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The Effect of Changes in Local Labour Market Conditions on Disability Benefit Take-Up: Evidence From Norway

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This thesis concludes my master's degree with a major in Economics at the Norwegian School of Economics. Working on this thesis has been challenging and, at times, frustrating but also exciting and has given me a strong sense of achievement. Delving into the topic of disability benefits and social welfare systems has been very interesting and rewarding. I have also enjoyed putting into practice what I learned in econometrics class.

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Abstract

This master's thesis examines the impact of changes in local labour market conditions on disability benefit take-up, particularly focusing on the 2014 oil price decline. Using municipality-level data for Norway from 2009-2021, the study employs a Two-Stage Least Squares methodology with instrumental variables to explore the relationship between changes in employment and disability benefits. A Difference-in-Difference and Event Study approach is applied to analyse the effects of the oil price decline in 2014 on disability benefits. This event significantly affected employment in Norwegian municipalities with a high dependence on the oil industry. By differentiating municipalities based on their level of oil workers, I investigate if the municipalities most dependent on the oil industry experienced a higher increase in benefit take-up compared to other municipalities post-event.

The Two-Stage Least Squares results reveal a significant inverse relationship between employment levels and disability benefit take-up with an elasticity of -1.454. The findings from the Difference-in-Difference and Event Study indicate that the decline in oil prices in 2014 led to a more pronounced increase in benefit recipients in municipalities with higher levels of oil workers, with a delayed effect that remained for several years after the event. The results indicate that economic shocks to local economies can increase disability benefits take-up. This suggests that for some individuals, disability benefits may function as a substitute for employment during economic downturns.

Keywords – Master Thesis, Economics, Econometrics, Two-Stage Least Square, Differcene in Difference, Event Study, Disability Benefits, Oil Price Decline

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1 Introduction

Norway has relatively high employment compared to other OECD countries. However, it also has the highest proportion of individuals on health-related benefits within the OECD, despite no evidence suggesting that the health status of the Norwegian population is worse compared to other countries (Norwegian Ministry of Finance, 2021). As of October 2023, 366,000 people aged 18 to 67 received disability benefits, representing 10.4 per cent of the population (NAV, 2023a). While the older age groups are overrepresented among the benefit recipients, there has been a doubling in younger individuals under the age of 30 on disability benefits over the last decade (Norwegian Ministry of Finance, 2021). A consequence of this development, in combination with an ageing population, is that a growing proportion of the population will be outside the workforce. This can have profound implications for the welfare state, with an increasing demand on the social welfare system and fewer individuals contributing to its funding. The OECD highlights generous income protection schemes as a barrier to work for many in Norway (Norwegian Ministry of Labour and Social Inclusion, 2021). At the same time, it is essential to ensure that individuals who genuinely need financial assistance due to illness or incapacity receive the support they require, which reduces poverty and enhances economic security for the population. Norway has a strong economy and healthcare system; it is a paradox that such a wealthy nation has a significant portion of its population reliant on benefits. To reduce benefit dependency, it is necessary to understand the dynamics behind the high rate of benefit recipients and what causes individuals to end up on benefits. This, in turn, can help find efficient policy designs that balance a low-benefit dependency and provide adequate support to those who need it.

In this thesis, I examine how fluctuations in employment and local labour market conditions affect disability benefit take-up. The decline in oil prices in 2014 can be considered an economic shock to Norwegian municipalities highly dependent on the oil industry, and it significantly affected employment in these regions. Therefore, I use this event to study how changes in local labour market conditions influence the number of disability benefits recipients. The analysis investigates if social welfare systems might unintentionally act as a substitute for employment during economic downturns. This can offer interesting insights for policy-making in a context where labour market changes can unexpectedly push individuals towards welfare support. In the thesis, I will try to answer the following question:

"How do changes in local labour market conditions affect disability benefit take-up?"

The thesis is inspired by the methodology used by Black et al. (2002) and Charles et al. (2018), which examined the impact of changing labour market conditions on disability insurance take-up in the United States. Both papers find a significant inverse relationship between changes in local labour market conditions and disability benefit take-up. Similarly to Charles et al. (2018), this thesis focuses on fluctuations in oil prices and studies the effect of the 2014 oil price decline on benefit take-up. To accomplish this, I use municipality-level data from the following sources: Statistics Norway (SSB), NAV, and the U.S. Energy Information Administration (EIA).

The findings from the analysis indicate a significant inverse relationship between employment and disability benefit recipients, with an estimated elasticity of -1.454. The impact of employment changes on disability benefits seems to have a delayed effect. In examining the effect of the oil price decline, I find that municipalities with more than five per cent oil workers experienced an average increase in disability benefits by approximately 5.2% compared to the others in the post-event period, indicating that economic shocks to local economies increase disability benefit take-up.

The structure of this thesis is outlined as follows: It begins with a review of previous literature related to the topic. Chapter 3 provides background information on NAV, disability benefits, and the oil sector in Norway. Chapter 4 presents the data used in the analysis, along with descriptive statistics. The methodology employed in the analysis is detailed in Chapter 5. Chapter 6 presents the analysis, and Chapter 7 discusses the results, including a discussion on the robustness of the analysis, limitations of the study, and suggestions for further research. In chapter eight, a conclusion of the findings is presented.

2 Literature Review

Previous empirical research has found a significant relationship between local economic conditions and disability benefit take-up. This chapter will review relevant literature on this subject. The upcoming sections will present findings from various studies, highlighting how economic fluctuations, policy reforms and demographic factors influence disability benefit take-up.

Studies by Black et al. (2002) and Charles et al. (2018) investigated how local earnings and employment fluctuations affect disability benefits take-up. Both studies used the Two-Stage Least Squares (2SLS) method with instrumental variables (IV) to address the potential endogeneity in earnings and employment; Black et al. (2002) research used data from the coal industry during the 1970s and 1980s boom and bust, whereas Charles et al. (2018) extended the analysis from 1970 to 2011, focusing on the oil and gas industry and using global oil price shifts as an IV. Their research revealed that worsening labour market conditions in a county increases benefits recipients in that area. In the Charles et al. (2018) paper, the elasticities of benefit payments to employment are -0.669 for SSDI (Social Security Disability Insurance) and -0.360 for SSI (Supplemental Security Income). Benefit payments to earnings elasticities are estimated at -0.29 for SSDI and -0.16 for SSI. In contrast, Black et al. (2002) reported a much larger elasticity of benefit payments to earnings. However, Charles et al. (2018) reports that much of these differences can be attributed to the federalisation of the SSI program in 1974, which introduced uniform eligibility standards and minimum benefits.

Charles et al. (2018) study has a broader time frame and studies the oil and gas sector, better representing the typical U.S. worker, compared to Black et al. (2002) focus on the coal industry. Charles et al. (2018) study also covered various states, demonstrating how disability programs respond in various regions and industries. These differences show that the results from the Black et al. (2002) study not only apply to less educated men, such as most of the coal industry workers before 1990 but also to more educated individuals during a much more recent period. The findings suggest that the disability benefit take-up responds to changes in economic conditions and appears similar across various regions and disability programs.

Other research, such as Michaud and Wiczer (2018), supports the findings of Black et al. (2002) and Charles et al. (2018). Their study analysed how changing macroeconomic conditions and demographics increased Social Security Disability Insurance (SSDI) beneficiaries since the mid-1980s. They found that worsening economic conditions were a significant factor in the growth of SSDI recipients, particularly in the late 1980s and 1990s. Demographic changes, driven by the ageing Baby Boomer generation, initially mitigated SSDI awards prior to 2000 but then contributed to a 13 per cent increase in the years after. The study also highlighted the impact of changing demographics and economic conditions on non-employment when disability is an option, where they found that individuals are leaving the labour force to apply for SSDI benefits. O'Brien (2013) study found that lower state GDP per capita and increased unemployment rates are linked to higher self-reported disability among workers. These findings were consistent across education levels and became more pronounced during economic downturns like the Great Recession. A study by Autor et al. (2013) found that rising exposure to Chinese import competition affects employment and wages and significantly increases disability benefit payments. Roberts and Taylor (2019) investigated the role of local labour market conditions in disability program participation, explicitly focusing on the Employment and Support Allowance (ESA) in the U.K. They found that health, labour market conditions, and benefit generosity influence the propensity to claim disability benefits conditional on not working. Together, these studies highlight how changes to local labour market conditions affect disability benefit take-up.

In Norway, research has also shown that unemployment often leads to higher disability claims. Bratsberg et al. (2010) found a strong link between employment opportunities and disability insurance claims, with job loss significantly increasing the likelihood of claiming disability benefits. Their findings indicate that unemployment and disability insurance programs are often close substitutes. Similarly, Rege et al. (2009) observed that workers from downsized plants were likelier to take disability pensions, often due to the adverse effects on their future employment prospects and mental health. Fevang and Røed (2006) report also found that downsizing increases the risk of disability among the employed; their results imply that the risk of becoming disabled increases as the degree of downsizing increases. These studies suggest that employment reductions, whether from individual job loss or larger-scale downsizings, increase the risk of disability among workers.

Previous research has studied how changes in policies are contributing to changes in benefit take-up; for instance, Jensen et al. (2019) found that recent labour market reforms, characterised by stricter eligibility criteria for disability benefits, have led to significant changes in the employment status of individuals with varying levels of health in Denmark and Sweden. The study reveals that employment rates increased after the reforms for those in good health, and the odds of receiving disability benefits were reduced, suggesting that these measures encouraged more individuals to remain in the workforce. However, individuals with moderate health problems faced an elevated risk of being on temporary or no benefits. Those with severe health problems showed relatively stable rates of permanent disability benefits. Similarly, Autor and Duggan (2003) found that the changes in the benefits supply, including factors like increased screening stringency and a rising replacement rate, significantly influenced the labour force behaviour of low-skilled workers. Their study found that an increased supply of DI benefits caused a higher propensity for these low-skilled workers to exit the labour force during economic downturns, reducing the measured unemployment rate. The results of these studies suggest that policy reforms influence disability benefit participation, that they hit different groups differently and are potentially pushing individuals with health issues into economic vulnerability.

Certain groups appear to be more sensitive to changes in local economic conditions and are more prone to ending up on benefits. Roberts and Taylor (2019) found that individuals with lower education levels, those from economically disadvantaged households, residents of urban areas (while acknowledging regional differences), and older individuals are more sensitive to changes in local labour market conditions. Fevang and Røed (2006) also explored various factors to find what groups are most likely to receive disability benefits in Norway. Using administrative data from 1993 to 2003, they found that age, gender, education, and immigration background played significant roles. Older individuals were more likely to transition into disability benefits. Gender disparities were also evident, as women were more likely to become recipients of disability benefits compared to men. Those with lower education levels faced higher risk, as did immigrants from North Africa and the Middle East. Family changes, like divorce or spousal loss, were also associated with a higher chance of receiving benefits, but the causal relationship was uncertain. Additionally, when examining the social welfare histories of individuals transitioning into disability benefits towards the end of the study period in 2002, it was found that many had extensive histories with these welfare systems, particularly among younger age groups. Bratberg et al. (2012) report that there seems to be a spillover effect between generations when it comes to receiving disability benefits and that children exposed to parents who receive disability benefits increase the likelihood of them receiving such benefits. The longer a child has experienced disabled parents, the stronger the effect. The study also notes that the effect is more significant when the father is disabled.

In summary, the previous empirical research presented in this review highlights how local and global economic shifts, policy reforms, and demographic factors affect disability benefits. The findings across different countries, including Norway, show how economic downturns significantly increase disability claims, with specific demographic groups being more vulnerable to these changes.

3 Background

Disability benefits are a part of the Norwegian National Insurance Scheme (NIS), established in 1967, and ensure financial security throughout life's various phases. The scheme is mandatory for all residents and employees in Norway. NIS is primarily financed through employee membership fees, employer taxes, and state subsidies (Norwegian Ministry of Labour and Social Inclusion, 2022). This chapter will look into the eligibility criteria for disability benefits in Norway, examine the demographics of benefit recipients, and assess the impact of the oil industry and oil price fluctuations on the country's economy. The aim is to provide relevant background information for the analysis in subsequent sections.

3.1 NAV

NAV administers the National Insurance Scheme, while health-related benefits are managed by the Norwegian Health Economics Administration (HELFO) (Lovdata, 2023). In 2006, the Norwegian Labour and Welfare Administration, NAV, was established through a significant welfare reform. This merger combined elements from municipal social services and the Norwegian Labour and Welfare Service. The NAV reform is considered one of the most important social welfare changes in recent times, where municipalities and the state now collaborate to deliver services to the citizens (NAV, 2023h).

"NAV's social task is to provide social and financial security and to facilitate the transition into work and activity. Our aim is to create an inclusive society, inclusive working life, and a well-functioning labour market" (NAV, 2023h).

