

Is it all relative?

The health impacts of changes to absolute and relative income

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Overview

- **Rising inequality might affect individuals' health through two channels:**

1. **Changes in absolute income levels**

- Stock market returns and (physical or mental) health (e.g. Schwandt 2018, Liu 2017)
- Housing wealth and hospitalizations (e.g. Currie and Tekin 2015)
- Tax credits and transfers on maternal and child health (e.g. Milligan and Stabile 2011)

2. **Changes in relative income**

- Economic satisfaction (conditional on absolute income) (e.g. Clark 2010)
- Health & longevity (e.g. Marmot 2004, Daly & Wilson 2009, Daly *et al* 2013)
- Deaths of despair (Case and Deaton 2015, 2017)

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Disentangling the health impacts of changes to absolute and relative income is challenging

⇒ Income (absolute and relative) is an endogenous input to health

- Health shocks can also lead to changes in absolute and relative incomes

⇒ Individuals' absolute and relative incomes tend to move simultaneously

- Negative shock to absolute income generally accompanied by a decrease in rank within the income distribution

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- Disproportionately impacts labour market outcomes for individuals working in the **oil industry**

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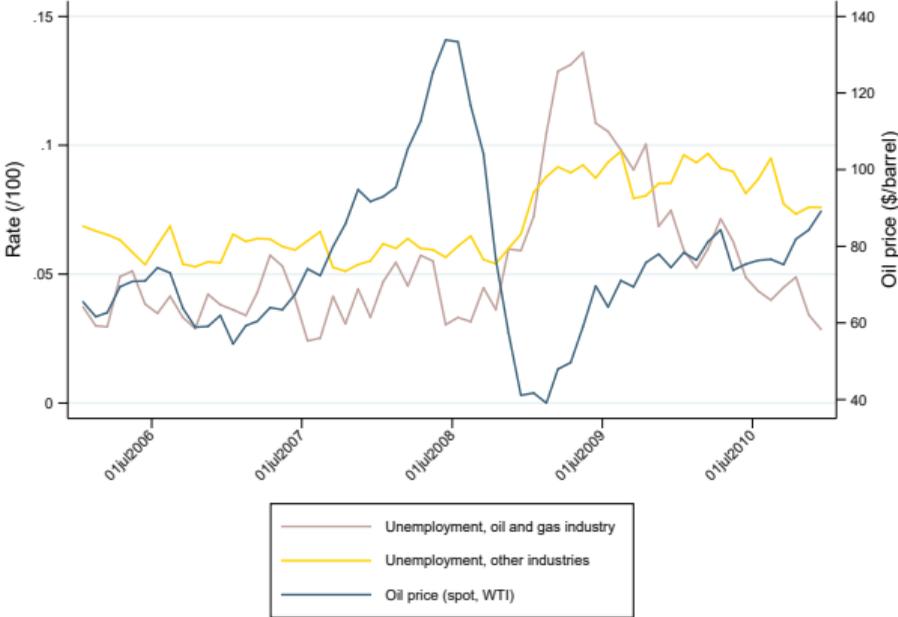
- Using exogenous changes in the price of oil
- Disproportionately impacts labour market outcomes for individuals working in the **oil industry**

2. Separately estimate the health impacts of changes to absolute and relative incomes

- Exploiting information on neighbourhoods' labour market composition
- Magnitude of the relative income changes from an oil price shock depends on:
 - Own industry of work
 - The % of individuals in the neighbourhood working in the oil industry
- Approach doesn't rely on a single moment of the neighbourhood's income distribution

Intuition

Can we reasonably use variations in oil prices as exogenous shocks that disproportionately impact the labour income of *some* workers?



Sample of labour force participants aged 20-60, excluding full-time students.
Source: Labour Force Survey, PUMFs, Statistics Canada

► Weekly earnings

Oil price and labour market outcomes

	Full sample	Men	Women
Panel A: Weekly earnings			
Oil price (one-quarter lag) × Oil industry	51.972*** (19.659)	61.126*** (22.848)	48.544 (34.368)
Oil price (one-quarter lag)	-6.107 (6.793)	-0.852 (10.588)	-10.782 (8.307)
Oil industry	318.000*** (15.273)	310.029*** (17.670)	303.701*** (27.719)
Panel B: Unemployment (marginal effects)			
Oil price (one-quarter lag) × Oil industry	-0.031*** (0.006)	-0.026*** (0.006)	-0.015 (0.013)
Oil price (one-quarter lag)	-0.001 (0.000)	0.004 (0.004)	-0.007* (0.004)
Oil industry	0.014*** (0.005)	0.013** (0.005)	0.003 (0.010)
Observations (unweighted)	2,352,429	1,182,008	1,170,42

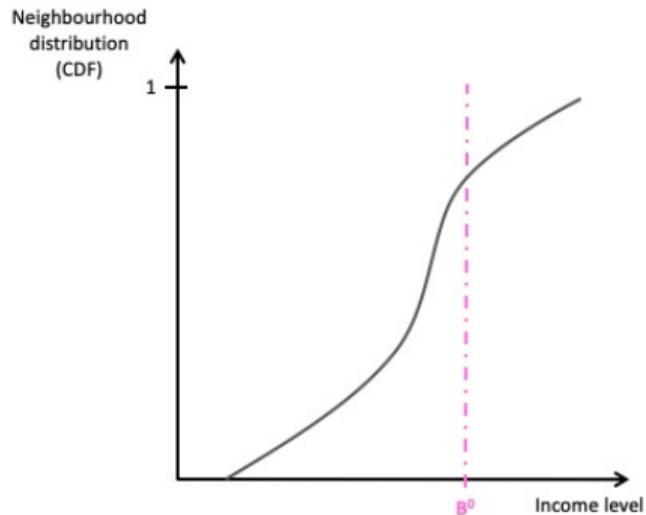
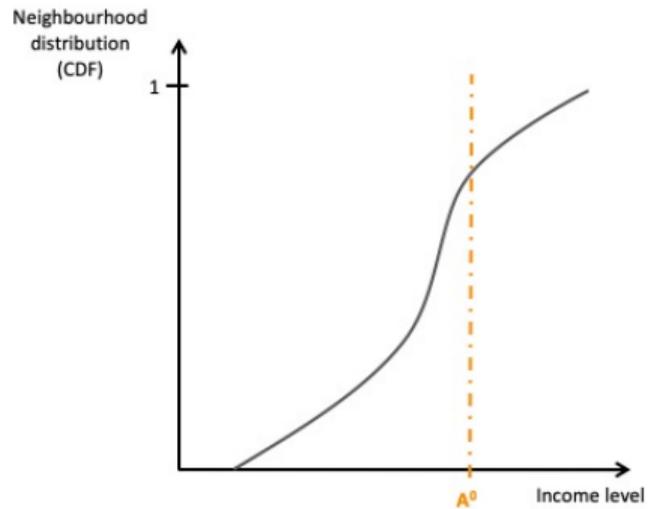
Notes: Data for 2006-2010 from the Labour Force Survey, PUMFs, Statistics Canada. Regressions include controls for gender, marital status, age groups, highest educational achievement, province, year and month fixed effects (no CMA-level information). Price multiplied by 10. Statistical significance: * 10% ** 5% *** 1%

Disentangling the impact of absolute and relative income on health

Intuition and conceptual framework

- Take 2 individuals, **A** and **B**, both working in the oil industry
 - **A** lives in a neighbourhood where no one else is employed in the oil industry
 - **B** lives in a neighbourhood where everyone is employed in the oil industry
 - **A** and **B** initially have the same income and rank within their respective income distribution

Intuition and conceptual framework



Legend:

A: Oil worker in a non-oil intensive neighbourhood

B: Oil worker in an oil intensive neighbourhood

Intuition and conceptual framework

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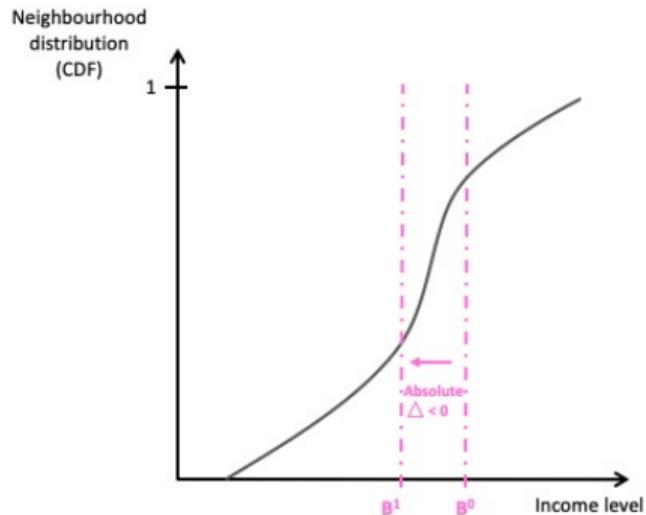
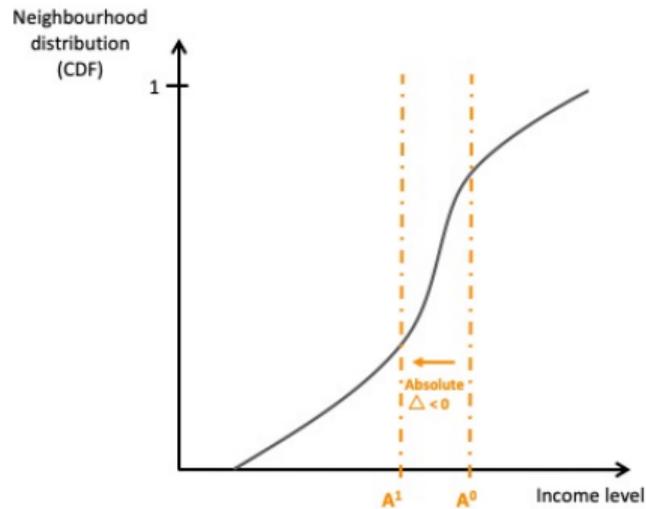
A lives in a neighbourhood where no one else is employed in the oil industry

