Worried sick: Stress symptoms during a local economic crisis [1]

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Abstract

We revisit the relationship between recession and health, studying a local recession in the western part of Norway after the 2014 oil price shock. We use data on drug prescriptions from the Norwegian Prescription Database (NorPD), as prescribed by general practitioners and mental health specialists as a measure of the first-order effect of recession on stress-symptoms. We use the variation between more and less oil-dependent regions to identify the effects in a difference-in-difference framework. We find that the local recession increased the probability of receiving a stress-related prescription by 1.9 percent, and that the number of prescriptions increased 3.2 percent relative to the pre-crisis mean. We found the largest effects among women and low-skilled/low-earning individuals.

Keywords: recession, health, prescriptions, inequality

JEL classifications:

1. Introduction

The relationship between economic crisis and health is ambiguous. On the one hand, earlier studies suggested that mortality is procyclical, increasing during upturns and decreasing during downturns (Ruhm 2000). This relationship seems to have weakened in recent years (Ruhm 2015). On the other hand, recent cross-country evidence shows that recessions are associated with elevated mortality rates – but that these adverse health effects are concentrated in emerging markets and developing countries (Doerr and Hofmann 2022). Using other types of variation, e.g. from firm closures (Eliason and Storrie 2009; Sullivan and von Wachter 2009) or manufacturing decline (Autor, Dorn, and Hanson 2019), several studies have found a clear negative effect of such adverse labor market shocks on mortality. The conflicting findings can be rationalized because several mechanisms can be at play and different types of labor market shocks can materialize into different types of health problems. In this study, we revisit the association between recession and health, using a local recession to identify the effects. We examine the effect on stress-related drug prescriptions as a indicator of early health symptoms,

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exploring how health effects are distributed throughout the downturn, across different sectors, and among various population groups.

We examine the consequences of the 2014 oil price shock on the uptake of prescriptions dispensed for stress-related medications. The fall in the oil price was an economic shock to the oil industry in Norway, which downsized its production massively. The shock spread to other industries and led to a local recession in a geographically concentrated part of Norway where most of the oil industry is situated (Bhuller, Strøm, and Wentzel 2024). Our identification strategy exploits the fact that the oil price crisis was not triggered by domestic factors but was an external shock to the Norwegian economy. Moreover, it affected some regions more than others, and particularly Stavanger - the 'oil capital' of Norway - and the surrounding region of Rogaland in the southwest of Norway. We use the variation over time across regions to study the impact of the oil price shock in a difference-in-differences framework, by comparing the affected area with non-affected areas in Norway, from a period before the oil price shock to a period after.

We utilize high-quality longitudinal Norwegian register data containing detailed information on objective health for the whole Norwegian population. Our data includes information from the Norwegian Prescription Database (NorPD) on number of prescriptions dispensed for stress-related medications, as prescribed by general practitioners, medical specialists or psychiatrists. Stress related medications include those for conditions such as coronary heart disease, migraines, muscle and skeletal pain, skin problems, anxiety, and depression. This provides an objective measure of stress related symptoms and illnesses at the individual level, ensuring both accuracy and reliability of the data, and reducing biases that can occur with self-reported information.

We find that the oil price shock resulted in a significant increase in medical prescriptions, both in terms of the probability of receiving a prescription for a potentially stress related condition and the quantity of medications prescribed. The probability of receiving a stress-related prescription increased by 0.8 percentage points (a 1.9 percent increase relative to the pre-crisis mean), and the number of prescriptions increased by 0.07 (a 3.2 percent increase relative to the pre-crisis mean). The results are robust to various robustness checks. The size of the effects only partly follows the economic impact. In line with the patterns of negative earnings effects, we found the largest effects among low-skilled/low-earning individuals. In contrast to the earnings effects, we found larger health effects for women, despite the economic shock being felt more strongly by men.

Our paper contributes to the broad literature on economic downturns and health. Various mechanisms have been proposed to explain how economic crises can impact health and mortality. Early research by Brenner (1975; 1979; 1973) found countercyclical variation in admissions to mental hospitals, infant mortality rates, and deaths and hypothesized that downturns cause detrimental changes in physical and mental health by increasing stress and risk-taking. This view was contested in e.g. Ruhm (2000) who found that mortality was pro-cyclical, and hypothesized that during periods of economic growth, employed individuals may face increasing demands to be more productive and work longer hours, leading to more job-related stress. Working long hours may lead to poor health and mortality (Ervasti et al. 2021), and particularly increase the risk of heart disease and stroke (Descatha et al. 2020; Li et al. 2020). What is more, some studies show that even work-related accidents increase during economic upturns (Ruhm 2000). Economic upturns are also linked to less healthy lifestyle choices, including increased smoking, poorer diets, and reduced physical activity — all of which are bad for health, and which contribute to higher mortality (Stevens et al. 2015; Ruhm 2000; Ruhm 2005; Ruhm and Black 2002).

The varying theoretical perspectives on how economic downturns affect health are reflected in the mixed findings in empirical studies. Several studies show that mortality rates increase during economic upturns and decrease in times of low economic activity. Such results are found in the U.S. (Ruhm 2000) , in Norway (Haaland and Telle 2014), in Germany (Neumayer 2004), and Sweden (van den Berg et al. 2017)[2]. Dadgar and Norström (2022) investigate the short- and long-term impacts of macroeconomic changes on mortality across 21 OECD countries, using data from 1960 to 2018. Their analysis reveals that increases in unemployment are associated with a reduction in the number of deaths per 100,000 population. Tapia Granados and Rodriguez (2015) find that most indicators of population health, such as self-reported health and life expectancy, improved in Greece, Finland and Iceland after the Great Recession. Moreover, Bratberg and Monstad (2015) found a decrease in sickness absence among public employees in municipalities affected by a financial shock in Norway.

On the other hand, there are studies which do not support these findings, and some even report contradictory results. A systematic review carried out by Mucci et al. (2016) provides evidence that economic crises have an adverse effect on health and mortality, implying that economic downturns work as a significant stressor on individuals. Lenhart (2017) examines health changes resulting from the negative economic shock in Germany. The study shows that

[2] Examples of other studies supporting that health and mortality rates are pro-cyclical are among others Buchmueller et al. (2007), Regidor et al. (2019) and Ariizumi & Schirle (2012).

an increase in state unemployment was associated with a significant decline in self-reported health status. McInerney et al (2013) show that the 2008 stock market crash in the U.S led to reduced wealth, which in turn increased the feelings of depression and the use of antidepressant medications among adults. In another study conducted by Currie et al (2015) they show that an increase in unemployment rates in the US leads to a decline in self-reported health status and an increase in smoking and drug use. In a systematic review by Simou and Koutsogeorgou (2014) they conclude that there have been negative effects of economic crises on population health in Greece. The review shows increasing rates of mental health problems, suicides, and epidemics, and decline in self-rated health. A recent meta-analysis by Picchio, M., & Ubaldi (2022) investigating the impact of unemployment on health, concludes that the average effect on health is negative, but small. However, they find clear negative impact of recessions on the psychological aspects of health.

Our study contributes to the empirical literature on recessions and health with plausibly exogenous variation in economic recession between regions in Norway. The difference-in-difference design allows us to control for normal business cycle variation in the economy. It is not necessarily so that a temporary business cycle downturn is the same as a recession, and the effects on health may therefore vary according to the severity of the downturn. The oil price crash clearly led to a local recession, that had large negative consequences on unemployment and earnings, and our estimates can therefore be interpreted as recession effects. Our study also provides a direct measure of the first-order effects of recession on stress. Specifically, we use data on prescriptions for stress-related medications, whereas most studies typically focus on general health and mortality as outcome measures. Even though several of the theoretical perspectives postulate that the economic downturn affects health through their impact on stress, few studies directly measure stress. The second-order effects on fatal outcomes, such as mortality, likely represents the cumulative effect of the crisis through various mechanisms. In this context, our study contributes by providing evidence on first-order effects of the crisis on stress, specifically by examining prescriptions for stress-related medication.

Our study is also related to the literature documenting adverse health effects of job displacement. Displaced workers face higher mortality rates (Browning and Heinesen 2012; Eliason and Storrie 2009; Sullivan and von Wachter 2009), suffer from worse physical and mental health outcomes (Schaller and Stevens 2015; Strully 2009), and report lower levels of subjective well-being (Song 2018). In the Norwegian context, Black et al. (2015) identified negative impacts of job displacement on cardiovascular health, while Rege et al. (2009) observed significant effects of plant downsizing on disability pension utilization. Moreover, a

recent study from Norway Heggebø (2022) shows that men who experienced unemployment have 80 to 90 percent higher risk of dying over the next ten years compared to those who remain employed. For women, the corresponding increase is 40 percent. Our study shows that the oil price shock led to a broad increase in unemployment in the private sector, and the negative health effects largely follow the patterns of unemployment and income effects. Our region-level evidence is therefore consistent with the worker-level evidence in the literature on job displacements.

The paper continues as follows. In section 2, we provide context by situating our study within the Norwegian setting. In section 3 we describe the data, while in section 4 we outline the identification strategy. Results and robustness checks follow in section 5 to 6. Finaly, a summary and some concluding remarks close the article.