NAV administers approximately one-third of the state budget and plays a vital role in the Norwegian welfare state. Its financial schemes encompass disability benefits, facilitated work, unemployment benefits, work assessment allowance, sickness benefits, pensions, financial and social assistance, parental benefits, child benefits, and cash-for-care benefits. The overarching goal is to provide timely financial support to those in need, simultaneously promoting increased workforce participation to reduce dependency on benefits (NAV, 2023h)

3.2 Eligibility Criteria for Disability Benefits

As of 2023, eligibility for disability benefits requires that illness or injury is the primary cause of reduced work and earning capacity. Applicants must be aged between 18 and 67, have been National Insurance Scheme members for five years before illness or injury occurred, and exhibit a reduction in work capacity by at least 50 per cent. Before receiving disability benefits, applicants must assess their work potential and complete vocational rehabilitation to enhance their earnings capacity (NAV, 2023c). Determining eligibility for disability benefits can be a long and demanding process. During this period, many individuals receive Work Assessment Allowance (AAP), a time-limited benefit for those with reduced working capacity. In 2022, 77 per cent of new disability benefit recipients previously received AAP. The rest comes from sickness allowance and persons without a particular connection to working life (the unknown category)(NAV, 2023d). AAP ensures income support when assistance from NAV is necessary due to illness and when work capacity is reduced by at least 50 per cent. The AAP duration can vary depending on work-related activities or necessary medical treatments. Generally, APP can be received for up to three years. In select cases, the period may be extended by two additional years. When receiving AAP, there is a "Duty to be active." In collaboration with NAV, specific duties and activities are tailored to each individual's capabilities. These duties and activities aim to facilitate a path towards improved work capacity. Failure to meet the "Duty to be active" requirements without a reasonable explanation can reduce or terminate the AAP allowance (NAV, 2023a).

3.3 Rates for Disability Benefits

NIS uses the "basic amount" as a benchmark for calculating pensions and benefits. It is annually adjusted based on expected wage growth in the current year, adjusted for any deviations between expected and actual wage growth in recent years. The basic amount is adjusted so that disability benefits, pensions, and other benefits are regulated according to wage growth. As of May 2023, the basic amount is NOK 188,620 (NAV, 2023e).

The calculation of disability benefits relies on the individual's income over the five years before the onset of illness or injury. Disability benefits constitute 66 per cent of the average pensionable income for the three best years within five years. However, only annual income up to six times the National Insurance Scheme basic amount (G) is included in the calculation (NAV, 2023c). Similar criteria apply to AAP, but only the income from the year before the work capacity reduction of at least 50 per cent is considered (NAV, 2023a). Individuals with limited or no prior income receive a minimum payment. The minimum payment is 2.28 times the National Insurance Scheme basic amount (G) for those living with a spouse, partner, or cohabitant and 2.48 times for single individuals. "Young disabled persons" disabled before age 26 have different benefit calculation rules, granting them higher minimum rates, either 2.66 or 2.91 times the National Insurance Scheme basic amount, depending on their marital status and living arrangements (NAV, 2023c).

3.4 Demographics of Benefit Recipients

In October 2023, 10.4 per cent of Norway's population between 18 and 67 received disability benefits. Certain demographic groups are experiencing more pronounced increases. Women outnumber men in benefit recipients, with 12.5 per cent of women compared to 8.5 per cent of men (NAV, 2023g). In recent years, there has also been a more substantial growth in the proportion of disabled women than men, extending across all age groups except those under 25. Furthermore, there has been a significant rise in the proportion of disabled individuals under 30. However, they still constitute a relatively small portion of all disability benefit recipients at 2.6 per cent of the population, but the number has doubled over the last decade. Conversely, the older age groups have witnessed a decline in benefit recipients since the mid-2000s. This decline can be attributed to increased education levels, improved health, less physically demanding jobs, and the availability of old-age pensions from age 62, introduced in 2011 (Ellingsen, 2017).

3.4.1 Diagnosis

Diagnosis statistics from 2017 reveal that the most common reasons for receiving disability benefits are mental illness and behavioural disorders, accounting for 37.7 per cent, followed by musculoskeletal diseases at 26.4 per cent. Between 2000 and 2016, there was an 8.2 per cent increase in the proportion of individuals with mental and behavioural disorders, while musculoskeletal disorders decreased by 6.9 per cent. As expected, musculoskeletal diseases positively correlate with age, given their prevalence in older individuals (NAV, 2023b). Additionally, more women than men receive disability benefits for musculoskeletal disorders, which might explain why there are more disabled women than men. Other factors might be that women more often have graded disability benefits where they combine work and benefits due to traditional gender roles (Normann, 2018). When it comes to mental illness, a higher proportion of young people and men receive disability benefits. Among the young disabled, 63 per cent is due to mental illness, potentially explaining why there is such an increase in young disabled. Other factors might be improved medical treatments allowing children with previously life-threatening diagnoses to survive and the expedited clearance of young individuals for disability benefits (Ekelund, 2022).

3.4.2 Graded Benefits

The majority of disability benefit recipients are considered 100 per cent disabled and do not work. Statistics from 2019 indicate that 18 per cent of all recipients were registered as working, 71 per cent of those receiving graded benefits are employed, and around 5 per cent of those with 100 per cent disability. Few who become disability benefit recipients re-enter the workforce, but evidence suggests that some who receive health-related benefits still have remaining work capacity. Therefore, there is potential for more people in this group to be employed (Sysselsettingsutvalget, 2021). Gender differences also emerge, with more women than men combining work with disability benefits. This disparity could be attributed to differences in diagnosis and occupational choices between men and women. Graded disability benefits are more prevalent in women-dominated professions, such as education and healthcare. At the same time, male-dominated industries like business services and manufacturing exhibit the lowest proportion of graded disability benefits. This discrepancy may suggest that men, to a greater extent than women, work in industries that are more difficult to combine with graded disability benefits (Jacobsen & Thune, 2013). Older recipients are more likely to combine work and benefits, possibly due to a higher proportion of severe diagnoses and extensive functional impairments among younger individuals. However, it may also be due to little work experience in the age group. Mental disorders, which are more common among the younger generation, reduce the likelihood of receiving graded disability benefits compared to musculoskeletal diseases, which are more likely to result in graded benefits (Sysselsettingsutvalget, 2021).

3.4.3 Education Levels

Regarding education, recipients with low levels of education are overrepresented among the recipients. In 2022, 24 per cent of all 18-67-year-olds with primary school as the highest completed education received disability benefits, marking a five per cent increase since 2015. Among those with upper secondary school as the highest education, 10.8 per cent received benefits, a 0.6 per cent increase during the same period. The percentage of individuals with a university or college education is 4.6, marking a 0.7 per cent increase. Since the population's education level is rising, the percentage of those with only primary school education is decreasing. This shift minimizes the effect of the increased proportion of primary school-educated individuals on the overall proportion of disabled persons. The increase in the proportion of individuals with only primary school education might be because individuals with lower education levels more frequently become disabled at a young age, hindering their ability to complete higher education. In 2022, over 90 per cent of individuals under 25 who became disabled had only completed primary school. The increase in young people becoming disabled over the last decade might contribute to an even higher proportion of disabled with low levels of education. Additionally, individuals who become disabled later in life often come from jobs with lower educational requirements, marked by stress and physical strain. In 2022, 30 per cent of individuals aged 55 and older who became newly disabled had primary school as their highest education level (Normann, 2023).

Low education levels also correlate with lower incomes. SSB data from 2021 indicates that individuals who receive disability benefits with only a primary school education earned, on average, NOK 34,000 less than those with only an upper secondary school education and NOK 77,100 less than those with a university or college education. Despite their lower earnings potential, individuals with only primary school education often receive more benefits than their more highly educated counterparts. This is primarily due to the lower prevalence of graded disability benefits among those with lower education levels. Graded disability benefit recipients often work more than fully disabled individuals, and additional income from employment, alongside disability benefits, typically results in higher total income. Other sources of income, including capital income and occupational pensions earned through previous work, further contribute to these differences (Normann, 2023).

3.4.4 Regional Differences

Significant differences exist between counties in the percentage of people receiving disability benefits. According to 2023 statistics, Oslo had the lowest percentage, with just 6.3 per cent, while Innlandet had the highest, with 14.2 per cent (NAV, 2023g). Generally, counties with a larger elderly population tend to exhibit higher rates of disability benefit recipients. Conversely, regions with a younger demographic contribute to lower percentages. Local variances in health and education levels further impact these statistics. The capital region has a more flexible and varied labour market, contributing to a lower percentage. Migration trends also play a role; individuals often relocate to urban areas like the capital region for educational or employment opportunities, whereas those on benefits typically do not migrate to cities to the same extent (NAV, 2022). Living in rural areas can be more cost-effective, which is advantageous for low-income individuals who rely on social security. These patterns are also observable at the municipal level, where city municipalities typically report fewer disabled individuals than district municipalities. For instance, in 2022, Bærum, located in the capital region, was the municipality with the lowest proportion of disabled, with only 5 per cent receiving disability benefits. Conversely, the county with the highest proportion was the district municipality Søndre Land in Innlandet, where 21.4 per cent of the population is on benefits (NAV, 2023g). Notably, there are ten municipalities where over 20 per cent of the population receives disability benefits, all considered district municipalities.

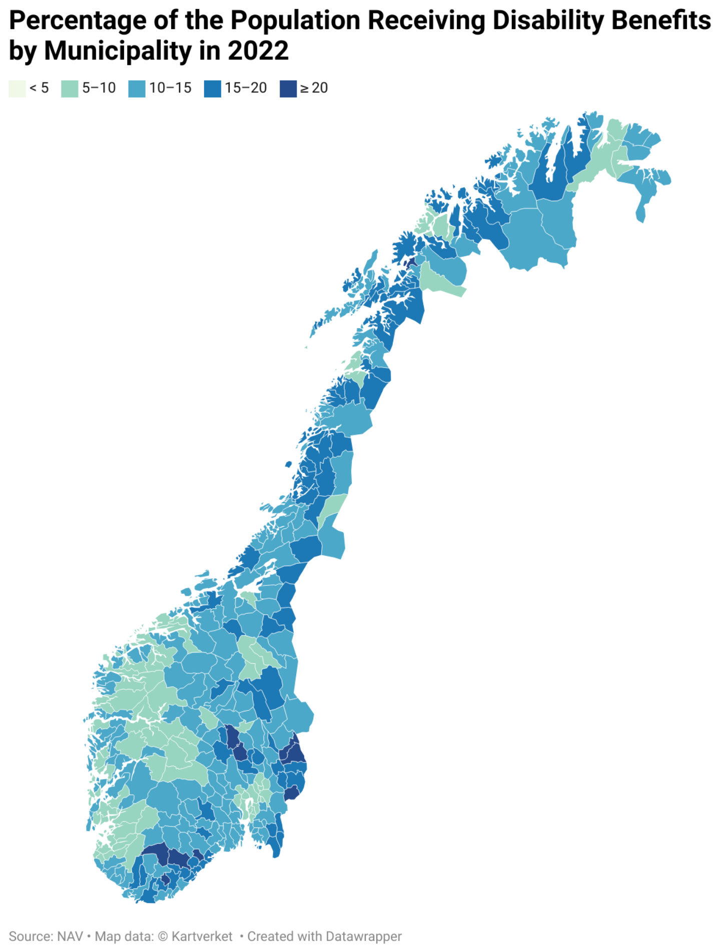

Figure 3.1: The map displays the percentage of the population receiving disability benefits by municipalities in 2022. The variations in colour intensity represent the different percentages of disability benefit recipients across Norway. Source: (NAV, 2023g)

3.5 The Oil and Gas Sector in Norway

In Norway, the oil and gas sector is the largest industry in terms of value creation, government revenues, investments and export value (Norwegian Petroleum, 2023). Data from SSB reported that in 2020 approximately 156 100 jobs were connected to the oil and gas sector, representing about 6 per cent of total employment nationwide (Hungnes et al., 2022). This industry is distributed throughout Norway, but its economic impact is particularly pronounced in Western and Southern regions where most oil and gas activities are concentrated (Norwegian Petroleum, 2023).

The Norwegian reliance on the oil industry makes the Norwegian Economy sensitive to oil and gas price changes. A significant decline in the oil price can affect the Norwegian Economy through several channels, as the demand for goods and services from the

Norwegian and international petroleum industry can be reduced, which can result in lower activity in the supplier industries, which in turn slows down the growth in the mainland economy and increases unemployment. Changes in oil prices also affect the krone exchange rate (by Royal Decre, 2016). These effects were particularly evident after the significant drop in oil prices in the fall of 2014 when the oil price almost halved, and the decline in the oil price lasted for several years, as one can see in the graph below. The Norwegian Economy entered a recession where economic growth slowed, and unemployment increased (Brander, 2019).