B lives in a neighbourhood where everyone is employed in the oil industry

A and B initially have the same income and rank within their respective income distribution

- As an exogenous decline in the price of oil happens
 - Both A's and B's absolute income levels decrease by the same amount

Intuition and conceptual framework



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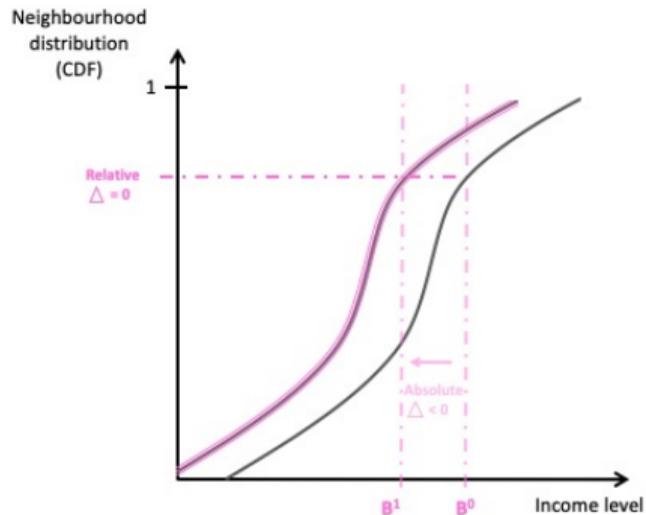
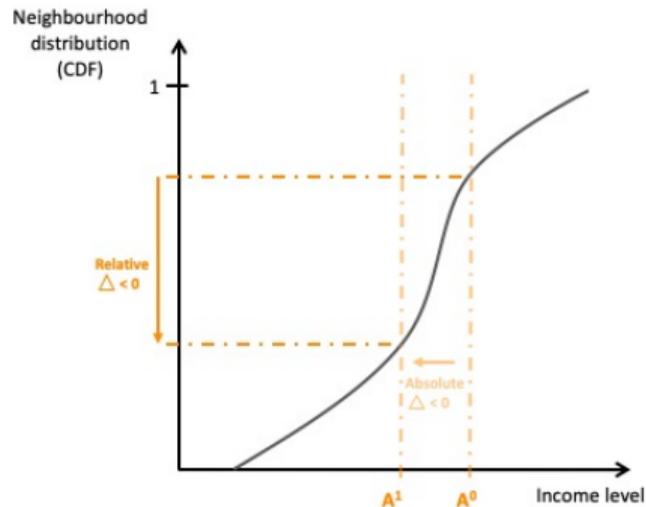
A and B initially have the same income and rank within their respective income distribution

As an exogenous decline in the price of oil happens

Both A's and B's absolute income levels decrease by the same amount

- However, for the same decline in absolute income, only A's relative income changes
 - A's income moves **along** an unchanged local distribution
 - B's income, however, moves **with** the local distribution

Intuition and conceptual framework



Legend:

A: Oil worker in a non-oil intensive neighbourhood

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Data

Data: Individually linked Census-Hospitalization records

1. 2006 Canadian Long-form Census

- 20% representative sample of the Canadian population
- Identifies individuals working in the oil & gas extraction industry (NAICS - 3 digits and occupation)
- The share of people working in the oil & gas extraction industry within each neighbourhood
 - Defined at the census-tract level (2500 to 8000 people)
 - Excludes rural areas (no census tract or CMA/CA)

2. Discharge Abstract Database (2006-2009)

- Universe of individual-level records for inpatient stays in Canadian hospitals
- Diagnoses for (co)morbidity associated with each hospitalization
- All health providers seen/procedures received by the patient during stay

3. Western Texas Intermediate historical (spot) price series

Data: Main estimating sample

- Working age men (20-62)
 - Subsamples by marital status
- All observations collapsed at the individual-quarter level
 - Coherent with movements in oil prices and incomes

A short note on the Canadian health policy context

- **Single (public) payer, universal coverage health care system**
 - Hospitalization reports cover the universe of inpatient stays across the country
 - For all patients
 - For all providers
 - Changes in income shouldn't influence access to hospital services
 - Δ in hospitalizations more likely to reflect Δ health

Empirical approach

Main estimating equation

$$\begin{aligned} \text{Hospit}_{imt} = & \alpha + \beta_1 \Delta p_t + \beta_2 \text{Oil}_i + \beta_3 \Delta p_t \times \text{Oil}_i + \beta_4 \Delta p_t \times \text{Oil}_i \times \text{ShareOil}_m \\ & + \beta_5 \Delta p_t \times \text{ShareOil}_m + \beta_6 \text{ShareOil}_m + \mathbf{X}'_{im} \lambda + \mu_m + \gamma_t + \epsilon_{imt} \end{aligned}$$

i = individual, m = neighbourhood, t = quarter

Where

- Hospit_{imt} : Binary (or count) variable for hospitalizations
- Δp_t : Change in the price of oil since $t - 1$
- Oil_i : Indicator for employment in the oil industry
- ShareOil_m : Neighbourhood share of employment in the oil industry
- \mathbf{X}'_{im} : Individual-level characteristics
 - Gender, educational achievement, marital status, age, household size, income (2005)
- μ_m, γ_t : Region (census metropolitan area or census agglomeration) and time FE

► Identifying assumptions

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Interpretation of β_4 and β_5 : Challenge due to interactions with continuous terms

Intuitive way to capture the relative income effect

$$\begin{aligned} Hospit_{imt} = & \alpha + \beta_1 \Delta p_t + \beta_2 Oil_i + \beta_3 \Delta p_t \times Oil_i + \beta_4 \Delta p_t \times Oil_i \times ShareOil_m \\ & + \beta_5 \Delta p_t \times ShareOil_m + \beta_6 ShareOil_m + X'_{im} \lambda + \mu_m + \gamma_t + \epsilon_{imt} \end{aligned}$$

i = individual, m = neighbourhood, t = quarter

Coefficients are initially interpreted for $ShareOil_m$ centered around 0

- β_1 : Impact of Δp_t for a non-oil worker, if no one else in the neighbourhood works in the oil industry
- β_3 : Impact of Δp_t for an oil worker, if no one else in the neighbourhood works in the oil industry

As $ShareOil_m$ is recentered around a different value Z , the interpretation of β_1 and β_3 changes

- β_1 : Impact of Δp_t for a non-oil worker if $Z\%$ neighbours work in the oil industry
- β_3 : Impact of Δp_t for an oil worker if $Z\%$ neighbours also work in the oil industry

Intuitive way to capture the relative income effect

$$\begin{aligned} \text{Hospit}_{imt} = & \alpha + \beta_1 \Delta p_t + \beta_2 \text{Oil}_i + \beta_3 \Delta p_t \times \text{Oil}_i + \beta_4 \Delta p_t \times \text{Oil}_i \times \text{ShareOil}_m \\ & + \beta_5 \Delta p_t \times \text{ShareOil}_m + \beta_6 \text{ShareOil}_m + \mathbf{X}'_{im} \lambda + \mu_m + \gamma_t + \epsilon_{imt} \end{aligned}$$

i = individual, m = neighbourhood, t = quarter

What we do:

1. Order all neighbourhoods by share of oil workers
2. Identify the share $Z\%$ of oil workers at different quantiles of the distribution
3. Subtract a value Z from the variable ShareOil_m and re-estimate the equation
4. Plot the results for β_1 and β_3
5. Repeat for different values of Z