2. The Norwegian context/setting

2.1. The 2014 oil price crash

The petroleum sector is one of the most important industries in Norway. In 2013, the year before the oil price shock, the oil sector accounted for 20 percent of GDP, 30 percent of investment and 49 percent of exports (Norwegian Petroleum Directorate).[3] The petroleum industry is geographically concentrated and mostly situated along the western and southern coast of Norway, particularly in regions where offshore oil extraction is prevalent. Concurrently, the industry employs a significant share of the Norwegian work force: in 2021 between 156 000-204 000 individuals were estimated to either directly or indirectly be employed by the industry, constituting six to ten percent of total employment in Norway (Aslesen et al. 2023; Hungnes, Midttun, and Strøm 2022) . There are, however, large geographical differences in the employment shares, as shown in Figure 1 (more detailed numbers are available in Figure A1 in the Appendix). In Rogaland, the main base for the petroleum industry in Norway, our data show that employment in the oil and oil support industries constitute 17% of total employment in the county. There are also significant shares in the surrounding counties and a few counties more north (Statistics Norway 2015).[4]

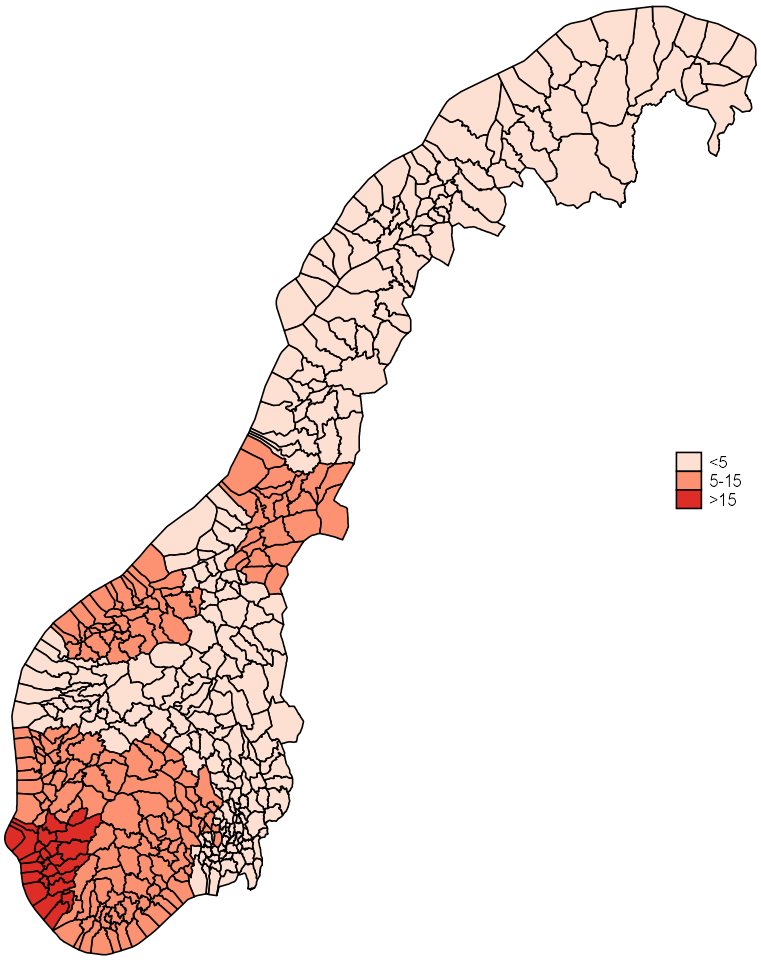
From mid-2014 to the start of 2015, the oil price fell from over $100 per barrel to under $40 per barrel. This decline was primarily attributed to increased production and advancements in technology, resulting in lower production costs. Additionally, weakened

[3] https://www.norskpetroleum.no/en/economy/governments-revenues/

[4] Our definition of the oil and the oil support industries follows the definition by Statistics Norway(2015), see Table 1 for a complete list of NACE codes

demand for oil due to a decrease in the price of other commodities and slow economic growth played a substantial role in driving oil prices down. Norway is a small actor at the international market, producing only 2 percent of the global oil demand, and there was no change in the Norwegian production before the oil price fell. The fall in oil prices can therefore be considered an exogenous shock to the Norwegian economy.

Figure 1 Employment in oil and oil support industries, by county, in 2013



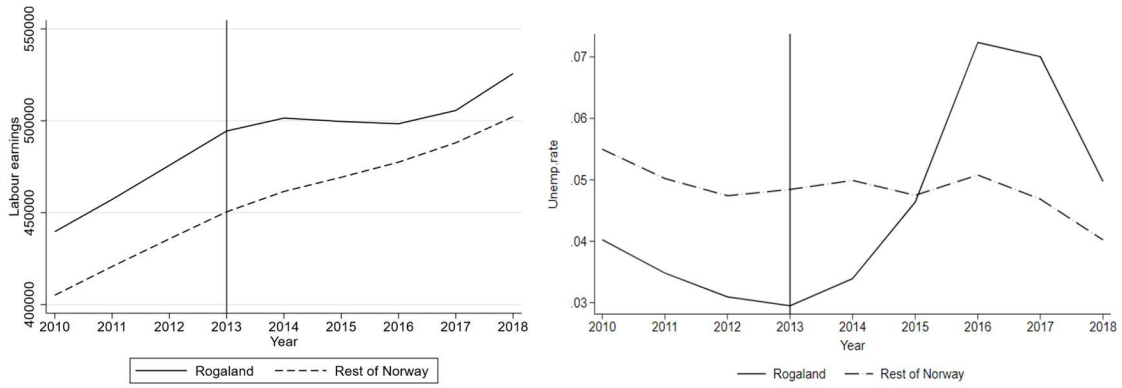
Note: The map shows the share of employees employed in the oil and oil support sectors across counties in Norway in 2013. Rogaland is the county with the highest share (dark red). Middle share (middle red) counties include Hordaland, Møre og Romsdal, Vest-Agder, Buskerud, Aust-Agder, Telemark and Nord-Trøndelag. More detailed shares are displayed in Figure A1 in the Appendix.

The shock was most severely felt in regions with a high proportion of workers employed in the oil industry. Figure 2 shows mean labor earnings (panel a) and unemployment rates (panel b) in Rogaland and the rest of Norway from 2010 to 2018. In Rogaland, labor earnings decreased relative to the rest of the country and the unemployment rate more than doubled from 2014 to 2016. In contrast, unemployment remained stable or decreased in other parts of Norway during the same period. Worth noting is also that Rogaland was on a similar trend as

the rest of Norway before the oil price shock hit, indicating that using the rest of Norway as a control group is suitable for our analysis.

Figure 2. Labor earnings and unemployment rate in Rogaland and the rest of Norway 2010-2018

a) Labor earnings *b) Unemployment rate*



Note: The figure shows mean labor earnings (from the tax register) and the unemployment rate (as measured by the Norwegian Welfare and Labor Administration) in Rogaland and the rest of Norway. The spike in 2013 marks the last pre-period year before the oil price crash in mid-2014.

2.2 The Norwegian welfare system

Norway has a comprehensive and universally accessible welfare system, providing social insurance and access to health care services for all citizens through the National Insurance Scheme. Established in 1967, the National Insurance Scheme is designed to provide financial support to residents and ensure social protection across various life events such as retirement, illness, disability and unemployment. Participation is mandatory, and the scheme is primarily tax funded. Importantly, access to health services and health insurance is not contingent on having a work relationship.

Health services are delivered at two levels. Primary Health Care, which includes general practitioners (GPs), municipal services and emergency care, is the first point of contact. GPs act as gatekeepers to Specialized Health Care, referring patients to specialized services, if necessary, provided by hospitals and specialist clinics. Overall, Norway spent $7771 per capita on health in 2022, which is above OECD average (OECD 2023).

Several key indicators reflect a high standard of living and good health in the Norwegian population at large (OECD 2023). For instance, in 2020 Norway had the highest life expectancy of Europe (https://health.ec.europa.eu/system/files/2021-12/2021_chp_no_english.pdf). The prevalence of lifestyle related diseases such as diabetes and cardiovascular conditions is below

the OECD-average. However, like in much of the western world there has also been an increase in symptoms and diagnoses related to mental health issues over time, particularly among young people (FHI).

Most social security services are managed by the Norwegian Welfare and Labor Administration (NWLA). Eligibility for specific benefits depends on factors such as residency, employment status, and previous contributions. Employed individuals who are temporarily unable to work due to illness are entitled to sickness benefits, which typically cover up to 100% of their salary up to a ceiling for up to one year. Unemployment benefits, covering 62 percent of previous wages, provide financial assistance for up to two years to individuals who lose their job, and eligibility requires a minimum period of previous employment and contributions to the National Insurance Scheme. Employees can be temporarily laid off for up to 26 weeks within 18 months, during which period the employer covers the first two weeks, and the state covers the equivalent to unemployment benefits the remaining 24 weeks. Individuals whose own economic means cannot cover basic needs are entitled to social assistance.

The Norwegian system provides income replacement and continued access to the health service system, serving as a buffer during periods of unemployment and economic crises. It is within this context that the effects of economic downturn should be interpreted.

3. Data and sample

Our database covers the full population of Norway aged 18 to 67 years old, in the years 2010-2018. The data contain longitudinal balanced data from administrative registers containing individual information on age, gender, civil status, immigrant status and education level. To these data, we can link the employer-employee register, tax-register with information about income and benefits, the social insurance database (FD-trygd, Statistics Norway's event database) with information on unemployment benefits, sickness absence and disability pension, and finally the Norwegian Prescription database (NorPD), which includes information on drug prescriptions dispensed at Norwegian pharmacies on all individuals from 2004 onwards.

Information about region is only available in the employer-employee register which has information about county of work. This data restriction defines our sample, which therefore consists of the full Norwegian working population aged 21 to 62 in 2013, the year before the oil price shock.[5] Individuals are allocated to the treatment and control group based on region of employment in 2013, and we do not condition on employment or region in any of the other

[5] This means that workers were at least 18 years of age in 2010 and 67 years of age at the most in 2018. Old age pension in Norway is 67 years old, for both men and women.

observation years (except in a robustness analysis). Individuals in our sample are therefore allowed to move in and out of employment and between regions both in the pre-period and the post-period.