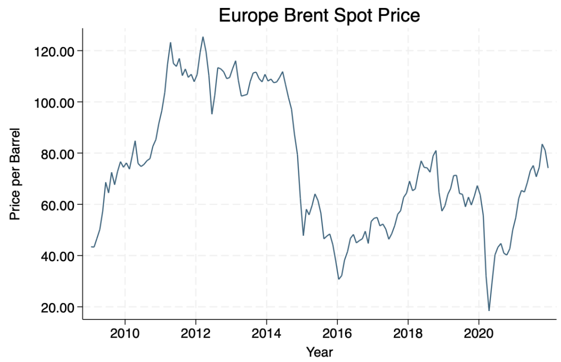

Figure 3.2: Europe Brent Spot Price. Source: (EIA, 2023)

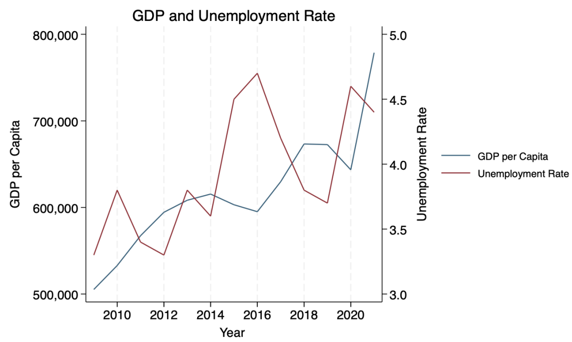

Figure 3.3: GDP and unemployment rate. Source: (SSB, 2023c), (SSB, 2023b).

The decline in oil prices significantly impacted employment, particularly in South and Western Norway. The counties that experienced the most substantial decline in unemployment were Rogaland, Hordaland, Møre og Romsdal, and Vest-Agder, all of which have a high concentration of oil industry workers and an industry dependent on oil (NAV, 2023f). However, this trend was not uniform across the country. Unemployment decreased in 8 of the 19 counties from 2014 to 2015. The counties with the most significant declines in unemployment were Hedmark, Oppland, and Østfold, which also had the lowest percentage of oil workers, revealing how differently the oil price decline affects different areas, depending on their dependence on the oil industry (Hvinden & Nordbø, 2016).

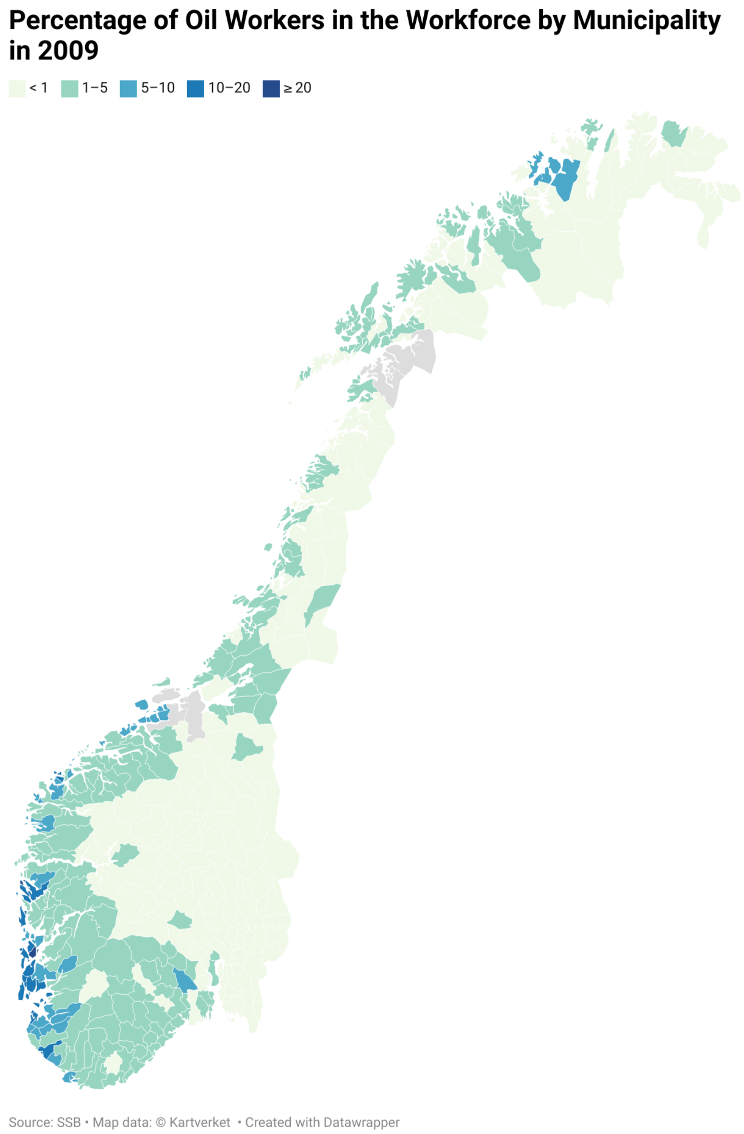

Figure 3.4: The map displays the percentage of oil workers in the workforce by municipality in 2009. The variations in colour intensity represent the regional distribution of oil industry employment across Norway. The choice to illustrate data from 2009 is deliberate, as it corresponds with the empirical data examined in this thesis. Source: (SSB, 2023a)

4 Data

To analyse the impact of changes in local labour market conditions on the number of disability benefit recipients in Norway, I have constructed a panel data set consisting of annual data on a municipality level from 2009 to 2021. The data is compiled from different sources: NAV provides the numbers on disability benefits recipients; SSB offers data on employment and other population statistics; and the U.S Energy Information Administration (EIA) is the source for oil price data.

Between 2009 and 2021, Norwegian municipalities underwent several structural changes. Given that the analysis is at a municipality level, the data set has been restructured to align with the 2020 structure. Restructuring the data is necessary for consistency in the analysis as it ensures that administrative changes in the municipalities do not influence the results. Not all the data from SSB is aggregated to fit the 2020 structure; therefore, I have identified all municipalities that have been merged or separated from 2009 to 2021. Information on the merges was found in official records from the Norwegian Government (Government of Norway, 2020). I aggregated the data for the merged municipalities to fit with their new entities by summing up their respective data points to create a single, unified data set for the new municipality.

Furthermore, some municipalities were divided, and new borders were established. Therefore, Hamarøy, Heim, Hitra, Narvik and Orkland have been excluded from the dataset to avoid the complexities of matching data for municipalities that consist of parts of previous entities. Consequently, the dataset consists of 351 municipalities. It is important to note that aggregating data from smaller municipalities into larger ones might obscure some local variations and specific characteristics. However, due to the scale of this study, I found that this method provides the best balance between data integrity and analytical feasibility.

4.1 Variable Description

This section provides a detailed description of the variables in the analysis, explaining their relevance to the study. Table 4.1 details the control variables alongside their respective identifiers in the Stata regressions.

Stata Variable Name	Description
MunicipalityID	Unique identifier for each municipality
Year	The year for which the data is recorded
lnEmployed	Log of the number of employed individuals
lnDisabilityBenefits	Log of the number of disability benefit recipients
OilWorkers2009	Percentage of oil workers based on 2009 data
RealOilPrice	Inflation-adjusted price of oil
lnPopulation	Log of total population in each municipality
SickLeave	Percentage of workforce on sick leave
OverAge50	Percentage of population over age 50
ShareWomen	Percentage of female residents
SharePrimaryEdu	Percentage with primary education
ShareSecondaryEdu	Percentage with secondary education
ShareAfrica	Percentage of residents from Africa
ShareAsia	Percentage of residents from Asia

Table 4.1: Variable names and descriptions

4.1.1 The Dependent Variable

In econometrics, the dependent variable is the outcome or the variable we try to explain. Independent variables are predictors believed to influence the dependent variable. In my study, the dependent variable is the number of disability benefit recipients, which is the variable I am trying to explain. The data captures the yearly number of disability benefit recipients in each municipality in 2009-2022. I use the logarithm of the dependent variable because log transformations help stabilise the variance and normalise the variable's distribution, reducing the impact of extreme values. It also allows regression coefficients to be interpreted as semi-elasticities, meaning that the coefficients represent the percentage change in the dependent variable in response to either a one-unit or one-percent change in an independent variable, making the results easier to interpret.

4.1.2 The Independent Variable

Employment, represented by the number of employed individuals residing in each municipality from 2009-2022, is the primary explanatory variable in the analysis. The data is from SSB and is the amount employed in each municipality registered in the year's fourth quarter. The aim is to see if employment changes in a municipality have an inverse relationship with the number of disability benefit recipients. The employment figures have also been transformed by using a logarithmic scale.

4.1.3 Control Variables

To establish the causal relationship between employment and disability benefits, the ceteris paribus conditions, meaning 'other things equal,' must be met (Wooldridge, 2020, p. 10). Municipalities differ in many ways, including size, demographics, policies, and governance. If these differences are not accounted for, it can lead to omitted variable bias. Therefore, control variables have been included in the analysis to account for additional factors that could influence the outcome and isolate the causal effect of the main variables of interest, disability benefits and employment. This approach can reduce the risk of bias, improving the precision of the estimated relationships. However, it is important to be careful when adding controls, as too many can result in overfitting and multicollinearity, which may affect the precision of the estimated coefficients and make interpretations less clear (Wooldridge, 2020, pp. 90-92).

The control variables in the analysis are included based on logical reasoning, availability, and previous literature presented in the literature review chapter, particularly the paper from Fevang and Røed (2006). All control variables, except for population, are expressed as percentages of the total population or specific demographic segments. Using percentages rather than absolute numbers shows relative changes and compositions within municipalities, which can provide a more nuanced understanding of the data. The controls in percentages are not log-transformed as it makes a more straightforward interpretation to leave them as percentages and not the log of a percentage. Percentages have values between 0-100, implying that they are less likely to exhibit the kind of extreme skewness or variance that would benefit from log transformation. It also prevents issues with variables that have a value of zero.

In the analysis, the log of population size was included as a control variable to account for year-to-year variations in the municipalities' populations. Sick leave is included as a control variable as it can indicate the general health status of the workforce in the municipalities. Therefore, sick leave can serve as an indicator for disability claims, independent of employment levels. The sick leave data is from SSB and is doctor-certified sickness absence for employees aged 16-69. This data is reported quarterly and in percentages of the workforce; therefore, I have taken the yearly average of the data to align with the temporal framework of the study. Education is included as it correlates with benefit dependency, as people with low levels of education are overrepresented among the disabled. The analysis includes the percentage of the total population with basic school-level education and upper secondary education, which might capture the potential impact that higher rates of individuals with lower education in a municipality could have on disability benefits. Fevang and Røed (2006) observed that immigration background significantly determines the likelihood of benefits, particularly among immigrants from North Africa and the Middle East; therefore, the percentage of immigrants from Africa and Asia have been included as controls. In Norway, there are higher levels of women and older age groups among the disabled population. To account for these demographic factors, gender and age are included as control variables in the analysis. Considering the higher prevalence of disability benefits among women, the model includes only the percentage of women in the total population. Regarding age, the analysis includes individuals between the ages of 50 and 66, represented as a percentage of the total population aged 18-66. This age range is chosen based on the eligibility criteria for disability benefits in Norway, where beneficiaries must be between 18 and 67. By focusing on this particular age group, the study aims to capture the potential impact older populations can have on benefits.

4.1.4 The Instrumental Variable

Employment is the variable of interest in this analysis, but the variable might be endogenous due to potential reverse causality and omitted variables. Therefore, an instrumental variable is used to replace employment and establish a causal relationship between changes in employment and benefits recipients. I will further explain the instrumental variable approach later in the methodology chapter.

In the analysis, the interaction between changes in the oil price and the percentage of oil workers in each municipality is used as the instrument, similar to the Charles et al. (2018) paper. Oil prices directly impact the oil industry, and price changes affect oil production, exploration, and investment, which impacts employment. The share of oil workers shows the importance of oil and gas in each municipality. International market dynamics, geopolitical events, and other external local economic conditions determine the price of oil. Hence, it can be considered an exogenous shock. The interaction term between the oil price and the importance of oil and gas captures how external price shocks affect municipalities depending on their exposure to the oil industry. Consequently, the impact of changes in oil prices can be considered an exogenous variation in employment.

The data on the oil price is from the U.S Energy Information Administration (EIA) and is the annual average of the European Brent Spot Price measured in dollars per barrel. The choice of Europe Brent as the oil price measure for Norway is based on its relevance to the Norwegian oil industry. The oil price is CPI-adjusted to account for inflation and ensure that the prices reflect real rather than nominal prices. This allows for an accurate comparison of oil prices over time, as the impact of fluctuation in the oil price will be isolated from changes in the general price level.

The share of oil workers in each municipality is annual data from SSB on employed persons by industry in the fourth quarter. To better reflect the oil sector's relative significance in each municipality, the data on oil workers, initially provided in absolute numbers, has been converted into a proportion of the total number of employed individuals. To find the workers in the oil industry, I have used the NACE 5-digit industry-level codes to find the industries where the employed are a direct part of the oil industry. Ten groups are 100% oil, and information on this was given to me by NORCE, The Norwegian Research Centre.

