/Loss\ in\ GDP\ 2021 \qquad (14)$$

7.3 Net analysis

7.3.1 Benefit

In this part of the analysis, the aim is to sum the costs and benefits in order to present one final bottom line for each country's Covid-19 response policy.

The net analysis is initiated by converting the QALYs lost for each country into a monetary value. The Value of A Statistical Life (VSL) according to the Swedish Transport Administration guidelines is set at 40,5 MSEK (described in section 3.1.3) and is used as the basis for calculating the value of a QALY. The median age of an individual dying in a traffic accident in Sweden in 2001 is 49 years (K Ahlm et al 2001). Further, the life expectancy in Sweden in the corresponding year was 79,5 years (SCB 2022a). Hence the lost life years of a person dying in a traffic accident was $79{,}5 - 49 = 30{,}5$ years. Note that these lost years of life are not discounted. The QALY weight for a 49-year-old, 0,85, is used to calculate QALYs lost resulting in a loss of 25,925 using formula 1.
The Value per QALY is 1,6 using formula 15. The calculations of value per QALY are summarized in Table 2.

$$\frac{VSL}{QALY\ loss} = Value\ per\ QALY \qquad (15)$$

Table 2. Summary of monetary valuation of a QALY
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Hultkrantz 2020; K Ahlm et al 2001; SCB 2022a

VSL Trafikverket	40,5
Lost years of life (Traffic Accident)	30,5
QALY Weight	0,85
Value per QALY (MSEK)	1,6

Finally, the QALYs lost for each country is multiplied with the above-mentioned value of a QALY. In order to facilitate comparison across the two countries, the lost QALYs will be presented per capita in SEK for both Sweden and Norway.

7.3.2 Cost

The sum of the GDP differences during the pandemic period are summed and presented. The benefits i.e., lost QALYs per capita in SEK and costs i.e., total difference in GDP per capita in SEK for each country are added up and compared to conclude the net result of each country's chosen response policy. Finally, setting one of the countries as a benchmark, the relative performance is illustrated. This can be interpreted as what the net results would be if one country would have implemented the response policy of the other country. The structure of the net analysis is presented in Table 3.

Table 3. Net analysis template (No external sources used)

	Norway	**Sweden**
Benefit		
Lost QALYs		
Monetary valuation of a QALY in MSEK		
Total QALYs lost in MSEK		
Total QALYs lost per capita in SEK		
Cost		
GDP loss per capita in SEK		
Net Result in SEK		
Total QALYs lost per capita		
GDP loss per capita		
Total		
Calculations Norway as benchmark		
Total QALYs lost per capita		
GDP loss per capita		
Total		
Calculations Sweden as benchmark		
Total QALYs lost per capita		
GDP loss per capita		
Total		

7.4 Sensitivity analysis

7.4.1 Benefit

The following sensitivity analyses were performed to test the robustness of the benefit results:

1. Comorbidity
2. Life expectancy
3. Combination of Comorbidity and Life expectancy
4. Monetary QALY Valuations
5. Discounted benefits

7.4.1.1. Comorbidity

It is well established that diseases decrease health related quality of life (Burström, Johannesson et al. 2001). It is also well established that the majority of Covid-19 related deaths occurred among people with underlying diseases, also called comorbidity (NBHW 2021b). The most common underlying diseases are cardiovascular diseases which affect life quality significantly. Thus, it is necessary to test the sensitivity of the baseline results by adjusting the QALY-weights for comorbidity.

This was performed by changing the last step in the method as described above in section 7.1. Instead of using the general population QALY-weights, they are downwardly adjusted with an absolute value of 0,1; 0,2; 0,3 respectively. Multiplying lost life years with these adjusted QALY weights results in total QALYs lost with adjustment made for different levels of comorbidity. As an example, it implies that the corresponding QALY weight for 50–59-year-olds decreases from 0,83 to 0,73; 0,63 and 0,53 respectively. The absolute change of 0,1-0,3 corresponds to an arbitrary collection of underlying diseases since it is unnecessarily complicated to adjust for specific diseases.

7.4.1.2 Life expectancy

In the baseline results, the life expectancy for the general Norwegian population is used. People who died by a Covid-19 infection may not be representative of the general population, translating into a lower life expectancy. A downward adjustment is tested in the sensitivity analysis by reducing 10-, 20- and 30% of life expectancy for each age group.

Combination of comorbidity and life expectancy — This sensitivity analysis combines the above-mentioned adjustments. The following combinations are tested:

- 10% adjustment of life expectancy and 0,1 adjustment for comorbidity
- 20% adjustment of life expectancy and 0,2 adjustment for comorbidity
- 30% adjustment of life expectancy and 0,3 adjustment for comorbidity

Other combinations are not tested since the two factors are presumably positively correlated.

7.4.1.3 Monetary QALY Valuations

As mentioned in section 3.1.3, different countries use different monetary valuations of a QALY. The fourth sensitivity analysis aims to test the influence of different valuations of a QALY in the net analysis on the result. A lower and upper bound is used and compared to the baseline value. For the lower bound, the NICE guideline valuation of £30 000 is used which corresponds to 0,4 MSEK using the 2021 conversion rate from GBP to SEK. The upper bound is set symmetrically; since the baseline valuation is 1,6 MSEK, the upper bound corresponds to 2,8 MSEK.

7.4.1.4 Discounted benefits

The final sensitivity analysis takes discounted life expectancy into account. Since life expectancy is included both in the calculation of lost QALYs and in the QALY valuation, there will be two effects on the result when discounting life expectancy.

To calculate discounted life expectancy, the annuity formula 16 below is used. The formula consists of each remaining year (C=1), the remaining years of life (N) and the discount rate (r).

$$\text{Present value } (A) = \frac{C}{r}\left(1 - \frac{1}{(1+r)^N}\right) \tag{16}$$

In this paper, the annuity corresponds to the discounted life expectancy. The discount rate (r) of 3% is used which is the most common discounting rate to use in CBAs (TLV 2020). The number of years (N) depends on the life expectancy for each age group.

In the first step, the life expectancy for each age group is discounted with formula 16. The result is a discounted life expectancy that is similar for Sweden and Norway since the same life expectancy is used for both countries as described earlier. The discounted lost life years for each age group is calculated using formula 2 using discounted life expectancy. Total discounted QALYs lost for each age group is calculated using formula 3, multiplying the discounted lost life years with the QALY weights used in the baseline results. In the second step, the discounted life expectancy translates into a discounted monetary valuation per QALY, following the same process as above.

To conclude, discounting life expectancy affects the net analysis in two ways, the amount of QALYs lost and the monetary valuation of a QALY.

7.4.2 Cost

The following sensitivity analyses were performed to test the robustness of the result on country specific characteristics:

1. GDP growth rate
2. GDP level

7.4.2.1 GDP growth rate

The first analysis checks for how differences in growth rates during the years prior to the pandemic (2015-2019) might have affected the baseline results. The nuance that this analysis aims to capture is the following: if Sweden experienced a particularly strong economic year during 2015-2019, this will raise the average growth rate and the predicted GDP. The GDP-difference will partly be explained by the Covid-19 pandemic and response policy but also partly by the particularly strong economic year that Sweden experienced. To test the sensitivity of the results on this potential effect the following steps are conducted:

1. The predicted GDP for 2020 and 2021 for both countries were based on one specific country's average GDP growth. In other words, one prediction for both countries using Sweden's average growth and one prediction for both countries using Norway's average growth.
2. The two different sets of predictions called "Swedish growth rates" and "Norwegian" growth rates" are used to calculate the GDP-difference for each country.

The GDP-difference in the context of this analysis is to be interpreted as the cost of the chosen response policy given that both countries have experienced the same economic growth.

7.4.2.2 GDP level

The second analysis aims to test the sensitivity for differences in initial GDP per capita levels between the two countries of comparison. In Figure 22 in appendix A, the initial level differences are visualized. In this case, the nuance captured is the following: Imagine that Sweden and Norway have lost an amount of 5000 SEK in GDP per capita. Instead of comparing absolute numbers, a deeper understanding is gained by relating to the respective countries' GDP per capita level. In other words, a loss of 5000 SEK is worse for a country that has a lower level of GDP per capita. The analysis is conducted in the following way:

1. The GDP loss ratio is calculated for each country according to formula 17

$$\frac{Total\ GDP\ difference\ 2020\text{–}2021}{GDP\ per\ capita\ 31st\ of\ December\ 2019} = GDP\ loss\ ratio \tag{17}$$

2. These ratios are utilized to calculate how large each country's loss would have been in the context of the other country's GDP per capita level. For example, how large would Norway's loss have been in the context of a Swedish economy and vice versa. In formula 18 below Sweden's loss in a Norwegian economy is exemplified.

$$SWE\ GDP\ loss\ ratio \times NOR\ GDP\ per\ capita = SWE\ loss\ in\ a\ NOR\ economy \tag{18}$$

Even though it is common to discount costs and benefits in CBA analyses, the costs are not discounted in this paper. The reason is that the effect of discounting on the cost side would be negligible since only a period of two years is considered.

8. Data sources

In this paper, publicly available data sources are used. In this section the data used in the benefit calculations is described followed by the data used in the cost calculations.

8.1 Benefit data

Data on Covid-19 related deaths was extracted from two databases that aggregate national agency's official Covid-19 death reports. One database is from The French Institute for Demographic Studies, INED (Ined 2022a). The Institute's missions are to study the populations of France and other countries and to ensure wide spread of knowledge and to provide training in research through research (Ined 2022b). The second database is a Covid-19 Data Repository compiled by the Center for Systems Science and Engineering at Johns Hopkins University (CSSE 2022). The data extracted originate from the Public Health Agency of Sweden (PHAS) and the National Board of Health and Welfare (NBHW) for Sweden and from the Norwegian Institute of Public Health (NIPH) for Norway. Data on life expectancy was extracted from Statistics Norway (SSB 2022a).

8.1.1 Descriptive statistics

In Figure 7-9 and Table 4 below, descriptive statistics of the data concerning Covid-19 related deaths are presented.

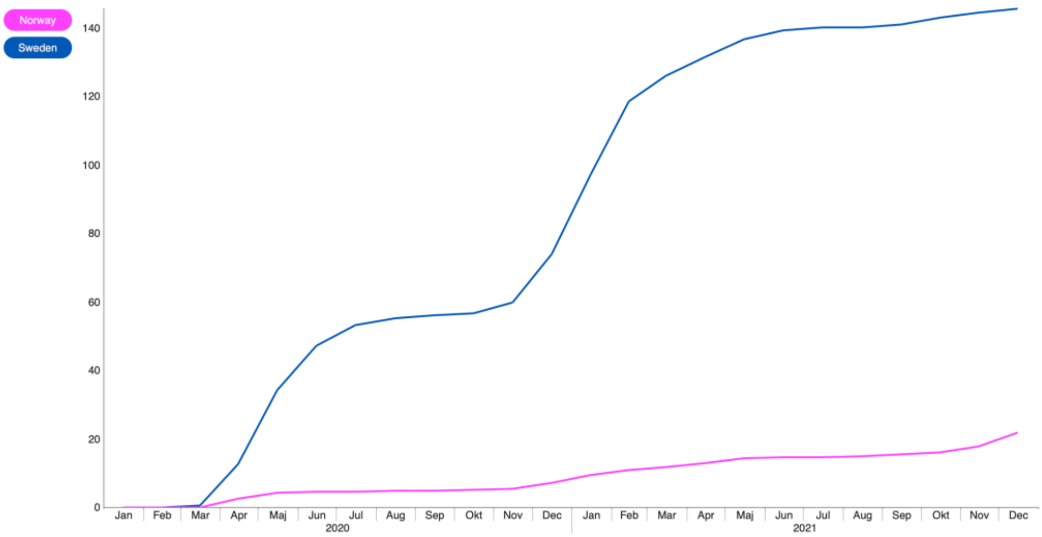

Figure 7. Cumulative Covid-19 mortality for Sweden and Norway per 100 000 inhabitants
Source: CSSE, 2022

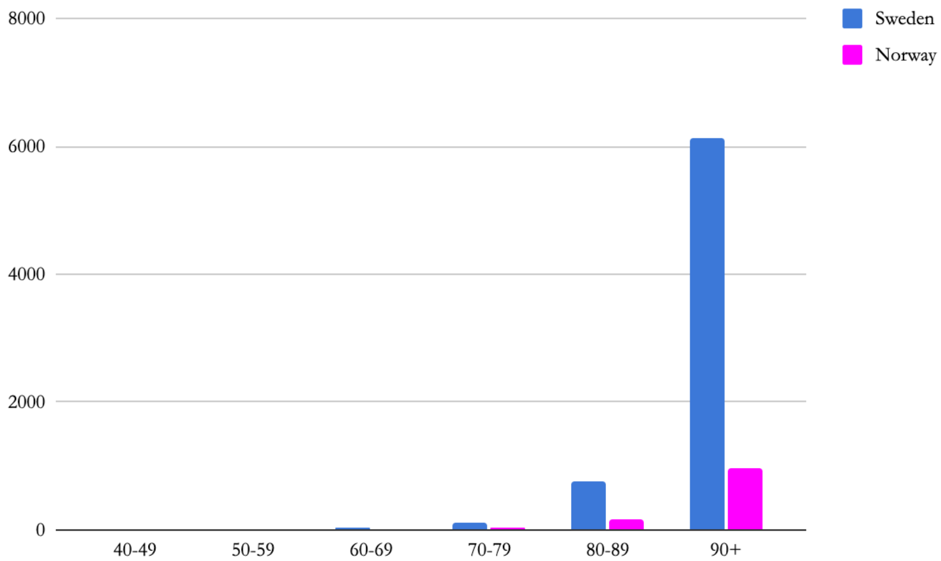

Figure 8. Covid-19 mortality per age group per 100 000 inhabitants from 40 years and above
Sources: Ined 2022a; SCB 2022b; SSB 2022

In Figure 8 above, the relative mortality for age groups between 40-69 years is not visible due to the large difference in mortality numbers. Thus, in Figure 9 below the relative mortality rate for Sweden and Norway is presented per 100 000 inhabitants for the pandemic period for those specific age groups.