Intuitive way to capture the relative income effect

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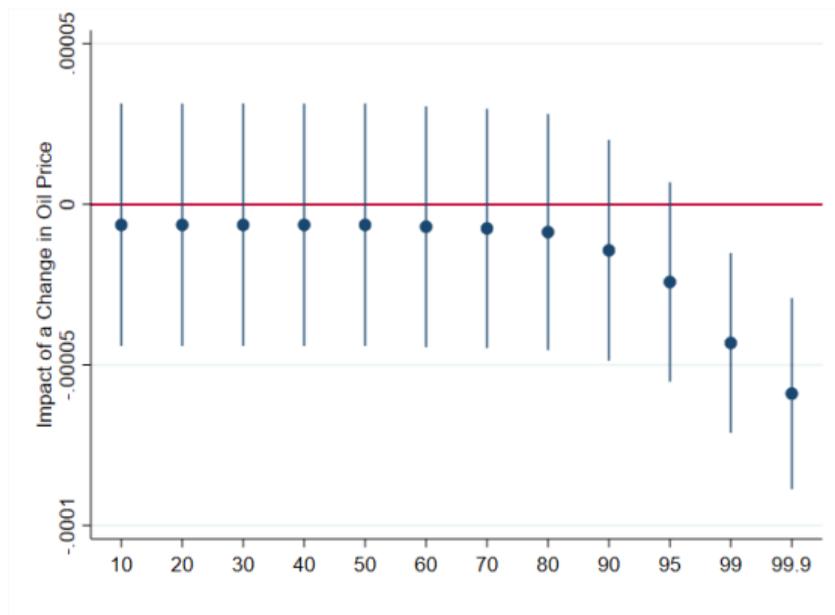
The results on the graph enable us to see:

β_1 : Health impact of a + shock to absolute and relative income (low Z)
+ shock *only* to absolute income (high Z)

β_3 : Health impact of a - shock to relative income (high Z)

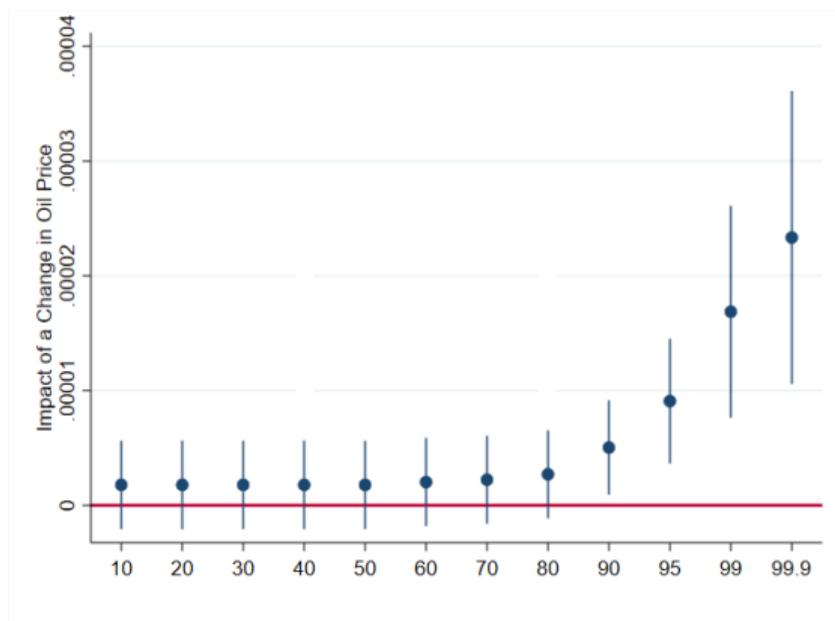
Results

Oil workers: Impact of changes in oil prices on the probability of hospitalization (β_3 estimates for married men, across local concentration of oil workers)



Note: 95% confidence intervals, standard errors clustered at the CMA/CA level. Coefficients from regressions controlling for immigrant status, single parent, number of individuals in the economic family, income and income², as well as CMA/CA, quarter and year fixed effects.

Non-oil workers: Impact of changes in oil prices on the probability of hospitalization (β_1 estimates for married men, across local concentration of oil workers)



Note: 95% confidence intervals, standard errors clustered at the CMA/CA level. Coefficients from regressions controlling for immigrant status, single parent, number of individuals in the economic family, income and income², as well as CMA/CA, quarter and year fixed effects.

Health impacts of changes to absolute and relative income, for married men

Changes in absolute income coming from oil prices

- For oil workers: Increase in the price of oil leads to a lower probability of hospitalization
 - $\beta_3 < 0$ across all neighbourhoods
 - Stronger effects in oil intensive neighbourhoods
 - Top decile of most oil-intensive neighbourhoods:
 - 10\$ increase in oil prices \rightarrow 1.3% - 4.3% decrease in the probability of hospitalization

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 - $\beta_1 > 0$ becomes statistically significant in the most oil-intensive neighbourhoods
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Results smaller and not s.s. for all men \rightarrow Mobility among singles

Alternative explanation: Inflation and purchasing power **OR** relative income

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1. An increase in oil prices leads to an increase in incomes for oil workers in oil intensive neighbourhoods
2. In response, prices (rent, food, etc.) also increase
3. In such neighbourhoods, the purchasing power of non-oil workers decreases
4. β_1 reflects this dynamic, not the health impacts of a decreasing income *relative* to that of others

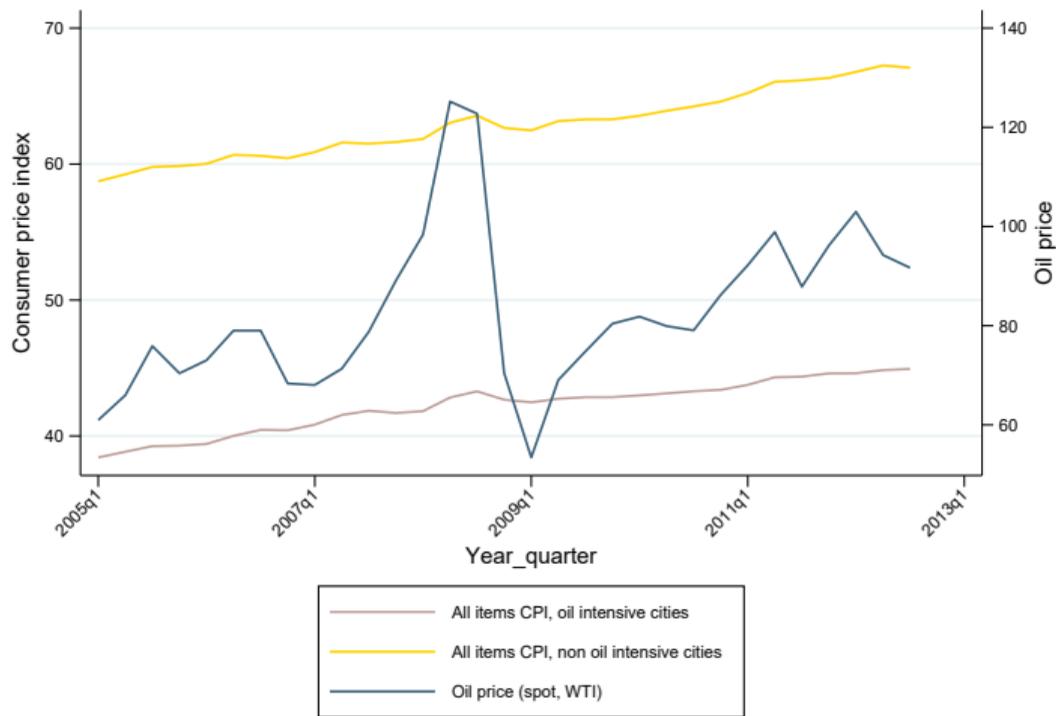
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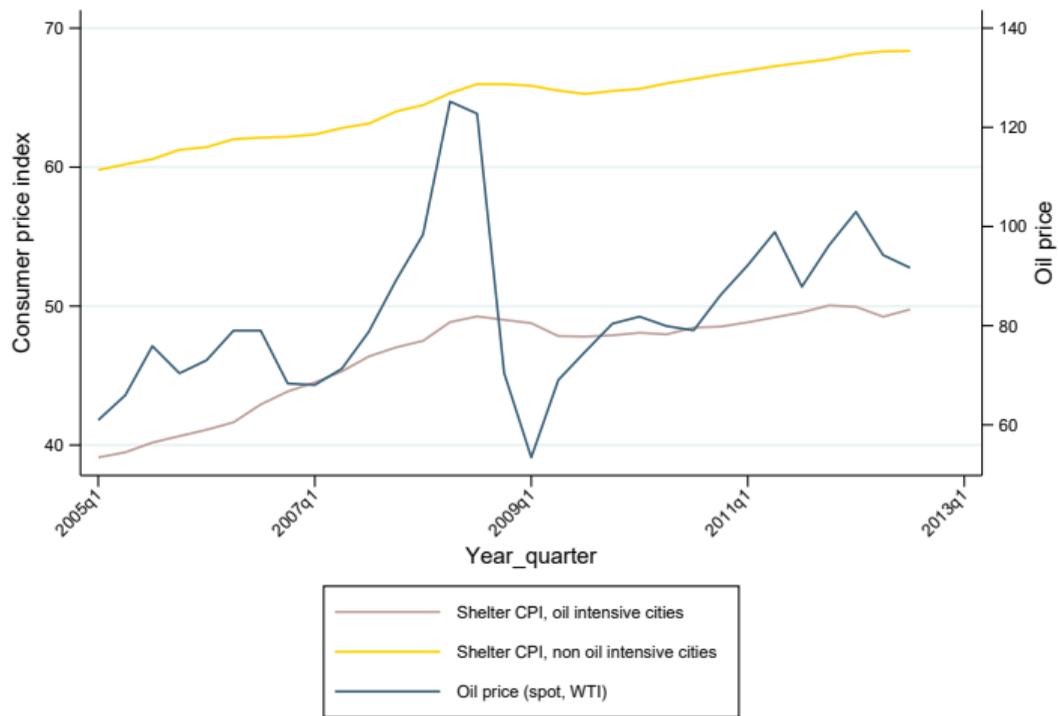
We can look at movements in price indices in relations to movements in oil prices