Our most important outcomes are based on information about prescriptions from the Norwegian Prescription database (NorPD). Drugs are classified according to the Anatomical Therapeutic Chemical classification (ATC), which measures, among other things, the number of times a person has collected medications at the pharmacy. This means that each time a prescription is filled, and medications are dispensed from the pharmacy, it is recorded in the prescription register. In other words, it represents the number of medication dispensations associated with a given prescription or prescription order (Table A1 in the Appendix). The frequency of pharmacy medication collections during the observation period was used as a proxy indicator for the following health conditions: cardiovascular disease, migraines, musculoskeletal pain, skin disorders and mental health problems such as anxiety, and depression (including sleep medications and anti-anxiety drugs). These are conditions that are found to be related to stress in previous literature (Green 2020).

Table 1 shows descriptive statistics for the workers in our sample, categorized by those employed in the oil county of Rogaland and those working in the rest of Norway, as measured in 2013 (the year prior to the oil shock). Table 1 shows that Rogaland, the oil county, had a slightly younger population of wage earners (less than 35 years old) than the rest of Norway, smaller share of females and of married workers. As regards human capital variables, they had a slightly lower share with university education, a lower share of workers on sick leave and on welfare benefits and had on average higher wage income. Table 1 also shows that the average number of stress related medications in 2013 was 2.16 in Rogaland and 2.34 in the rest of Norway, and the share of workers with at least one prescription was slightly lower in Rogaland compared to the rest of country. Distribution by diagnosis reveals that the lower proportion and number of prescriptions in Rogaland apply to all included diagnoses in the sample. Since workers in the treatment and control group differ somewhat, we include controls for age, gender, marital status, immigrant status, and education in the estimations. In Table A2 in the Appendix, we test the difference in number of prescriptions, controlling for observable characteristics. The mean differences in number of prescriptions are reduced almost to zero when we include control variables, indicating that the control variables capture a large part of the level difference in number of prescriptions.

Table 1: Descriptive statistics of the population in the oil region and the rest of Norway in 2013, one year before the oil price shock.

	Control group Rest of Norway		Treatment group Rogaland		Test
Background characteristics:					
Young (<35)	0.282	(0.450)	0.305	(0.460)	<0.001
Prime-aged (35-49)	0.420	(0.493)	0.416	(0.493)	0.002
Older (55+)	0.298	(0.458)	0.280	(0.449)	<0.001
Female	0.487	(0.500)	0.458	(0.498)	<0.001
Immigrant background	0.110	(0.313)	0.118	(0.322)	<0.001
Married	0.462	(0.499)	0.537	(0.499)	<0.001
Highest completed education:					
-Below secondary education	0.165	(0.372)	0.164	(0.370)	0.057
-Secondary education	0.420	(0.494)	0.459	(0.498)	<0.001
-Higher education	0.414	(0.493)	0.378	(0.485)	<0.001
Share receiving welfare benefits:					
-Sick pay	0.209	(0.406)	0.181	(0.385)	<0.001
-Temporary disability benefits	0.027	(0.163)	0.019	(0.135)	<0.001
-Other welfare benefits	0.376	(0.484)	0.349	(0.477)	<0.001
Wage income in 1000 NOK (average)	474	(215)	524	(241)	<0.001
Outcome variables:					
Number of prescriptions dispensed for stress related medications:	2.337	(5.269)	2.164	(5.247)	<0.001
-Psychological	0.464	(2.256)	0.451	(2.299)	0.027
- Cardiovascular	0.821	(2.744)	0.749	(2.619)	<0.001
-Skin	0.160	(0.853)	0.151	(0.828)	<0.001
Musculoskeletal	0.745	(2.384)	0.677	(2.320)	<0.001
-Migraine	0.106	(0.928)	0.090	(0.808)	<0.001
Share receiving prescriptions for stress related symptoms:	0.445	(0.497)	0.420	(0.494)	<0.001
-Psychological	0.115	(0.319)	0.110	(0.313)	<0.001
- Cardiovascular	0.143	(0.351)	0.131	(0.337)	<0.001
-Skin	0.076	(0.265)	0.071	(0.258)	<0.001
-Musculoskeletal	0.265	(0.441)	0.246	(0.431)	<0.001
-Migraine	0.028	(0.166)	0.025	(0.156)	<0.001
Number of observations	1,760,337	(90.4%)	180,705	(9.6%)	

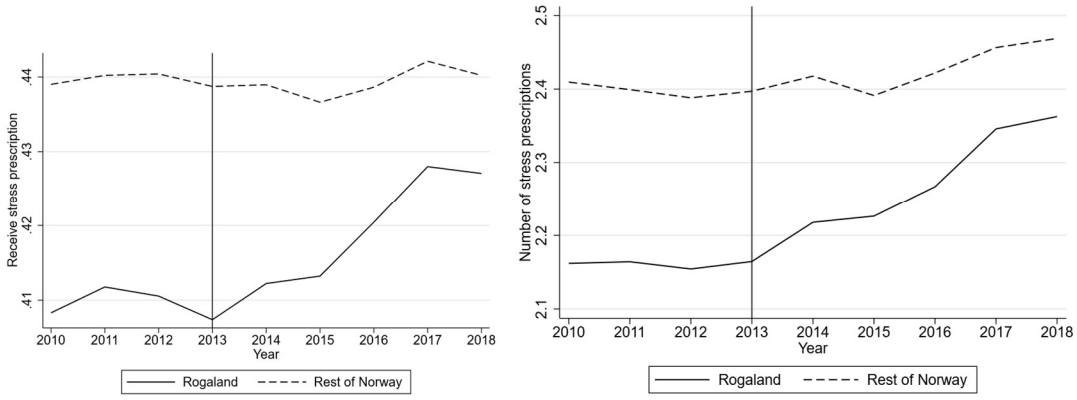
Note: The table shows means and standard deviations (in parenthesis) of the sample. The top panel shows background characteristics, while the bottom panel shows more detail on our two main outcomes; number of prescriptions and share receiving prescriptions.

Identification of effects in our difference-in-differences framework rely, however, on a parallel trends assumption (see below), and any remaining level differences cancel out in the estimation. Figure 3 shows the means of our main outcome variables in the treatment and control counties (Rogaland and the rest of the country), over the period that we study. We observe the level difference, but the pre-trends are remarkably similar before the crisis. After the oil-price shock,

prescriptions are visibly increasing more in Rogaland compared to the rest of the country. The figure underlines two key points; first, the parallel pre-trends indicate that the rest of the country is a suitable control group to Rogaland. Second, the increase in prescriptions in Rogaland following the oil-price shock supports the shock's relevance for studying health behaviour. This comparison between Rogaland and the rest of Norway will pick up an actual increase in prescriptions in Rogaland, and not e.g. a decrease in prescriptions in the rest of the country during the same period.

Figure 3. Prescriptions for stress-related medications in Rogaland and the rest of Norway 2010-2018

a) Probability of receiving stress prescription b) Number of stress prescriptions



Note: The figure shows the mean probability of receiving a prescription for stress-related medications and the number of prescriptions in Rogaland and the rest of Norway.

4. Empirical strategy

As described in Section 3.1, the 2014 oil price shock led to a local economic recession in Norway. Norway is a price-taker at the international market, and the price shock came unexpected. With petroleum industries geographically delimited to areas with oil platforms, we have between-region variation in the potential impact of the oil-price-shock. This provides an ideal setup for using difference-in-differences (DD) methodology. We estimate simple DD-variants of:

$$Y_{it} = \beta_1 \sum_{2010}^{2018} Year + \beta_2 Treat + \beta_3 DD_t + \beta_4 X_{it} + \varepsilon_{it} \quad (1)$$

Where *Y* is our main dependent variable and *i* stands for individual, *t* for time interval. *Treat*=1 if *i* worked in Rogaland county in 2013, and 0 if *i* worked in any other county of Norway. *Treat* interacted with *Year* provides the difference-in-differences estimator *DD*. The

years 2010-2012 are pre-periods and 2014-2018 are post-periods. X includes individual control variables (i.e. age, gender, civil status, immigrant status, education, earnings), all measured in 2013. ε are the robust standard errors.[6]

We estimate equation (1) on different outcomes. The main outcomes are the number of prescribed stress-related medications (both as a categorical and continuous variable) and an indicator (binary) variable for whether the individual had at least one such prescription. We also do regressions by type of diagnosis, i.e. skeletomuscular diseases, cardiovascular diseases, psychological problems, skin problems, and migraines. We conduct separate analyses by gender, level of education, age groups and industries, to see if there are important heterogeneity of effects.

The main identifying assumption for equation (1) to identify causal effects of the economic shock on health outcomes, is that treatment and control groups would have developed in parallel in the absence of treatment. This assumption is not possible to test, but parallel pre-trends are indicative of whether the assumption holds. The estimated coefficients on pre-crisis periods serve as a test of parallel pre-trends. We perform a more formal test of parallel trends using the test suggested in Rambachan and Roth (2023) in Section 6.

Another important assumption is the Stable Unit Treatment Assumptions. First, the composition of the treatment and control units need to be stable over the period. We define treatment by county of employment in the year before the crisis and use a balanced panel. The treatment and control groups are therefore the same during our whole time-window, and our estimate is an intention-to-treat effect, and not biased e.g. by endogenous moving in the post-period. Second, there should be no spillover effects. In our main DD- analyses we compare the county of Rogaland with the remaining counties in Norway. As there are more regions that have oil-related industry, and these are also often neighboring counties (see Figure 1 and Figure A1), we check the robustness of our results to a different control group, removing counties that had more than 5 percent employment in the oil and oil support industries. Results are robust to this alternative control group, which is reassuring (see Section 6).

The last identifying assumption concerns the exogeneity of the shock. The oil price fall was the consequence of international events, and as such not related to the outcomes that we study pre crisis. Relatedly, units should not be able to act on prior knowledge of the crisis by, for example, moving to a county not affected by the oil crisis. We do two analyses to investigate if this no-anticipation assumption holds as robust checks in Section 6.