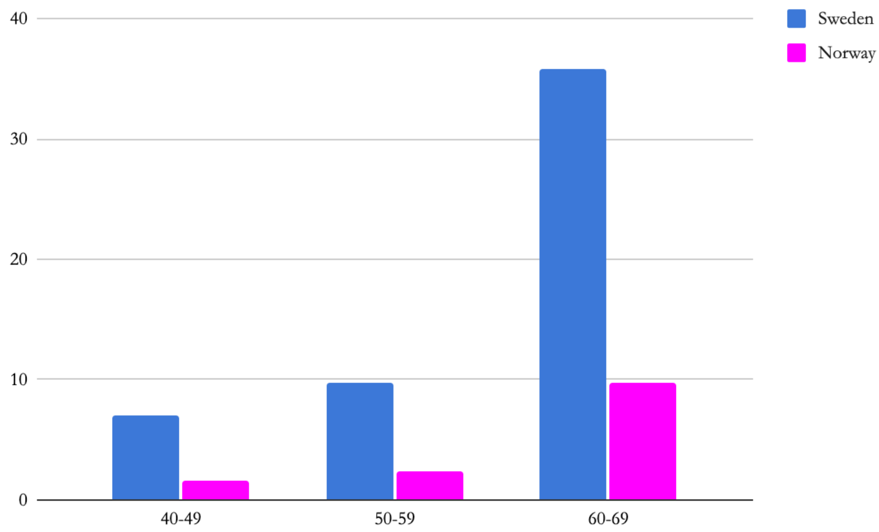

Figure 9. Covid-19 mortality per age group per 100 000 inhabitants from 40- 69 years
Sources: Ined 2022a; SCB 2022b; SSB 2022

In Table 4 below the share of Covid-19 related deaths within each age group is presented.

Table 4. Covid-19 mortality share per age group for Sweden and Norway
Source: Ined 2022a

Sweden			**Norway**	
Age group	Total death count	Share of total	Total death count	Share of total
<40	92	1 %	12	1 %
40-49	129	1 %	17	1 %
50-59	398	3 %	57	4 %
60-69	1091	7 %	139	11 %
70-79	3443	22 %	312	24 %
80-89	6209	41 %	440	34 %
90+	3946	26 %	328	25 %
Total	15308	100 %	1305	100 %

8.1.2 Limitations of benefit-related data

A limitation with Covid-19 related deaths data is that the reporting of Covid-19 related deaths has been changed by NIPH from 17th of March 2022 in Norway and is effective in retrospect (NIPH 2022a). The reason is a presumed underdiagnosis of Covid-19 related deaths with the early definition. The early definition included deaths where both of the following criterias were met while the new definition excludes the second criteria:

1. Covid-19 diagnosis registered on the death certificate
2. A registration in the Norwegian Surveillance System for Communicable Diseases (MSIS) database (where doctors report positive SARS-CoV-2 tests)

The change of definition implied 357 number of extra deaths during the pandemic period where the majority occurred during January to March 2022. However, by only including data until 30th of December 2021, both the new and old definitions give similar results. Since the data until 30th of December is considered not to have been affected to a large extent by the change of definition it is therefore likely not to have suffered from underdiagnosis.

Further, the issue of whether people registered as a Covid-19 related death have died *by* or *with* the virus has been debated. In April 2021, NBHW published a cross country comparison concerning differences and similarities of how Covid-19 deaths and cases are reported. It concludes that the Nordic countries report Covid-19 related deaths in similar ways[9]. Sweden and Norway define a Covid-19 related death as a death occurring within 30 days from laboratory-confirmed diagnosis. Manual correction is performed in both countries, both excluding deaths that are considered not to be caused *by* Covid-19 and inclusion of suspected missed Covid-19 related deaths. However, the exact criteria for how this exclusion and inclusion is done and to what extent is not described (NBHW 2021). This remains as a minor limitation of the data.

[9]The report was published before the change in definition by NIPH in Norway.

8.2 Cost data

Data on GDP, inflation rates and PPP conversion rates was retrieved from the OECD.Stat database. The database includes data and metadata for OECD countries and selected non-member economies such as Norway.

8.2.1 GDP

The national accounts estimates are compiled according to the ESA 2010, a methodology to produce national accounts data derived by Eurostat (the statistical office of the European Union) (Eurostat 2010). The data for Norway and Sweden is compiled by Statistics Norway (SSB) and Statistics Sweden (SCB) respectively and provided to the OECD via Eurostat. The extracted data is calculated with an output approach published in local currency (NOK and SEK) in original chain constant price estimates referenced to 2015 (OECD 2022a). Yearly data was extracted from 1st of January 2015 until 2021 (31st of December) for both countries. Descriptive GDP-data is presented in appendix A.

8.2.2 Inflation

On a national level, Consumer Price Indices (CPIs) is a common measure to account for inflation (The Swedish Central Bank 2022). However, to enable international comparison of inflation between countries, Harmonized Indices of Consumer Prices (HICPs) is used to adjust for country specific factors that affect national CPIs. The dataset on inflation used in this paper contains statistics on Consumer Price Indices including national CPIs, Harmonized Indices of Consumer Prices (HICPs) and their associated weights and contributions to national annual inflation (OECD 2022b). Thus, the data set is put together using the most relevant price statistics and adjusted to ensure a fair international comparison.

8.2.3 PPP

Data on PPP was extracted from the OECD.Stat database of PPP conversion rates. The indicator is measured in national currency per US dollar (OECD 2021). The PPP conversion rate NOK/SEK is simply the ratio of PPP conversion rate of NOK/USD and PPP conversion rate of SEK/USD. The PPP conversion rate for 2021 of NOK/SEK was 1,3 (in rounded numbers).

8.2.4 Population

Data on total population and population per age group was retrieved from Statistics Sweden, SCB for Sweden (SCB 2022b) and SSB for Norway (SSB 2022).

9. Results

In the subsequent section, the baseline results are presented first, starting with the benefit side, then the cost side followed by a net analysis where benefits and costs are put together. Finally the results from the sensitivity analysis are presented, starting with the tests on the benefit side then on the cost side.

9.1 Benefits

In Table 5 and 6 the results for the benefit calculations are presented for Norway and Sweden.

Table 5. Numbers of QALYs lost during the pandemic period in Norway
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; SSB 2022a; SSB 2022

Norway						
Age group	Total death count	Life expectancy	Lost life years	QALY weights	QALYs lost	QALYs lost per capita
<40	12	58,63	704	0,88	619	0,00011
40-49	17	39,21	667	0,86	573	0,00011
50-59	57	29,80	1699	0,83	1410	0,00026
60-69	139	20,93	2909	0,8	2327	0,00043
70-79	312	13,05	4072	0,79	3217	0,00059
80-89	440	6,73	2961	0,74	2191	0,00040
90+	328	2,55	836	0,74	619	0,00011
Total	**1305**	N/A	**13847**	N/A	**10956**	**0,00202**

Table 6. Numbers of QALYs lost during the pandemic period in Sweden
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; SSB 2022a; SCB 2022b

Sweden						
Age group	Total death count	Life expectancy	Lost life years	QALY weights	QALYs lost	QALYs lost per capita
<40	92	58,63	5394	0,88	4747	0,00045
40-49	129	39,21	5058	0,86	4350	0,00042
50-59	398	29,80	11860	0,83	9844	0,00094
60-69	1091	20,93	22835	0,8	18268	0,00175
70-79	3443	13,05	44931	0,79	35496	0,00340
80-89	6209	6,73	41787	0,74	30922	0,00296
90+	3946	2,55	10062	0,74	7446	0,00071
Total	**15308**	N/A	**141927**	N/A	**111072**	**0,01063**

As shown in column two, both Sweden and Norway experienced an increasing number of Covid-19 related deaths as age increases (until the age of 89). For all age groups and in total, Sweden has lost more life years than Norway in absolute terms. This is expected since Sweden has a larger population than Norway. In column four, both Sweden and Norway suffered the highest number of deaths in the age group of 70-79. In column six, the number of QALYs lost are presented. Since Sweden has experienced a larger loss of life years with a similar age group distribution as Norway, Sweden has consequently lost more QALYs in each group and in total. The largest number of lost QALYs come from the age group 70-79 for both countries. In the last row of column six, the total QALYslost during the pandemic period are summarized. Sweden has lost 111 072 QALYs compared to 10 956 in Norway. In the final column the total amount of lost QALYs per capita is presented, Norway suffered a QALY loss per capita of 0,00202 while Sweden suffered a QALY loss per capita of 0,01063.

9.2 Costs

The analysis was initiated by adjusting the total GDP data in 2015 prices for country specific characteristics such as currency, inflation and population (see appendix A for detailed calculations). The results are presented in Figure 10 below.

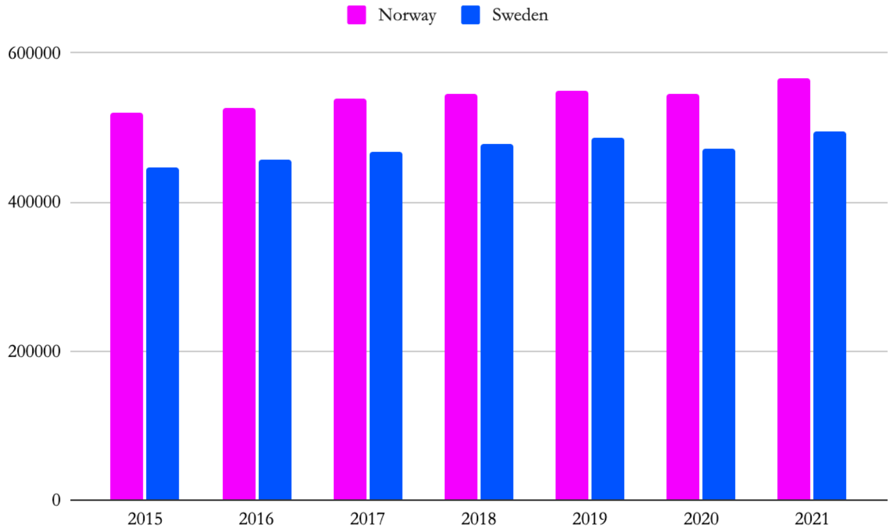

Figure 10. Outcome total GDP Constant prices 2021, MSEK (PPP conversion rate 2021)
Authors rendering of data from sources: OECD 2021; OECD 2022a; OECD 2022b

Having converted the GDP data to enable comparison, it can be concluded that Norwegian economic standard is higher than in Sweden. The growth trend was similar for all years; a steady increase until 2020 where there was a decrease, followed by an increase in 2021.

The average growth rate for the years 2015-2019 was 1,31% per year for Norway and 2,14% per year for Sweden (see appendix B for detailed calculations). Using these growth rates, the predicted GDP per capita levels for 2020 and 2021 were calculated. The comparison of actual and predicted GDP per capita for 2020 and 2021 are summarized in Table 7 below. In the final column, the actual yearly growth rates for 2020 and 2021 are presented (see appendix B for detailed calculations).

Table 7. Actual vs Predicted GDP per capita in SEK, constant 2021 Prices, constant 2021 PPPs
Authors rendering of data from sources: OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022

	Year	**Actual**	**Predicted**	**Difference**	**Actual yearly GDP per capita development (in %)**
Norway	2020	544 770	555 920	−11 150	−0,72%
	2021	566 140	563 230	2 910	3,92%
Sweden	2020	472 216	496 971	−24 755	−2,94%
	2021	494 886	507 625	−12 739	4,80%

In Table 7 it is shown that both countries economically underperform in 2020. Further, Norway experienced a negative GDP per capita growth of 0,72% instead of a predicted positive growth of 1.31%. Sweden experienced a negative growth of 2,94% compared to the predicted positive growth of

2,14%. During 2021 Norway managed not only to reach predicted GDP per capita levels, but to overperform by 2 910 SEK per capita relative to the predicted GDP per capita. This overperformance is reflected in an actual positive growth of 3,92% between 2020-2021. Sweden experienced an actual positive growth of 4,8% but missed predicted levels by 12 739 SEK.