Movements in oil prices and all items CPI



Source: CPI are provided by Statistics Canada, wti crude oil prices converted in CAD using Bank of Canada change rates

Movements in oil prices and shelter CPI



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Oil prices and local inflation

(Oil-intensive and non oil-intensive Canadian cities)

	CPI all items		CPI shelter	
Oil price (one quarter lag)	0.020*	0.017*	0.040***	0.040***
	(0.011)	(0.008)	(0.009)	(0.009)
Oil price(one quarter lag) × Oil intensive		0.004		0.014
		(0.018)		(0.050)
Observations	270	270	270	270

Notes: Statistical significance: * 10% ** 5% *** 1%. Standard errors are clustered at the CMA/CA level.
 Monthly observations. All columns include year, month and city fixed effects.

Data limitations: Potential threats to identification

i Possible wage spillovers to other industries

- Increase in oil prices → Increase in non-oil workers' income
- Potentially more important in oil intensive neighbourhoods (Fortin & Lemieux 2015)

ii Possible changes in neighbourhoods' industrial composition

- Increase in oil prices → Growth in oil and gas employment
- Measurement error in oil worker status
 - Non-random measurement error in neighbourhoods' share of oil workers

iii Possible migration of workers

- Increase in oil prices → Workers' movement towards oil intensive neighbourhoods
- Error in workers' neighbour assignment
 - Non-random error in neighbourhoods' share of oil workers and oil worker status
- Less likely to matter for married individuals

Should work against our main findings

Main sensitivity analyses/Falsification tests

- **Alternative neighbourhood definition**

- Literature sometimes finds sign reversal from small to large reference groups
- Using census subdivisions (city/municipality)
 - More heterogeneity in neighbourhood sizes
 - Can cast a wide net in some cities (e.g. Toronto: 2.5M, Montréal: 1.6M)
 - Captures more rural areas
- Results are qualitatively similar, although of smaller magnitude and less precisely identified

- **Inverse hyperbolic sine transformation**

- **Including individual fixed effects**

- **Placebo industries**

Main sensitivity analyses/Falsification tests

- **Alternative neighbourhood definition**
- **Inverse hyperbolic sine transformation**
 - Focusing on the number of hospitalizations and the mass at zero
 - Similar patterns than when using a linear in probability model

Graphs

- **Including individual fixed effects**
- **Placebo industries**

Main sensitivity analyses/Falsification tests

- **Alternative neighbourhood definition**
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Main sensitivity analyses/Falsification tests

- **Alternative neighbourhood definition**
- **Inverse hyperbolic sine transformation**
- **Including individual fixed effects**
- **Placebo industries**
 - Replace oil industry by another, in which incomes shouldn't be affected by oil prices
 - Nursing and residential care facilities & Hospitals
 - Professional, scientific and technical services
 - β_1 and β_3 are all close to and not statistically different from zero

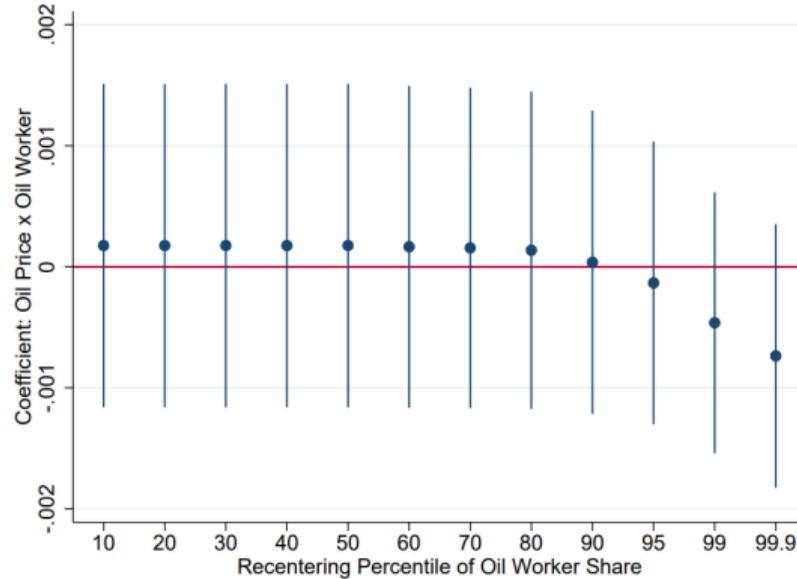
Potential pathways

- Case and Deaton (2015) highlight the impact of *falling behind* on certain types of deaths
 - Drug poisonings / prescription drugs overdoses
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 - Suicides

Potential pathways

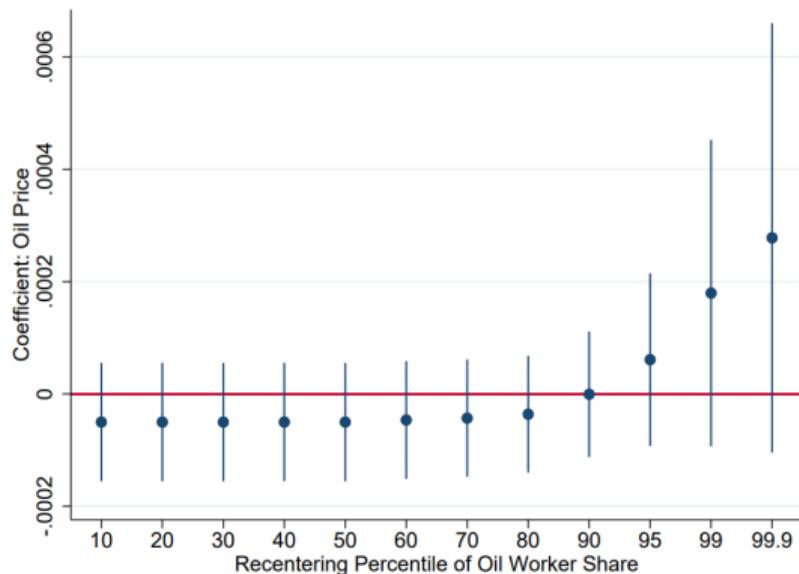
- Case and Deaton (2015) highlight the impact of *falling behind* on certain types of deaths
 - Drug poisonings / prescription drugs overdoses
 - Alcohol-related liver diseases
 - Suicides
- We can focus on hospitalizations caused by similar conditions (ICD codes)
 - Drug and/or alcohol poisonings
 - Mental health and psychiatric episodes
 - Self-harm

Oil workers: Probability of "Despair" hospitalization, conditional on hospitalization (β_3 estimates for married men, across local concentration of oil workers)



Note: 95% confidence intervals, standard errors clustered at the CMA/CA level. Coefficients from regressions controlling for immigrant status, single parent, number of individuals in the economic family, income and income², as well as CMA/CA, quarter and year fixed effects.

Non-oil workers: Probability of "Despair" hospitalization, conditional on hospitalization
(β_1 estimates for married men, across local concentration of oil workers)



Note: 95% confidence intervals, standard errors clustered at the CMA/CA level. Coefficients from regressions controlling for immigrant status, single parent, number of individuals in the economic family, income and income², as well as CMA/CA, quarter and year fixed effects.

Conclusion

Conclusion

Using oil price shocks in the context of the Canadian economy

- We find evidence that (for less mobile men):
 - i Absolute income can have a protective effect on health
 - ii Increases in neighbours' income can have positive externalities IF own absolute income also increases
 - iii Falling behind (b/c other are getting ahead) can have small harmful effects on health
- Effects potentially coherent with mental health struggles and "deaths of despair" narrative
- Results are small, but non-trivial when compared to the rate of hospitalizations in sample

Thank you so much!