The following industries are used to calculate the share of employed in the industry:

NACE Code	**Industry Sector**
06.100	Extraction of crude petroleum
06.200	Extraction of natural gas
09.101	Drilling services for petroleum and natural gas extraction
09.109	Other support activities for petroleum and natural gas extraction
19.200	Manufacture of refined petroleum products
30.113	Building of oil-platforms and modules
30.116	Installation and completion work on platforms and modules
49.500	Transport via pipeline
50.204	Supply and other sea transport offshore services
52.223	Offshore supply terminal

Table 4.2: NACE codes for oil and gas industry sectors

4.2 Descriptive Statistics

4.2.1 Disability Benefits

Summary statistics for disability benefits are presented in Table 4.3, highlighting significant variation in recipient numbers across municipalities. The range spans from as few as 7-16 recipients in municipalities with the lowest counts to a substantial 24,044-30,266 in those with the highest. This wide range illustrates the wide range of benefits recipients between municipalities. The mean represents the mean of benefits recipients of all municipalities from 2009 to 2021. There has been a steady increase in the average number of disability benefit recipients in Norway from 2009 to 2021. This trend suggests a growing reliance on disability benefits across municipalities, with the average and maximum number of recipients rising annually. The standard deviation also increases over the years, indicating widening disparities in benefit recipient numbers among municipalities.

Table 4.3: Descriptive statistics of disability benefits recipients

Year	Observations	Mean	Std. Dev.	Min	Max
2009	351	803.3	1744.7	10	24044
2010	351	817.9	1758.9	9	23941
2011	351	834.4	1784.5	11	24215
2012	351	845.0	1797.2	10	24211
2013	351	835.6	1776.7	9	23798
2014	351	853.7	1821.5	7	24387
2015	351	862.5	1833.7	8	24336
2016	351	872.5	1855.4	9	24294
2017	351	894.3	1908.1	9	24910
2018	351	932.3	2014.9	16	26634
2019	351	968.2	2118.8	15	28439
2020	351	982.6	2185.9	15	29965
2021	351	993.1	2205.8	14	30266

4.2.2 Oil Workers

Summary statistics of oil workers as a percentage of the total workforce across Norwegian municipalities in 2009 are presented in Table 4.4. The average employment rate in the oil sector is 2.3%, which is 66,691 individuals, with significant variation across regions. However, the oil worker data consist of those directly employed in the oil industry. If the indirectly employed were included, the percentage would be higher. The municipalities are divided into three groups for the analysis: above the median, above three per cent, and five per cent, indicating different levels of dependency on the oil sector. The group with the most oil-dependent municipalities have an average of 8.19% of oil workers.

Table 4.4: Descriptive statistics for the percentage of oil workers and treatment groups

Group	Obs	Mean	Median	Standard Deviation	Min	Max
Total	351	2.3022	1.1115	3.2221	0	23.8295
Above Median						
Comparison	176	0.4520	0.3632	0.3148	0	1.0998
Treatment	175	4.1419	2.5678	3.7273	1.1115	23.8295
Above Three Percent						
Comparison	273	0.9553	0.7653	0.7775	0	2.9081
Treatment	78	7.0165	5.8176	4.0292	3.0086	23.8295
Above Five Percent						
Comparison	308	1.3052	0.9102	1.2381	0	4.9167
Treatment	43	9.4435	8.1911	4.0047	5.0226	23.8295

5 Methodology

5.1 Pooled Ordinary Least Squares (OLS)

Pooled Ordinary Least Squares (OLS) is the initial technique used in this study for regression analysis to estimate the relationship between employment and disability benefits. It minimizes the sum of squared residuals, which are the differences between the observed values of the dependent variable and the values predicted by the regression model (Wooldridge, 2020, p. 27). In the standard OLS method, the data's cross-sectional and time series dimensions are not explicitly accounted for. When combining panel data with OLS, the data will be pooled, meaning it is combined without differentiating between individual entities or time periods, treating it as a large cross-sectional study (Wooldridge, 2020, pp. 8-9). The Pooled OLS regression, specified in Equation (5.1), includes the natural logarithm of disability benefits as the dependent variable and the natural logarithm of employed individuals as the independent variable of interest. Here, β_0 represents the intercept of the regression line, while β_1 indicates the percentage change in disability benefits for a one per cent change in employment. The vector X includes the control variables, with θ representing their respective coefficients, and ε is the error term.

$$\ln(\text{DB}) = \beta_0 + \beta_1 \cdot \ln(\text{E}) + \theta X + \varepsilon \tag{5.1}$$

When the conditions of linearity, absence of perfect collinearity, random sampling, zero conditional mean, and homoscedasticity are satisfied, the OLS method can produce unbiased, efficient, and consistent estimations of the true population parameters. However, it does not account for individual and time effects in panel data (Wooldridge, 2020, pp. 339-342).

The dataset for this analysis consists of 351 diverse municipalities, each with potentially unique and time-constant characteristics that can affect the number of disability claims in various ways. Not accounting for these characteristics can lead to omitted variable bias. Therefore, fixed effects are added to the model to control these time-invariant characteristics through within-municipality changes over time. Year dummies are also included to control for temporal shocks or trends that could affect all municipalities. This isolates the explanatory variables' effect on the dependent variable from year-specific influences. Lags of employment are included in the model to capture both immediate and delayed effects on disability benefits, acknowledging that changes in employment might not lead to immediate changes in benefits claims and the period for the application process. The fixed effects model is specified as follows:

$$\ln(\mathrm{DB}_{it}) = \beta_0 + \beta_1 \cdot \ln(\mathrm{E}_{it}) + \beta_2 \cdot \ln(\mathrm{E}_{it-1}) + \beta_3 \cdot \ln(\mathrm{E}_{it-2}) + \theta X_{it} + \alpha_i + \mu_t + \varepsilon_{it} \quad (5.2)$$

Where i and t represent each municipality and time period, respectively. β_0 is the intercept, β_1 is the coefficient on the current period's employment, β_2 for the first lag of employment, and β_3 for the second lag. θ represents coefficients for the control variables X_{it}, α_i captures municipality-specific fixed effects, μ_t denotes year fixed effects, and ε_{it} is the idiosyncratic error term.

5.2 The Instrumental Variable Approach (IV)

As mentioned in previous chapters, analysing the causal relationship between employment and disability benefits presents a challenge due to the potential endogeneity of employment. There might be unobserved factors in the municipality, such as economic conditions, local health trends, or policy changes that simultaneously affect employment and disability benefits, causing omitted variable bias. For instance, local initiatives to improve mental health in the population can simultaneously boost employment and reduce disability claims, which can lead to biased estimates if they are not controlled for. Additionally, reverse causality can also be an issue as municipalities with high levels of disability benefits might experience reduced employment opportunities, as reduced labour force participation in an area can affect investment and job creation negatively. Consequently, I will use the instrumental variable method to avoid these potential issues that might give biased results. As previously discussed in the data section, the interaction between changes in the oil price and the share of oil workers is used as the instrument to address the endogeneity of employment.

The instrumental variable approach tackles the omitted variable problem by using another variable (the instrument) correlated with the observed variable but not with the error term. This ensures the variation used for estimation is unbiased by omitted variables (Wooldridge, 2020, pp. 495-497).

Following Charles et al. (2018) approach, I also use the interaction between the oil price and the percentage of oil workers as an instrumental variable for employment. The oil price can influence employment in Norway, especially in sectors and regions heavily reliant on oil production and related industries. Sharp fluctuations in oil prices can lead to significant employment changes in these sectors, causing ripple effects in local economies. The number of oil workers in each municipality in Norway differs significantly, ranging from 0 to 24 per cent of the workforce. To account for this, I have created an interaction term between the oil price and the percentage of oil workers in each municipality in 2009 to capture the different effects of changes in oil prices on municipalities depending on their level of employment in the oil sector. The percentage of oil workers in each municipality is fixed at the 2009 level, which is the beginning of the analysis period. This ensures that the interaction term captures the effects of changes in oil prices and is not affected by the fluctuations in the percentage of oil workers. P_{it} represents the real oil price, and W_i the percentage of oil workers in each municipality, and the interaction term can be presented as follows:

$$O_{it} = P_{it} \times W_i \tag{5.3}$$

However, for the IV approach to be valid, the instrument (the interaction term) must satisfy two conditions:

1. **Relevance**: The instrument, here O_{it} must be correlated with the endogenous explanatory variable, employment E_{it}. In this study's context, oil price changes are expected to significantly impact employment, especially in regions with high levels of oil workers.

$$\text{cov}(O_{it}, E_{it}) \neq 0 \tag{5.4}$$

(Wooldridge, 2020, p. 497)

2. **Exogeneity**: The instrument should not correlate with the error term u_{it}. This means that while oil prices influence employment, they should not directly impact

the number of individuals receiving disability benefits, except through their effect on employment.

$$\text{cov}(O_{it}, u_{it}) = 0 \tag{5.5}$$

(Wooldridge, 2020, p. 597)

If these conditions hold, using the interaction term of the real oil price and oil workers as an instrument allows for isolating the variation in employment driven solely by exogenous changes in the oil price. The exogenously induced variation in employment can then be used to estimate the impact of employment on the number of individuals receiving disability benefits without the biases that can occur with direct OLS estimation.

In practical terms, this strategy involves two stages, the so-called 2SLS method. The first stage involves regressing employment on the interaction term (along with other control variables) to capture the variation in employment driven by oil price fluctuations. In the second stage, the predicted values from the first-stage regression are used to estimate the causal effect of employment on the number of disability benefit recipients.

First Stage Regression: The first stage regression models employment E_{it} as a function of the interaction term and other controls.

$$lnE_{it} = \beta_0 + \beta_1 O_{it} + \beta_2 O_{it-1} + \beta_3 O_{it-2} + \theta X_{it} + \alpha_i + \mu_t + \epsilon_{it} \tag{5.6}$$

In the first stage regression, lnE_{it} represents employment in region i at time t. The instrument variables, O_{it}, O_{it-1}, and O_{it-2}, include the current and lagged values of the interaction term. This approach acknowledges the potential delayed impact of oil price changes on employment. The variable X_{it} is a vector of control variables, α_i captures municipality-specific fixed effects, μ_t represents year-fixed effects, and ϵ_{it} is the idiosyncratic error term.

From this regression, the predicted values $\widetilde{E}_{it}$ are obtained, which represent the component of employment that is driven by changes in the instrument. This will be used in the two following 2SLS equations.

Second Stage Regressions: The second stage regressions estimate the impact of employment on disability benefits. Equation (5.7) includes only the immediate predicted employment, while equation (5.8) includes lags of predicted employment to capture potential delayed effects.

$$\ln(DB_{it}) = \pi_0 + \pi_1 \ln(\tilde{E}_{it}) + \theta X_{it} + \alpha_i + \mu_t + u_{it} \tag{5.7}$$

$$\ln(DB_{it}) = \pi_0 + \pi_1 \ln(\tilde{E}_{it}) + \pi_2 \ln(\tilde{E}_{it-1}) + \pi_3 \ln(\tilde{E}_{it-2}) + \theta X_{it} + \alpha_i + \mu_t + u_{it} \tag{5.8}$$

In the second stage regression, DB_{it} represents the number of individuals receiving disability benefits in region i at time t. The variables $\widetilde{E}_{it}$, $\widetilde{E}_{it-1}$, and $\widetilde{E}_{it-2}$ are the predicted employment values from the first stage, including the current and two lagged values. X_{it} is a vector of control variables. α_i captures municipality-specific fixed effects μ_t accounts for year-specific effects, u_{it} is the idiosyncratic error term.

5.2.1 Assessing Instrument Validity in 2SLS Analysis

In 2SLS analysis, for an instrument to be considered valid, it must be both relevant and exogenous. An instrument's relevance can be evaluated in the first-stage regression of 2SLS. If the instrument is statistically significant (typically at the 5% level or lower) and with a F-statistic for excluded instruments greater than a predefined threshold, commonly above 10, it indicates its relevance, suggesting that it explains a substantial portion of the variation in the endogenous variable. However, relevance alone does not confirm validity, as the instrument must also be exogenous.

In a 2SLS regression, Stata uses the following statistical tests to evaluate the validity of an instrument:

- **Kleibergen-Paap rk LM Statistic:** This test checks the instrument's relevance by determining whether it strongly correlates with the endogenous regressors (Bazzi & Clemens, 2013).
- **Cragg-Donald Wald F Statistic:** Provided in Stata's 2SLS output, this statistic evaluates the strength of the instruments. A value below ten may indicate weak instruments, potentially leading to biased 2SLS estimates (Bazzi & Clemens, 2013).
- **Hansen J Statistic:** This test addresses overidentifying restrictions by checking whether the instruments are uncorrelated with the error term (Stata, 2023).

Combining these tests can indicate instrument validity, essential in determining causal inference in 2SLS analysis.

5.3 Difference in Differences (DID)

A Difference in Difference (DID) approach is employed to assess the causal impact of the 2014 oil price decline on disability benefits. The DID method is well-suited for situations where a 'treatment' affects a particular group at a specific time.

In this analysis, the treatment indicator, D_{it}, differentiates municipalities based on their exposure to the oil industry. Specifically, D_{it} is assigned a value of 1 for municipalities with a percentage of oil workers above a predefined threshold, indicating a higher potential impact from the oil price decline. For municipalities with lower levels of oil workers, D_{it} is set to 0, thereby the comparison group. An essential condition in this method is the parallel trends assumption, which says that, in the absence of treatment, the average outcomes for both groups would have followed similar trends over time.