The final step is the summation of the difference between actual and predicted GDP over the whole pandemic period. The results are shown in Table 8 below.

Table 8. Total GDP difference 2021-2021 per capita for Norway and Sweden.
Authors rendering of data from sources: OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022

	Total GDP per capita difference 2020-2021
Norway	−8240
Sweden	−37 493

Thus, during the whole pandemic period, Norway experienced a total GDP per capita loss of 8 240 SEK compared to a corresponding Swedish loss of 37 493 SEK.

9.3 Net analysis

Compiling benefits and costs, the net result is presented in Table 9 below.

Table 9. Net results
Authors rendering of data from sources:
Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022

	Norway	**Sweden**
Benefit		
Lost QALYs	10956	111072
Monetary valuation of a QALY in MSEK	1,6	1,6
Total QALYs lost in MSEK	−17116	−173517
Total QALYs lost per capita in SEK	−3155	−16601
Cost		
GDP loss per capita in SEK	−8240	−37493
Net Result in SEK		
Total QALYs lost per capita	−3155	−16601
GDP loss per capita	−8240	−37493
Total	−11395	−54094
Calculations Norway as benchmark		
Total QALYs lost per capita	0	−13446
GDP loss per capita	0	−29253
Total	0	−42699
Calculations Sweden as benchmark		
Total QALYs lost per capita	13446	0
GDP loss per capita	29253	0
Total	42699	0

In the first section of the table, it is shown that Sweden has lost more QALYs, in total and per capita, than Norway. Comparing QALYs lost per capita expressed in SEK between Sweden and Norway shows that Sweden has lost 5,3 times the amount that Norway has lost (16 601/3 155≈5,26).

In the second section, it is shown that Sweden lost 37 493 SEK in GDP per capita while Norway lost 8 240 SEK. This implies that Sweden's GDP per capita loss was 4,6 times larger loss than Norway's loss (37 493/8 240≈4,55). Adding these together in the third section, it can be concluded that Sweden lost 54 094 SEK per capita during the pandemic and Norway 11 395 SEK per capita. This implies a 4,7 times larger loss for Sweden compared to Norway (54 094/ 11 395≈ 4,7).

In the last section, calculations to enable comparison between the countries are presented by setting Norway and Sweden as benchmarks respectively. It implies that if Sweden would have adopted the strategy of Norway, Sweden would have saved 42 699 SEK per capita during 2020-2021.

Correspondingly, if Norway would have adopted the strategy of Sweden, they would have lost 42 699 SEK more per capita during 2020-2021.

9.4 Sensitivity analysis

9.4.1 Benefit

9.4.1.1 Comorbidity

The following can be concluded when testing the sensitivity for comorbidity: As the downward adjustment was increased, the difference between Norway and Sweden in QALYs lost per capita decreased and consequently the difference in Total Net Results. In Figure 11 below, the total amount of QALYs lost per capita is visualized for Norway in pink colors and Sweden in blue colors for the baseline results and 0,1, 0,2 and 0,3 downward adjustments of QALY weights. Using Norway as the benchmark, the downward adjustments of 0.1, 0.2 and 0.3 reduced the QALYs lost per capita *difference* to -11 723, -10 001 and -8 278 SEK respectively. Consequently, the Total Net Result *difference* was reduced to -40 977, -39 254 and -37 532 SEK. Compared to the baseline results, these new differences in Total Net results correspond to a percentage change of - 4%, -8% and -12% respectively (see appendix C for detailed calculations).

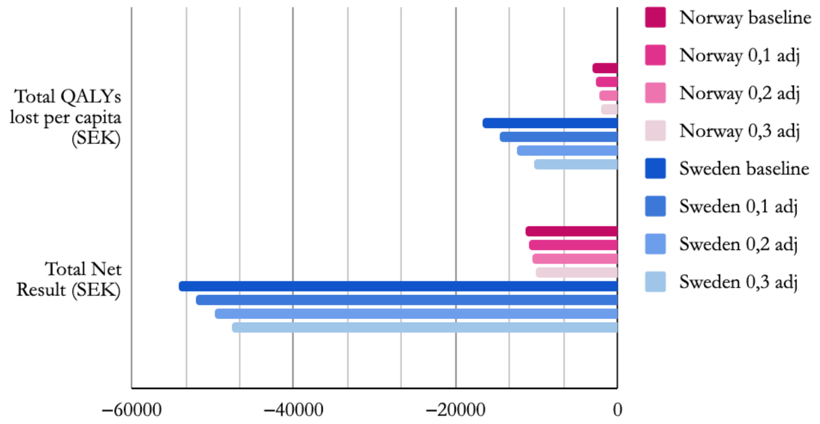

Figure 11. Sensitivity analysis Comorbidity
Authors rendering of data from sources:
Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022

9.4.1.2 Life expectancy

The following can be concluded when testing the sensitivity for shorter life expectancy among the people who died due to Covid-19: The *difference* in QALYs lost per capita between Sweden and Norway is reduced as the life expectancy adjustment increases and consequently the *difference* in Total Net Results. In Figure 12 below, the total amount of QALYs lost per capita is visualized for Norway in pink colors and Sweden in blue colors for the baseline results and 10%, 20% and 30% downward adjustments of life expectancy. Using Norway as the benchmark, the downward life expectancy adjustment of 10%, 20% and 30% reduced the QALYs lost per capita *difference* to -12 101, -10 757 and -9 412 SEK. Consequently, the Total Net Result *difference* was reduced to -41 355, -40 010 and -38 665 SEK. Compared to the baseline results, these new *differences* in Total Net results correspond to a percentage change of -3%, -6% and -9% respectively (see appendix D for detailed calculations).

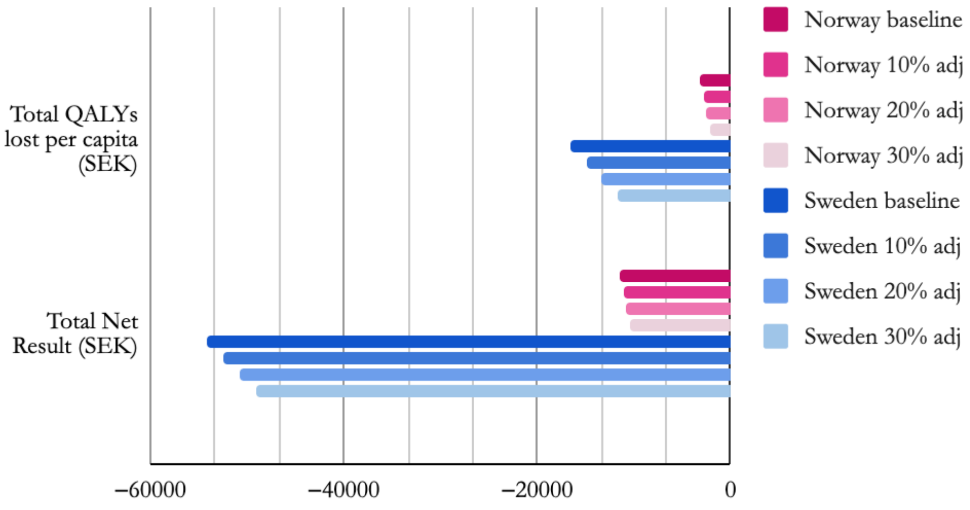

Figure 12. Sensitivity analysis life expectancy
Authors rendering of data from sources:
Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022

9.4.1.3 Comorbidity and life expectancy

The combination of the two aforementioned adjustments impacted the results in the following manner: As the comorbidity/life expectancy adjustment was increased, the *difference* in QALYs lost per capita between the countries was decreased, and consequently the *difference* in total net results. In Figure 13 below, the total amount of QALYs lost per capita is visualized for Norway in pink colors and Sweden in blue colors for the baseline results and 0,1/10%, 0,2/20% and 0,3/30% downward adjustments of QALY weights/life expectancy respectively. Using Norway as the benchmark, the downward adjustments of 0.1/10%, 0.2/20% and 0.3/30% reduced the QALYs lost per capita *difference* to -10 551, -8001 and -5795 SEK. Consequently, the total net result *difference* was reduced to -39 804, -37 254 and -35 048 SEK. Compared to the baseline results, these new *differences* in total net results corresponded to a percentage change of -7%, -13% and -18% respectively (see appendix E for detailed calculations).

To conclude, when testing the result for sensitivity of comorbidity and life expectancy, Sweden's relative loss in QALYs per capita and total net result was not as large as the baseline results first suggested. Nonetheless, Norway's response policy remained the most efficient in terms of QALYs lost per capita and total net result.

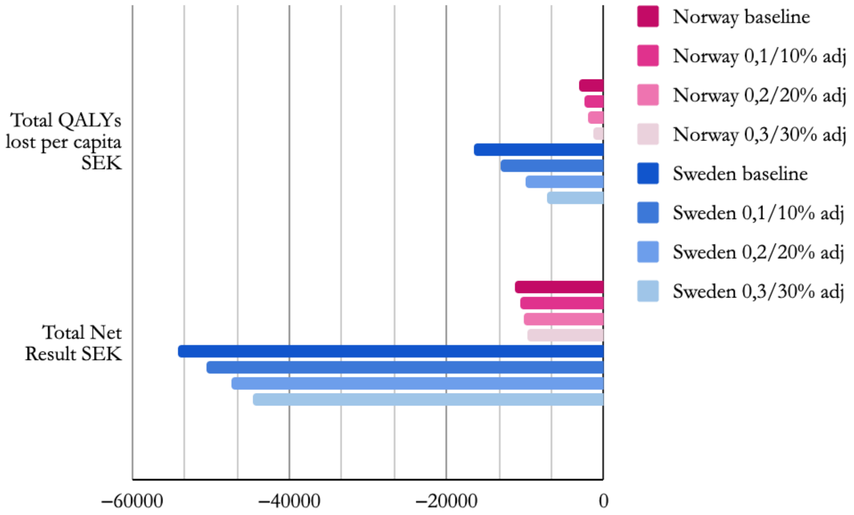

Figure 13. Sensitivity analysis comorbidity + life expectancy
Authors rendering of data from sources:
Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022

9.4.1.4 Monetary QALY Valuations

The different monetary valuations of a QALY are visualized for Norway in the Figure 14 below. The lower bound (one QALY equals 0,4 MSEK), baseline valuation (one QALY equals 1,6 MSEK) and upper bound (one QALY equals 2,8 MSEK) are visualized for the total amount of QALYs lost per capita and total net result.

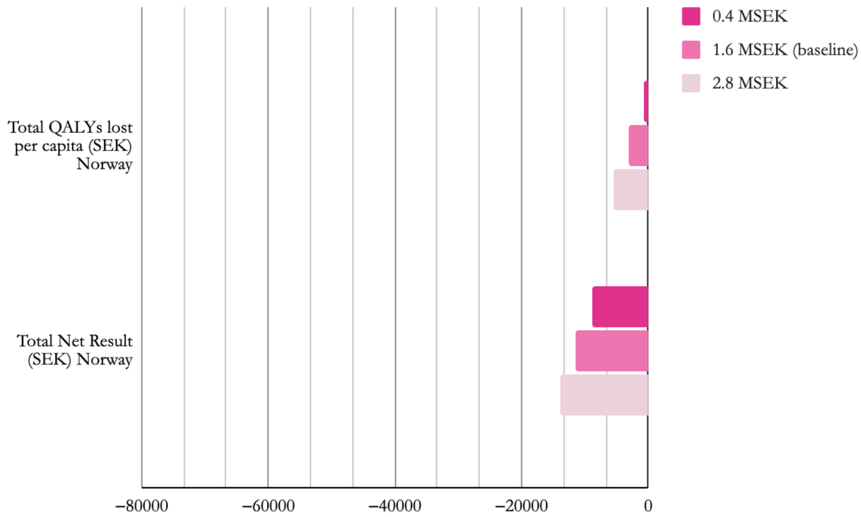

Figure 14. Sensitivity Analysis Norway with different monetary valuations of a QALY
Authors rendering of data from sources:
Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022; NICE Citizens Council, 2010

The corresponding result for Sweden is visualized in Figure 15 below.

