Mining and Alcohol Consumption: New Evidence from Northern Canada

by

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Abstract

Mines operate throughout the world to keep up with the growing demand for mineral resources. While economic development depends on the minerals mines extract, there can be environmental, economic, and social effects to areas and communities nearby. This thesis focuses on the impact of mining on alcohol consumption. Existing literature provides qualitative findings regarding social changes that may occur during a mining boom, possibly correlated with an increase in alcohol use by individuals who live in communities nearby. However, to the best of our knowledge, the literature fails to offer quantitative evidence of such impacts obtained through rigorous statistical methods.

In order to determine a measurable effect of mining on alcohol consumption in communities nearby, this study collects data from various sources to build a unique dataset of individuals in northern Canada. Our dataset includes Global Positioning System (GPS) coordinates of respondents and operating mines, which allows us to estimate the number of additional alcoholic drinks individuals consume due to living near a mine. Northern Canada is an important area of focus due to the many small and isolated resource reliant communities, the large share of Aboriginal peoples in the total population, and the concentration of mines.

Our estimation technique relies on propensity score matching. This is important because the respondent's location of residence (i.e. proximity to a mine) may be endogenously determined. Our rich dataset allows us to match respondents that live close to a mine with respondents that live far. The matching is based on a large number of important socioeconomic covariates such as income, employment, consumption, education, age, gender, marital status, ethnicity, lifestyle, and seasonality.

Results are consistent with the established qualitative literature. We estimate that individuals who live within 10 km of a mine consume, on average, an additional 2 alcoholic drinks a week. This effect decreases as mines get farther away. Additionally, we use unconditional quantile regressions to find that the effect of mines is larger for individuals to the right of the

mean of the distribution of alcohol consumption. We compare our estimates with those from other studies that examine various factors that influence alcohol consumption. This exercise puts our estimates in perspective and shows that the effect of proximity to mines is larger than, for example, proximity to casinos or bars. The thesis provides empirical evidence that supports past qualitative studies, which may aid the implementation of more effective policies that can improve wellbeing in these small rural communities near mines and facilitate more sustainable development.

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Although the research and analysis are based on data from Statistics Canada, the opinions expressed do not represent the views of Statistics Canada or the Canadian Research Data Centre Network (CRDCN). © These data include information copied with permission from Canada Post Corporation.

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Chapter 1: Introduction

The world population has relied on mines and the minerals they produce as important sources of individual and national wealth for thousands of years (Nriagu, 1996). The number of mines in operation worldwide has been steadily on the rise since the industrial revolution, but with a growing world population the global economy and mineral production have undergone exceptionally large amounts of growth in the last twenty years.[1] With new technologies emerging, more areas are now feasible to mine. Technological progress also requires innovating resources, leading to the demand for new types of minerals (Hannington et al., 2017; Alonso et al., 2012). This fast pace of mining growth creates both opportunities and challenges. For example, resource rich economies in the world rely heavily on mining – some see huge benefits, while others find it a curse (Van der Ploeg, 2011). At the community level, large development projects may cause important social disruptions on small rural communities (Freudenburg and Jones, 1991; Gramling and Freudenburg, 1992). Whether for better or for worse, mining remains a critical part of global economic development and our every day lives.

Mining can cause both positive and negative socioeconomic impacts in their economies. Along with the obvious benefits gained from the minerals extracted through mining operations, mining can help reduce poverty in certain mining communities through higher wages and employment (Black et al., 2005), and improve long-term macroeconomic growth (Robinson et al., 2003). Often, these economic benefits appear to come at a cost as mining can cause environmental degradation to areas nearby (Lindberg et al., 2011; Palmer et al., 2010), and sometimes contributes to the exacerbation of social problems in both developing

[1] Information on mineral production accessed through the Austrian Federal Ministry of Science, Research and Economy's annual publication, "World Mining Data". Details on publication available at `https://www.en.bmwfw.gv.at/Energy/WorldMiningData/Seiten/default.aspx`. Information on world population and GDP accessed through the World Bank's website. Data available at `http://data.worldbank.org/indicator/SP.POP.TOTL`.

and developed countries (Bebbington and Bury, 2009; Shandro et al., 2011; Gramling and Freudenburg, 1992).