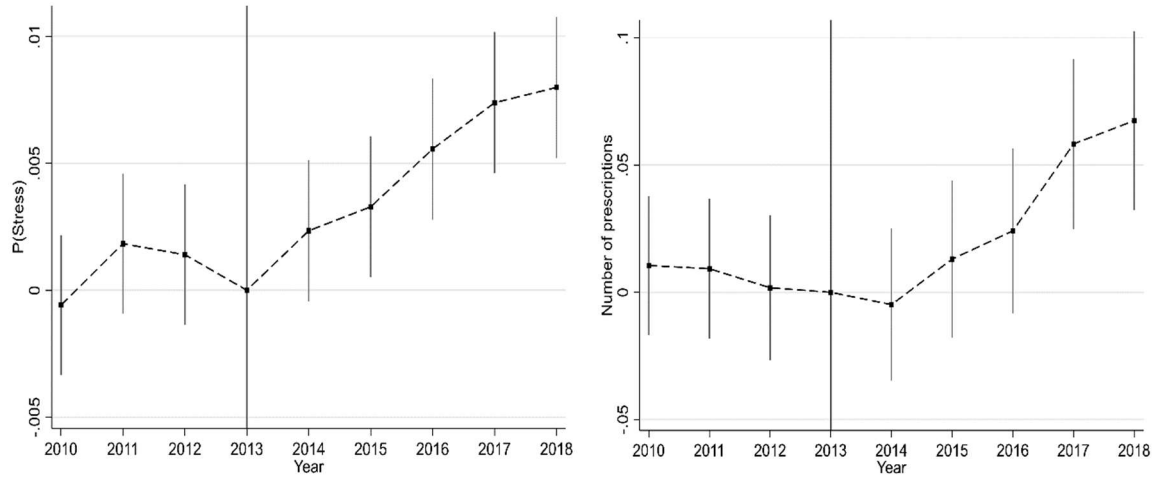
[6] Std are not clustered. According to Abadie et al (2023) one should cluster at the level where assignment occurred. Given our assignment rule (few clusters), clustering is not recommendable. (Angrist & Pischke, 2009)

5. Results

5.1 Medical prescriptions

Figure 4 shows our main results: the impact of the oil price shock in terms of the percentage of workers getting stress related prescriptions (a) and the average number of prescriptions collected (b). In all regressions we include age (annual dummies), gender, level of education, (ln) earnings, marital status and immigrant status (e.g. born in Norway or elsewhere), as control variables.[7] All control variables are measured prior to the oil crisis, in 2013. The vertical line associated with each point estimate shows the 95% confidence interval.

Figure 4: DID estimates of the use of stress related medications. Period 2010-2018.
a) The probability of collecting prescriptions *b) The number of prescriptions collected*



Note: Estimates are based on equation (1) with pre oil price shock related controls (gender, age, civil status, immigrant, education and wages, all measured in 2013. Point estimates and 95 percent confidence intervals. The vertical line marks the year prior to the oil price shock (mid 2014).

The picture is clear: Figure 4 shows a strong increase in the use of stress-related medication in the post period (after the vertical line) relative to the before period for employed individuals living in the oil region compared to those living in another region in 2013, the year before the price shock. Figure 4b shows a clear rise in the number of medications prescribed per year after the price shock and it continues to rise. The increase in the probability of prescription recipiency (left graph) grows to around 0.8 percentage point higher probability (a 1.9 percent increase relative to the pre-crisis probability of 0.420). The

[7] Table A2 shows the DD-estimates, where we have pooled all post periods, rather than showing year for year, with and without control variables. It shows that results are not sensitive to excluding control variables. In section 6 we discuss alternative specifications of treated and controls.

number of prescriptions (right graph) increased by 0.07 in the last year (a 3.2 percent increase relative to the pre-crisis mean of 2.164). In short, both the share of workers collecting prescriptions, and the number of prescriptions received increased as a consequence of the oil price shock, and the effects are considerable. The largest effect in percent is seen at the intensive margin, but the difference is not large. The growth in the number of prescriptions is therefore driven both by more people getting prescriptions, and by a growth in the number of prescriptions collected among individuals that received prescriptions before the crisis.

The increase in prescriptions reflects the decline in earnings, indicating a close connection between the two. Figure A2 in the Appendix shows the development in earnings, estimated using the same specification. It shows that the economic shock is severe with large negative effects on earnings throughout the entire post-period. Although the decline in earnings levels off in the later years, the number of prescriptions continues to grow. This may be due to a delayed health response to economic stress, as people do not immediately develop health problems requiring treatment following an economic shock. Furthermore, we may be capturing increased stress from job applications, interviews, and working in new firms toward the end of the downturn.

5.2 Impacts across sectors of the economy

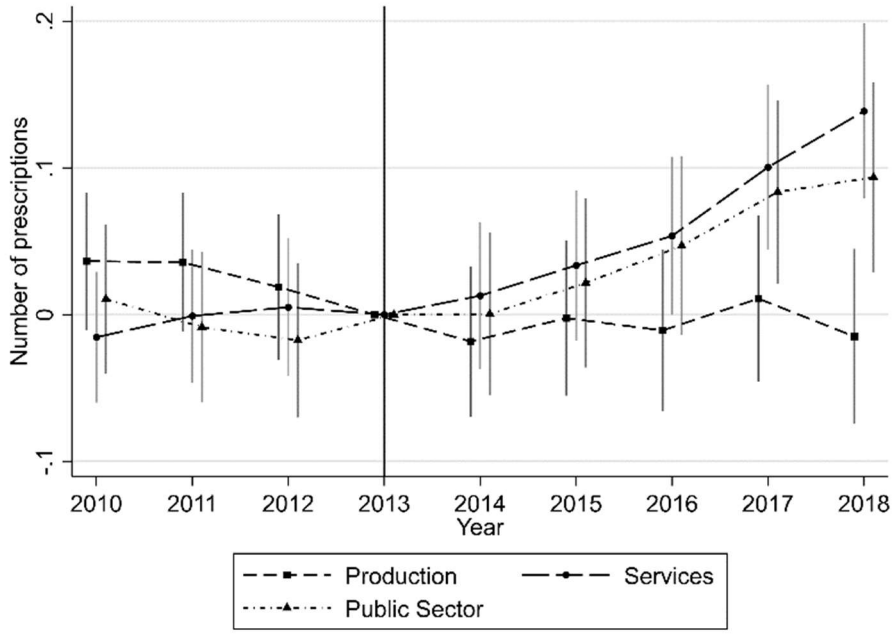
In this section, we estimate the effects of the economic crisis separately by sector of employment, to see if the health effects follow the economic effects. We group categories in NACE Rev. 2 (the classification of economic activities corresponding to ISIC Rev.) in three main groups and run regressions by the industry the worker was attached to in 2013; i) production sector (NACE 01-43, e.g. quarrying, manufacturing, construction), ii) service sector (NACE 45-82, e.g. retail, transport, business services) and iii) public sector (NACE 84-96, e.g. education, health, public administration).

Surprisingly, we find no effect on production sector workers, which was one of the sectors that was largest hit economically (and where the oil and oil support industries belong), as Figure A2 in the Appendix shows. We find the largest health effects in the services sector, which was equally negatively hit by the crisis as the production sector, but the effects are also large among public sector workers that were almost not affected economically. The production sector is male dominated (82 % men), and we see in section 5.4 that the effects are much larger for women than for men. The small effects in the production sector may therefore be related to male health-behavior, where several studies have found that men visit their doctor less often,

and for more severe illnesses (see the discussion in 5.4). Likewise, the public sector is dominated by women (70%), which may contribute to explain the impact on the public sector.

The large negative effects on prescriptions in the public sector also indicates that the shock was felt more broadly than only among workers that were directly affected by the shock. The response to the shock is therefore consistent with macro-level impacts being an important driving mechanism. As the shock hit broadly across industries, it may have increased the general feeling of economic uncertainty and stress in the population, regardless of the direct economic effect on the individual itself.

Figure 5: DID estimates of the number of stress related prescriptions collected, by sector. Period 2010-2018.



Note: Estimates are based on equation (1) with pre oil price shock related controls (gender, age, civil status, immigrant, education and wages, all measured in 2013). Point estimates and 95 percent confidence intervals. The vertical line marks the year prior to the oil price shock (mid 2014).

5.3 Type of prescriptions and comorbidity

In this section, we explore in some detail whether specific types of prescriptions are responsible for the increase. There are many studies that have examined economic uncertainty and job insecurity on general health. Less attention has been given to specific types of health problems. Our data provides the possibility to look closer into the link between specific health

conditions, divided into five broad categories of stress related diagnoses, and economic uncertainty among the employed.[8]

There is some evidence in the literature on which type of stress related illnesses are more likely to emerge or increase during periods of economic uncertainty. For instance, Kawachi and Kyriopoulos (2023) show that economic uncertainty (as opposed to a job loss, which is certain) is strongly associated with cardiovascular disease mortality. Similar results are found by Black et al. (2015), who show that job displacement negatively affects cardiovascular disease. These results are supported by a review by Mucci et al., (2016), which shows that economic decline increases the risk of conditions such as cardiovascular diseases. Moreover, Caroli and Godard (2016) found that job insecurity have a health-damaging effect for illnesses such as headaches, eyestrain and skin problems. The review article by Buscemi et al (2019) indicate that there is a correlation between perceived stress and life stressor and the development of arthritis and back pain. Similarly, Mateos-González et al. (2023) found that job insecurity is linked to musculoskeletal disorders. In a recent meta-analysis by Picchio and Ubaldi (2024), they found that mental health stands out as the aspect most negatively impacted by economic uncertainty, measured by unemployment. The study by Kuhn, Lalive, and Zweimüller (2009) examines the impact of a plant closure on public health costs in Austria. It shows an increase in spending on antidepressants and related medications, as well as for hospitalizations due to mental health problems for men (but not for women). Related to this, Cherrie et al (2021) conclude, using the Scottish Longitudinal Study, that local labour market decline and austerity measures, which delay the post Great Recession recovery, were associated with an increase in the use of antidepressants. Similarly, following the Brexit referendum, Liew, Goodwin, and Walasek (2020) found that antidepressant prescriptions increased in England

Next, we show how the effects are distributed across five different stress related diagnosis groups: *musculoskeletal*, *psychological, cardiovascular, skin* and *migraines.* 2013 is the reference year, our pre-period year, while we pool all the post-periods into one average post-period effect. In Table 2 the dependent variable is the share of workers receiving a prescription (binary outcome), while Table 3 shows the number of prescriptions collected (continuous variable).