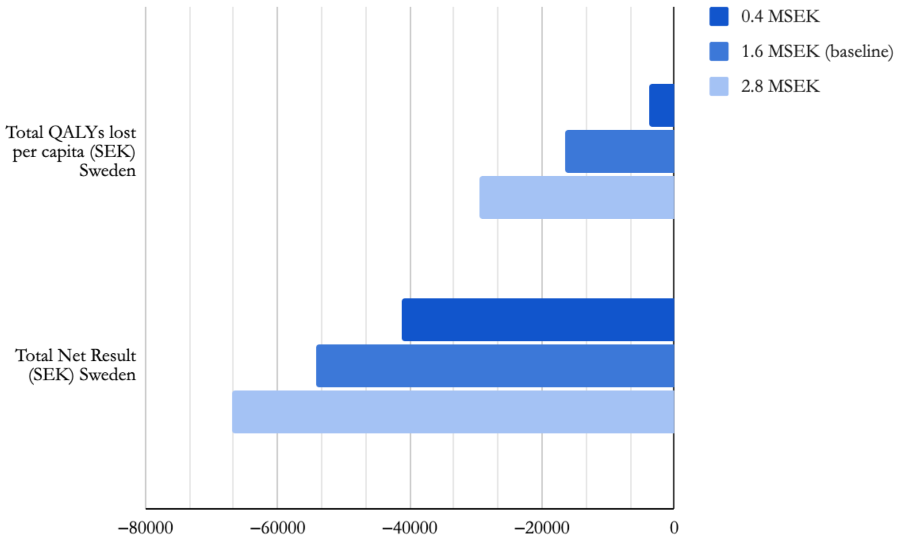

Figure 15. Sensitivity Analysis Sweden with different monetary valuations of a QALY
Authors rendering of data from sources:
Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022; NICE Citizens Council, 2010

Using Norway as the benchmark, the lower bound *difference* for Sweden in total QALYs lost per capita was -3 048 and the upper bound *difference* was -23 844 SEK respectively. Consequently, the *difference* in total net results for the lower bound changed to -32 301 and the upper bound to -53 097 SEK. This implies that using the lower bound QALY valuation, Sweden has performed relatively better (-32 301) than in the baseline result (-42 699 SEK per capita) but using the upper bound Sweden has performed relatively worse (-53 097 compared to - 42 699 in the baseline result). The *difference* corresponds to a percentage change of -24% for the lower bound and +24% for the upper bound (see appendix F for detailed calculations). To conclude, regardless of the valuation of a QALY, Norway's response policy remained the most efficient in terms of QALYs lost per capita and total net result, however within each country different QALY valuations have an impact.

9.4.1.5 Discounting benefits

Discounting the life expectancy resulted in Norway and Sweden having lost fewer QALYs than in the baseline case 8433 (Norway) and 88 342 (Sweden) compared to 10 956 (Norway) and 111 072 (Sweden). Further, the monetary valuation of a QALY was discounted as described in section 7.4.1.4. The result is shown in Table 10 below where the monetary valuation of a QALY equals 2,4 MSEK which is larger than the non-discounted value of 1.6 MSEK. This implies that each QALY lost is valued higher than in the baseline result. To conclude, the two affected factors when discounting benefits are opposing; discounted lost life years results in Sweden losing fewer QALYs per capita, however valuing higher each QALY lost results in an increase of the monetary loss.

Table 10. Monetary QALY valuation with discounted life expectancy
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Hultkrantz 2020; K Ahlm et al 2001; SCB 2022a; TLV 2020

VSL Trafikverket	40,5
Lost years of life (Traffic Accident)	30,5
Discounted lost life years	19,6
QALY Weight	0,85
Value per QALY (MSEK)	2,4

In Figure 16 below, total QALYs lost per capita and total net result is visualized for Sweden and Norway respectively after discounting life expectancy and monetary valuation of a QALY.

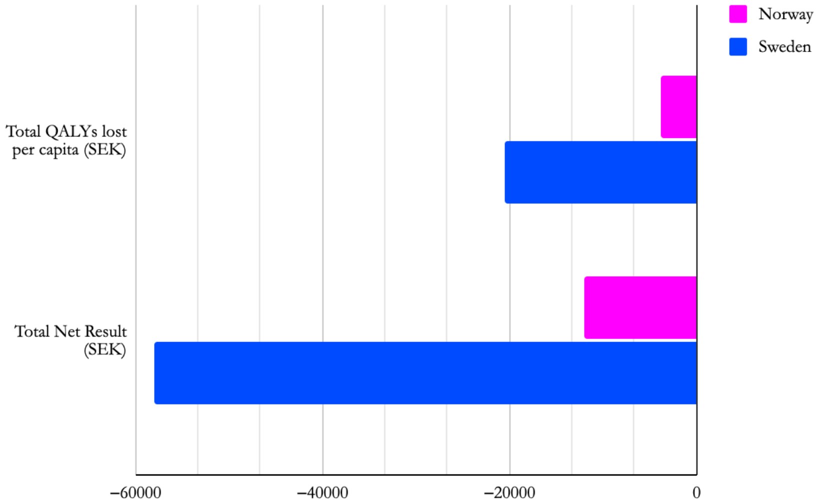

Figure 16. Sensitivity analysis discounted QALYs
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022; TLV 2020

As mentioned, the two effects are opposing but the total QALYs lost and total net result are reduced for both Norway and Sweden. Discounting benefits results in 20% lower total QALYs lost per capita in SEK for Norway and 24% lower total QALYs lost per capita in SEK for Sweden and 5% reduced total net result for Norway and 7% reduced total net result for Sweden. Using Norway as benchmark, discounting life expectancy increases the *difference* in total net results to -46 021 SEK (see appendix G for detailed calculations). This suggests that Sweden has performed even poorer relative to the baseline result when discounting benefits.

9.4.2 Cost

9.4.2.1 GDP per capita growth rate

In Figure 17 below, the average GDP per capita loss and total net result per capita are visualized for Sweden with Swedish and Norwegian growth rates and for Norway with Norwegian and Swedish growth rates (see appendix H for detailed calculations).

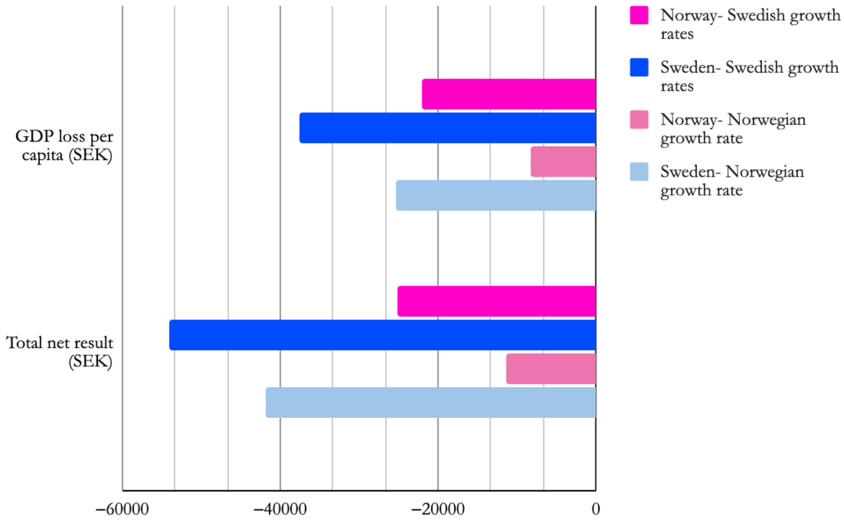

Figure 17. Sensitivity analysis similar GDP per capita growth rates
Authors rendering of data from sources:
Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022

When both countries experience the Swedish average GDP per capita growth rate, Norway is estimated to experience a total GDP per capita loss of -22 041 SEK. This corresponds to more than double the baseline GDP per capita loss for Norway (-8 240 SEK). In this setting, Norway has a net result of -25 195 SEK and Sweden -54 094 SEK i.e., Sweden's baseline net result. This net result corresponds to a twice as large negative result for Sweden relative to Norway, compared to the factor of 4,7 in the baseline result.

Conversely, when both countries experience the Norwegian average GDP per capita growth rate, Sweden is to experience a total GDP per capita loss of -25 256 SEK, almost half the baseline GDP per capita loss for Sweden (-37 493 SEK). In this setting, Sweden has a net result of -41 857 SEK and Norway -11 395 SEK i.e. Norway's baseline result. This net result corresponds to a 3,6 times larger negative result relative to Norway, compared to the factor of 4,7 in the baseline result.

Thus, when testing the sensitivity for country specific economic growth rates, Sweden is performing better in relation to Norway. Using Norway as the benchmark, in the baseline results, Sweden had lost 42 699 SEK relative to Norway. When setting Swedish growth rates for both countries, Sweden had on average lost -28 899 SEK relative to Norway and with Norwegian growth rates for both countries -30 462 SEK correspondingly. Compared to the baseline results, these losses correspond to a percentage change of -32% and -29% respectively. To conclude, testing sensitivity for GDP growth rates, it appears that Sweden is on average performing 30% better compared to baseline, although Norway's response policy remained as the most efficient one.

9.4.2.2 GDP per capita level

In Figure 18 below, the GDP per capita loss and total net result per capita is visualized for Sweden with Swedish and Norwegian GDP levels and for Norway with Norwegian and Swedish GDP levels (see appendix I for detailed calculations).

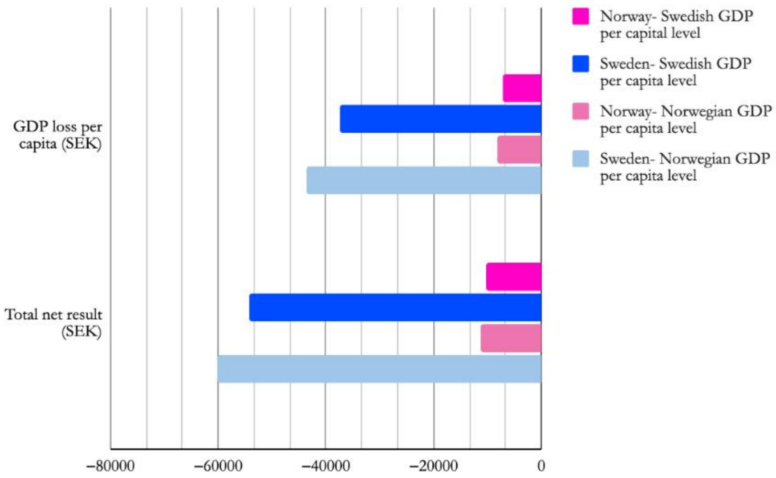

Figure 18. Sensitivity analysis similar GDP per capita levels
Authors rendering of data from sources:
Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022

As both countries are set to have Swedish 2019 GDP per capita levels (486 541 SEK), Norway is estimated to have experienced a total GDP per capita loss of -7072 SEK, which corresponds to 17% less than baseline case of -8240 SEK. In this setting, Norway has a net result of -10 227 SEK and Sweden -54 094 SEK i.e., Sweden's baseline result. Using Norwegian 2019 GDP per capita levels (548 705 SEK), Sweden is estimated to experience a total GDP per capita loss of -43 687 SEK, 17% larger than the baseline result of -37 493 SEK. In this setting, Sweden, Sweden has a net result of -60 288 SEK and Norway -11 396 i.e., Norway's baseline result.

Using Norway as the benchmark, Sweden had lost -42 699 SEK compared to Norway in the baseline results. When setting Swedish GDP per capita levels for both Sweden and Norway, Sweden had lost 3% more compared to baseline results. Setting Norwegian GDP per capita levels for both Sweden and Norway, Sweden had lost 15% more compared to baseline results. On average Sweden lost -46 380 SEK more than Norway, which corresponds to a 9% larger loss compared to the baseline result. To conclude, testing sensitivity for country specific GDP per capita levels, shows that Sweden is performing worse compared to the baseline result.

10. Discussion

With the results at hand, the research question and hypothesis that this paper aimed to answer is revisited:

Out of the two Covid-19 response policies, which one was the most efficient?

Hypothesis: *A country with more responsive restrictions will result in lower death rates and a smaller economic burden for society than a country with more uniform restrictions.*

10.1 Baseline result

The findings imply that the Swedish response policy performed worse relative to the Norwegian response policy both in terms of benefit and cost. More specifically, Sweden experienced a 4,5 times larger GDP per capita loss and a 5,3 times larger loss of QALYs per capita than Norway. Sweden has lost 54 094 SEK per capita during the pandemic and Norway 11 395 SEK per capita. This implies a 4,7 times larger total net result loss for Sweden compared to Norway. These findings suggest that if Sweden would have adopted the Norwegian response policy, Sweden would have saved 42 699 SEK per person during the pandemic period.

To understand the factors driving these results, the attention is turned to the stringency index of the two countries' response policies, illustrated in Figure 2. Overall, the two countries have experienced severe restrictions and surpassed each other in terms of stringency. However, comparing 2020 and 2021, it seems as if it was primarily during 2020 that the two countries diverged from each other. What characterizes the first-year differences was not only the levels of stringency but also their respective responsiveness. Norway swiftly implemented more stringent NPIs and relatively quickly repealed them. Sweden was slower to respond and never surpassed Norway's highest level of stringency. Sweden also held on to their stringency level relatively longer.

In the beginning of the pandemic, Sweden experienced high levels of Covid-19-related deaths compared to its neighboring countries. Looser government restrictions were believed to have played a role (Yarmol-Matusiak, Cipriano et al. 2021). This thesis' results coincide with theirs in the sense that Sweden's slow response in the beginning is one of the major differences when studying the characteristics of the countries' response policy. Also, Figure 7 clearly shows the difference in the pace of growing Covid-19 related deaths during the first half of 2020 between Sweden and Norway. Furthermore, this thesis' results indicates that Sweden never managed to recover from their initial inaction. Albeit Sweden remained at higher levels of stringency afterwards and co-moved with Norway to a high degree during 2021.