There is a large amount of quantitative evidence supporting the regional and individual economic benefits associated with mining, as well as macroeconomic quantitative research on the resource curse or 'Dutch Disease'.[2] Other than some studies examining the effects of mining on the health of individuals living nearby (von der Goltz and Barnwal, 2017; Hendryx and Ahern, 2008), the literature on the social impacts of mining is almost all qualitative and lacks formal empirical support.[3] Additionally, these qualitative studies lack data to examine the spatial reach of mine impacts, and differentiate the size of these effects based on the distance an individual lives from mines.

This work contributes to the literature by estimating the effect of mines on the consumption of alcoholic drinks of individuals residing close to mining operations. Estimating possible impacts of mining operations on alcohol consumption is important because excessive drinking is often associated with multiple socioeconomic externalities. Examples include, but are not limited to, productivity losses, driving accidents, domestic violence, crime, and lower mental health.

The empirical approach uses a unique dataset of 3,928 individuals residing in northern Canada. The dataset is compiled by connecting six years of socioeconomic information collected by Statistics Canada's Canadian Community Health Survey and mining data collected by Natural Resources Canada. Our data allow us to calculate the distance between the postal code representative point of each respondent and all mining sites in northern Canada. This allows us to estimate mining impacts for a gradient of distances.

Our estimation strategy relies on Propensity Score Matching (PSM), and the average (treatment) effect of residing close to a mine is identified by cross-sectional variation in the location of consumers, i.e. some are located close and some far from mines. The PSM approach is designed to control for the possibly endogenous location decisions, i.e. individuals that reside close to mines may have stronger preferences for alcoholic drinks. This could be the case, for instance, for young males.

[2]Dutch Disease refers to negative macroeconomic consequences from the appreciation of the exchange rate of a resource rich economy due to the inflow of foreign resource-related investments. Refer to Van der Ploeg (2011) for a review of this literature.

[3]See chapter 2 for a review of this literature.

We use socioeconomic variables to match 'treated' individuals (those who live close to a mine) with 'control' individuals (those who live far from mines) and compare their alcohol consumption. The matching model includes data on income, assets (e.g. home ownership), consumption (e.g. food security), employment, education, sense of community belonging, behaviour (e.g. physical activity), demographics (e.g. age, sex, race, ethnicity), and seasonality (e.g. individuals interviewed during the summer). In addition to PSM estimates of the average effect, we also use unconditional quantile regressions to estimate the effect mines have on individuals at different parts of the distribution of alcohol consumption.

The results show that, on average, the presence of a mine within 10 kilometres (km) from the respondent's residence causes the individual to consume 2 additional alcoholic drinks a week. While this effect may not seem like a substantial amount at first glance, it represents 64.5 percent of mean alcohol consumption for the northern sample. In fact, this effect is very large when compared to other factors that influence individual's alcohol drinking behavior, e.g. proximity to casinos and bars (Baltagi and Goel, 1990; Manning et al., 1995; Picone et al., 2010; Saffer and Dave, 2002; Mathes, 2014).

The magnitude of the mine effect is heavily dependent on the distance between the mines and the residence of respondents, with the effect being stronger for residents at close proximity. As the distance between the mines and respondents increases, the number of additional drinks consumed decreases. For instance, the effect of mines within a 30 km radius decreases to 1.4 additional drinks, and it is not statistically significant when residents are located within 40 km from a mine.

In addition, we estimate the effect of non base metal mines (e.g. diamond mines) on alcohol consumption. We find that these mines have a stronger and more distance-persistent effect. For example, we estimate that living within 40 km from a non base metal mine increases alcohol consumption, on average, by 1.7 drinks per week. Moreover, we use unconditional quantile regressions to test the hypothesis of differential effects of mines along the distribution of drinking. We find that individuals that live within 10 km from a mine *and* are located on the 75th quantile of the drinking distribution increase their alcohol consumption by 2.8 drinks a week. This estimate increases to 6.6 additional weekly drinks for individuals at the 90th quantile. Interestingly, we find both living in a community prohibiting alcohol and having Aboriginal ethnicity do not affect the amount of alcohol consumed.