[8] While our data makes it possible to distinguish between different diagnosis groups, it is important to have in mind that prescription records not always indicate a confirmed diagnosis, as medications sometimes are prescribed for off-label uses related to other conditions.

Table 2: DID estimates for the probability of collecting prescriptions, by type of diagnosis.

	Psychological	Musculo skeletal	Cardio vascular	Skin	Migraine
DD	.0031397*** (.0009015)	.002581** (.0012034)	.0010995 (.0009659)	.0017087** (.0007519)	-.0002192 (.0004665)
N	11165376	11165376	11165376	11165376	11165376
R2-adj	0.0341	0.0295	0.1418	0.0041	0.0144

Note: Regressions with all controls (gender, age, civil status, immigrant, education and wages, all measured in 2013)

Table 3: DID estimates for the number of stress related prescriptions collected at a pharmacy, by type of diagnosis.

	Psychological	Musculo skeletal	Cardio Vascular	Skin	Migraine
DD	.0023077 (.0070717)	.0227193** (.0077227)	-.0014298 (.008334)	.0043103 (.0024485)	-.0019514 (.002761)
N	11165376	11165376	11165376	11165376	11165376
R2-adj	0.0215	0.0215	0.1207	0.0026	0.0076

Note: Regressions with all controls (gender, age, civil status, immigrant, education and wages, all measured in 2013)

Table 2 shows an increase in the share of workers receiving a prescription for all diagnosis groups except migraine, with a significant increase for psychological, musculoskeletal and skin diseases. The effect is largest for prescriptions related to psychological diseases. This is in line with previous literature (Picchio and Umbaldi (2024). Results also resonates well with stress related gender differences, in that women predominate among those collecting prescriptions for all types of stress related diagnoses - and particularly psychological diagnoses, except for heart diseases where men predominate (see Table A3 in the Appendix). However, Table 3 shows that the impact on the number of the different types of prescriptions is mixed and only significantly positive for symptoms related to musculoskeletal problems (dominated by women and by far the largest group as shown in Table A3)

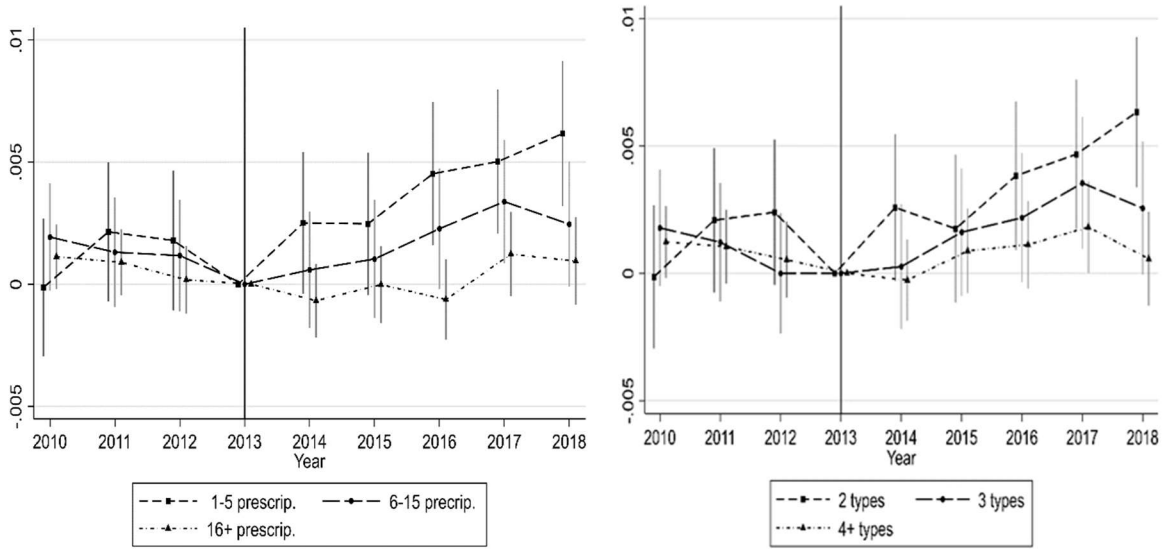
Next, we explore in more detail at what margins the number of prescriptions increase most. We divide the number of prescriptions in three intervals: 1 to 4 prescriptions, 5-15 prescriptions and over 15 prescriptions[9] and estimate the model separately for each interval. Figure 6 (left) shows results for three different regressions. It shows no effect on the probability of receiving 16 prescriptions or more. We observe a slight increase in the probability of

[9] Descriptive show that about half of the population does not get any prescriptions, 30 percent collect less than 5 prescriptions annually, 12 percent get 5-15 and the remaining 6 percent collect more than 15 prescriptions annually.

collecting prescriptions in the mid-range, but we find the largest effects on the probability of receiving 1-5 prescriptions. The crisis seems therefore to have hit broad, but not very severely, as the probability of receiving a high number of receipts is not affected.

Figure 6: DID estimates of number of collected prescriptions and likelihood of comorbidity. Period 2010-2018.

a) Number of prescriptions, indicators *b) Comorbidity*



Note: Panel a) shows the effect of the oil shock on the probability of receiving i) 1-5 prescriptions, ii) 6-15 prescriptions and iii) 16+ prescriptions. Panel b) shows the probability of receiving prescriptions for more than one condition at the same time i) two different types of prescriptions; ii) three different types of prescriptions; iii) four or all different types of prescriptions. The reference category is no prescriptions (panel a) and no comorbidity (panel b). The vertical line marks the year prior to the oil price shock (mid 2014).

The next question we ask is if prescriptions collected are of the same type or whether there is an indication of comorbidity, as exemplified by the likelihood of collecting prescriptions related to two or more medical conditions within the same years. Descriptives show that comorbidity was experienced by 18 percent of the population, of which over two thirds (72 percent) collected prescription for two distinct illnesses. [10] Figure 2 (right) shows that the increase is mainly among those getting prescription for two types of prescriptions. We observe a rise in comorbidity towards the end of the period, indicating persistence increases the likelihood that other illnesses flourish. The most frequent comorbidity observed is that of psychological and musculoskeletal ill-health (the two biggest groups in our data). This is line with other studies,

[10] Psychological in combination musculoskeletal related illness was the most frequent comorbidity.

showing that patients with musculoskeletal disorders experience significantly higher levels of anxiety, depression, fatigue, and insomnia compared to patient without these conditions (Garnæs et al. 2022).

5.4. Heterogeneity of effects across population subgroups

Next, we investigate heterogeneity of the effects of the oil crisis on the uptake of stress related prescriptions. We look at men and women separately, three different educational levels (below upper secondary, completed upper secondary and tertiary), age group (young, prime-age and older) and by income level (above/below median income).

Figure 7 shows estimates from these regressions. Panel a) shows that the increase in stress related medications after the oil crisis was stronger for women than for men, and the gender gap got bigger over time. This pattern partly goes against the severity of the economic shock, as men's incomes were more affected by the oil shock than women's (see Figure A2 in the Appendix). The smaller effect on men's recipience of receipts may however partly reflect different health behavior between men and women. In Norway women on average have more doctor visits than men (Skyrud, Qureshi, and Gjefsen 2024) and they also use more medications (Norwegian Institute of Public Health 2019). The larger effect on prescriptions for women may therefore be a result of their tendency to seek medical help faster than men, even when the underlying stress is similar (or smaller).

Panel b) shows results by educational level. There is a significant increase in the group with the lowest level of education, which is unfinished upper secondary school, and no significant increase for the group with completed upper secondary school or the group with education above upper secondary. This pattern is consistent with the economic impact of the shock, where the least educated group experienced the largest earnings decline (Figure A2). The results are also consistent with the results by income group in panel c). We split the sample in two by median income in 2013, which was 410 000 NOK[11] at the time, and find the largest effects on the number of collected prescriptions among those in the lower part of the earnings distribution. Higher income earners were also affected but to a lesser extent on average.