In the counterfactual lockdown scenario constructed by Born et al. (2021) they found that a 9-week lockdown in the first half of 2020 would have reduced Covid-19 infections and deaths by 75% and 38% respectively. One caveat to consider in this paper concerns the perception that Sweden constitutes a no-lockdown country. During the mentioned period 15 March - 17 May 2020, Sweden might not have implemented lockdown but still maintained stringency levels around 60. Norway reached a top of 75 during that same period. This caveat should have us interpret the results of Born et al. (2021) with caution. Nevertheless, this paper's findings point at some positive effects of lockdown that Norway enjoyed. Returning to the stringency index, the first half of 2020 is characterized by Norwegian restrictions being more responsive and Swedish restrictions being less responsive and uniform. Swedes reduced their social interaction substantially but not to the same extent as a lockdown would. This notion is confirmed in the paper by Yarmol-Matusiak et al. (2021) They find that Swedes initially reduced their mobility by half as much as their Nordic peers that implemented lockdown and suffered fewer casualties. To conclude, these two papers both point to the initial period of the pandemic as where the answers to the discrepancies in outcomes for Sweden and Norway can be found.

Sweden never experienced a lockdown while Norway was considered to have done so during 2020. The negative economic effects of a lockdown are clear cut. However, the results raise questions when observing the relative economic losses that Sweden and Norway have suffered. Norway's GDP per capita loss in 2020 was only half as large as the loss of Sweden. In a comparison of elimination and mitigation strategies, König et al. (2021) found that countries pursuing an elimination strategy suffered less severe economic effects than countries employing a mitigation strategy. Worth mentioning is that both Sweden and Norway were considered to be employers of a mitigation strategy in this study. However, when comparing the two countries based on stringency, Norway is considered to be closer to an elimination strategy and Sweden a mitigation strategy. This thesis' results for 2020 thus concur with the findings in this paper. Norway's swift and severe response i.e. elimination approach helped minimize economic losses. The potential dynamics explaining this could be that elimination strategies allow for countries to open up quicker and the following economic pickup-effect might compensate for the negative lockdown effects. While mitigation strategies do not put societies under an equal amount of pressure as an elimination strategy, the midway solution might incur smaller but continuous economic losses (König, Winkler 2021).

In a working paper by the IMF analyzing the economic effects of Swedish Covid-19 response policies, it is suggested that Sweden's less stringent strategy might have eased the negative economic impact initially. Sweden was unique in experiencing positive economic growth during the first quarter of 2020. However, they point out that these economic benefits could be lost subsequently, due to higher infection rates and a prolonged pandemic. Indicators of monthly economic activity presented by the authors show that Swedish economic contraction accelerated in April and continued in May. This stands in contrast to Norway where economic growth seems to have rebounded in May (Bricco, Misch et al. 2020). Returning to the stringency index in Figure 2 in this paper, it is during May that Norway lifts their lockdown. This thesis' results further affirm the pattern suggested in the IMF paper since Norway for 2020 had a negative GDP growth of -0.72 and correspondingly for Sweden -2.94. Besides the aforementioned rebound-effect, another aspect of this could be that Sweden's continuously high infection rates in May relative to Norway depressed economic activity.

In Figure 7, a rise in Covid-19 related death cases for both countries is notated from November 2020 - May 2021. Sweden was however experiencing a faster increase in Covid-19 related deaths compared to Norway. Once again, utilizing the stringency index in Figure 2, what might explain Norway's increasing death count could be the relaxed stringency levels during June - October 2020 that allowed the virus to spread. The stringency index does not pose a clear explanation to Sweden's rise in death count since Sweden's levels remained uniform. To explain the seemingly counterintuitive relationship between Sweden's stringency and its mortality rates, other explaining factors not studied in this paper would have to be included.

To conclude this part of the discussion, the results are clear, Norway's response policy was the most efficient one. Using the stringency index as the main tool to identify time periods of interest, it is noted that Sweden's initial response is an important driver. The slow and lenient approach left Sweden more exposed. The negative economic consequences of severe NPIs are clear. However, when studying a longer period and thus including repealed restrictions, economic rebound-effects should be considered and negative economic effects from high infection rates. These dynamics could explain why Norway managed to implement a lockdown without suffering greater economic losses than Sweden. The stringency index can pose an explanation to why Norway experienced a rise in mortality rates during November 2020 - May 2021. Sweden's rise in mortality during the same period is not clearly explained by the stringency index, indicating that other variables might have to be included.

10.2 Sensitivity analysis

10.2.1 Benefits

When adjusting the QALY-weights for comorbidity and/or life expectancy it is shown that a downward adjustment of both variables, separately and in combination, decreases the QALY loss for Sweden relative to Norway. However, in Table 4, the age group distribution of the Covid-19 related deaths between Sweden and Norway are similar. This implies that old and sick people only explain part of the relatively high QALY-loss in Sweden. On the other hand, discrepancies such as the 7% difference of death cases among 80–89-year-olds (Sweden: 41%, Norway: 34%) do partly contribute to Sweden's relatively large QALY loss in the baseline results. The explanation for the decrease in QALYs lost once adjusted for comorbidity and/or life expectancy is simply due to Sweden having lost substantially more lives across all age groups compared to Norway, as illustrated in Figures 8-9. According to the report from Coronakommissionen, it is specifically pointed out that the elderly care in Sweden was suffering from deficiencies in medical competence and equipment. They stood unprepared to handle a pandemic. Further they conclude that the decisions for restrictions in the elderly care were late and insufficient (Coronakommissionen 2020). This paper's results do not directly contradict the conclusions of Coronakommissionen but rather add to the conclusion that the Swedish response policy failed to protect all age groups compared to Norway.

However, even when the sensitivity for both comorbidity and life expectancy are tested, the baseline conclusion stays valid. It shows that the loss among the elderly and sick only explains some of the results. Sweden's overall response policy remains inferior compared to Norway's response policy.

When taking the time-factor into account by discounting the benefit side, the results indicate that Sweden experienced even a greater loss than the baseline results suggested. However, this result should be interpreted with caution since the discount rate, 3%, is an arbitrary rate.

Testing for different QALY valuations, shows that Norway's response policy remained the most efficient which is to be expected. The analysis rather gives some interesting insights on how countries might view their own performance depending on how they value a QALY. The $\pm$ 24 % difference represents a non-trivial amount. Therefore, countries should carefully choose the QALY valuation.

10.2.2 Costs

Testing the sensitivity for country specific characteristics on the cost-side does not change the conclusion that Norway's response policy remained the most efficient. The two tests gave contradicting outcomes which is reasonable since the annual growth rate Norway experiences during 2015-2109 is lower than the Swedish growth rate but Norway has a higher prevailing GDP per capita level than Sweden. Further, the magnitudes of the effects are different. In the test for GDP per capita growth rates, Sweden seems 30 % relatively better off than in the baseline case. However, in the GDP per capita level test, Sweden performs 9 % worse than in the baseline case. Thus, it can be concluded that the GDP per capita growth rate was the most impactful factor that needed to be tested for.

To conclude, the sensitivity analysis does not reject the baseline result which indicates that the assumptions in this paper hold.

The call for a health-economic perspective on the Covid-19 pandemic was based on the need to normalize the view of the virus similar to other diseases (Archer 2020). Assessing Sweden's and Norway's Covid-19 response policies in a cost-benefit structure has enabled a better understanding of the implications for their respective societies. The results have shown that the Norwegian policy was the most efficient one. Norway's initial swift- and responsiveness was found to be the main explanation for these results. In hindsight, it is straightforward to deem which country's response policy was the most efficient. However, it is acknowledged that this pandemic was unexpected and truly challenged policy makers. The robustness tests had the main conclusion remain valid, but it also raised several ethical questions. The application of QALYs to measure benefit shows the difficulties in valuing a life. The comorbidity/life expectancy sensitivity analysis suggested essentially that Sweden's response policy was not as inadequate as the baseline results indicated. The old and sick people were either living substandard lives or expected to die soon. Further, the different valuations of a QALY highlighted the discrepancies that exist between comparable countries and perhaps the need for harmonization.

10.3 Limitations and further research

The choice of studying stringency index highlighted nuances of the respective countries Covid-19 response policy. However, the OxCGRT Covid-19 Stringency Index only consists of a limited number of indicators that could potentially fail to include important nuances. Furthermore, since the NPIs aimed to stop the spread by distancing, a combination of stringency and mobility change might better reflect the true effect of the NPIs.

Concerning benefits, mortality was chosen as a basis for the benefit measure which does not catch all effects of the pandemic. Individuals that got infected and never fully recovered suffer from "long-term" Covid-19, which decreases life quality (NBHW 2021a) and are not included. Further, a possible explanation to the high mortality in Sweden during the initial months of the pandemic could be that Sweden experienced a mild flu during the years prior to the pandemic. In contrast, Norway had a high flu-mortality during these years which could partly explain the relatively low mortality rates in Norway during the initial months of the pandemic (Dagens medicin 2020).

Concerning costs, there are several costs related to the pandemic that are not included in this paper. Such costs are healthcare costs and costs for testing. In fact, these costs are included in GDP but increasing instead of decreasing GDP. For example, private companies distributing laboratory tests for Covid-19 testing earn money from procuring government contracts but viewing them as a GDP gain is questionable. Furthermore, the effect on mental health is only partly covered by GDP by those people that are on sick leave and not contributing to production. All people that experience mild mental distress are not included. It is also possible that some people gained from the restrictions by experiencing increased work-life balance by working remotely. Moreover, other types of medical care were displaced during the pandemic period, such as diagnosis and treatment of cancer, which has raised a worrying issue of "health care-debt" (Torkelsson 2022). This is presumed to burden the healthcare system in terms of monetary terms and quality of life amongst the concerned.

When comparing costs and benefits in a net analysis, the underlying assumption is that the costs of the response policies occur without delay during the pandemic period. It is reasonable to suspect a time lag of economic effects which implies that there are effects of the response policies that will occur in the future. Other indirect costs are likely to occur long after the end of the pandemic. Such effects are for example reduced educational quality during the pandemic.

An inevitable consequence of conducting a cost benefit analysis of a health economic question where benefits are not initially measured in monetary terms, is that a conversion is necessary. All valuation systems have shortcomings since this concerns a complicated topic. This is important to keep in mind when interpreting the results of this paper.

Concerning the case in this paper, several research groups have studied the differences in Covid-19 response policies between Nordic countries. This paper contributes to that group of research by comparing two of the Nordic countries. The comparability of Sweden and Norway can be questioned. An example of such a factor is population growth prior and during the pandemic that differs between Norway and Sweden but is treated as constant in this paper. An important factor affecting population growth is the years of the refugee crisis in 2015, where Sweden received 2,5 times the amount of asylum applications per capita compared to Norway (Migration policy institute 2016). Thus, the increase in the Swedish population potentially affected the GDP growth effect that was prevailing during the years before the pandemic and used to calculate predicted GDP levels during the pandemic. Population density is another potential variable that can explain a part of the result since there are more densely populated areas in Sweden which makes it likely that a more rapid spread of the virus is taking place by making social distancing more difficult.

An ideal case that compares identical countries is a utopia. However, there are possibilities to find certain geographical areas where similarities are larger than comparing Sweden and Norway as a whole. Such a case could be to compare the Gothenburg and Oslo region that have similar population size and density. Since the long-term effects of Covid-19 are unknown, simply revisiting this topic in a period of time would also be of value. These are topics that future research could examine.

11. Conclusion

This paper shows in hindsight that the Swedish Covid-19 response policy of Sweden was less efficient than the Norwegian response policy by comparing relative benefits in the form of lives lost and costs in the form of relative GDP performance during the pandemic period. In the baseline result, Sweden would have saved 42 699 SEK per capita if Sweden would have adopted the Norwegian response policy. The result holds when testing the sensitivity for the main assumptions made in this paper since none of the tests changed the result so that the Swedish response policy would outperform the Norwegian response policy. It can thus be concluded that more responsive restrictions, which were the characteristics of the Norwegian response policy, were more efficient when facing the Covid-19 pandemic than the more uniform characteristics of the response policy of Sweden.

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13. Appendix

Appendix A. GDP calculations

In this section, the calculations from GDP in absolute numbers in local currency, 2015 prices to GDP in SEK per capita in 2021 and converted using 2021 PPP conversion rate is presented. The data in Table 11 below was retrieved from the OECD.Stat database and was the starting point for the calculations. It is graphically presented in Figure 19 below.