The thesis offers a new (statistical, quantitative) perspective of the social impacts mining can have on individuals living nearby. Our estimates show an important negative social effect that must be considered when evaluating the general impacts of mining on small communities. With alcoholism at the root of many other societal problems, the implications of our results may be much further reaching than the focus of the study alone. As discussed by Baltagi and Goel (1990), understanding the demand for alcohol is important not only due to public health issues but also due to criminal activity related to alcohol consumption. We uncover previously unmeasured effects that can have important consequences to the sustainable development of northern Canada. These estimates may help not only Canadians, but may also assist the design of more accurate and effective policies aimed at the improvement of the wellbeing of mining communities throughout the world.

The remainder of this thesis is organized as follows. Chapter 2 reviews the literature on the relationship between mining and communities. Chapter 3 discusses the pathways through which mining can affect alcohol consumption. Chapter 4 describes the methods. Chapter 5 presents the results and offers a discussion of our findings. Chapter 6 examines effects along the distribution of alcohol consumption using unconditional quantile regressions. Chapter 7 offers concluding remarks discussing policy implications, limitations of the study, and directions for future research.

Chapter 2: Mining: Opportunities and Challenges

Mining brings both opportunities and challenges. These are usually social, economic, environmental, or cultural in nature. Some interesting studies give examples of how mines can have a positive social impact on communities in different areas. For example, Wilson (2012) finds mining booms result in a reduction in risky sexual behavior in Zambian copper mining cities due to the additional employment opportunities created for women. Greer and Stokes (2011) show that in Queensland, Australia, the mining sector has a lower divorce rate than other sectors of the economy. Looking at the socio-economic effects of mines in Nordic countries, Frederikson and Kadenic (2016) find mines increase the number of young people, and decrease unemployment and crime in the municipalities of Arctic regions.

Several papers report positive economic impacts of mining, and mining activities often have immediate local economic benefits to those living nearby. For example, Black et al. (2005) examine the coal mining areas of Kentucky, Ohio, Pennsylvania, and West Virginia and find mining booms to reduce the rate of poverty in those areas due to increased wages and levels of employment. Similar effects are found in developing countries such as Tanzania, where Kitula (2006) finds local livelihoods of individuals in the Geita District of Tanzania to be benefited through mining operations in the area. The study reveals that both miners and non-miners see benefits from mining through higher incomes, more employment, and better infrastructure and economic conditions in their communities. In Sub-Saharan Africa, Kotsadam et al. (2013) find mining to bring more employment opportunities in the service industry for women. Other studies find similar local economic benefits from mining (Moritz et al., 2017; Akudugu et al., 2013; Kotey and Rolfe, 2014; Aragón and Rud, 2013). Many studies also find that when proper institutions are in place, mining activities can lead to sustainable macroeconomic growth (Mehlum et al., 2006; Boschini et al., 2007; Stern, 1995; Davis, 1995; Ding and Field, 2005). An example of this is Botswana, a country that has seen successful long-term development partially due to a large diamond mining sector in the economy (Robinson et al., 2003).

On the other hand, literature also reports the negative economic effects that can result from mining. Literature shows that often times mining and other forms of resource development contribute to slower economic growth and lower incomes per capita (Sachs and Warner, 1995, 1999; Arezki and Van der Ploeg, 2011; Pegg, 2006). Many scholars refer to this phenomenon as the 'Resource Curse' due to the debilitating effect it can have on a country's economy (Van der Ploeg, 2011; Neumayer, 2004). Other studies find that the local economic benefits generated by mining can be very unequally distributed (Betz et al., 2015; Rolfe et al., 2007; Dai et al., 2014), leading to higher economic inequality in the mining region during a boom (Lawrie et al., 2011). Mines can also have an effect on the value of properties nearby. Using a Hedonic model, Fitzpatrick and Parmeter (2017) find mines in two northern Appalachian counties to decrease the price of homes sold within 2.9 kilometers by 17 and 24 percent.

Several papers, mainly in a qualitative literature in sociology, find negative social effects related to mining operations. A smaller quantitative literature looks mostly at the effect mines have on the health of individuals living nearby. In a study looking at 44 developing countries throughout the world, von der Goltz and Barnwal (2017) find a tradeoff between the health and wealth of individuals living near mines. The findings show that individuals living closest to mines receive the largest wealth benefits, however adult women and children living near the mines have lower hemoglobin levels than those farther away. Mines can also affect the health of individuals living nearby in developed countries, such as the United States. Findings show that as coal production increases in West Virginia individuals living near mines have worse health status (Hendryx and Ahern, 2008) and more hospitalizations for hypertension and Chronic Obstructive Pulmonary Disease (Hendryx et al., 2007).