For comments: maripier.isabelle@ecn.ulaval.ca



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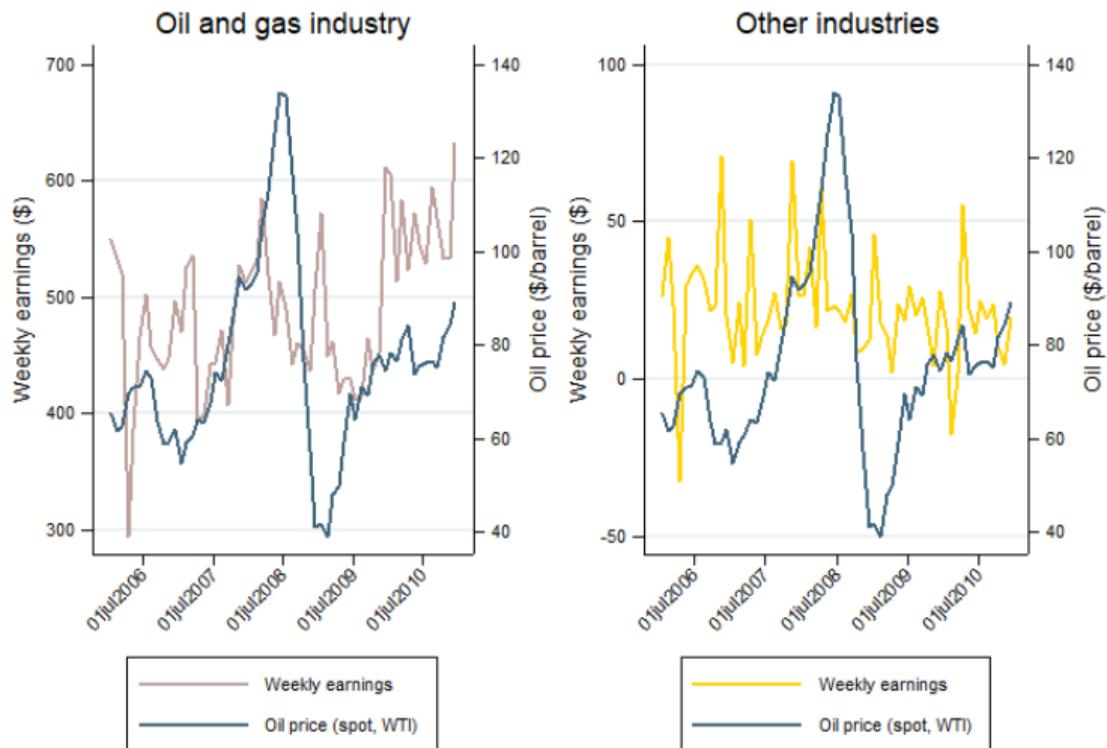


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Additional material

Oil price and weekly earnings, by industry



Sample of labour force participants aged 20-60, excluding full-time students.
Source: Labour Force Survey, PUMPs, Statistics Canada
Weekly earnings are conditional on month and year effects

Portrait of the oil industry (i)

Workforce characteristics

	Oil Sector	Other Sectors
Male (%)	81.16 (39.10)	50.52 (50.00)
Actual weekly earnings (\$)	1202.10 (853.45)	733.92 (601.96)
Actual hours per week at all jobs	40.07 (22.10)	32.50 (17.22)
Actual hours per week at main job	39.71 (21.90)	31.90 (16.87)

Notes: Weighted statistics. Standard deviation in parentheses. Sample of labour force participants aged 20-60, excluding full-time students.

Source: Labour Force Survey 2006-2010, PUMFs, Statistics Canada.

Portrait of the oil industry (ii)

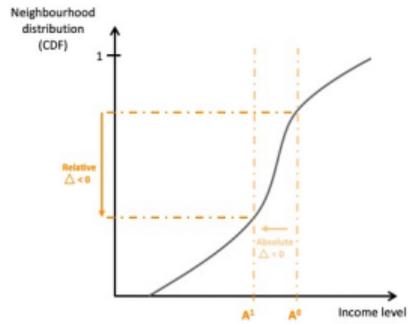
Distribution of workers across occupations

	Oil Sector	Others
Senior management (A011-A016)	0.54	0.52
Professionals in business and finance (B011-B022)	4.16	2.91
Financial, secretarial and administrative (B111-B318)	4.75	5.18
Natural and applied sciences(C011-C183)	15.87	7.78
Health, nurse supervisors and registered nurses (D011-D112)	0.03	2.73
Retail Sales (G011,G211-G311)	0.01	5.65
Sales and service (G013-G016,G711-G732,G911-G983)	0.73	7.47
Construction trades (H111-H145)	1.55	2.34
Other trades (H211-H535)	11.24	6.03
Primary industry (I011-I216)	34.22	1.63

Notes: Weighted proportions. Sample of labour force participants aged 20-60, excluding full-time students.

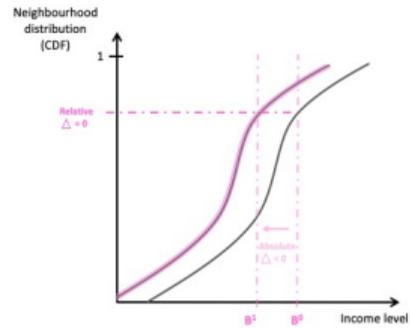
Source: Labour Force Survey 2006-2010, PUMFs, Statistics Canada. (NOC-S 2006 codes).

Movements in absolute and relative income



Legend:

A: Oil worker in a non-oil intensive neighbourhood



B: Oil worker in an oil intensive neighbourhood

Identifying assumptions

1. Δp disproportionately impacts oil workers' labour market outcomes

- Evidence from the Labour Force Survey
- If spillovers, Fortin et Lemieux (2015) suggest it would happen in oil-intensive areas
- If monotonic in *ShareOil*, interpretation of the coefficients remains, but:
 - True changes in relative income are smaller than what we assume
 - Measurement error should bias our estimates of β_1 in oil intensive neighbourhoods towards zero
 - Measurement error should be concentrated in high-oil neighbourhoods

Identifying assumptions

1. Δp disproportionately impacts oil workers' labour market outcomes
2. Fixed industrial composition at the neighbourhood level during our sample period
 - It is possible that *ShareOil* increases with $\Delta p > 0$
 - Including as workers from non oil-intensive regions move
 - Especially in oil-intensive areas (Fortin et Lemieux 2015)
 - Changes in relative income would again be smaller than what we assume for non-oil workers in oil-intensive areas
 - Works against us to find $\beta_1 > 0$ in oil-intensive neighbourhoods

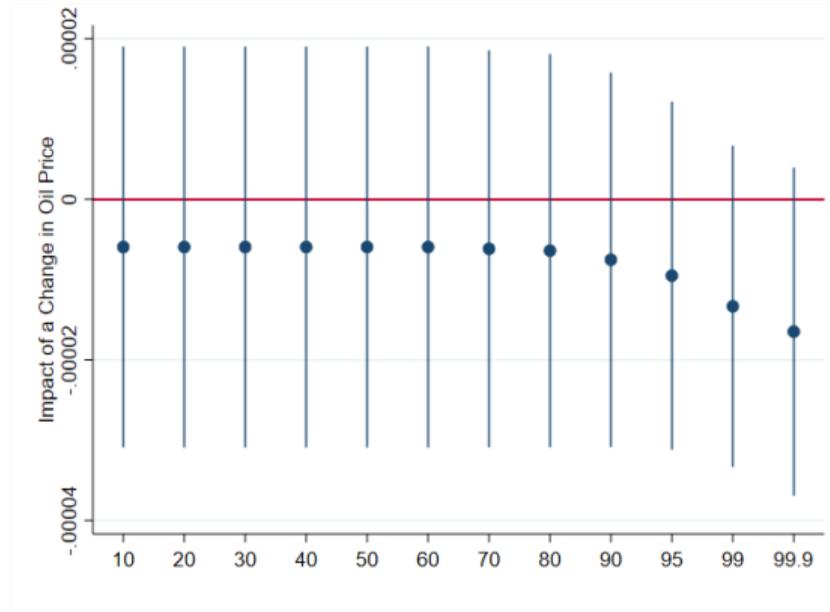
Identifying assumptions

1. Δp disproportionately impacts oil workers' labour market outcomes
2. Fixed industrial composition at the neighbourhood level during our sample period)
3. Individuals don't move during our sample period
 - Most repeated hospitalizations are at the same establishment
 - Most likely scenario is individuals move to oil-intensive neighbourhoods to become oil workers when $\delta p_t > 0$
 - Would work against us finding our main results