Table 11. Total absolute GDP in 2015 prices, local currency (NOK/SEK), in millions
Source: OECD 2022a

	2015	2016	2017	2018	2019	2020	2021
Norway	3111168	3144506	3217562	3253561	3277826	3254318	3381974
Sweden	4260470	4348687	4460358	4547336	4637655	4501114	4717195

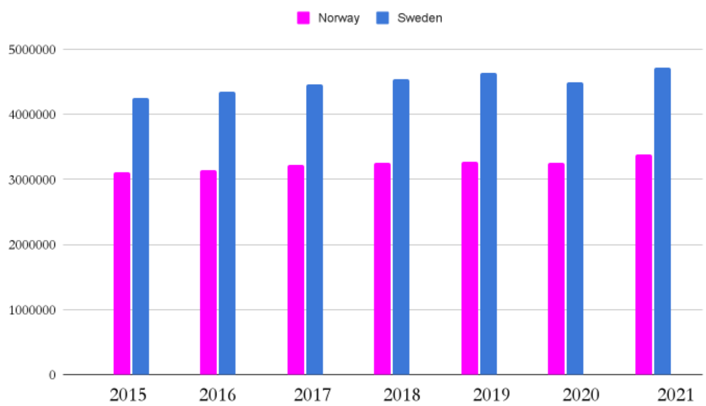

Figure 19. Total GDP in constant 2015 prices, local currency (NOK/SEK), in millions
Source: OECD 2022a

In the next step, data is converted to 2021 prices by adjusting for inflation. Using data on the inflation rates from OECD.Stat database for the years 2015-2021, the compound inflation rate is calculated by multiplying inflation rates over the period, see Table 12 below.

Table 12. Inflation rates are used to calculate the compound inflation rates for Norway and Sweden
Authors rendering of data from source: OECD 2022b

Inflation rate	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Norway	0,022	0,036	0,019	0,028	0,022	0,013	0,035
Sweden	0,000	0,010	0,018	0,020	0,018	0,005	0,022
Compound inflation Norway	18,84%						
Compound inflation Sweden	9,66%						

The compound inflation is used to calculate the total GDP in constant 2021 prices in local currency by multiplying each GDP value expressed in 2015 prices with the compound inflation. The results are presented in Table 13 below where GDP is expressed in 2021 prices for the years 2015-2021 and is graphically presented in Figure 20 below.

Table 13. Total absolute GDP in constant 2021 prices, local currency (NOK/SEK), in millions
Authors rendering of data from sources: OECD 2022a; OECD 2022b

	2015	2016	2017	2018	2019	2020	2021
Norway	3697448	3737069	3823892	3866674	3895512	3867574	4019286
Sweden	4671879	4768614	4891069	4986446	5085486	4935760	5172707

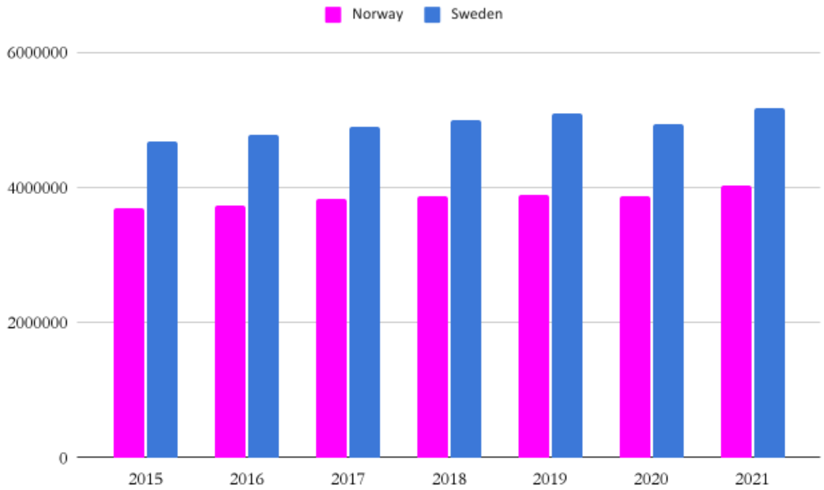

Figure 20. Total GDP in constant 2021 prices, local currency (NOK/SEK), in millions
Authors rendering of data from sources: OECD 2022a; OECD 2022b

In the next step, currency conversion for Norway is performed using the PPP conversion rate for 2021 of 1,3 in order to express GDP in SEK for both countries. In Table 14 below the outcome in total GDP constant 2021 prices in MSEK is presented and is graphically presented in Figure 21 below.

Table 14. Outcome total GDP constant prices 2021 in MSEK (PPP conversion rate 2021)
Authors rendering of data from sources: OECD 2021; OECD 2022a; OECD 2022b

	2015	2016	2017	2018	2019	2020	2021
Norway	2825518	2855795	2922143	2954837	2976874	2955524	3071460
Sweden	4671879	4768614	4891069	4986446	5085486	4935760	5172707

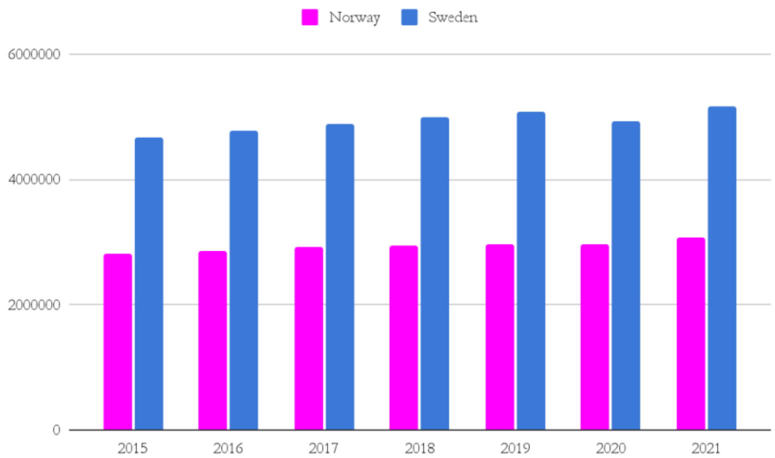

Figure 21. Total GDP in constant 2021 prices, MSEK PPP conversion rate 2021
Authors rendering of data from sources: OECD 2021; OECD 2022a; OECD 2022b

In the last step, the above GDP values are converted into per capita by dividing each value with the population at the end of 2021 for each country in Table 15 below the above numbers are converted into per capita and is graphically presented in Figure 22 below. These values are the values presented in the result section 9.2.

Table 15. Outcome GDP per capita in constant prices 2021 in SEK (PPP conversion rate 2021)
Authors rendering of data from sources: OECD 2021; OECD 2022a ; OECD 2022b; SCB 2022b, SSB 2022.

	2015	2016	2017	2018	2019	2020	2021
Norway	520807	526388	538617	544643	548705	544770	566140
Sweden	446970	456225	467941	477066	486541	472216	494886

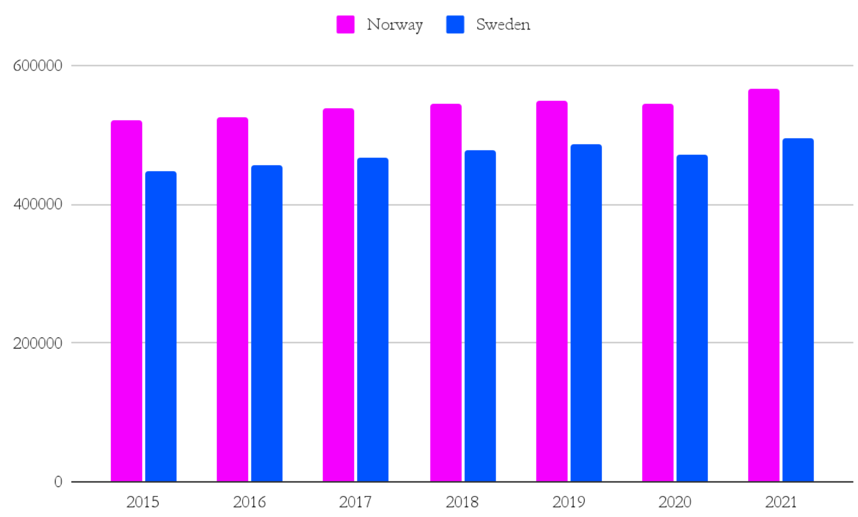

Figure 22. GDP per capita in constant 2021 prices, MSEK PPP conversion rate 2021
Authors rendering of data from sources: OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b, SSB 2022.

Appendix B. Calculations for average growth rates

In Table 16 below the calculations of the yearly growth rates between 2015-2021 and the average yearly growth rates between 2015-2019 are presented.

Table 16. Yearly average growth rates 2015-2021 and average yearly growth rates 2015-2019
Authors rendering of data from sources: OECD 2021; OECD 2022a; OECD 2022b

Yearly Growth Rates	2015	2016	2017	2018	2019	2020	2021
Norway	N/A	0,0107	0,0232	0,0112	0,0075	−0,0072	0,0392
Sweden	N/A	0,0207	0,0257	0,0195	0,0199	−0,0294	0,0480
Average yearly growth rate 2015-2019							
Norway	1,31%						
Sweden	2,14%						

Appendix C. Calculations sensitivity analysis comorbidity

Table 17. Sensitivity analysis comorbidity: 0,1 QALY adjustment
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; SSB 2022a; SCB 2022b; SSB 2022

Norway						
Age group	Total death count	Life expectancy	Lost life years	QALY weights baseline	QALY weights comorbidity	QALYs lost comorbidity
<40	12	58,63	704	0,88	0,78	549
40-49	17	39,21	667	0,86	0,76	507
50-59	57	29,80	1699	0,83	0,73	1240
60-69	139	20,93	2909	0,8	0,7	2036
70-79	312	13,05	4072	0,79	0,69	2809
80-89	440	6,73	2961	0,74	0,64	1895
90+	328	2,55	836	0,74	0,64	535
Total	1305	N/A	13847	N/A		9572
Sweden						
Age group	Total death count	Life expectancy	Lost life years	QALY weights baseline	QALY weights comorbidity	QALYs lost comorbidity
<40	92	58,63	5394	0,88	0,78	4207
40-49	129	39,21	5058	0,86	0,76	3844
50-59	398	29,80	11860	0,83	0,73	8658
60-69	1091	20,93	22835	0,8	0,7	15984
70-79	3443	13,05	44931	0,79	0,69	31002
80-89	6209	6,73	41787	0,74	0,64	26743
90+	3946	2,55	10062	0,74	0,64	6440
Total	15308	N/A	141927	N/A		96880

Table 18. Sensitivity analysis Comorbidity: 0,2 QALY adjustment
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; SSB 2022a; SCB 2022b; SSB 2022

Norway						
Age group	Total death count	Life expectancy	Lost life years	QALY weights baseline	QALY weights comorbidity	QALYs lost comorbidity
<40	12	58,63	704	0,88	0,68	478
40-49	17	39,21	667	0,86	0,66	440
50-59	57	29,80	1699	0,83	0,63	1070
60-69	139	20,93	2909	0,8	0,6	1746
70-79	312	13,05	4072	0,79	0,59	2402
80-89	440	6,73	2961	0,74	0,54	1599
90+	328	2,55	836	0,74	0,54	452
Total	1305	N/A	13847	N/A		8187
Sweden						
Age group	Total death count	Life expectancy	Lost life years	QALY weights baseline	QALY weights comorbidity	QALYs lost comorbidity
<40	92	58,63	5394	0,88	0,68	3668
40-49	129	39,21	5058	0,86	0,66	3338
50-59	398	29,80	11860	0,83	0,63	7472
60-69	1091	20,93	22835	0,8	0,6	13701
70-79	3443	13,05	44931	0,79	0,59	26509
80-89	6209	6,73	41787	0,74	0,54	22565
90+	3946	2,55	10062	0,74	0,54	5434
Total	15308	N/A	141927	N/A		82687

Table 19. Sensitivity analysis Comorbidity: 0,3 QALY adjustment
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; SSB 2022a; SCB 2022b; SSB 2022

Norway						
Age group	Total death count	Life expectancy	Lost life years	QALY weights baseline	QALY weights comorbidity	QALYs lost comorbidity
<40	12	58,63	704	0,88	0,58	408
40-49	17	39,21	667	0,86	0,56	373
50-59	57	29,80	1699	0,83	0,53	900
60-69	139	20,93	2909	0,8	0,5	1455
70-79	312	13,05	4072	0,79	0,49	1995
80-89	440	6,73	2961	0,74	0,44	1303
90+	328	2,55	836	0,74	0,44	368
Total	1305	N/A	13847	N/A		6802
Sweden						
Age group	Total death count	Life expectancy	Lost life years	QALY weights baseline	QALY weights comorbidity	QALYs lost comorbidity
<40	92	58,63	5394	0,88	0,58	3128
40-49	129	39,21	5058	0,86	0,56	2833
50-59	398	29,80	11860	0,83	0,53	6286
60-69	1091	20,93	22835	0,8	0,5	11417
70-79	3443	13,05	44931	0,79	0,49	22016
80-89	6209	6,73	41787	0,74	0,44	18386
90+	3946	2,55	10062	0,74	0,44	4427
Total	15308	N/A	141927	N/A		68494

Table 20. Net sensitivity analysis comorbidity adjustment
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022

	0,1 adjustment		0,2 adjustment		0,3 adjustment	
Benefit	Norway	Sweden	Norway	Sweden	Norway	Sweden
Lost QALYs	9572	96880	8187	82687	6802	68494
Monetary valuation of a QALY in MSEK	1,6	1,6	1,6	1,6	1,6	1,6
Total QALYs lost in MSEK	−14953	−151345	−12790	−129173	−10626	−107001
Total QALYs lost per capita in SEK	−2756	−14480	−2357	−12358	−1959	−10237
Cost						
GDP loss per capita in SEK	−8240	−37493	−8240	−37493	−8240	−37493
Net Result in SEK						
Total QALYs lost per capita	−2756	−14480	−2357	−12358	−1959	−10237
GDP loss per capita	−8240	−37493	−8240	−37493	−8240	−37493
Total	−10996	−51973	−10597	−49852	−10199	−47730
Calculations Norway as benchmark						
Total QALYs lost per capita	0	−11723	0	−10001	0	−8278
GDP loss per capita	0	−29253	0	−29253	0	−29253
Total	0	−40977	0	−39254	0	−37532
Calculations Sweden as benchmark						
Total QALYs lost per capita	11723	0	10001	0	8278	0
GDP loss per capita	29253	0	29253	0	29253	0
Total	40977	0	39254	0	37532	0

Table 21. Comparison total net results with comorbidity adjustment and Norway as benchmark
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022

Sweden	Baseline	−0,1	−0,2	−0,3
Total net result	−42699	−40977	−39254	−37532
Percentage change		−4%	−8%	−12%

Explanation: 0,1 QALY adjustment corresponds to a 4% decrease in total net result, a 0,2 QALY adjustment corresponds to a 8 % decrease in total net result and a 0,3 QALY adjustment corresponds to a 12% decrease in total net result.