Almost all literature looking at other social effects of mining use qualitative methods – small sample sizes, one-on-one or small group in-depth interviews, or case studies. For example, Caxaj et al. (2014) show that through community conflicts mining activities in

Guatemala can lead to a segregated and militarized environment, resulting in an increase in threats, intimidation, kidnapping, and other violent activities. This in turn can increase problems with mental illnesses such as anxiety and depression. Bebbington and Bury (2009) reveal that similar social conflicts within communities and other regions are associated with mining development in Peru. At a more individual level, mining can lead to increases in mental and physical illness, drugs and alcohol, gambling and prostitution, violence, and injuries (Shandro et al., 2011; Mactaggart et al., 2016; Gibson and Klinck, 2005). Some studies show that women are particularly affected by mining activities through violence and a lack of economic opportunities (Shandro et al., 2011; Sharma, 2010).

The environmental impacts of mining has been an area of interest to scholars for many years (Nriagu, 1996). Research in North America shows that mining activities can alter or destroy surrounding ecosystems and biodiversity (Palmer et al., 2010; Lindberg et al., 2011; Rooney et al., 2012; Gilbert, 2010). Ecological impacts like these can have a direct effect on the health of individuals living nearby (Plumlee and Morman, 2011; White, 2013). Moreover, fatal accidents can result from improper and unsafe exposure to certain compounds (Jamieson, 2014). Environmental contamination from mining can often be worse in developing countries where regulatory framework is weak. Studies in these countries find mining to be responsible for large amounts of environmental degradation, deforestation and heavy pollution of rivers, air, and land (Suleman, Mariwah, and Mensah, Suleman et al.; Swenson et al., 2011; Veiga et al., 2001).

Indigenous groups throughout the world are often more susceptible to the effects of mining (Acuña, 2015). This is often due to their unique cultures and strong connection to the land. Concerns and conflicts of indigenous groups over mining development occur in both developing and developed countries. Examples of these include a banned bauxite mine that was proposed to be built on sacred land in Odisha, India (Temper and Martinez-Alier, 2013), the displacement of multiple Wopkaimin communities for development of the Ok Tedi mine in Papua New Guinea (Hilson, 2002), and approval of the Jabiluka mine in the homeland of the Mirrar people in Australia (Banerjee, 2000).

There are also important concerns in Canada. For example, in response to diamond mining near the Dene First Nation in Lutsel K'e, Northwest Territories, Parlee et al. (2007) find that the Dene people continue to spend large amounts of time on the land and are concerned with how diamond mining may affect the caribou they hunt as a source of traditional food. Many northern Aboriginal communities have found resource development to sometimes increase social problems like poor mental health, income inequality, substance abuse, crime, poor housing conditions, and assault against women (Buell, 2006). More recently it has become a major concern for communities and researchers to understand these socio-economic effects of development (Gibson and Klinck, 2005). Aboriginal peoples make up a large percentage of the population in northern Canada,[4] making the results of this study very relevant to indigenous groups throughout the world.

[4]Refer to Statistics Canada's website for details. Available at `http://www12.statcan.gc.ca/nhs-enm/2011/as-sa/99-011-x/2011001/tbl/tbl02-eng.cfm`.

Chapter 3: Pathways from Mining to Alcohol Consumption

There is a long history of mainly sociology literature that examines the effects of large economic development projects on small rural communities, and why these boomtowns are so susceptible to the affects of development (Krannich and Greider, 1984; England and Albrecht, 1984; Freudenburg and Jones, 1991; Gramling and Freudenburg, 1992; Walker et al., 2000; Smith et al., 2001; Brown et al., 2005; Jacobsen and Parker, 2014). While the socio-economic effects of mining may not be exclusive to communities experiencing boom-bust cycles, an examination of the literature is worthwhile to gain a better understanding into the development of these social issues. Although the effects are likely dependent on the timeframe employed (Freudenburg, 1992), mainstream literature explains that when existing social, cultural, and economic systems within these small rural communities are disrupted by large-scale external development, many of the individuals' lives and perspectives change, sometimes leading to an increase in crime, drug and alcohol use, mental health problems, and a deterioration of the sense of community (Gramling and Freudenburg, 1992).