The DID model estimates the treatment effect by comparing changes in disability benefits across treated and comparison groups before and after the event. The DID two-way fixed effects model is based on the notation and terminology described by Angrist and Pischke (2009, p.229) and is specified as follows:

$$Y_{it} = \gamma_i + \lambda_t + \delta D_{it} + \theta X_{it} + \epsilon_{it} \tag{5.9}$$

Here, Y_{it} is the disability benefits in each municipality i at time t. The term γ_i is municipality-specific fixed effects, and λ_t represents year fixed effects. The coefficient δ captures the average effect of the oil price decline on the treated group post-2014.

In addition to the basic two-way fixed effects model, the equation includes control variables here θX_{it}. A post-event control is also included, which controls for the general impact of the post-event period on disability benefits in all municipalities.

5.3.1 Event Study

In the final part of the analysis, an Event Study approach is employed to understand how the treatment groups responds to the treatment over time. By interacting the treatment indicator with each year, the model provides more detailed estimates of the event's impact on disability benefits. In addition, it allows us to see if the parallel trends assumption holds by studying the years before the event.

The event study design follows the standard two-way fixed effect methodology described by Borusyak et al. (2022). Considering that the oil price decline was unforeseen, accounting for anticipatory effects is unnecessary. As the event simultaneously affected all municipalities, the model does not include leads and lags, typically used when staggered treatment effects are present. In this model, 2013 is deliberately excluded to serve as the baseline year. All other years, from 2009 to 2021, are compared to this baseline to assess the different impacts of the treatment over time.

$$\ln(\mathrm{DB}_{it}) = \gamma_i + \lambda_t + \sum_{t=1}^{T} \delta_t D_{it} + \theta X_{it} + \epsilon_{it} \tag{5.10}$$

$\ln(\mathrm{DB}_{it})$ represents the natural logarithm of disability benefits for each municipality i at each time t, with γ_i as municipality-specific fixed effects and λ_t as year fixed effects. The term $\sum_{t=1}^{T} \delta_t D_{it}$ captures the interaction between the treatment indicator and each time period, encompassing all years in the study. The θX_{it} term includes control variables, and ϵ_{it} is the idiosyncratic error term.

6 Analysis

6.1 The Fixed Effect Model

Table 6.1 shows the results from estimating the fixed effect (FE) equation (5.2) with different lags and controls. The regression results from (1) and (2) include only municipality and year-fixed effects, and in regression (2) two lags are included. In model (1), the coefficient for lnEmployed is 0.812, indicating a significant and positive relationship when no other controls are included. The introduction of lags in model (2) adjusts the coefficient of lnEmployed to 0.618. Both lag coefficients are positive; the first lag is not statistically significant, while the second is significant at the 1% level. That there seems to be a positive relationship between employment and benefits is somewhat surprising. However, when controls are added to the model (3) and (4), the coefficients for lnEmployed have a smaller negative effect and are less significant. The lags of employment also take on negative values, but they are not significant at the 5% level. Still, it suggests that including controls, such as population demographics and education levels, might provide further insights and better explain the variations in disability benefits. None of the lnEmployed coefficients has negative values. While it is counter-intuitive that an increase in employment leads to an increase in disability benefits recipients, this can suggest that increased employment does not immediately affect disability benefits. The controls for population, age, the second lag of sick leave, and primary education show a positive and significant relationship with benefits. Immigration controls for Africa and Asia have a significant negative association with disability benefits.

Table 6.1: Fixed Effects (FE)

VARIABLES	(1) Simple	(2) With Lags	(3) Added Controls	(4) All controls
lnEmployed	0.812***	0.618***	0.268***	0.131
	(0.0875)	(0.110)	(0.0996)	(0.0990)
L1_lnEmployed		0.0667	-0.166*	-0.146*
		(0.0707)	(0.0932)	(0.0849)
L2_lnEmployed		0.293***	-0.144	-0.177*
		(0.104)	(0.101)	(0.102)
lnPopulation			1.382***	1.590***
			(0.186)	(0.178)
ShareAge50_66			0.0233***	0.0202***
			(0.00357)	(0.00373)
ShareWomen			0.00889	0.00767
			(0.00743)	(0.00728)
L1_SickLeave				0.00510
				(0.00349)
L2_SickLeave				0.00842***
				(0.00280)
SharePrimaryEdu				0.0132***
				(0.00391)
ShareSecondaryEdu				0.00743*
				(0.00393)
ShareAfrica				-0.0153**
				(0.00762)
ShareAsia				-0.0201***
				(0.00602)
Constant	-0.548	-1.828**	-6.929***	-8.015***
	(0.692)	(0.829)	(0.942)	(0.932)
N	4,563	3,861	3,861	3,861

Note: Year dummies are included in the regressions but excluded from the table. Robust standard errors in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

6.2 Instrumental Variable

The potential endogeneity of the employment variable may compromise the validity of the fixed-effects regression results. Therefore, an instrumental variable approach has been employed. The estimated equation (5.6), which represents the first-stage regression, is displayed in Table 6.3. The first-stage regression indicates a significant and positive relationship between employment and the interaction term, as well as with one lag of the interaction term. The strength of these instruments is further confirmed by a first-stage F-statistic for excluded instruments, exceeding the conventional threshold of 10 for both models with added controls, suggesting that they are not weak instruments and are correlated with the endogenous variable.

Table 6.3 also presents the outcomes of the second-stage regression, with the interaction term as an instrument for the potentially endogenous employment variable. The lags of the interaction term are included to account for the time the oil industry and disability benefits need to adjust to an economic shock. Across both models with added control variables, a significant negative association between the log of employment and the log of disability benefits is observed. This suggests that an increase in employment causes a decrease in disability benefits. The elasticity is -5.961 in the model that only controls for municipality and year-fixed effects, which suggests a substantial negative impact. Incorporating additional controls reduces the coefficient, resulting in an elasticity of -1.351 and -1.454. The differences between the models with added controls imply that the inclusion of controls for education, sick leave, and immigration status seems to have some impact on the outcome.

Table 6.2: 2SLS results

Model	(1) Simple	(2) Added Controls	(3) All controls
lnEmployed	-5.961	-1.351***	-1.454**
	(3.764)	(0.458)	(0.596)
First-Stage Estimates			
Oil Interaction	1.53e-06	2.74e-05***	2.59e-05***
	(9.14e-06)	(6.15e-06)	(6.31e-06)
L1_Oil_Interaction	1.62e-05***	2.52e-05***	1.96e-05***
	(4.57e-06)	(4.52e-06)	(4.23e-06)
L2_Oil_Interaction	2.64e-06	4.39e-06	3.98e-06
	(4.85e-06)	(4.42e-06)	(4.15e-06)
F-statistic for excluded instruments	4.88	29.41	22.81
N	3,861	3,861	3,861

Note: Table reports 2SLS regression estimates. Upper panel: second-stage results; lower panel: first-stage results with instruments. Robust standard errors are in parentheses. Year dummies and additional controls are included in the regressions but excluded from the table. Significance: *** p<0.01, ** p<0.05, * p<0.1.

6.2.1 Adding Lags to the Instrumental Variable Estimation

To understand the temporal impact of employment disability benefits, Table 6.3 extends the 2SLS regression model to include two employment lags. In the first model, which controls only for municipality and year-fixed effects, the coefficients for the employment variables are not statistically significant. When more controls are included in the second and third models, the coefficients for immediate employment remain negative but with a less negative impact than the model without lags. The second lag of employment (L2_lnEmployed) shows a significant negative effect at the 5% level in both the second and third models, with elasticities of -1.343 and -0.897, respectively. These results suggest a delayed negative impact of employment on disability benefits, indicating that changes in employment might affect the number of disability benefit recipients over time. The initial 2SLS model, which does not explicitly include employment lags, may capture some of these delayed effects since the predicted employment, used as an instrumental variable, is also derived from the instruments' lags. Excluding lags from models where there is a delayed effect might cause an overestimation or underestimation of the immediate coefficient. Adding lags of lnEmployment to the model makes the delayed effect more visible. However, adding employment lags to the 2SLS model increases its complexity. Therefore, these results should indicate a potential trend rather than evidence of causality.

Table 6.3: 2SLS results with lags of employment

	(1) Simple	(2) Added Controls	(3) All controls
lnEmployed	-10.99	-0.596	-0.419
	(10.84)	(0.707)	(0.722)
L1_lnEmployed	6.080	-0.163	-0.821
	(7.118)	(0.718)	(0.570)
L2_lnEmployed	-4.311	-1.343**	-0.897**
	(4.222)	(0.532)	(0.440)
N	3,861	3,861	3,861

Note: Table reports 2SLS second equation regression estimates. Year dummies and additional controls are included in the regressions but excluded from the table. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

6.3 Difference in Difference Analysis

Table 6.4 illustrates the outcomes from the DID equation estimation as represented in equation (5.9). The analysis is conducted across three different models; each treatment group has a different threshold of oil workers' levels. In these models, all controls are added; Table A2.1 in the appendices displays the result with different controls. In the first model, municipalities with oil worker levels above the median, which is more than 1.1%, are considered the treatment group. In the second and third models, the treatment groups are determined by 3% and 5% thresholds, respectively.

All models consistently show a positive and significant post-event dummy coefficient, indicating a general increase in disability benefits recipients by approximately 14.4% to 14.6% after the event. This trend could be attributed to various economic and policy factors, but it may also result from the decline in oil prices. After examining the coefficients for the treatment groups, positive and significant effects are found. In municipalities above the median threshold, disability benefits increased by approximately 1.93% compared to the comparison group. For the 3% and 5% thresholds, benefits increased by approximately 2.36% and 5.23%, respectively, compared to the control group.

The coefficients for the treatment groups indicate that in municipalities with higher proportions of oil workers, the post-event increase in disability benefits was more pronounced compared to the comparison group. The larger the threshold for defining the treatment group, the more substantial the increase, suggesting that a greater level of oil workers in a municipality is associated with a more significant rise in disability benefits post-event.

However, this model does not test the parallel trend assumption, which ensures that the treatment and control groups had similar trends before the event. This is critical for attributing the post-event differences in disability benefits to the decline in oil prices. The following subsection will present an Event Study to investigate the pre- and post-event effects on the treatment groups further, which will help confirm if the parallel trend assumption holds.

Table 6.4: Difference in Difference analysis

	(1) Median	(2) Three Per Cent	(3) Five Per Cent
PostEvent	0.144***	0.148***	0.146***
	(0.0254)	(0.0248)	(0.0242)
TreatXPostMedian	0.0193**		
	(0.00932)		
TreatXPost3Pct		0.0236**	
		(0.0116)	
TreatXPost5Pct			0.0523***
			(0.0125)
lnPopulation	1.344***	1.325***	1.304***
	(0.0877)	(0.0882)	(0.0863)
ShareAge50_66	0.0220***	0.0217***	0.0218***
	(0.00338)	(0.00338)	(0.00333)
ShareWomen	0.00884	0.00911	0.00770
	(0.00740)	(0.00749)	(0.00743)
SickLeave	0.00359	0.00373	0.00258
	(0.00375)	(0.00360)	(0.00371)
SharePrimaryEdu	0.0137***	0.0139***	0.0138***
	(0.00361)	(0.00361)	(0.00358)
ShareSecondaryEdu	0.0101**	0.00996**	0.00997**
	(0.00395)	(0.00393)	(0.00397)
ShareAfrica	-0.00617	-0.00569	-0.00542
	(0.00720)	(0.00724)	(0.00719)
ShareAsia	-0.0197***	-0.0186***	-0.0190***
	(0.00574)	(0.00576)	(0.00576)
Constant	-7.630***	-7.480***	-7.216***
	(0.906)	(0.916)	(0.902)
Pre-treatment mean	5.92	5.92	5.92
N	4,563	4,563	4,563

Note: Year dummies are included in the regressions, but excluded from the table. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

6.4 Event Study

The outcomes from the event study are presented in Table 6.5. The models are estimated with all controls, but only the year outcomes are included. Table A3.1 in the appendices show the result for the above five per cent group with different amounts of controls added. All three models show no significant coefficients at the five per cent level pre-event, except for Year -4 in the model with a three per cent threshold. This supports the assumption that the trends for both groups were parallel before the event, as there are no considerable differences between the treatment and comparison groups before the event.

The sum of the post-event treatment effects (TE) indicates the combined impact over the years following the event. All the treatment groups have a positive (TE), suggesting a higher total increase in disability benefits than the comparison group. The Median group has an approximately 17.5% increase; the three per cent group has a 22.1% increase, and the five per cent group has a substantial approximate 40% increase compared to the comparison group over the years post-event. The results imply that the most pronounced effect is observed in the municipalities with the highest dependency on the oil industry. Post-event, the model with the five per cent threshold exhibits positive and statistically significant coefficients from years 2 to 7. For models with the median and three per cent thresholds, coefficients become significant from year four onwards. This trend shows a delayed effect of the decline in oil prices that gets stronger over time, and it seems to remain throughout all post-event years included in the model. Furthermore, the magnitude of the event's effect appears to be larger for models with a higher treatment threshold in all the years post-event.

Coefplots in Figures 6.1 to 6.3 visualise these findings, with increased disability benefits seen in all treatment groups after the event. This trend is particularly pronounced in Figure 6.3 with above five per cent treatment group, indicating that areas with a greater dependence on the oil industry experienced a larger rise in disability benefits recipients after the event.