Appendix D. Calculations sensitivity analysis life expectancy

Table 22. Sensitivity analysis life expectancy: 10% life expectancy adjustment
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; SSB 2022a; SCB 2022b; SSB 2022

Norway						
Age group	Total death count	Life expectancy	Adjusted life expectancy	Adjusted lost life years	QALY weights Baseline	QALYs Lost adjusted lost life years
<40	12	58,63	52,767	633,20	0,88	557
40-49	17	39,21	35,289	599,91	0,86	516
50-59	57	29,80	26,82	1528,74	0,83	1269
60-69	139	20,93	18,837	2618,34	0,8	2095
70-79	312	13,05	11,745	3664,44	0,79	2895
80-89	440	6,73	6,057	2665,08	0,74	1972
90+	328	2,55	2,295	752,76	0,74	557
Total	1305	N/A		12462,48	N/A	9861
Sweden						
Age group	Total death count	Life expectancy	Adjusted life expectancy	Adjusted lost life years	QALY weights Baseline	QALYs Lost adjusted lost life years
<40	92	58,63	52,767	4854,56	0,88	4272
40-49	129	39,21	35,289	4552,28	0,86	3915
50-59	398	29,80	26,82	10674,36	0,83	8860
60-69	1091	20,93	18,837	20551,17	0,8	16441
70-79	3443	13,05	11,745	40438,04	0,79	31946
80-89	6209	6,73	6,057	37607,91	0,74	27830
90+	3946	2,55	2,295	9056,07	0,74	6701
Total	15308	N/A		127734,39	N/A	99965

Table 23. Sensitivity analysis life expectancy: 20% life expectancy adjustment
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; SSB 2022a; SCB 2022b; SSB 2022

Norway						
Age group	Total death count	Life expectancy	Adjusted life expectancy	Adjusted lost life years	QALY weights Baseline	QALYs Lost adjusted lost life years
<40	12	58,63	46,904	562,85	0,88	495
40-49	17	39,21	31,368	533,26	0,86	459
50-59	57	29,80	23,84	1358,88	0,83	1128
60-69	139	20,93	16,744	2327,42	0,8	1862
70-79	312	13,05	10,44	3257,28	0,79	2573
80-89	440	6,73	5,384	2368,96	0,74	1753
90+	328	2,55	2,04	669,12	0,74	495
Total	1305	N/A		11077,76	N/A	8765
Sweden						
Age group	Total death count	Life expectancy	Adjusted life expectancy	Adjusted lost life years	QALY weights Baseline	QALYs Lost adjusted lost life years
<40	92	58,63	46,904	4315,17	0,88	3797
40-49	129	39,21	31,368	4046,47	0,86	3480
50-59	398	29,80	23,84	9488,32	0,83	7875
60-69	1091	20,93	16,744	18267,70	0,8	14614
70-79	3443	13,05	10,44	35944,92	0,79	28396
80-89	6209	6,73	5,384	33429,26	0,74	24738
90+	3946	2,55	2,04	8049,84	0,74	5957
Total	15308	N/A		113541,68	N/A	88858

Table 24. Sensitivity analysis life expectancy: 30% life expectancy adjustment
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; SSB 2022a; SCB 2022b; SSB 2022

Norway						
Age group	Total death count	Life expectancy	Adjusted life expectancy	Adjusted lost life years	QALY weights Baseline	QALYs Lost adjusted lost life years
<40	12	58,63	41,041	492,49	0,88	433
40-49	17	39,21	27,447	466,60	0,86	401
50-59	57	29,80	20,86	1189,02	0,83	987
60-69	139	20,93	14,651	2036,49	0,8	1629
70-79	312	13,05	9,135	2850,12	0,79	2252
80-89	440	6,73	4,711	2072,84	0,74	1534
90+	328	2,55	1,785	585,48	0,74	433
Total	1305	N/A		9693,04	N/A	7669
Sweden						
Age group	Total death count	Life expectancy	Adjusted life expectancy	Adjusted lost life years	QALY weights Baseline	QALYs Lost adjusted lost life years
<40	92	58,63	41,041	3775,77	0,88	3323
40-49	129	39,21	27,447	3540,66	0,86	3045
50-59	398	29,80	20,86	8302,28	0,83	6891
60-69	1091	20,93	14,651	15984,24	0,8	12787
70-79	3443	13,05	9,135	31451,81	0,79	24847
80-89	6209	6,73	4,711	29250,60	0,74	21645
90+	3946	2,55	1,785	7043,61	0,74	5212
Total	15308	N/A		99348,97	N/A	77751

Table 25. Net sensitivity analysis life expectancy adjustment
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022

	0,1 life expectancy adjustment		0,2 life expectancy adjustment		0,3 life expectancy adjustment	
Benefit	Norway	Sweden	Norway	Sweden	Norway	Sweden
Lost QALYs	9861	99965	8765	88858	7669	77751
Monetary valuation of a QALY in MSEK	1,6	1,6	1,6	1,6	1,6	1,6
Total QALYs lost in MSEK	−15405	−156165	−13693	−138814	−11981	−121462
Total QALYs lost per capita in SEK	−2839	−14941	−2524	−13281	−2208	−11621
Cost						
GDP loss per capita in SEK	−8240	−37493	−8240	−37493	−8240	−37493
Net Result in SEK						
Total QALYs lost per capita	−2839	−14941	−2524	−13281	−2208	−11621
GDP loss per capita	−8240	−37493	−8240	−37493	−8240	−37493
Total	−11079	−52434	−10764	−50774	−10448	−49114
Calculations Norway as benchmark						
Total QALYs lost per capita	0	−12101	0	−10757	0	−9412
GDP loss per capita	0	−29253	0	−29253	0	−29253
Total	0	−41355	0	−40010	0	−38665
Calculations Sweden as benchmark						
Total QALYs lost per capita	12101	0	10757	0	9412	0
GDP loss per capita	29253	0	29253	0	29253	0
Total	41355	0	40010	0	38665	0

Table 26. Comparison total net results with life expectancy adjustment and Norway as benchmark
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022

Sweden	Baseline	−10%	−20%	−30%
Total net result	−42699	−41355	−40010	−38665
Percentage change		−3%	−6%	−9%

Explanation: a 10% decrease in life expectancy corresponds to a 3% decrease in total net result, a 20% decrease in life expectancy corresponds to a 6 % decrease in total net result and a 30% decrease in life expectancy corresponds to a 9% decrease in total net result.

Appendix E. Calculations sensitivity analysis comorbidity and life expectancy

Table 27. Sensitivity analysis comorbidity and life expectancy: 0,1 QALY-adjustment and 10% life expectancy adjustment
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; SSB 2022a; SCB 2022b; SSB 2022

Norway							
Age group	Total death count	Life expectancy	Adjusted life expectancy	Adjusted lost life years	QALY weights baseline	QALY Weights comorbidity	QALYs Lost Com. + adj lost life years
<40	12	58,63	52,77	633,20	0,88	0,78	494
40-49	17	39,21	35,29	599,91	0,86	0,76	456
50-59	57	29,80	26,82	1528,74	0,83	0,73	1116
60-69	139	20,93	18,84	2618,34	0,8	0,7	1833
70-79	312	13,05	11,75	3664,44	0,79	0,69	2528
80-89	440	6,73	6,06	2665,08	0,74	0,64	1706
90+	328	2,55	2,30	752,76	0,74	0,64	482
Total	1305	N/A		12462,48	N/A		8615
Sweden							
Age group	Total death count	Life expectancy	Adjusted life expectancy	Adjusted lost life years	QALY weights baseline	QALY Weights comorbidity	QALYs Lost Com. + adj lost life years
<40	92	58,63	52,77	4854,56	0,88	0,78	3787
40-49	129	39,21	35,29	4552,28	0,86	0,76	3460
50-59	398	29,80	26,82	10674,36	0,83	0,73	7792
60-69	1091	20,93	18,84	20551,17	0,8	0,7	14386
70-79	3443	13,05	11,75	40438,04	0,79	0,69	27902
80-89	6209	6,73	6,06	37607,91	0,74	0,64	24069
90+	3946	2,55	2,30	9056,07	0,74	0,64	5796
Total	15308	N/A		127734,39	N/A		87192

Table 28. Sensitivity analysis QALY-adjustment and life expectancy: 0,2 QALY-adjustment and 20% life expectancy adjustment
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; SSB 2022a; SCB 2022b; SSB 2022

Norway							
Age group	Total death count	Life expectancy	Adjusted life expectancy	Adjusted lost life years	QALY weights baseline	QALY Weights comorbidity	QALYs Lost Com. + adj lost life years
<40	12	58,63	46,90	562,85	0,88	0,68	383
40-49	17	39,21	31,37	533,26	0,86	0,66	352
50-59	57	29,80	23,84	1358,88	0,83	0,63	856
60-69	139	20,93	16,74	2327,42	0,8	0,6	1396
70-79	312	13,05	10,44	3257,28	0,79	0,59	1922
80-89	440	6,73	5,38	2368,96	0,74	0,54	1279
90+	328	2,55	2,04	669,12	0,74	0,54	361
Total	1305	N/A		11077,76	N/A		6550
Sweden							
Age group	Total death count	Life expectancy	Adjusted life expectancy	Adjusted lost life years	QALY weights baseline	QALY Weights comorbidity	QALYs Lost Com. + adj lost life years
<40	92	58,63	46,90	4315,17	0,88	0,68	2934
40-49	129	39,21	31,37	4046,47	0,86	0,66	2671
50-59	398	29,80	23,84	9488,32	0,83	0,63	5978
60-69	1091	20,93	16,74	18267,70	0,8	0,6	10961
70-79	3443	13,05	10,44	35944,92	0,79	0,59	21208
80-89	6209	6,73	5,38	33429,26	0,74	0,54	18052
90+	3946	2,55	2,04	8049,84	0,74	0,54	4347
Total	15308	N/A		113541,68	N/A		66149

Table 29. Sensitivity analysis QALY-adjustment and life expectancy: 0,3 QALY-adjustment and 30% life expectancy adjustment
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; SSB 2022a; SCB 2022b; SSB 2022

Norway							
Age group	Total death count	Life expectancy	Adjusted life expectancy	Adjusted lost life years	QALY weights baseline	QALY Weights comorbidity	QALYs Lost Com. + adj lost life years
<40	12	58,63	41,04	492,49	0,88	0,58	286
40-49	17	39,21	27,45	466,60	0,86	0,56	261
50-59	57	29,80	20,86	1189,02	0,83	0,53	630
60-69	139	20,93	14,65	2036,49	0,8	0,5	1018
70-79	312	13,05	9,14	2850,12	0,79	0,49	1397
80-89	440	6,73	4,71	2072,84	0,74	0,44	912
90+	328	2,55	1,79	585,48	0,74	0,44	258
Total	1305	N/A		9693,04	N/A		4762
Sweden							
Age group	Total death count	Life expectancy	Adjusted life expectancy	Adjusted lost life years	QALY weights baseline	QALY Weights comorbidity	QALYs Lost Com. + adj lost life years
<40	92	58,63	41,04	3775,77	0,88	0,58	2190
40-49	129	39,21	27,45	3540,66	0,86	0,56	1983
50-59	398	29,80	20,86	8302,28	0,83	0,53	4400
60-69	1091	20,93	14,65	15984,24	0,8	0,5	7992
70-79	3443	13,05	9,14	31451,81	0,79	0,49	15411
80-89	6209	6,73	4,71	29250,60	0,74	0,44	12870
90+	3946	2,55	1,79	7043,61	0,74	0,44	3099
Total	15308	N/A		99348,97	N/A		47946