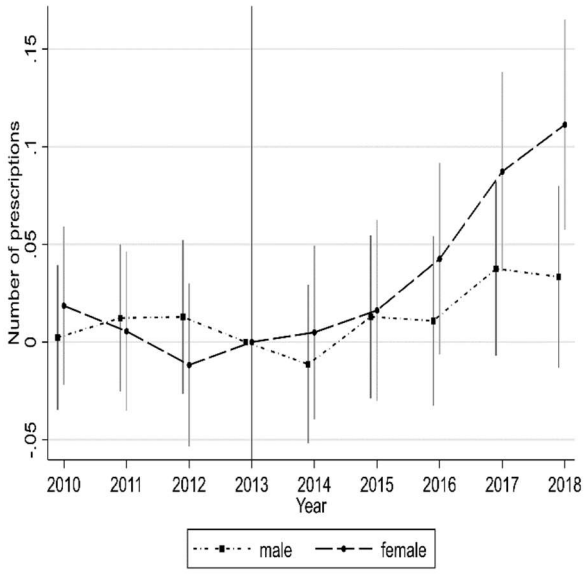
Panel d shows the effects of the oil price shock by age group. The results suggest that young workers (below 35) and prime age workers (between 35 and 55) are little affected, while older workers (above 55) seem to have experienced increased number of prescriptions collected. As shown in Figure A2, all age groups are economically impacted by the oil crisis,

[11] This corresponds to 5 253 Euro (1 NOK = 7,8052 EUR in 2013)

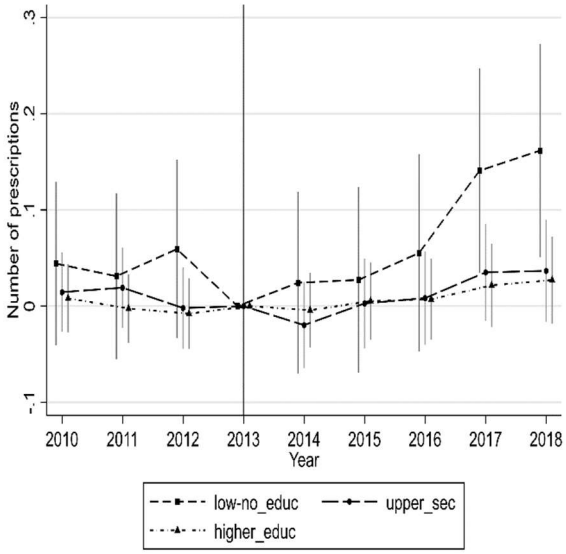
and the younger age groups were more severely affected than older age groups. However, older workers are more likely to have chronic health conditions, such as cardiovascular and musculoskeletal diseases, which may be exacerbated by stress (Ratnakaran 2023). In addition, although older workers were not hit harder economically by the oil crisis than the other age groups, the negative economic impact may have been felt more acutely due to impending retirement and less time to recover financially.

Figure 7: DID estimates of the effect for different subgroups, with all controls. Period 2010-2018.

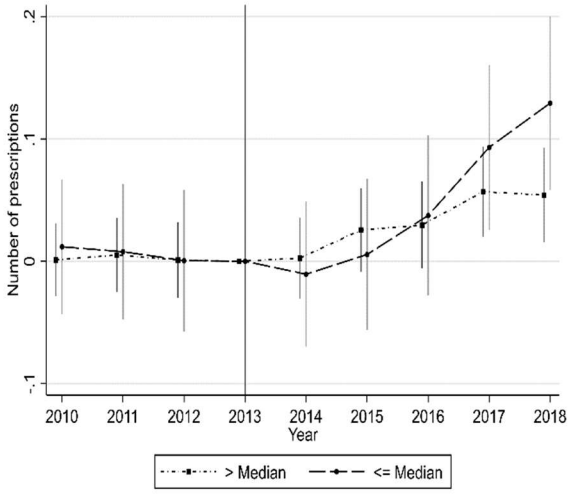
a) By gender



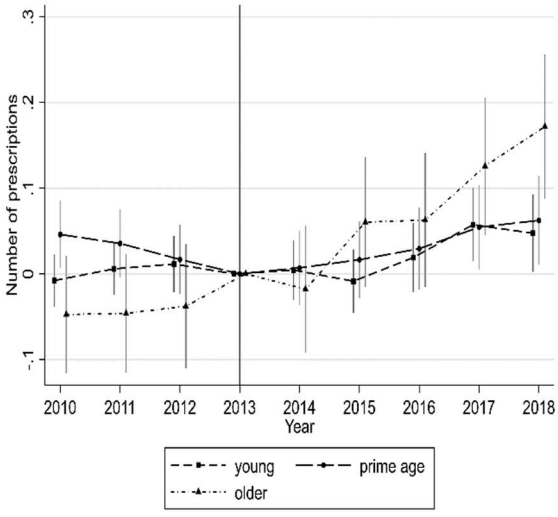
b) By education



c) By income in 2013



d) By age



Note: Panel b divides education into not completed upper secondary, completed upper secondary and beyond secondary education. Panel c divides income into above median income and below median

income. Panel d divides age groups into below 35, 35 to 55 and above 55 years old. All measured in 2013.

To sum up, the increase in prescriptions after the oil price shock is driven by women, low-skilled, low-income, older workers and workers in the private sector (both service and production). These are workers that are relatively more vulnerable to shocks from the outset, as they may have relatively fewer work opportunities and more insecure income prospects. The patterns does not, however, systematically follow the actual economic impact of the shock across groups, indicating that the stress reaction is felt more broadly in the local population and covaries with other characteristics of the individual than the individual economic impact.

6. Robust checks

Alternative control group

Not only the county of Rogaland, which is the oil region par excellence, but also other regions of Norway were potentially affected by the oil price crash. We therefore check the robustness of our results by removing other regions that are not as oil-dominated as Rogaland, but that have some oil-industry.[12] The regions we remove are situated mostly in the south-west of Norway, and account for 7 of 20 counties in Norway (see figure 1 for a map of the regions). The results are reported in Figure A3 and show that a more restrictive definition of the control group does not change the results. As expected, when other less oil dependent counties are removed from the analysis the impact is larger but not significantly different from estimates in our original control group.

Moving municipality

Treatment is given by region of work in the year before the oil crisis, 2013, and is as discussed previously, an intention-to-treat estimate. This means that some of the workers in our treatment group may have moved to a control group region during the crisis, and our estimates may thus represent a lower bound because some workers had already moved when the crisis hit. In this paragraph, we check the robustness of our results by removing from the sample treated units that moved during 2014-2015 to other counties. This accounts for about 6 percent of the original treat group. Figure A4 shows that our results are robust to removing movers. As expected, the

[12] Hordaland, Aust-Agder, Vest-Agder, Møre og Romsdal. Telemark, Buskerud and Nord Trøndelag

effect gets larger when we restrict the sample to only those who resided in Rogaland during the crisis.

Robustness to pre-trends

We test the sensitivity of our results to violations of the parallel-trends assumption using the test suggested in Rambachan and Roth (2023). The results are included in Figure A5 for the probability of collecting prescriptions and number of prescriptions collected in our main sample. Panel A shows that the "breakdown value" for a significant effect on the probability of collecting prescriptions is $M \approx 1.25$, meaning that the deviation from trend linearity can be more than double as large as the largest deviation in the pre-period (which is 0.01 in 2011). The robustness of the effect on number of prescriptions collected is similar. The results from this test indicate therefore that the parallel trends assumption is robust to deviations from a zero difference in trends that are much larger than what we observe, giving us confidence that our identification is sound.

7. Conclusion

We have studied the impact of a local recession in Norway on the take-up of stress related prescriptions. The 2014 negative oil price shock led to a recession in the western region Rogaland, where a major part of the oil and oil support industries in Norway are situated. We use the variation between oil-intense and non-oil-intense regions before and after the oil price shock to estimate the effects in a difference-in-difference framework. Our data includes prescriptions for medication used for stress-related symptoms from general practitioners and health care specialists, and are as such objective measures of early health-effects of a local economic crisis.

It is important to note that there are significant individual variations in 'whether' and 'when' poor health leads toa doctor visit or result in a medical prescription. Prescribing practices may also vary among doctors and across regions. Furthermore, not all health-related conditions require prescriptions, and over-the-counter medications or alternative treatments are not captured in our data. As a result, while our data offers a reliable estimate, it is likely an underestimate of the true effect of an economic crisis on stress related illnesses.

Unlike self-reported health data, prescription records offer an objective measure of health and symptoms in a population. However, prescription data does not always provide a direct link to a specific diagnosis. Medications can be prescribed for multiple reasons, and many medications are used for conditions beyond their primary approved indication. While we on the

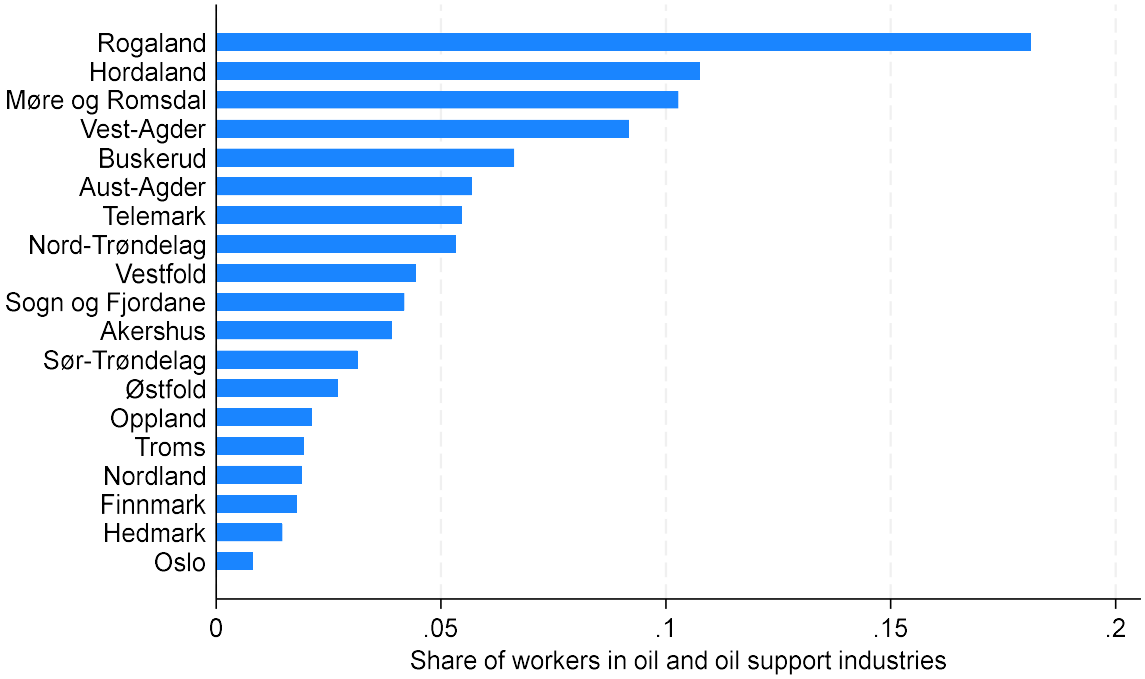
one hand may miss cases where no medication is prescribed, we may also incorrectly assume a higher prevalence of one disease if a medication is prescribed for multiple conditions. Our measure of stress includes a wide range of symptoms and medications, making misclassification less of a concern. It is nonetheless important to have this in mind, particularly in the sub-analysis where we do separate analyses by type of prescription.