Aboriginal communities can be especially at risk due to unique social and cultural systems, and discontinuity of these systems can result in catastrophic consequences, as was the case for certain Aboriginal communities in British Columbia with an alarmingly high number of youth suicides (Chandler and Lalonde, 2008; Kirmayer et al., 2000). Often large-scale economic development projects near small rural communities are related to natural resource exploration, creating a strong link between resource development and various social changes in rural communities. In a study based in Hinton, Alberta, Parkins and Angell (2011) examine how certain economic and social changes occurring in a community during a resource boom can lead to increased alcohol and substance use. They find the most common pathways through which resource development may lead to increased alcohol use are multiple divergent economic sectors, transience, shift work, high income, and a culture of entitlement in the community.

As discussed in the previous chapter, not all individuals benefit equally in a resource boom, even within a resource dependent community. While there are definite economic gains made in certain industries more closely tied to resource development, others may experience very limited growth. This leads to what Parkins and Angell (2011) call economically divergent sectors. Economically divergent sectors arise when individuals in the fast growing resource sectors experience higher incomes, while those in other sectors struggle to keep up with rising prices in the community. Tight knit social groups tend to form based off common incomes and industries, leading to less unity within the community as a whole. The competition that develops amongst individuals spending more money to keep up with others within the high income groups can push many towards increased substance use as a way to deal with the added stress. On the other hand, those in the low income groups may increase substance use as a way to cope with feelings of hopelessness and frustration created by the community's high cost of living and social exclusions. The idea that income inequality is strongly correlated with social problems such as substance abuse is consistent with findings from other studies (Wilkinson and Pickett, 2009).

Another characteristic of resource dependent communities is a high population turnover with a large amount of transient workers. Literature shows this influx in mobile workers can present some socio-economic challenges for the community, which may result in a decline in social wellbeing (Vodden and Hall, 2016). Parkins and Angell (2011) find this influx of temporary residents leads to increases in the amount of alcohol consumed in Hinton. This is partly because a large amount of migration in a community can cause residents to draw a distinction between 'insiders' and 'outsiders' (O'Connor, 2015). Transient workers who come usually lack the social support of others in the community. These feelings of isolation and loneliness often lead individuals to cope through increased alcohol use. Permanent residents then need to deal with an added stress in the community due to the social disruption caused by this influx in new residents. In order to cope with this added stress, permanent residents may also increase alcohol use (Parkins and Angell, 2011).

Shift work is very common within the resource industries. Many studies find shift work to have a serious impact on an individual's family life and structure. In a study that examines the relationship between work schedules and drug and alcohol use among nurses in the United States, Trinkoff and Storr (1998) find that having longer and less desirable work schedules increases the likelihood of individuals using alcohol. Members of the individual's family often feel the heavy burden of shift work too. Through examining the perceptions, attitudes, and concerns of offshore workers in the UK sector of the North Sea, Parkes et al. (2005) find that repeated partings and reunions due to offshore work creates many emotional demands and tensions within the relationships of the worker and the spouse. Mauthner et al. (2000) find that children of workers in Scotland's offshore oil industry also feel the effects of separation from parents during shift work, which in turn can have a strong effect on the child's development. Parkins and Angell (2011) find that these same problems related to shift work exist in Hinton, and that many times these added stressors lead to increased alcohol use. Often times alcohol is simply used as a way to relax after a heavy and straining day of work. Other times alcohol is used as a way to cope with the separation from normal home-life activities and structure, and the added tension within the family. Parkins and Angell (2011) also find shift work in Hinton to have a negative effect on children at home, and lack of parenting and supervision can even lead to children being involved in substance use too.

High incomes are another economic pathway that connects resource development to increases in alcohol use. Parkins and Angell (2011) find that in some cases high incomes gained by individuals in the resource industries are used as a means to finance an individuals addiction. In Hinton, paramedics report they usually have the majority of their emergency calls to the bar on the first few days after pay day, suggesting many individuals are using their large earnings to drink excessive amounts of alcohol. High incomes offered by the resource industries in these towns also act as a lure for individuals to drop out of high school to work in town and not go on to university or other additional training (Parkins and Angell, 2011). Many of these individuals then feel unfulfilled later in life, and stuck in a pattern of long hours, large pay, and substance use in order to compensate.