Table 30. Net sensitivity analysis comorbidity and life expectancy adjustments
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022

	0,1 adj life exp/0,1 adj com.		0,2 adj life exp/0,2 adj com.		0,3 adj life exp/0,3 adj com.	
Benefit	Norway	Sweden	Norway	Sweden	Norway	Sweden
Lost QALYs	8615	87192	6550	66149	4762	47946
Monetary valuation of a QALY in MSEK	1,6	1,6	1,6	1,6	1,6	1,6
Total QALYs lost in MSEK	−13458	−136211	−10232	−103339	−7439	−74901
Total QALYs lost per capita in SEK	−2481	−13032	−1886	−9887	−1371	−7166
Cost						
GDP loss per capita in SEK	−8240	−37493	−8240	−37493	−8240	−37493
Net Result in SEK						
Total QALYs lost per capita	−2481	−13032	−1886	−9887	−1371	−7166
GDP loss per capita	−8240	−37493	−8240	−37493	−8240	−37493
Total	−10721	−50525	−10126	−47380	−9611	−44659
Calculations Norway as benchmark						
Total QALYs lost per capita	0	−10551	0	−8001	0	−5795
GDP loss per capita	0	−29253	0	−29253	0	−29253
Total	0	−39804	0	−37254	0	−35048
Calculations Sweden as benchmark						
Total QALYs lost per capita	10551	0	8001	0	5795	0
GDP loss per capita	29253	0	29253	0	29253	0
Total	39804	0	37254	0	35048	0

Table 31. Comparison total net results with comorbidity and life expectancy adjustment with Norway as benchmark
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022

Sweden	Baseline	−0,1/10%	−0,2/20%	−0,3/30%
Total net result	−42699	−39804	−37254	−35048
Percentage change		−7%	−13%	−18%

Explanation: a 0,1/10% decrease in life expectancy corresponds to a 7% decrease in total net result, a 0,2/20% decrease in life expectancy corresponds to a 13 % decrease in total net result and a 0,3/30% decrease in life expectancy corresponds to a 18% decrease in total net result.

Appendix F. Calculations sensitivity analysis monetary QALY-valuations

Table 32. Net sensitivity analysis different monetary QALY valuations
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022; NICE Citizens Council, 2010

	Lower boundary (NICE)		Baseline		Upper boundary	
Benefit	Norway	Sweden	Norway	Sweden	Norway	Sweden
Lost QALYs	10956	111072	10956	111072	10956	111072
Monetary valuation of a QALY in MSEK	0,4	0,4	1,6	1,6	2,8	2,8
Total QALYs lost in MSEK	−3880	−39335	−17116	−173517	−30352	−307699
Total QALYs lost per capita in SEK	−715	−3763	−3155	−16601	−5595	−29438
Cost						
GDP loss per capita in SEK	−8240	−37493	−8240	−37493	−8240	−37493
Net Result in SEK						
Total QALYs lost per capita	−715	−3763	−3155	−16601	−5595	−29438
GDP loss per capita	−8240	−37493	−8240	−37493	−8240	−37493
Total	−8955	−41257	−11395	−54094	−13835	−66932
Calculations Norway as benchmark						
Total QALYs lost per capita	0	−3048	0	−13446	0	−23844
GDP loss per capita	0	−29253	0	−29253	0	−29253
Total	0	−32301	0	−42699	0	−53097
Calculations Sweden as benchmark						
Total QALYs lost per capita	3048	0	13446	0	23844	0
GDP loss per capita	29253	0	29253	0	29253	0
Total	32301	0	42699	0	53097	0

Table 33. Comparison total net results per capita with a low and high QALY valuation using Norway as benchmark
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022; NICE Citizens Council, 2010

Sweden	Lower bound	Baseline	Upper bound
Total net result per capita	−32301,37	−42699,18	−53096,98
Percentage difference	24%	N/A	24%

Appendix G. Calculations sensitivity analysis discounting benefits

Table 34. Sensitivity analysis discounted life expectancy 3%
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; SSB 2022a; SCB 2022b; SSB 2022; TLV 2020

Norway						
Age group	Total death count	Life expectancy	Discounted life expectancy 3%	Discounted lost life years	QALY weights baseline	Discounted QALYs lost
<40	12	58,63	27,44	329	0,88	290
40-49	17	39,21	22,87	389	0,86	334
50-59	57	29,80	19,52	1113	0,83	923
60-69	139	20,93	15,38	2138	0,8	1710
70-79	312	13,05	10,67	3329	0,79	2630
80-89	440	6,73	6,01	2646	0,74	1958
90+	328	2,55	2,42	794	0,74	587
Total	1305			10736		8433
Sweden						
Age group	Total death count	Life expectancy	Discounted life expectancy 3%	Discounted lost life years	QALY weights baseline	Discounted QALYs Lost
<40	92	58,63	27,44	2525	0,88	2222
40-49	129	39,21	22,87	2951	0,86	2538
50-59	398	29,80	19,52	7769	0,83	6448
60-69	1091	20,93	15,38	16777	0,8	13422
70-79	3443	13,05	10,67	36732	0,79	29018
80-89	6209	6,73	6,01	37335	0,74	27628
90+	3946	2,55	2,42	9550	0,74	7067
Total	15308			113638		88342

Table 35. Net sensitivity analysis discounted life expectancy and QALY valuation with discounting rate of 3%
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022; TLV 2020

Benefit	Norway	Sweden
Lost QALYs	8433	88342
Monetary valuation of a QALY in MSEK	2,4	2,4
Total QALYs lost in MSEK	−20499	−214757
Total QALYs lost per capita in SEK	−3778	−20546
Cost		
GDP loss per capita in SEK	−8240	−37493
Net Result in SEK		
Total QALYs lost per capita	−3778	−20546
GDP loss per capita	−8240	−37493
Total	−12019	−58040
Calculations Norway as benchmark		
Total QALYs lost per capita	0	−16768
GDP loss per capita	0	−29253
Total	0	−46021
Calculations Sweden as benchmark		
Total QALYs lost per capita	16768	0
GDP loss per capita	29253	0
Total	46021	0

Table 36. Calculations for percentage difference discounted QALYs per capita and net result per capita for Sweden and Norway
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022; TLV 2020

	Norway	Sweden
Baseline total QALYs lost per capita in SEK	−3155	−16601
Discounted total QALYs lost per capita in SEK	−3778	−20546
Percentage difference	−20%	−24%
	Norway	Sweden
Baseline net result per capita in SEK	−11395	−54094
Discounted net result per capita in SEK	−12019	−58040
Percentage difference	−5%	−7%

Appendix H. Calculations sensitivity analysis GDP growth rates

Tabell 37. Sensitivity analysis same GDP growth rates for Sweden and Norway

Authors rendering of data from sources: OECD 2021; OECD 2022a ; OECD 2022b; SCB 2022b, SSB 2022.

Average yearly growth rate 2015-2019			
Norway	1,31%		
Sweden	2,14%		
Outcome total GDP constant prices 2021 in MSEK (PPP conversion rate 2021)	2019	2020	2021
Norway	2976874	2955524	3071460
Sweden	5085486	4935760	5172707
Predicted total GDP with Swedish growth rates	2020	2021	
Norway	3040689	3105872	
Sweden	5194503	5305857	
Actual vs Predicted total GDP	2020	2021	
Norway	−85164	−34412	
Sweden	−258743	−133150	
Difference actual vs predicted GDP per capita	Total Difference in MSEK	Population	Per capita in SEK
Norway	−119576	5425270	−22041
Sweden	−391893	10452326	−37493
Predicted total GDP with Norwegian growth rates			
Predicted GDP	2020	2021	
Norway	3016015,99	3055673	
Sweden	5152353,88	5220101	
Actual vs Predicted total GDP	2020	2021	
Norway	−60492	15787	
Sweden	−216593	−47393	
Difference actual vs predicted GDP per capita	Total Difference in MSEK	Population	Per capita in SEK
Norway	−44705	5425270	−8240
Sweden	−263987	10452326	−25256

Tabell 38. Net sensitivity analysis same GDP growth rates for Sweden and Norway
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022

	Swedish growth rate		**Norwegian growth rate**	
Benefit	Norway	Sweden	Norway	Sweden
Lost QALYs	10956	111072	10956	111072
Monetary valuation of a QALY in MSEK	1,6	1,6	1,6	1,6
Total QALYs lost in MSEK	−17116	−173517	−17116	−173517
Total QALYs lost per capita in SEK	−3155	−16601	−3155	−16601
Cost				
GDP loss per capita in SEK	−22041	−37493	−8240	−25256
Net Result in SEK				
Total QALYs lost per capita	−3155	−16601	−3155	−16601
GDP loss per capita	−22041	−37493	−8240	−25256
Total	−25195	−54094	−11395	−41857
Calculations Norway as benchmark				
Total QALYs lost per capita	0	−13446	0	−13446
GDP loss per capita	0	−15453	0	−17016
Total	0	−28899	0	−30462
Calculations Sweden as benchmark				
Total QALYs lost per capita	13446	0	13446	0
GDP loss per capita	15453	0	17016	0
Total	28899	0	30462	0

Tabell 39. Calculations for percentage difference in GDP per capita using Norway as benchmark.
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022

Sweden	Swedish growth rate	Norwegian growth rate
Net result per capita	−28899	−30462
Net result baseline	−42699	−42699
Percentage difference	32%	29%

Explanation: Using Swedish growth rate for both Sweden and Norway results in a net result per capita difference of 28899 SEK per capita. Compared to the baseline difference of 42699 SEK per capita (using Swedish growth rates for Sweden and Norwegian growth rates for Norway) using Swedish growth rate for both countries corresponds to a 32% lower net result. Correspondingly using Norwegian growth rates for both Sweden and Norway this corresponds to a 29% lower net result.

Appendix I. Calculations sensitivity analysis GDP levels

Tabell 40. Sensitivity analysis same GDP levels for Sweden and Norway

Authors rendering of data from sources: OECD 2021; OECD 2022a ; OECD 2022b; SCB 2022b, SSB 2022.

GDP per capita in constant prices 2021, MSEK (PPP conversion rate 2021)	2019-12-31
Norway	520807
Sweden	446970
GDP loss per capita in SEK	
Norway	−8240
Sweden	−37493
GDP per capita loss ratio (GDP loss/ GDP per capita 2019-12-31)	
Norway	−1,58%
Sweden	−8,39%
GDP per capita loss cross country comparison	
Norway GDP loss - Swedish GDP per capita as baseline	−7072
Sweden GDP loss - Norwegian GDP per capita as baseline	−43687

Table 41. Net sensitivity analysis same GDP levels for Sweden and Norway
Authors rendering of data from sources: Burström, Johannesson et al. 2001; Ined 2022a; OECD 2021; OECD 2022a; OECD 2022b; SCB 2022b; SSB 2022

	Swedish GDP per capita		**Norwegian GDP per capita**	
Benefit	Norway	Sweden	Norway	Sweden
Lost QALYs	10956	111072	10956	111072
Monetary valuation of a QALY in MSEK	1,6	1,6	1,6	1,6
Total QALYs lost in MSEK	−17116	−173517	−17116	−173517
Total QALYs lost per capita in SEK	−3155	−16601	−3155	−16601
Cost				
GDP loss per capita in SEK	−7072	−37493	−8240	−43687
Net Result in SEK				
Total QALYs lost per capita	−3155	−16601	−3155	−16601
GDP loss per capita	−7072	−37493	−8240	−43687
Total	−10227	−54094	−11395	−60288
Calculations Norway as benchmark				
Total QALYs lost per capita	0	−13446	0	−13446
GDP loss per capita	0	−30421	0	−35447
Total	0	−43867	0	−48893
Calculations Sweden as benchmark				
Total QALYs lost per capita	13446	0	13446	0
GDP loss per capita	30421	0	35447	0
Total	43867	0	48893	0

Table 42. Calculations of GDP loss per capita with same GDP per capita levels
Authors rendering of data from sources: OECD 2021; OECD 2022a ; OECD 2022b; SCB 2022b, SSB 2022.

	Swedish GDP per capita	Norwegian GDP per capita
GDP loss per capita in SEK Norway	−7072	−8240
Percentage difference	−17%	N/A
GDP loss per capita in SEK Sweden	−37493	−43687
Percentage difference	N/A	−17%

Tabell 43. Calculations for percentage difference in GDP levels per capita and net result using Norway as benchmark.
Authors rendering of data from sources: OECD 2021; OECD 2022a ; OECD 2022b; SCB 2022b, SSB 2022.

Sweden	Swedish GDP per capita	Norwegian GDP per capita	Average
Net result GDP loss per capita	−43867	−48893	−46380
Net result GDP per capita baseline	−42699	−42699	N/A
Percentage difference	−3%	−15%	−9%