We find that the probability of collecting stress related prescriptions increased by 0.8 percentage points (1.9 percent increase relative to the pre-crisis mean) and the number of prescriptions collected increased by 0.07 (3.2 percent). The most pronounced effect is therefore observed in the number of prescriptions among those already receiving medication, but the size of the effect is not very different for the extensive and the intensive margin. The largest increase is in the probability of receiving 1-5 prescriptions, suggesting that the crisis hit broadly among people with a limited number of prescriptions and not severely among people with a high number of prescriptions.

The effects on health only partly reflect the economic earnings effects. We find the largest health effects among low skilled workers – who were also the workers that experienced the largest negative economic shock. We do find large health effects among public sector workers and women, however, who felt the economic crisis less. These findings suggest that the economic stress was perceived in a broader part of the local population than only those who were directly affected by the crisis. They also underline the collectivity of local shocks and how they can affect individuals from the macro-level, not only through the individual economic distress.

Appendix

Figure A1 Share of workers in oil and oil-support industries, by county, in 2013



Note: The Figure shows detailed shares of workers working in the oil and oil support industries in 2013.

Table A1. Prescription of drugs for the selected ATC codes below were used as a proxy for the following health problems: muscle and skeleton pain, coronary heart disease, anxiety and depression, skin problems and migraine

Muscle and skeleton pain[13]	**ATC codes**
Antiinflammatory and antirheumatic	M01A
Opioids	N02A
Other analgesics and antipyretics	N02B
Coronary heart disease [14]	
Lipid modifying agents	C10
Agents acting on the renin-angiotensin system	C09
Calcium channel blockers	C08
Beta blocking agents	C07
Diuretics	C03
Cardiac Therapy	C01
Antithrombotic agents	B01

[13] The selected ATC codes are based on: Norgeshelsa statistikkbank (2018) http://norgeshelsa.no/norgeshelsa/» Legemiddelbrukere.
[14] The selected ATC codes are based on: FHI (2017) Bruk av legemidler blant pasienter utskrevet fra sykehus med hjerte- og karsykdom, https://www.fhi.no/hn/helseregistre-og-registre/hjertekar/bruk-av-legemidler-blant-pasienter-utskrevet-fra-sykehus-med-hjerte--og-kar/

Mental health problems: Medications for anxiety and depression (sleep medications, and anti-anxiety medications are included)[15]	
Antipsychotics	NO5A
Antidepressants	N06A
Anxiolytika	N05B
Hypnotics and sedatives	N05C
Skin problems[16]	
Antipsoriatic geralen, acitretin,fumarix acid, methotrexate, efalizumab, etanercept, adalimumab, ciclosporin	D05BA03, D05BB02, D05BX51, L044X03, L01BA01, L04AA21, L04AB01, L04AB04, L04AD01
Antipruritics, including antihistamines, anesthetics, etc	D04
Corticosteroids, dermatological preparations	D07
Migraine[17]	N02CA, N02CC, N02CX

Table A2. Difference-in- difference estimates for the number of prescriptions, unadjusted (model 1) and adjusted (model 2)

	Model 1	Model 2
Treat	-0.1735524 (0.0154782)	0.0496969 (0.0150561)
After	0.6374944 (0.0052469)	0.639317 (0.0050941)
Treat*After	0.031532 (0.0169555)	0.0316173 (0.0164821)
Controls	No	Yes
R2 -adj	0.0015	0.0758
N	11322252	11165376

Note: In the DID regression the pre-period is 2013 and the post-period is the average of 2014-2018. Treated and controls as used in the main results, i.e. Rogaland vs the rest of the country. First column shows estimates with the constant term only while the second column shows the DID estimate when we include all controls.

Table A3. Collection of prescriptions by gender, share.

	Female		Male		Test
N	11396457	(49.3%)	11711961	(50.7%)	
Psychological	0.197	(0.398)	0.121	(0.326)	<0.001

[15] The selected ATC codes are based on: Norgeshelsa statistikkbank (2018) http://norgeshelsa.no/norgeshelsa/» Legemiddelbrukere.

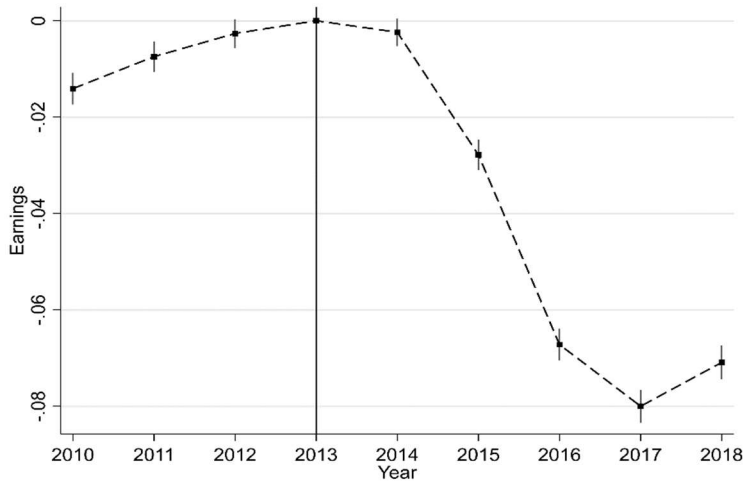
[16] The selected ATC codes on psoriasis are based on: Modalsli EH, Asvold BO, Romundstad PR, Langhammer A, Hoff M, Forsmo S, et al. Psoriasis, fracture risk and bone mineral density: the HUNT Study, Norway. Br J Dermatol 2017;176(5):1162-9, and other dermological drugs: Legemiddelforbruket i Norge 2012–2016, rapport 2017:1. Folkehelseinstituttet.

[17] The selected ATC codes on Migraine are based on Norgeshelsa statistikkbank (2018) http://norgeshelsa.no/norgeshelsa/» Legemiddelbrukere, and Antonazzo IC, Riise T, Cortese M, Berge LI, Engeland A, Bernt Fasmer O, et al. Diabetes is associated with decreased migraine risk: A nationwide cohort study. Cephalalgia 2017:333102417748573.

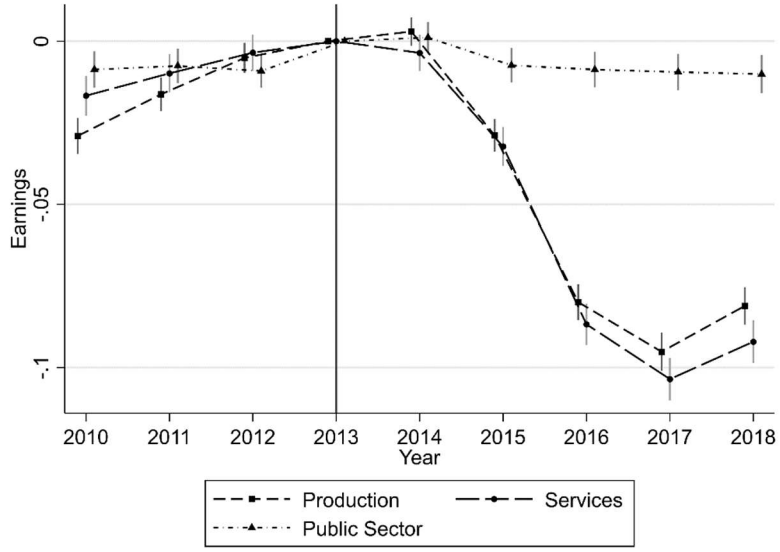
Cardiovascular	0.161	(0.367)	0.174	(0.379)	<0.001
Skin	0.092	(0.289)	0.073	(0.260)	<0.001
Musculoskeletal	0.320	(0.466)	0.247	(0.431)	<0.001
Migraine	0.050	(0.217)	0.011	(0.106)	<0.001

Figure A2. DID estimates of (ln) earnings. Period 2010-2018.