Table 6.5: Event Study results

Model	(1) Median	(2) Three Per Cent	(3) Five Per cent
Year -5	0.0149	0.0182*	0.0169
	(0.00961)	(0.0104)	(0.0132)
Year -4	0.0143*	0.0206**	0.0149
	(0.00813)	(0.00887)	(0.0117)
Year -3	0.0103	0.0103	0.00633
	(0.00666)	(0.00805)	(0.0116)
Year -2	0.00138	-0.00126	-0.00596
	(0.00480)	(0.00552)	(0.00762)
Year 0	-0.00437	-0.000424	-0.00275
	(0.00514)	(0.00663)	(0.00970)
Year 1	0.00423	0.00985	0.0149
	(0.00713)	(0.00840)	(0.0102)
Year 2	0.0125	0.0168	0.0263**
	(0.00839)	(0.0102)	(0.0127
Year 3	0.0180*	0.0193*	0.0384***
	(0.00952)	(0.0113)	(0.0133)
Year 4	0.0296***	0.0395***	0.0789***
	(0.0104)	(0.0145)	(0.0191)
Year 5	0.0319***	0.0389**	0.0772***
	(0.0116)	(0.0161)	(0.0181)
Year 6	0.0416***	0.0469***	0.0827**
	(0.0117)	(0.0156)	(0.0187)
Year 7	0.0416***	0.0504***	0.0843***
	(0.0131)	(0.0170)	(0.0196)
Sum Post Event TE	0.175	0.221	0.400
Pre-treatment mean	5.92	5.92	5.92
N	4,563	4,563	4,563

Note: Control variables and year dummies are included in the regression but excluded from the table. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

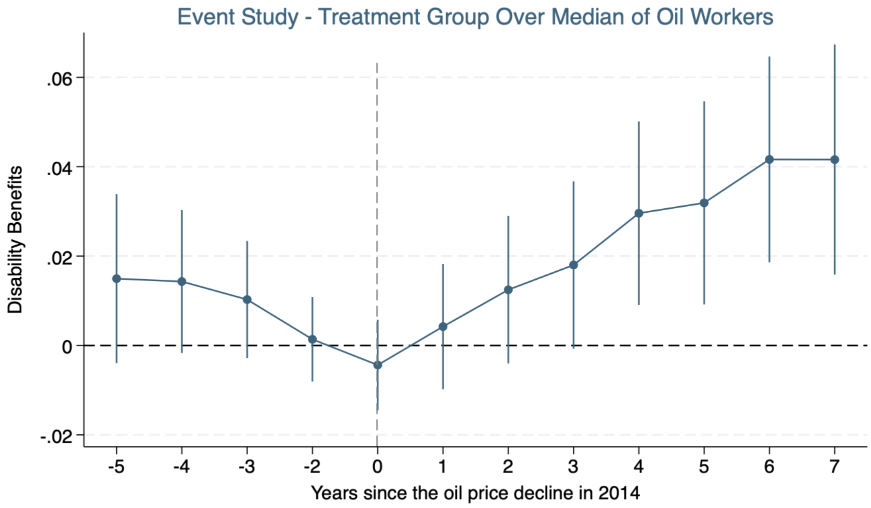

Figure 6.1: Event Study coefplot with above median oil workers

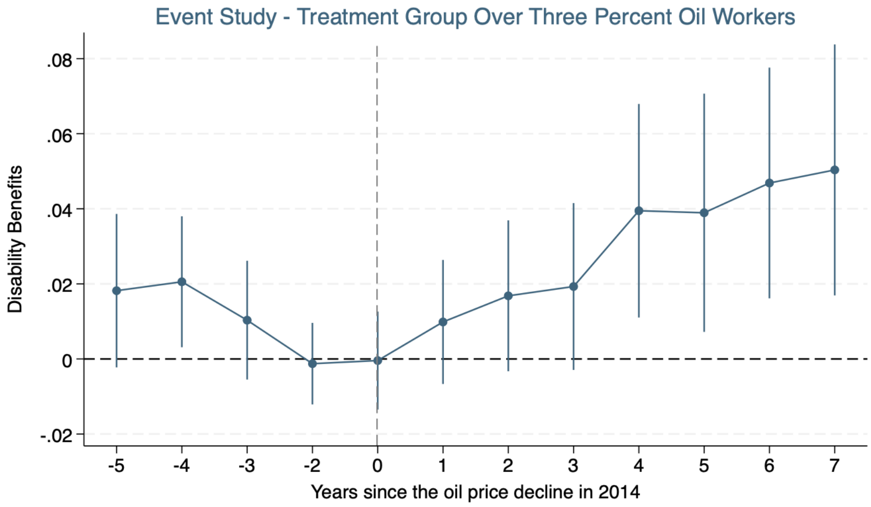

Figure 6.2: Event Study coefplot with more than three per cent oil workers

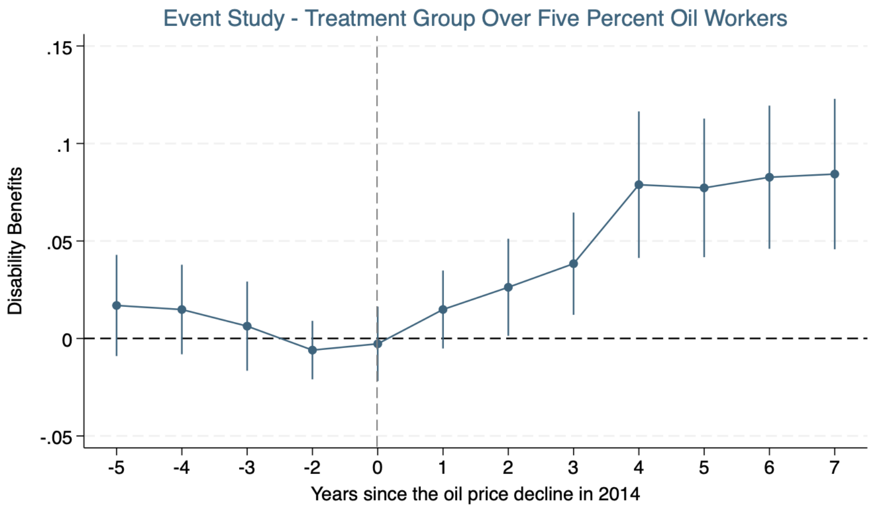

Figure 6.3: Event Study coefplot with more than five per cent oil workers

7 Discussion

This analysis aims to contribute to understanding the relationship between employment, local economic conditions, and disability benefit take-up. Consistent across all models, changes in employment seem to impact disability benefit take-up significantly, aligning with existing research findings. This section will discuss these findings in relation to prior literature and economic theories, explore the robustness and limitations of the analysis, and make suggestions for further research.

7.1 Discussion of the Results

The 2SLS analysis uncovers a significant inverse relationship between employment and the number of disability benefits recipients, indicating an elasticity of -1.454. This aligns with Charles et al. (2018), who reports a similar but less pronounced inverse relationship with an elasticity of -0.699. While Charles et al. (2018) primarily focuses on disability payments, this study uses the number of benefit recipients, making a direct comparison challenging. Despite differences in the dependent variables, the consistent negative elasticities in both studies underscore the robustness of the relationship between employment fluctuations and disability benefits. The stronger relationship observed in Norwegian municipalities might be attributed to the economy's reliance on the oil industry and the structure of its social welfare system.

As done by Charles et al. (2018), lags of the instrument are incorporated to account for adjustment times of new wells and businesses to international shocks and the delayed adjustment of disability benefit recipients to economic changes. This study extends this approach by also including direct employment lags. The significant negative elasticity for the second employment lag (-0.897) in the 2SLS model with lags suggests that the impact of employment changes on disability benefits emerges over time. This temporal aspect aligns with economic theories that labour market shocks take time to affect benefits, especially considering application and processing times for benefit claims. The results from the Event Study suggest significant effects from the oil price decline from 2016 onwards, underlining this delayed effect. The fact that the effect seems to last until 2021 indicates a prolonged impact on the labour market in municipalities with a high percentage of oil workers. The oil price remained low for a long time after 2014, which might explain the prolonged effect on benefits take-up. These observations are similar to the findings of Rege et al. (2005), who found that economic shocks to local economies, such as downsizing, can increase the likelihood of individuals claiming disability benefits. This increase might be due to the negative impact on future employment opportunities and mental health.

Furthermore, a mismatch of skills in the labour market and structural shifts within industries, leading to a permanent reduction in job availability, could be contributing factors. Prolonged unemployment may also make it harder to re-enter the workforce, increasing the likelihood of applying for benefits as a more stable form of income. This can explain the positive immediate relationship between employment and disability benefits observed in the fixed effects model, suggesting that the effects of economic changes on disability benefits are delayed.

The significant post-event coefficients in the DID models suggest a general increase in disability benefits after 2014 for all municipalities, possibly due to factors other than the decline in oil prices. The results also suggest that municipalities with a higher concentration of oil workers experience a higher increase in disability benefits recipients. This finding, combined with the findings from the Event Study, implies that the change is consistent with the notion that the number of disability benefit recipients rises in response to adverse economic conditions in local economies, as demonstrated in studies by Black et al. (2002), Charles et al. (2018), and Michaud and Wiczer (2013). This may imply that areas heavily reliant on single industries are more vulnerable to experiencing rapid increases in benefits compared to areas with more diverse industries.

The control variables across all models have shown consistent trends that align with findings from previous literature. Notably, the positive and mainly significant coefficients for population, share of individuals aged 50-66, and primary education levels support existing research indicating higher disability benefit dependency among these groups. This aligns with studies by Roberts, J., & Taylor, K. (2019) and Fevang and Røed (2006). Conversely, the consistently negative and significant coefficients for immigrants from Asia and Africa differ from previous research, which often indicates a higher propensity for disability benefit uptake among immigrants from specific regions like the Middle East and North Africa. This broader categorisation of immigrants from the entire continents of Asia and Africa may mask regional differences in benefit take-up. The negative coefficients in this study could be attributed to underlying socioeconomic factors, such as urbanisation. Areas with higher immigrant populations often have more dynamic labour markets, attracting individuals seeking employment, which might explain the lower levels of disability benefits in these regions. Moreover, urban areas in Norway, where immigrants from Asia and Africa are more likely to reside, typically report lower benefit levels, potentially contributing to this outcome. The gender variable, represented by the percentage of women in the municipalities, was consistently positive but was not statistically significant. This could be due to the minor gender variations within counties, which might not be substantial enough to reflect the higher likelihood of women receiving disability benefits, as Fevang and Røed (2006) reported. Interestingly, the coefficients for sick leave and its lags were positive but insignificant, suggesting that changes in sick leave might not strongly predict disability benefits.

The analysis results underscore the importance for policymakers to implement strategies to reduce the rise in benefits claims following economic shocks or changes in local labour market conditions. Responding to economic downturns by continually adapting social welfare policies at both national and local levels can potentially reduce the increase in benefits take-up. One effective measure could be increased facilitation and follow-ups, with long-term support and retraining programs, offering alternatives to individuals who might otherwise turn to benefits in challenging labour markets. Acknowledging and addressing the significant impact of economic downturns and unemployment on mental health might be beneficial, especially in areas experiencing economic challenges. It can also be helpful to consider the situation of those already on benefits or Assistance and Attendance Programs (AAP) during hard times, as challenging labour markets can hinder their efforts to return to work. The observed inverse relationship between employment and benefit recipients reveals that for some individuals with disabilities, participation in disability programs is a marginal decision. While this does not solely determine their suitability for receiving disability benefits, efficient policies could provide the necessary support for them to remain in or rejoin the workforce. Particular attention might also be given to specific groups, such as those with lower education levels, who are more likely to receive benefits. Tailored support programs for these groups, ensuring better follow-up during challenging times, can be helpful. Additionally, it might be advantageous to implement stricter eligibility criteria for granting disability benefits during economic downturns. Finding a balance between benefit generosity, adequate support, and implementing necessary measures during economic downturns might contribute to a more adaptive and resilient social welfare system better equipped to meet the needs of individuals facing economic and employment uncertainty.

Overall, this study provides insights into the relationship between labour market conditions and disability benefits in Norway. The results from the Fixed Effects and 2SLS methodologies, along with DID and Event Study approaches, consistently reveal that worsening labour market conditions increase disability benefits recipients and the likelihood of individuals resorting to these benefits. This causal relationship is evident after the oil price decline and persists over time, highlighting the long-term effects of economic shocks on social welfare systems.

7.2 Robustness of the Models

A combination of Pooled OLS, Fixed Effects, IV, DiD, and Event Study methods, along with various controls, was employed to ensure the robustness of the results in this analysis. These methodologies, each with its strengths and weaknesses, contribute to the analysis of the relationship between employment fluctuations and disability benefits in Norway.