Identifying assumptions

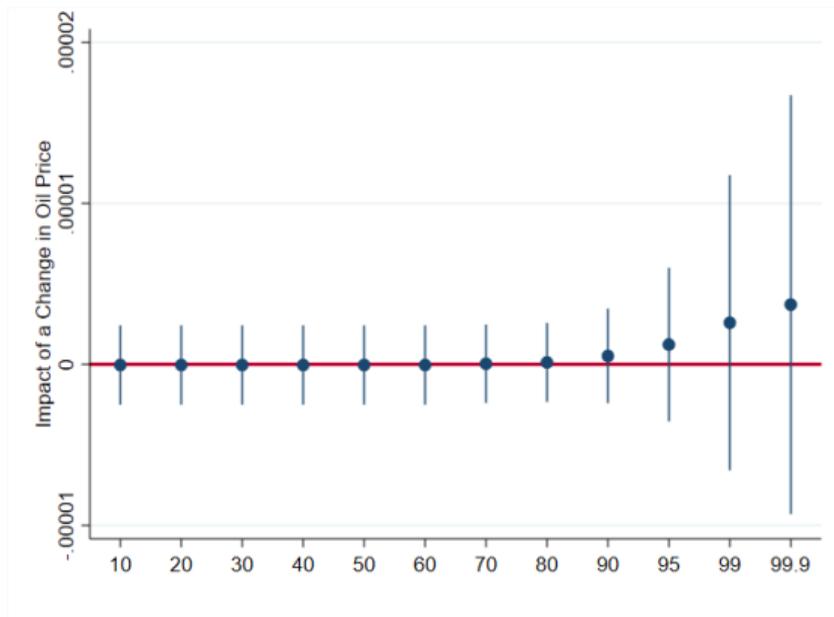
1. Δp disproportionately impacts oil workers' labour market outcomes
2. Fixed industrial composition at the neighbourhood level during our sample period)
3. Individuals don't move during our sample period
4. Δp does not directly affect hospitalizations
 - Most likely candidates are respiratory conditions from increased pollution
 - Most vulnerable to these conditions (children, elderly) excluded from the sample
 - Results hold when excluding these conditions
 - Results on oil workers working in oil intensive neighbourhoods don't fit this story

Non-oil workers: Impact of changes in oil prices on the probability of hospitalization (β_1 estimates for all men and women, across local concentration of oil workers)



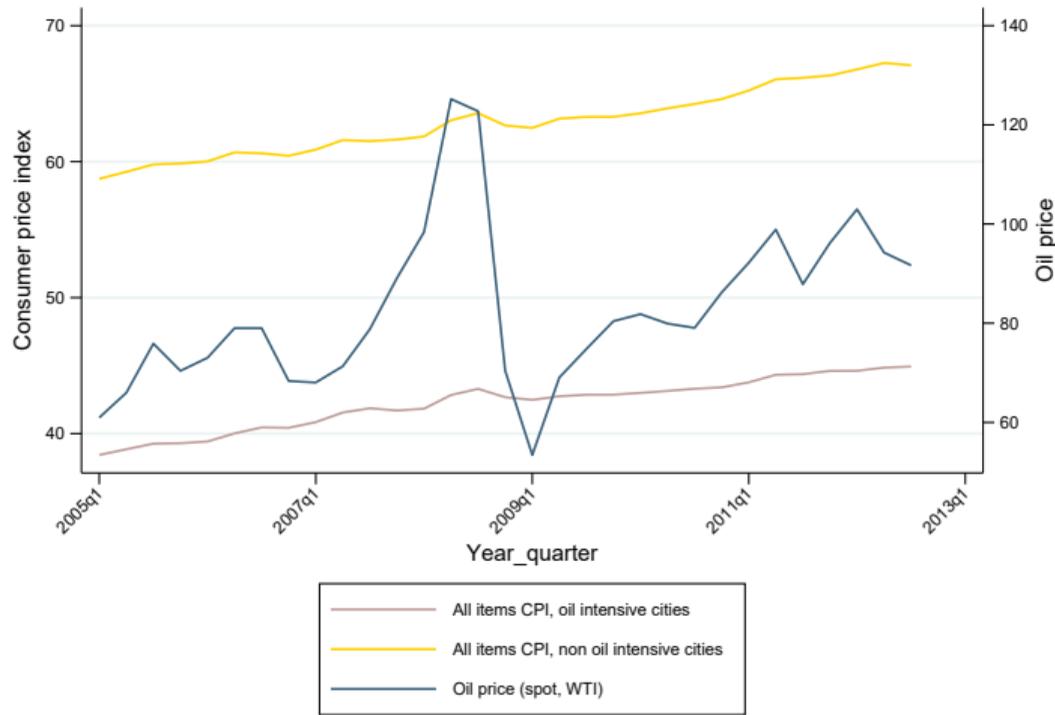
Note: 95% confidence intervals, standard errors clustered at the CMA/CA level. Coefficients from regressions controlling for immigrant status, single parent, marital status, number of individuals in the economic family, income and income², as well as CMA/CA, quarter and year fixed effects.

Non-oil workers: Impact of changes in oil prices on the probability of hospitalization (β_1 estimates for all men and women, across local concentration of oil workers)



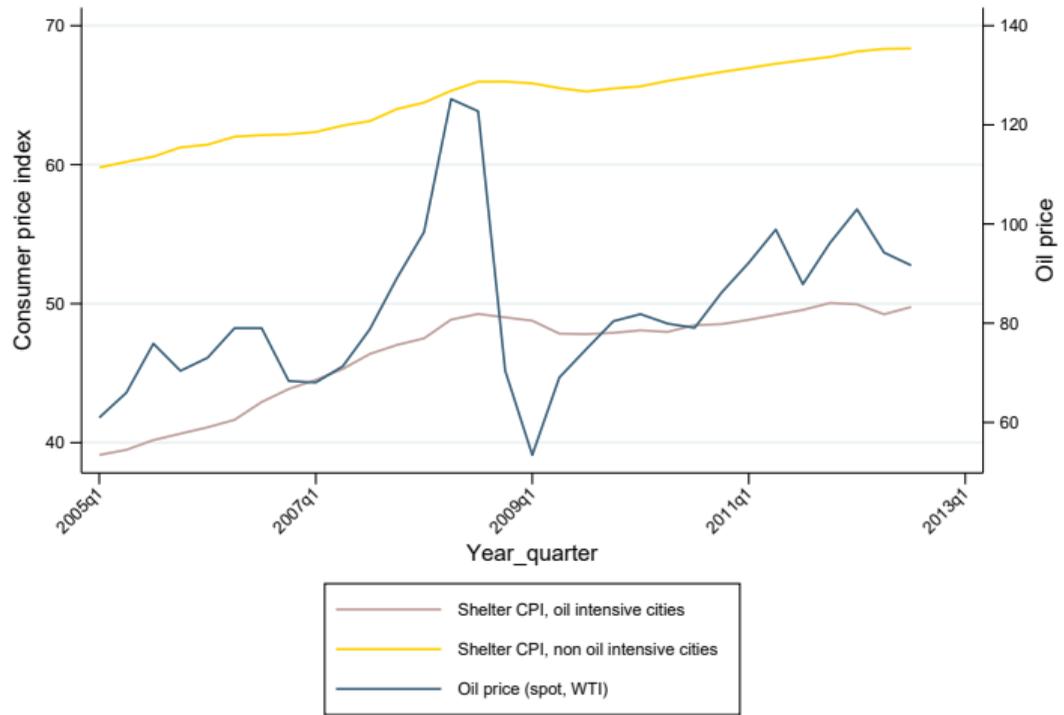
Note: 95% confidence intervals, standard errors clustered at the CMA/CA level. Coefficients from regressions controlling for immigrant status, single parent, marital status, number of individuals in the economic family, income and income², as well as CMA/CA, quarter and year fixed effects.

Movements in oil prices and in consumer price index Oil-intensive and non-oil intensive Canadian cities



Source: CPI are provided by Statistics Canada, wti crude oil prices converted in CAD using Bank of Canada change rates

Movements in oil prices and in shelter costs Oil-intensive and non-oil intensive Canadian cities



Source: CPI are provided by Statistics Canada, wti crude oil prices converted in CAD using Bank of Canada change rates