The last factor that Parkins and Angell (2011) identify as a pathway to connect resource development with increased alcohol use is the large number of union jobs within resource dependent communities. High incomes mixed with union protection can often create a culture of entitlement, where individuals lack respect and feel many of their actions are inconsequential. Parkins and Angell (2011) find individuals often show attitudes of defiance and indifference to law enforcement officers in Hinton. Their attitudes demonstrate a lack of respect for the impact of their decisions, and that they believe they have the right to do whatever they want, as long as they have the ability to pay for it. These feelings of invincibility and entitlement sometimes contribute to high risk behavior and poor life decisions, which can also lead to substance use and addiction.

Chapter 4: Methods

4.1 Data

This research project compiles data from several sources.[5] We use Statistics Canada's 2000-2001, 2005-2006, and 2011-2012 annual components of the Canadian Community Health Survey (CCHS).[6] Each CCHS annual component offers a nationally representative cross-sectional sample of individual-level responses to several socio-economic questions, including questions about health, education, income, employment, demographics, and other socio-economic variables. Our objective is to estimate the impact of residing close to a mine on the consumption of alcoholic drinks. Identification of this effect relies on spatial variation in a cross-sectional design. Therefore, we combine all three annual components of the survey in one dataset. In total, the three surveys contain information on approximately 380,000 individuals in Canada.

Our analysis requires information on the distance between CCHS respondents and operating mines. To calculate this distance, first we use the Statistics Canada's Postal Code Conversion File (PCCF) to translate the postal code of the residence of the respondent (which is available in the confidential CCHS database) into Global Positioning System (GPS) coordinates. The PCCF lists all the postal codes in Canada combined with other geographical information, such as GPS coordinates for postal code representative points (Statistics Canada, 2016). A representative point is a coordinate point centrally located along the line

[5] Refer to Appendix D for details on the procedures to create our datafile.

[6] A detailed description of the CCHS is available at `http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&Id=114112`. Statistics Canada offers different levels of data accessibility. Access to the CCHS microdata is granted exclusively through Statistics Canada Research Data Centres (RDC) upon approval of a research proposal and security clearance. All statistical analyses must be conducted inside a RDC and results must undergo a Statistics Canada vetting process. More information on Statistics Canada data accessibility is available at `http://www.statcan.gc.ca/eng/health/acces`.

or population weighted in the polygon that forms a postal code area.[7] We use the average of GPS coordinates when postal codes have more than one representative point. Second, we use the GEOSCAN Database from Natural Resources Canada to collect the GPS coordinates of all operating mines in Canada for the years 2000, 2001, 2005, 2006, 2011, and 2012 (Natural Resources Canada, 2001, 2002, 2007, 2008, 2013, 2014). Finally, using GPS coordinates we calculate straight-line distances (in kilometres) – accounting for curvature of the earth – between each CCHS respondent and each Canadian mine.

The focus of this study is northern Canada. As discussed above, this region is sparsely populated and is composed of mainly small communities, with a high concentration of aboriginal peoples. In addition, the Canadian North has been experiencing an increasing number of resource development projects (Prowse et al., 2009). According to a large sociology literature (e.g. Krannich and Greider, 1984; Freudenburg and Jones, 1991; Gramling and Freudenburg, 1992), these elements may contribute to social disruptions in the North, possibly inducing an increase in substance use, while this would be less likely to occur in southern Canada, where large cities make this region more densely populated and socio-economically established.