Testing the robustness of the 2SLS model was done by adding different lags of the instrument and the employment variable to assess the consistency of the results across different model specifications. The appendices (Tables A1.1-A1.7) provide different variations of the 2SLS model. The findings demonstrate a relatively stable inverse relationship between employment and disability benefits, but with slight variations in coefficient sizes. The validity and strength of the instruments were tested using the Kleibergen-Paap rk LM Statistic, the Cragg-Donald Wald F Statistic and the Hansen J Statistic tests for overidentification. The Cragg-Donald Wald F Statistic confirmed strong instruments in all models with added controls, and the Kleibergen-Paap rk LM Statistic consistently indicated relevant instruments. However, the Hansen J Statistic presents some variability. Ideally, it should not be statistically significant, as a p-value higher than the 0.05 threshold is preferred. It suggests that the instruments are not correlated with the error term, confirming their validity. In the models without added controls, the

Hansen J Statistic is significant, supporting the instruments' validity. However, in some models with added controls and different lags of the instrument, the significance of the Hansen J Statistic varies, which may raise concerns about the instruments' validity in those models. The consistently inverse relationship between employment and disability throughout models can suggest that the main conclusions in the study are robust despite the potential weaknesses identified by the Hansen J test.

In the FE and 2SLS models with additional controls, multicollinearity was detected during Variance Inflation Factors (VIFs) diagnostics. This can be expected in municipality-level panel data. While multicollinearity can lead to inflated standard errors and complicate the interpretation of individual coefficients, it does not undermine the model's capacity for causal inference. However, it makes it necessary to be cautious when interpreting the results of the individual coefficients. In 2SLS models, the primary concern is the validity and strength of the instruments rather than multicollinearity among explanatory variables. Consequently, the main findings, supported by consistent results across various model specifications, help confirm the robustness of the analysis.

Table A2.1 in the appendices includes the result of the DID analysis with coefficients for the treatment group with various controls. All the coefficients are positive, and all the coefficients for the fire per cent group are significant at either the five or one per cent level. For the three per cent group, two out of three are significant. Similarly, for the event study of the five per cent group in Table A3.1 in the appendix, which shows the results with different controls, the pre-event coefficients are insignificant for all treatment groups, strengthening the parallel trend assumption. The post-event coefficients are positive and significant from year two onwards. The coefficients for the models with added and all controls are similar, but the difference in the model that controls for only fixed and year effects is larger. The controls can account for confounding factors that were previously causing bias in the estimation of the coefficients.

7.3 Limitations and Suggestions for Further Research

This analysis faces certain limitations due to the constraints of the available data, which restricts the study to a specific period. Examining a broader timeframe could offer additional insights, particularly in understanding how historical fluctuations in oil prices have influenced disability benefits in Norway. Investigating whether previous declines in oil prices yielded similar results or if periods of high oil prices led to decreased benefit recipients in areas heavily dependent on the oil sector would strengthen the study's conclusions. Using municipality-level data helps analyse regional impacts, but it has limitations as it does not allow for observing how individuals respond to employment changes. Future research could focus on individual-level data, potentially using individual data provided by Microdata.no to further investigate how changes in employment affect individuals based on personal employment history, demographic characteristics, and other individual factors. Such an analysis could give a more comprehensive analysis of how individuals respond to changes in employment and factors that make individuals more prone to applying for benefits during economic downturns. Further research could also examine the transition dynamics between different social security programs. This can be done through investigating the relationship between changes in local employment opportunities, Work Assessment Allowance (AAP) and disability benefits. This study could explore the influence of local labour market conditions on the duration and frequency of AAP usage and the potential increase in transitions to disability benefits due to economic shocks or downturns.

Lastly, it is important to acknowledge the limitations of econometric modelling. Future studies might consider alternative econometric approaches or the inclusion of additional variables and instruments that could affect the employment-disability benefits relationship, giving additional information on the dynamics between employment and benefit take-up.

8 Conclusion

This thesis contributes to the literature on how changes in local labour market conditions impact disability benefit take-up. Inspired by the studies conducted by Black et al. (2002) and Charles et al. (2018), I have employed a similar methodology in a Norwegian context at the municipal level. A Two-Way Least Squares approach, addressing potential endogeneity in the employment variable, was employed to analyse the impact of employment changes from 2009 to 2021 on benefit take-up. This approach used an interaction term of oil price changes and the percentage of oil workers in each municipality in 2009 as an instrument. The impact of the 2014 oil price decline was examined using Difference-in-Difference and Event Study methodologies to investigate the effects of economic shocks to local economies on disability benefit take-up.

The Two-Way Least Square analysis reveals a significant and inverse relationship between employment and disability benefit take-up with an elasticity of -1.454. The results also suggest that the effect is not immediate, and the response has a time lag. The Difference in Difference analysis suggests that in municipalities with more than five per cent of oil workers, the increase in benefit recipients after the oil price decline was, on average, approximately 5.23 per cent higher compared to municipalities with a lower percentage of oil workers. This pattern is consistent across different thresholds, suggesting that higher levels of oil workers increase the benefit take-up post-event. The Event Study further confirms these results, showing a significant difference in the increase in benefits take-up deepening on the percentage of oil workers. The Event Study also suggests that the effect is not immediate, with the effects emerging two years post-event and persisting for several years.

The results of this thesis suggest that for some individuals, disability benefits work as a substitute for employment during economic downturns. When facing unemployment or a difficult labour market, applying for benefits can become an alternative to employment. Additionally, the mental and physical stress associated with unemployment might exacerbate health issues, leading more individuals to seek disability benefits as a source of income stability in challenging times.

Hopefully, the findings from this thesis can contribute to understanding the complex and challenging issue of the high benefit dependency among the Norwegian population. Providing further insights into this issue might help policymakers in implementing changes and policies that reduce benefit dependency. Future research, particularly on an individual level, might further reveal the specific circumstances where applying for benefits is a marginal decision, which can help create more targeted policies.

References

Angrist, J. D., & Pischke, J.-S. (2009). *Mostly harmless econometrics: An empirisist's companion* (1st ed.). Princeton University Press.

Autor, D. H., Dorn, D., & Hanson, G. H. (2013). The china syndrome: Local labor market effects of import competition in the united states. *American Economic Review*, *103*(6), 2121–2168. https://doi.org/10.1257/aer.103.6.2121

Autor, D. H., & Duggan, M. G. (2003). The rise in the disability rolls and the decline in unemployment. *The Quarterly Journal of Economics*, *118*(1), 157–206. https://doi.org/10.1162/00335530360535171

Bazzi, S., & Clemens, M. A. (2013). Blunt instruments: Avoiding common pitfalls in identifying the causes of economic growth (online appendix). *American Economic Journal: Macroeconomics*, *5*(2). https://typeset.io/pdf/blunt-instruments-avoiding-common-pitfalls-in-identifying-4fzjj1va1p.pdf

Black, D., Daniel, K., & Sanders, S. (2002). The impact of economic conditions on participation in disability programs: Evidence from the coal boom and bust. *American Economic Review*, *92*(1), 27–50.

Borusyak, K., Jaravel, X., & Spiess, J. (2022). *Revisiting event study designs: Robust and efficient estimation (cemmap working paper, no. cwp11/22)*. https://doi.org/10.47004/wp.cem.2022.1122

Brander, A. S. (2019). *Nytt oljeprisfall vil bremse veksten i norsk økonomi [A new fall in oil prices will slow growth in the Norwegian economy]*. Retrieved December 12, 2023, from https://www.norges-bank.no/bankplassen/arkiv/2019/nytt-oljeprisfall-vil-bremse-veksten-i-norsk-okonomi/

Bratberg, E., Nilsen, Ø. A., & Vaage, K. (2012). *Is recipiency of disability pension hereditary?* (Tech. rep. No. SAM 10 2012). Norwegian School of Economics, Department of Economics.

Bratsberg, B., Fevang, E., & Røed, K. (2010). Disability in the welfare state: An unemployment problem in disguise? *IZA Discussion Paper*, (4897). https://doi.org/10.2139/ssrn.1595538

by Royal Decre, C. A. (2016). *Nou 2016: 15 lønnsdannelsen i lys av nye økonomiske utviklingstrekk [Wage formation in the light of new economic developments]* (tech. rep.). Finansdepartementet [Ministry of Finance]. Retrieved December 12, 2023, from https://www.regjeringen.no/contentassets/77d435e6aa6d421480708c971ce734a9/no/pdfs/nou201620160015000dddpdfs.pdf

Charles, K. K., Li, Y., & Stephens Jr, M. (2018). Disability benefit take-up and local labor market conditions. *Review of Economics and Statistics*, *100*(3), 416–423.

Ekelund, R. (2022). *Kan raskere avklaringer bli for raske [Can faster clarifications become too fast]*. Retrieved November 11, 2023, from https://www.nav.no/no/nav-og-samfunn/kunnskap/analyser-fra-nav/arbeid-og-velferd/arbeid-og-velferd/arbeid-og-velferd-nr.3-2022/kan-raskere-avklaringer-bli-for-raske

Ellingsen, J. (2017). *Utviklingen i uføretrygd per 31. desember 2017 [The development in disability benefits as of December 31, 2017]* (tech. rep.). Arbeids- og Velferdsdirektoratet / Statistikkseksjon. Retrieved September 11, 2023, from https://www.nav.no/_/attachment/download/7756c570-e767-4311-a9e2-e557e228e1dd:a8098ccbf7390c072e5d9d1d2e2d472885a12af9/statistikknotat-uforetrygd-desember2017.pdf

Fevang, E., & Røed, K. (2006). *Veien til uføretrygd i norge [The road to disability benefits in norway]* (tech. rep. No. 10). Ragnar Frisch Centre for Economic Research. https://www.frisch.uio.no/publikasjoner/pdf/rapp06_10.pdf

Government of Norway. (2020). *Kommunesammenslåinger i kommunereformen [Municipal mergers in the municipal reform]* [Available online: https://www.regjeringen.no/no/tema/kommuner-og-regioner/kommunestruktur/nye-kommuner/id2470015/].

Hungnes, H., Midttun, S., & Strøm, B. (2022). *Ringvirkninger av petroleumsnæringen i norsk økonomi basert på endelige nasjonalregnskapstall for 2020 [The impact of the petroleum industry on the Norwegian economy based on final national accounts for 2020]* (tech. rep.). Statistics Norway (SSB). Retrieved December 14, 2023, from https://www.ssb.no/nasjonalregnskap-og-konjunkturer/konjunkturer/artikler/ringvirkninger-av-petroleumsnaeringen-i-norsk-okonomi.basert-pa-endelige-nasjonalregnskapstall-for-2020/_/attachment/inline/5733eafa-244b-4e3f-a4c4-89e1fa719c61:9ffd3951bf8f57045263f0df34230229f07d3c71/RAPP2022-49.pdf

Hvinden, E. C., & Nordbø, E. W. (2016). *Oljeprisfallet og arbeidsmarkedet [The oil price decline and the labour market]* (tech. rep. No. 7). Norges Bank. Retrieved December 14, 2023, from https://www.norges-bank.no/contentassets/d469bee4f3d94903bb5179df62e55a8d/aktuell_kommentar_7_2016.pdf

Jacobsen, O., & Thune, O. (2013). *Uførepensjon og gradering [Disability pension and grading]* (tech. rep.). NAV. Retrieved December 12, 2023, from https://www.nav.no/no/nav-og-samfunn/kunnskap/analyser-fra-nav/arbeid-og-velferd/arbeid-og-velferd/uforepensjon-og-gradering

Jensen, N. K., Brønnum-Hansen, H., Andersen, I., Thielen, K., McAllister, A., Burström, B., Barr, B., Whitehead, M., & Diderichsen, F. (2019). Too sick to work, too healthy to qualify: A cross-country analysis of the effect of changes to disability benefits. *Journal of epidemiology and community health*, *73*(8), 717–722. https://doi.org/10.1136/jech-2019-212191

Lovdata. (2023). *Lov om folketrygd [Act on national insurance]*. Retrieved September 11, 2023, from https://lovdata.no/dokument/NL/lov/1997-02-28-19

Michaud, A., & Wiczer, D. (2018). *The disability option: Labor market dynamics with macroeconomic and health risks* (tech. rep. No. 2018-7). The University of Western Ontario, Centre for Human Capital and Productivity (CHCP). London (Ontario). https://www.econstor.eu/bitstream/10419/197793/1/1045808385.pdf

NAV. (2022). *Stabil uføreandel hittil i 2022 [Stable disability rate so far in 2022]*. Retrieved October 10, 2023, from https://www.nav.no/no/nav-og-samfunn/statistikk/aap-nedsatt-arbeidsevne-og-uforetrygd-statistikk/nyheter/stabil-uforeandel-hittil-i-2022

NAV. (2023a). *Arbeidsavklaringspenger (aap) [Work assessment allowance]*. Retrieved October 23, 2023, from https://www.nav.no/aap#kort

NAV. (2023b). *Diagnoser uføretrygd [Diagnoses for disability benefits]*. Retrieved November 11, 2023, from https://www.nav.no/no/nav-og-samfunn/statistikk/aap-nedsatt-arbeidsevne-og-uforetrygd-statistikk/uforetrygd/diagnoser-uforetrygd

NAV. (2023c). *Disability benefit in brief*. Retrieved October 29, 2023, from https://www.nav.no/uforetrygd/en