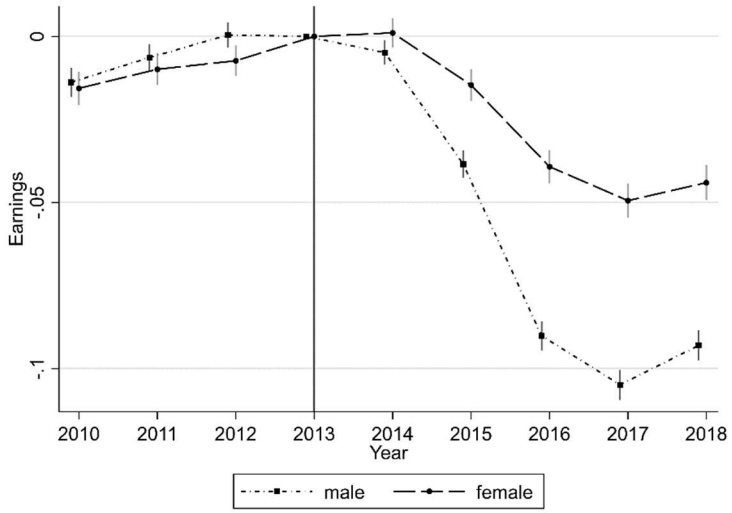
a) *All*



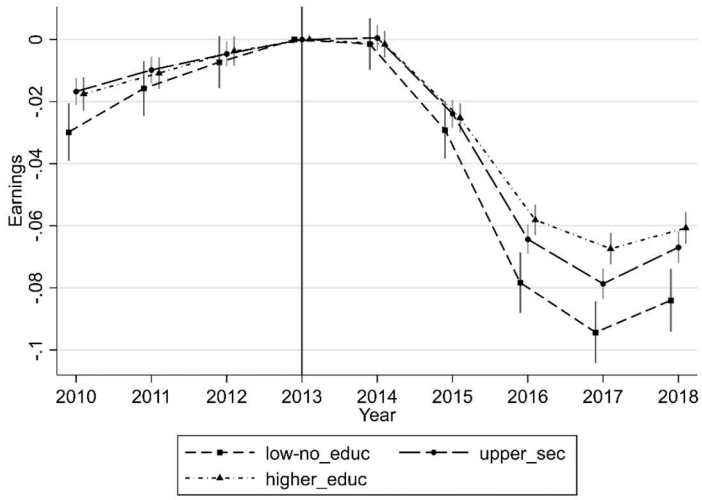
b) *By industry*



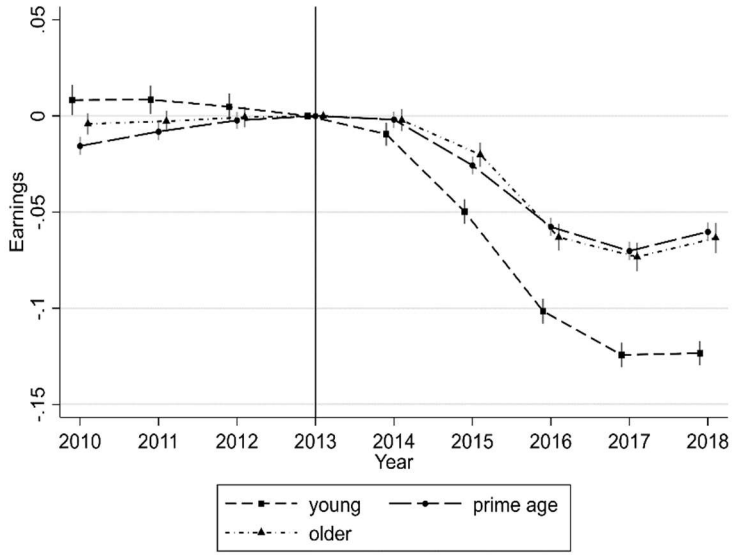
c) *By gender*



d) By education



e) By age



f) By income group

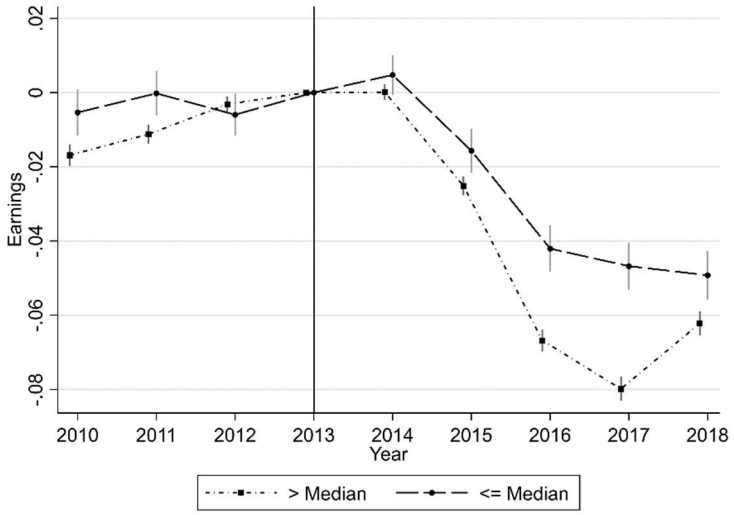
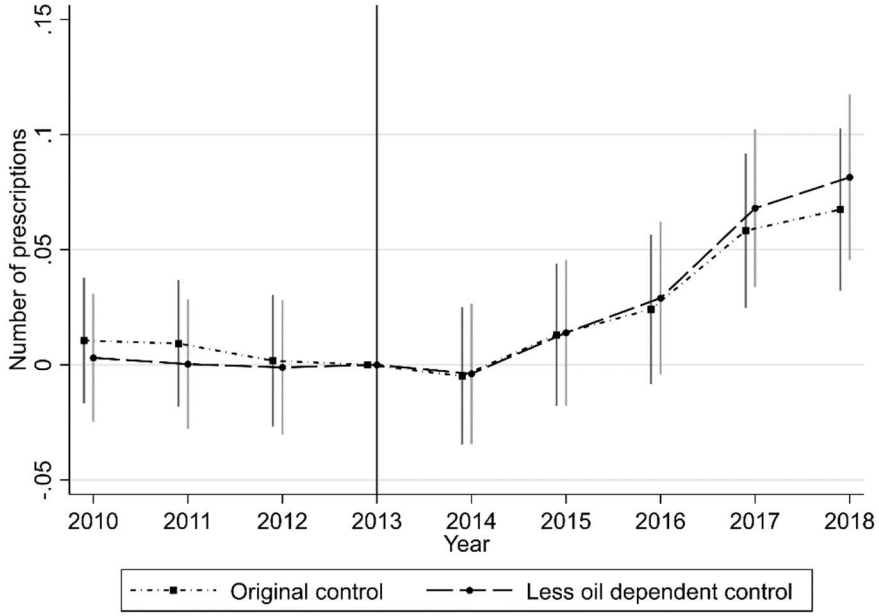
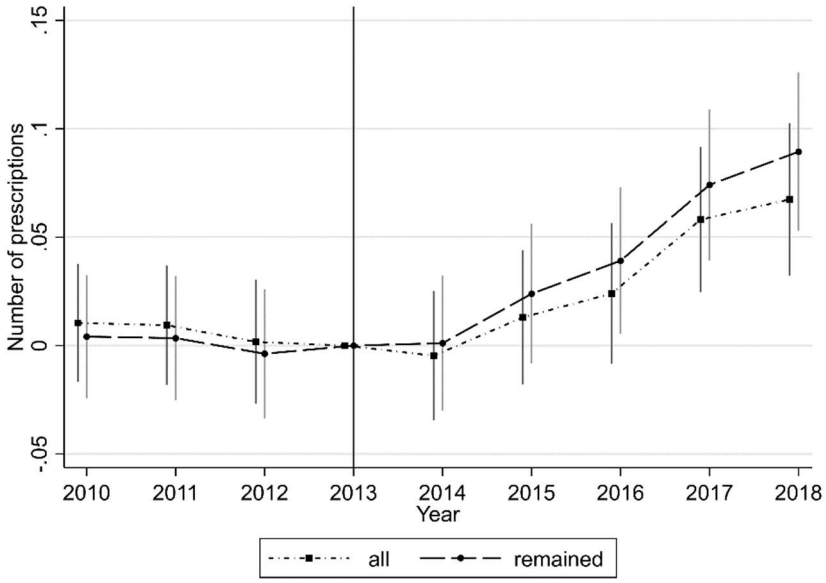


Figure A3 DID estimates, number of stress related medications. Period 2010-2018. Alternative control group



Note: 'All control counties' includes all counties other than the major oil county, Rogaland. 'Fewer control counties' includes counties with less that 5 percent of the working population working in the oil sector (se figure 1)

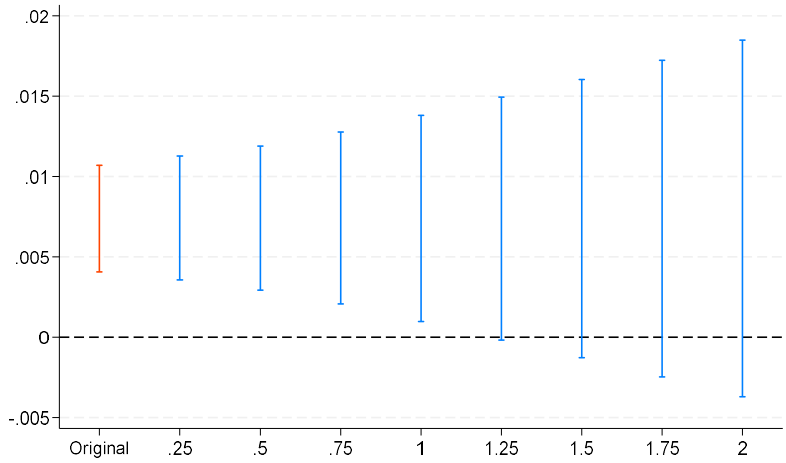
Figure A4. Stayers vs all workers in Rogaland compared with the rest of Norway. DID estimates of the effect the number of stress related medications (left) and share receiving welfare support (right) with all controls. Period 2010-2018.



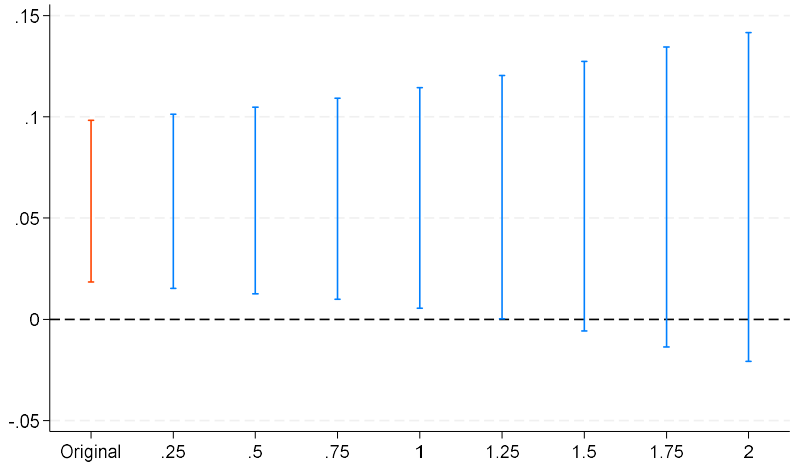
Note: 'All' refers the original treated group, while 'remained' refers to a treated group where those that moved out are removed from the sample

Figure A5 Sensitivity analysis Rambachan and Roth (2023)

Panel A The probability of collecting prescriptions



Panel B The number of prescriptions collected



Note: The Figure shows the results from testing the sensitivity of the last period coefficient

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