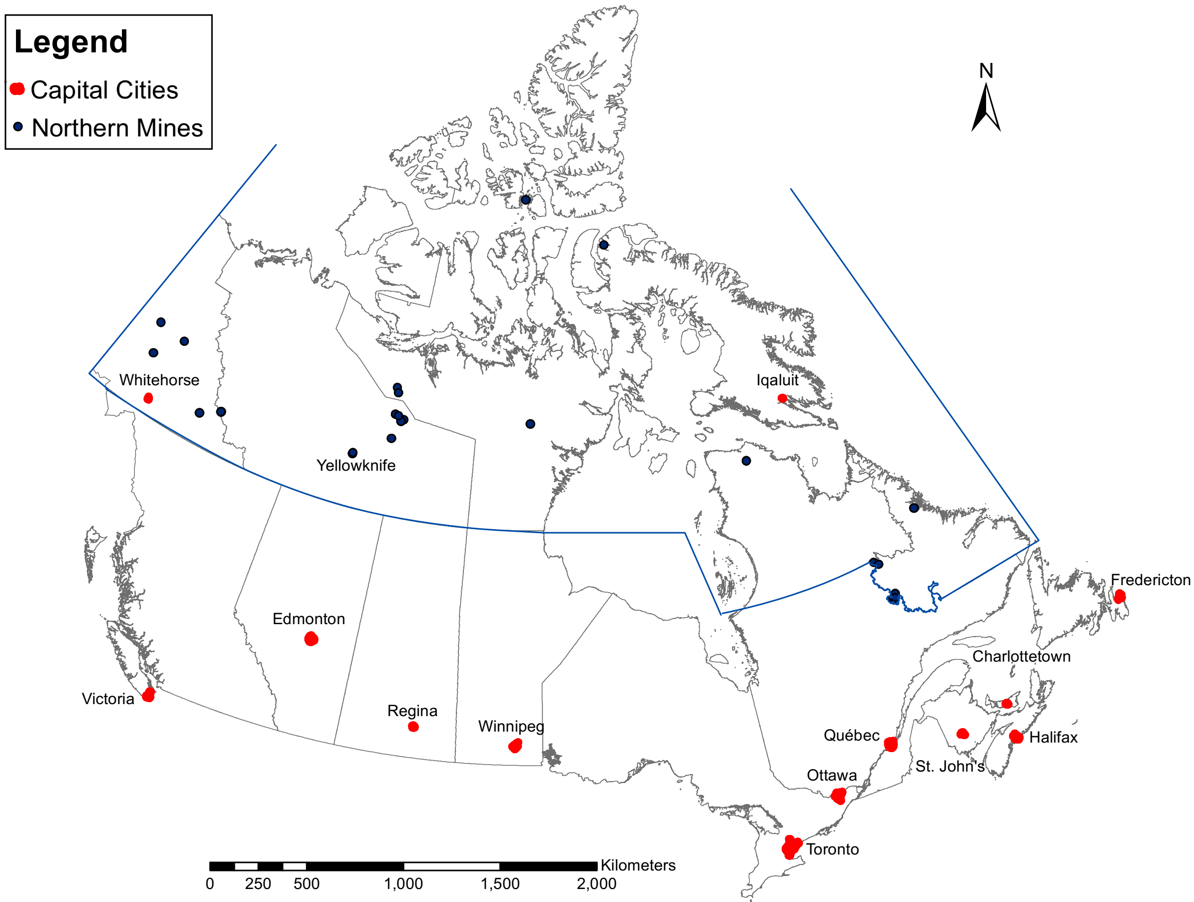
To study northern Canada, we restrict our sample to respondents and mines located in the territories of Yukon, Northwest Territories, Nunavut, the Nunavik region of Quebec, and Labrador. These regions are commonly included by research networks focusing on socio-economic research in northern Canada.[8] After pooling the three CCHS survey cycles, our sample includes 9590 respondents in northern Canada. Figure 4.1 shows the map of Canada, a blue line bordering our northern Canadian region, and the location of all mines that operated during our survey periods.

Using the CCHS data, we measure alcohol consumption by the number of alcoholic drinks consumed in the week before the survey. We construct dummy variables that are equal to 1 if, at the cycle period of the CCHS interview, an operating mine was located within r km from the respondent's location, 0 otherwise. Table 4.1 shows summary statistics on

[7] Refer to Statistics Canada's website for details. Available at `http://www.statcan.gc.ca/pub/92-195-x/2011001/other-autre/point/point-eng.htm`.

[8] For example, both Social Economy Research Network of Northern Canada (SERNNoCa) and Resources and Sustainable Development in the Arctic (ReSDA) focus research on these five regions of northern Canada. Information on SERNNoCA is available at `http://yukonresearch.yukoncollege.yk.ca/sern/aboutsernnoca/` and information on ReSDA is available at `http://yukonresearch.yukoncollege.yk.ca/resda/`.