NAV. (2023d). *Flere uføretrygdede i 2022 [An increase in disabled in 2022]*. Retrieved October 23, 2023, from https://www.nav.no/no/nav-og-samfunn/statistikk/aap-nedsatt-arbeidsevne-og-uforetrygd-statistikk/nyheter/flere-uforetrygdede-i-2022

NAV. (2023e). *Grunnbeløpet i folketrygden The basic amount in the national insurance scheme]*. Retrieved September 11, 2023, from https://www.nav.no/grunnbelopet

NAV. (2023f). *Historisk statistikk over arbeidssøkere og stillinger [Historical statistics on job seekers and employment opportunities]*. Retrieved December 12, 2023, from https://www.nav.no/no/nav-og-samfunn/statistikk/arbeidssokere-og-stillinger-statistikk/historisk-statistikk

NAV. (2023g). *Uføretrygd - månedsstatistikk [Disability benefits - monthly statistics]*. Retrieved September 11, 2023, from https://www.nav.no/no/nav-og-samfunn/statistikk/aap-nedsatt-arbeidsevne-og-uforetrygd-statistikk/uforetrygd/uforetrygd-ma%CC%8Anedsstatistikk

NAV. (2023h). *What is nav?* Retrieved December 11, 2023, from https://www.nav.no/hva-er-nav/en

Normann, T. M. (2018). *Kvinner kombinerer uføretrygd og arbeid oftere enn menn [Women combine disability benefits and work more often than men]*. Retrieved October 8, 2023, from https://www.ssb.no/sosiale-forhold-og-kriminalitet/artikler-og-publikasjoner/kvinner-kombinerer-uforetrygd-og-arbeid-oftere-enn-menn

Normann, T. M. (2023). *Flere uføre med lav utdanning [More disabled with low education]*. Retrieved October 10, 2023, from https://www.ssb.no/sosiale-forhold-og-kriminalitet/trygd-og-stonad/statistikk/uforetrygdede/artikler/flere-ufore-med-lav-utdanning

Norwegian Ministry of Finance. (2021). *Perspektivmeldingen 2021 [Perspectives report 2021]* (Meld. St. No. 14 (2020–2021)). Norwegian Ministry of Finance. https://www.regjeringen.no/no/dokumenter/meld.-st.-14-20202021/id2834218/f

Norwegian Ministry of Labour and Social Inclusion. (2021). *Ingen utenfor – en helhetlig politikk for å inkludere flere i arbeids- og samfunnsliv [No one left out – A comprehensive policy for including more people in work and wociety]* (Meld. St. No. 32 (2020–2021)). Norwegian Ministry of Labour and Social Inclusion. https://www.regjeringen.no/no/dokumenter/meld.-st.-32-20202021/id2856870/?ch=1f

Norwegian Ministry of Labour and Social Inclusion. (2022). *Folketrygden [The Norwegian social insurance scheme]* (tech. rep.). Norwegian Ministry of Labour and Social Inclusion. Retrieved September 11, 2023, from https://www.regjeringen.no/contentassets/03b0e088c8f44a8793ed0c0781556b11/the-norwegian-social-insurance-scheme_2022.pdf

Norwegian Petroleum. (2023). *Economy*. Retrieved December 12, 2023, from https://www.norskpetroleum.no/en/economy/

O'Brien, R. L. (2013). Economy and disability: Labor market conditions and the disability of working-age individuals. *Social Problems*, *60*(3), 321–333. https://doi.org/10.1525/sp.2013.60.3.321

Rege, M., Votruba, M., & Telle, K. (2009). The effect of plant downsizing on disability pension utilization. *Journal of the European Economic Association*, *7*(4), 754–785. http://www.jstor.org/stable/40282788

Roberts, J., & Taylor, K. B. (2019). New evidence on disability benefit claims in the uk: The role of health and the local labour market. *IZA – Institute of Labor Economics*, (12825). https://doi.org/10.2139/ssrn.3510436

Stata. (2023). *Ivregress postestimation — postestimation tools for ivregress*. Retrieved December 15, 2023, from https://www.stata.com/manuals13/rgmmpostestimation.pdf

Statistics Norway. (2023a). *Employment, register-based*. Retrieved October 10, 2023, from https://www.ssb.no/en/statbank/table/13470/

Statistics Norway. (2023b). *Labour force survey*. Retrieved December 12, 2023, from https://www.ssb.no/en/statbank/table/05111

Statistics Norway. (2023c). *National accounts*. Retrieved December 12, 2023, from https://www.ssb.no/en/nasjonalregnskap-og-konjunkturer/nasjonalregnskap/statistikk/nasjonalregnskap

Sysselsettingsutvalget. (2021). *Nou 2021: 2 kompetanse, aktivitet og inntektssikring — tiltak for økt sysselsetting [NOU 2021: 2 competence, activity, and income security — measures for increased employment]* (tech. rep.). Arbeids- og sosialdepartementet. Retrieved December 12, 2023, from https://www.regjeringen.no/no/dokumenter/nou-2021-2/id2832582/?ch=11

U.S. Energy Information Administration. (2023). *Europe brent spot price fob*. Retrieved December 10, 2023, from https://www.eia.gov/dnav/pet/hist/rbrteD.htm

Wooldridge, J. M. (2020). *Introductory econometrics: A modern approach* (7th ed.). Cengage Learning.

Appendices

A1 Two-Stage Least Squares

Table A1.1: The first 2SLS equation with controls

Model	(1) Simple	(2) With Lags	(3) Added Controls	(4) All Controls
Oil_Interaction	1.40e-05	1.53e-06	2.74e-05***	2.59e-05***
	(1.06e-05)	(9.14e-06)	(6.15e-06)	(6.31e-06)
L1_Oil_Interaction		1.62e-05***	2.52e-05***	1.96e-05***
		(4.57e-06)	(4.52e-06)	(4.23e-06)
L2_Oil_Interaction		2.64e-06	4.39e-06	3.98e-06
		(4.85e-06)	(4.42e-06)	(4.15e-06)
lnPopulation			0.888***	0.940***
			(0.0226)	(0.0281)
ShareAge50_66			0.00108	0.000225
			(0.000736)	(0.000647)
ShareWomen			0.00271	0.00230
			(0.00177)	(0.00181)
L1_SickLeave				-0.00174**
				(0.000805)
L2_SickLeave				-0.00195**
				(0.000898)
SharePrimaryEdu				0.00375***
				(0.000933)
ShareSecondaryEdu				0.00486***
				(0.000918)
ShareAfrica				-0.00396**
				(0.00155)
ShareAsia				-0.00570***
				(0.00160)
Constant	7.922***	7.932***	0.101	-0.541*
	(0.00344)	(0.00417)	(0.220)	(0.281)
N	4,563	3,861	3,861	3,861

Note: Year dummies are included in the regression but excluded from the table. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table A1.2: 2SLS second equation with controls

	(1) Simple	(2) Added Controls	(3) All Controls
lnEmployed	-5.961	-1.351***	-1.454**
	(3.764)	(0.458)	(0.596)
lnPopulation		2.505***	2.762***
		(0.395)	(0.550)
ShareAge50_66		0.0247***	0.0204***
		(0.00375)	(0.00378)
ShareWomen		0.0105	0.00957
		(0.00835)	(0.00841)
L1_SickLeave			0.000931
			(0.00400)
L2_SickLeave			0.00481
			(0.00347)
SharePrimaryEdu			0.0193***
			(0.00535)
ShareSecondaryEdu			0.0158***
			(0.00574)
ShareAfrica			-0.0191**
			(0.00813)
ShareAsia			-0.0276***
			(0.00797)
N	3,861	3,861	3,861

Note: Year dummies are included in the regression but excluded from the table. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table A1.3: 2SLS second equation with two lags of employment and controls

lnEmployed	-10.99	-0.596	-0.419
	(10.84)	(0.707)	(0.722)
L1_lnEmployed	6.080	-0.163	-0.821
	(7.118)	(0.718)	(0.570)
L2_lnEmployed	-4.311	-1.343**	-0.897**
	(4.222)	(0.532)	(0.440)
lnPopulation		3.199***	3.418***
		(0.628)	(0.766)
ShareAge50_66		0.0266***	0.0216***
		(0.00408)	(0.00399)
ShareWomen		0.00751	0.00433
		(0.00806)	(0.00787)
L1_SickLeave			0.00265
			(0.00412)
L2_SickLeave			0.00228
			(0.00376)
SharePrimaryEdu			0.0135***
			(0.00499)
ShareSecondaryEdu			0.0138**
			(0.00580)
ShareAfrica			-0.0265***
			(0.00844)
ShareAsia			-0.0299***
			(0.00837)
N	3,861	3,861	3,861

Note: Year dummies are included in the regression but excluded from the table. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table A1.4: 2SLS regression with no lags of the instrument

	1	2	3
Specification	Simple	Added Controls	All controls
lnEmployed	-7.248	-1.179***	-1.184**
	(6.499)	(0.445)	(0.559)
First-Stage Estimates			
Oil_Interaction	1.40e-05	4.69e-05***	4.13e-05***
	(1.06e-05)	(6.22e-06)	(6.19e-06)
F-statistic for excluded instruments	1.74	56.89	44.54
N	4,563	4,563	3,861

Note: Control variables and year dummies are included in the regression but excluded from the table. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A1.5: 2SLS regression with one lag of the instrument

Specification	1 Simple	2 Added Controls	3 All controls
lnEmployed	-5.029*	-1.315***	-1.416**
	(2.621)	(0.448)	(0.584)
First-Stage Estimates			
Oil_Interaction	-3.86e-06	2.96e-05***	2.41e-05***
	(1.04e-05)	(6.20e-06)	(5.51e-06)
L1_Oil_Interaction	2.29e-05***	2.55e-05***	2.37e-05***
	(4.90e-06)	(4.15e-06)	(4.17e-06)
F-statistic for excluded instruments	11.09	36.07	26.67
N	4,212	4,212	3,861

Note: Control variables and year dummies are included in the regression but excluded from the table. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A1.6: 2SLS regression with one lag of employment and one lag of the instrument

Specification	1 Simple	2 Added controls	3 All controls
lnEmployed	-6.015	0.112	0.0316
	(4.557)	(0.541)	(0.605)
L1_lnEmployed	0.0678	-1.839***	-1.912***
	(1.340)	(0.610)	(0.608)
N	3,861	3,861	3,861

Note: Control variables and year dummies are included in the regression but excluded from the table. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A1.7: 2SLS regression with one lag of employment and two lags of the instrument

	1 Simple	2 Added controls	3 All controls
lnEmployed	-6.015	0.112	0.0316
	(4.557)	(0.541)	(0.605)
L1_lnEmployed	0.0678	-1.839***	-1.912***
	(1.340)	(0.610)	(0.608)
N	3,861	3,861	3,861

Note: trol variables and year dummies are included in the regression but excluded from the table. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

A2 Difference in Difference

Table A2.1: DID regression with different controls

	(1) Simple	(2) Added controls	(3) All controls
TreatXPostMedian	0.0191	0.0138	0.0193**
	(0.0128)	(0.00977)	(0.00932)
TreatXPost3Pct	0.0482***	0.0211*	0.0236**
	(0.0143)	(0.0121)	(0.0116)
TreatXPost5Pct	0.0870***	0.0500***	0.0523***
	(0.0152)	(0.0121)	(0.0125)
N	4,563	4,563	4,563

Note: Control variables and year dummies are included in the regression but excluded from the table. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

A3 Event Study

Table A3.1: Event Study results for the above five per cent treatment group with different controls

	(1) Simple	(2) Added controls	(3) All controls
Year -5	-0.00726	0.0178	0.0169
	(0.0159)	(0.0136)	(0.0132)
Year -4	-0.00331	0.0164	0.0149
	(0.0136)	(0.0120)	(0.0117)
Year -3	-0.00613	0.00767	0.00633
	(0.0130)	(0.0117)	(0.0116)
Year -2	-0.0117	-0.00424	-0.00596
	(0.00805)	(0.00782)	(0.00762)
Year 0	0.0103	-0.00110	-0.00275
	(0.00886)	(0.0102)	(0.00970)
Year 1	0.0329***	0.0168*	0.0149
	(0.0104)	(0.00934)	(0.0102)
Year 2	0.0435***	0.0208*	0.0263**
	(0.0126)	(0.0116)	(0.0127)
Year 3	0.0611***	0.0340***	0.0384***
	(0.0140)	(0.0130)	(0.0133)
Year 4	0.107***	0.0769***	0.0789***
	(0.0198)	(0.0182)	(0.0191)
Year 5	0.110***	0.0798***	0.0772***
	(0.0194)	(0.0181)	(0.0181)
Year 6	0.116***	0.0821***	0.0827***
	(0.0216)	(0.0185)	(0.0187)
Year 7	0.118***	0.0834***	0.0843***
	(0.0229)	(0.0193)	(0.0196)
Constant	5.892***	-5.911***	-7.223***
	(0.00582)	(0.894)	(0.902)
Sum Post Event TE	0.599	0.393	0.400
Pre-treatment mean	5.92	5.92	5.92
N	4,563	4,563	4,563

Note: Control variables and year dummies are included in the regression but excluded from the table. Robust standard errors in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$.