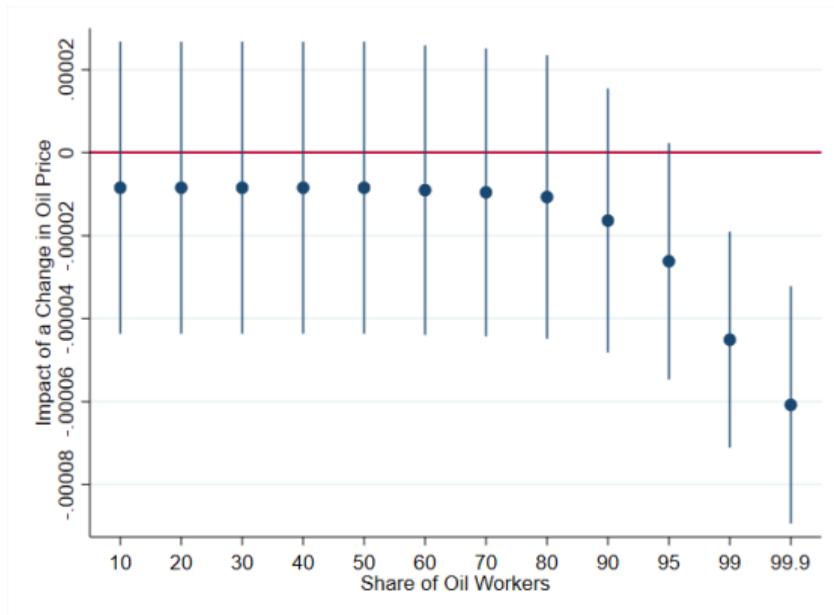
Oil prices and local inflation

	CPI shelter		CPI all items	
Oil price (one quarter lag)	0.040*** (0.009)	0.040*** (0.009)	0.020* (0.011)	0.017* (0.008)
Oil price(one quarter lag) × Oil intensive		0.014 (0.050)		0.004 (0.018)
Observations	270	270	270	270

Notes: Regressions include year, month and city fixed effects. Monthly observations. 2006-2011. Statistical significance: * 10% ** 5% *** 1%

Oil workers: Impact of changes in oil prices on the probability of hospitalization

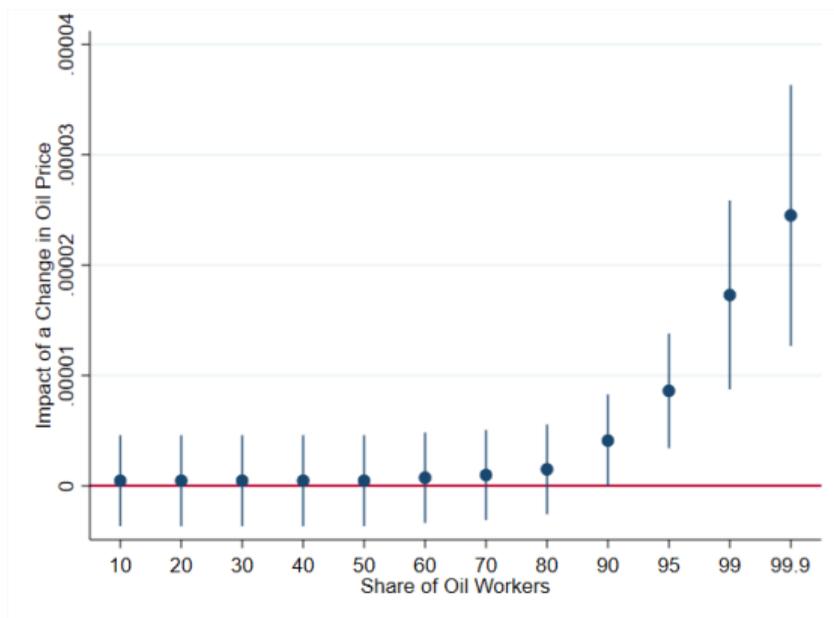
(β_3 estimates from inverse hyperbolic sine transformation, across local concentration of oil workers)



Note: 95% confidence intervals, standard errors clustered at the CMA/CA level. Coefficients from regressions controlling for immigrant status, single parent, marital status, number of individuals in the economic family, income and income², as well as CMA/CA, quarter and year fixed effects.

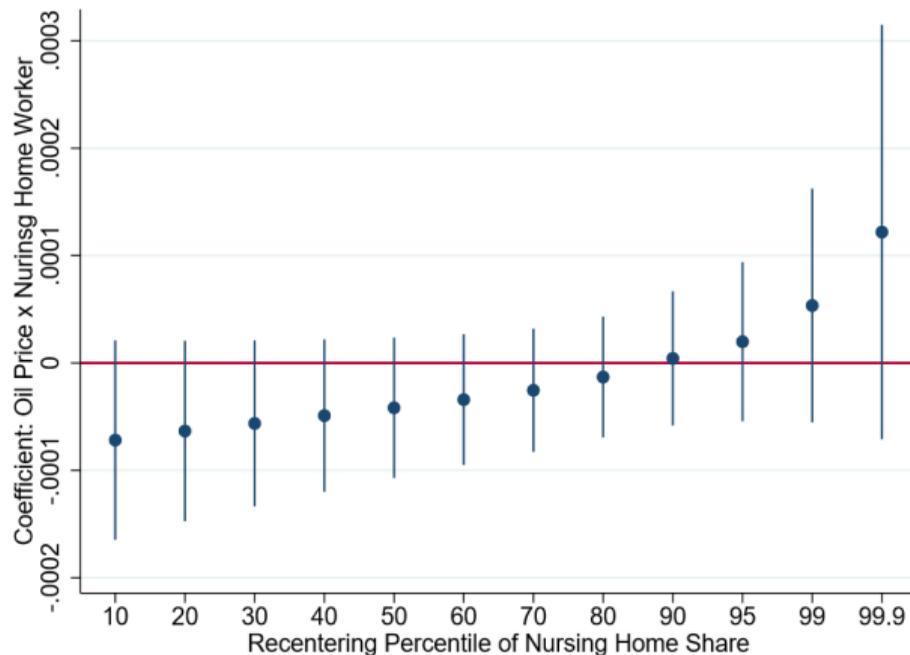
Non-oil workers: Impact of changes in oil prices on the probability of hospitalization

(β_1 estimates from inverse hyperbolic sine transformation, across local concentration of oil workers)



Note: 95% confidence intervals, standard errors clustered at the CMA/CA level. Coefficients from regressions controlling for immigrant status, single parent, marital status, number of individuals in the economic family, income and income², as well as CMA/CA, quarter and year fixed effects.

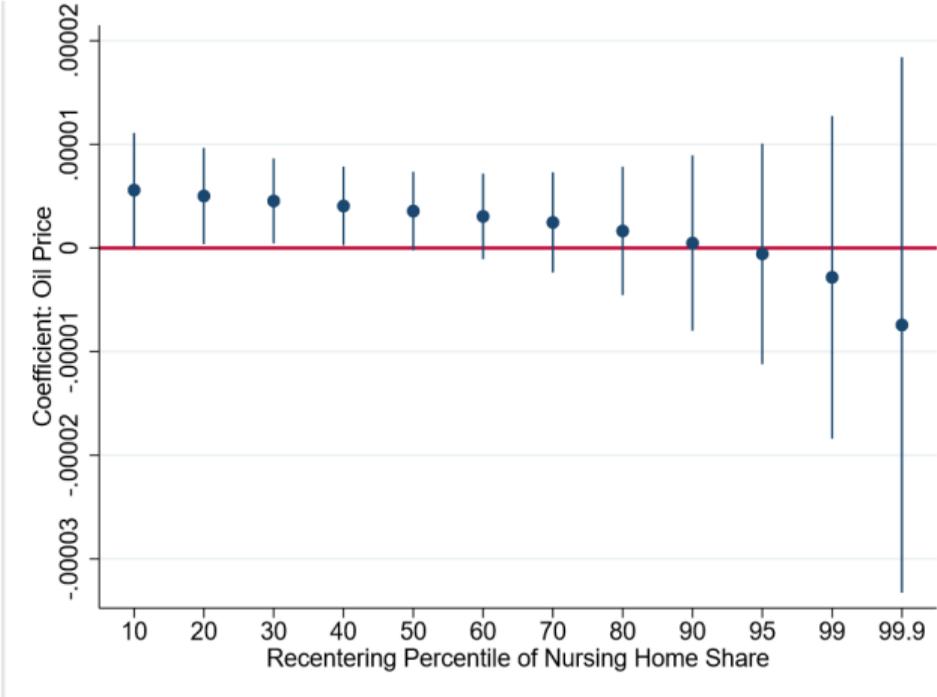
Nursing home and hospital workers: Impact of changes in oil prices on the probability of hospitalization (β_3 estimates, across local concentration of nursing home and hospital workers)



Note: 95% confidence intervals, standard errors clustered at the CMA/CA level. Coefficients from regressions controlling for immigrant status, single parent, marital status, number of individuals in the economic family, income and income², as well as CMA/CA, quarter and year fixed effects.

Non-nursing home and hospital workers: Impact of changes in oil prices on the probability of hospitalization

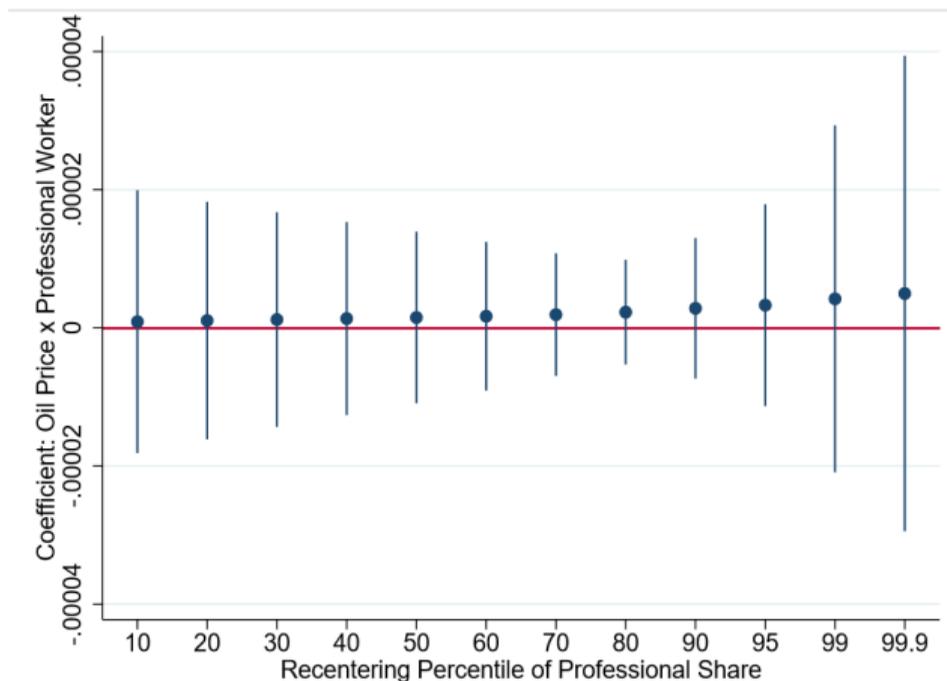
(β_1 estimates, across local concentration of nursing home and hospital workers)



Note: 95% confidence intervals, standard errors clustered at the CMA/CA level. Coefficients from regressions controlling for immigrant status, single parent, marital status, number of individuals in the economic family, income and income², as well as CMA/CA, quarter and year fixed effects.

Professional, scientific and technical services workers: Impact of changes in oil prices on the probability of hospitalization

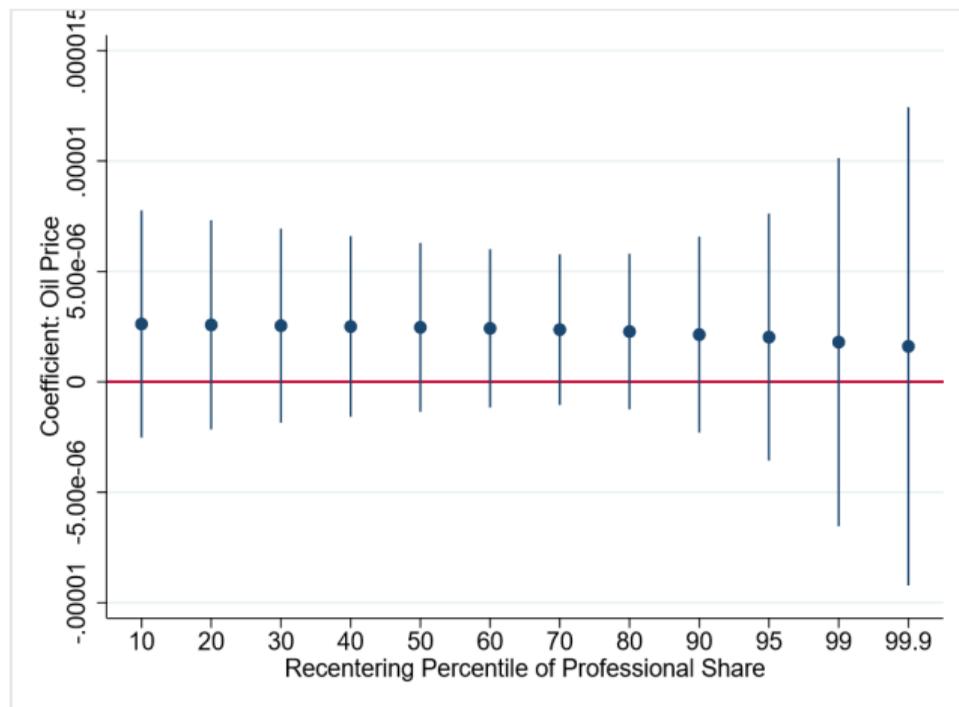
(β_3 estimates, across local concentration of professional/scs/tech workers)



Note: 95% confidence intervals, standard errors clustered at the CMA/CA level. Coefficients from regressions controlling for immigrant status, single parent, marital status, number of individuals in the economic family, income and income², as well as CMA/CA, quarter and year fixed effects.

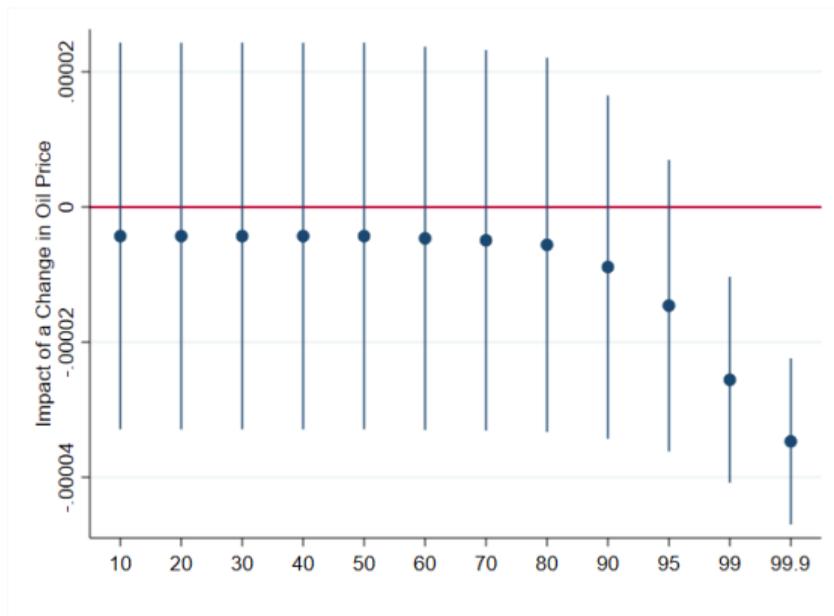
Non-professional, scientific and technical services workers: Impact of changes in oil prices on the probability of hospitalization

(β_1 estimates, across local concentration of professional/scs/tech workers)



Note: 95% confidence intervals, standard errors clustered at the CMA/CA level. Coefficients from regressions controlling for immigrant status, single parent, marital status, number of individuals in the economic family, income and income², as well as CMA/CA, quarter and year fixed effects.

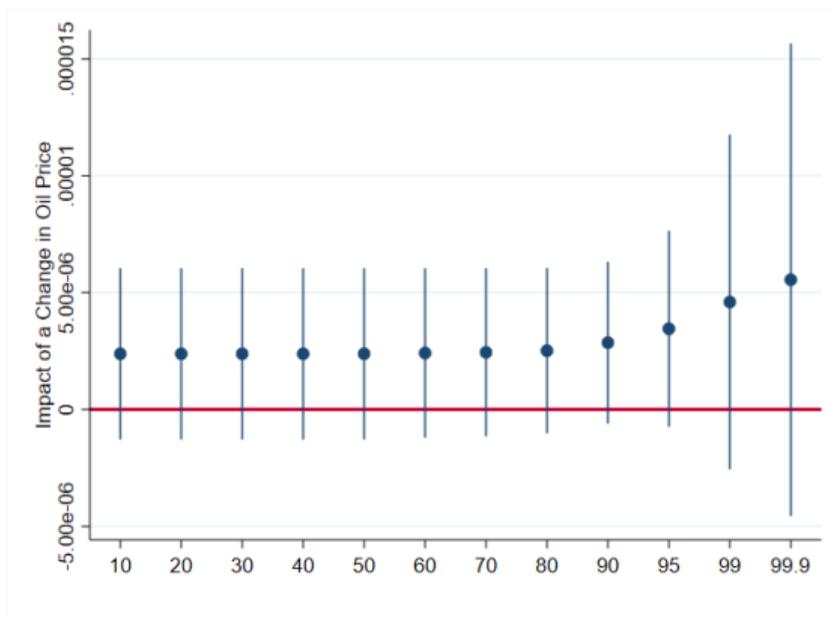
Oil workers: Impact of changes in oil prices on the probability of hospitalization (β_3 estimates for all men, across local concentration of oil workers)



Note: 95% confidence intervals, standard errors clustered at the CMA/CA level. Coefficients from regressions controlling for immigrant status, single parent, marital status, number of individuals in the economic family, income and income², as well as CMA/CA, quarter and year fixed effects.

Non-oil workers: Impact of changes in oil prices on the probability of hospitalization

(β_1 estimates for all men, across local concentration of oil workers)



Note: 95% confidence intervals, standard errors clustered at the CMA/CA level. Coefficients from regressions controlling for immigrant status, single parent, marital status, number of individuals in the economic family, income and income², as well as CMA/CA, quarter and year fixed effects.