Figure 4.1: Map of Canada – Northern Region and Mines



these variables, and other socio-economic indicators. Our data reveal that, on average, three alcoholic drinks are consumed in a week in northern Canada. The table also shows that approximately 10% of the respondents reside within 10 km from an operating mine, and approximately 15% reside within 150 km from a mine.

Table 4.1: Summary Statistics

Variable	Obs	Mean	Std. Dev.
Weekly Alcohol Consumption	7180	3.080	7.673
PRESENCE OF A MINE			
within 10 Km	9590	0.104	0.305
within 30 Km	9590	0.104	0.306
within 50 Km	9590	0.114	0.318
within 100 Km	9590	0.146	0.354
within 150 Km	9590	0.149	0.357
within 200 Km	9590	0.175	0.380
WEALTH AND EMPLOYMENT			
Household Income ($10,000)	8073	7.618	7.461
Unemployed	8753	0.067	0.251
Home Owner	9472	0.534	0.499
Household Food Secure	8106	0.779	0.415
HUMAN CAPITAL/BEHAVIOR/SEASON			
Years of Education	9461	12.529	4.435
Community Belonging	9169	0.783	0.412
Physically Active	9235	0.280	0.449
Summer	9590	0.226	0.418
DEMOGRAPHICS			
Age	9590	38.753	17.278
Married	9567	0.470	0.499
Male	9590	0.489	0.500
Household Size	9590	2.895	1.745
Born in Canada	9613	0.920	0.271
Aboriginal Ethnic Origin	9457	0.404	0.491

4.2 Estimation Strategy

Identification of the mine effect on alcohol consumption faces important econometric challenges. We are interested in estimating the *average treatment effect* (ATE) of mine proximity on alcohol consumption. Interestingly, proximity between a respondent and a mine is a function of both mines' and consumers' location decisions. Our identification strategy relies on the fact that mining operations are located where mineral deposits exist, hence, they are exogenous to alcohol consumption. The respondents' decisions about the location of residence, however, may be correlated with several factors that influence alcohol consumption. The problem with respondent self-selection is that individuals who already have a higher propensity to consume alcohol excessively may choose to live near mines. For example, as discussed in chapter 3, temporary workers (usually young adult males) are more likely to both consume higher amounts of alcohol and to be attracted by mining job opportunities. Clearly, several factors may be correlated with both alcohol consumption and the probability of residing close to a mine, which makes the comparison of alcohol consumption between individuals living near and far from mines problematic. Therefore, the standard approach of regressing alcohol consumption on a dummy indicator for the presence of a mine may deliver biased estimates.

We use Propensity Score Matching (PSM) to estimate the ATE of mines on alcohol consumption (Rosenbaum and Rubin, 1983; Abadie and Imbens, 2016). We categorize respondents into 'treatment' or 'control' groups based on the presence of a mine, where a treated individual lives within r km of a mine (control group otherwise). A typical PSM approach involves two steps. First, a logit (or probit) model is estimated to predict the probability of treatment. This probability is known as the propensity score. The second step involves the estimation of the ATE. Individuals from each group (treatment and control) are matched with individuals from the other group.[9] With PSM, the task of finding matches is simplified as it relies solely on the propensity scores of individuals, i.e. an individual in one group is matched with an individual from the opposite group with the closest propensity score.[10] The ATE estimate is simply the average difference between the outcomes (in our case alcohol consumption) of individuals in the treatment and control groups. The principle underlying this estimate is that a 'matched' individual is an individual similar to the observed individual and can serve as a counter-factual. Therefore, a comparison between an individual and its match carries information about differences between observed and potential outcomes.[11]

In our application, the PSM first step involves a logit model for the location of residence (relative to locations of mines), i.e. the treatment variable is a dummy indicating that

[9] This contrasts with the approach to estimate the *average treatment effect on the treated* (ATET) where only matches for individuals in the treatment group are required.

[10] Our matching relies on nearest neighbor, with a minimum match of one individual, but multiple individuals form the benchmark group in instances of ties of the closest propensity score.

[11] For individuals in the treatment group, we observe their alcohol consumption and know they live 'close' to mines. Thus, the counter-factual refers to the alcohol consumption of these same individuals had they lived 'far' from mines. For individuals in the control group we observe their alcohol consumption and know that they live 'far' from mines. In this case, the counter-factual refers to what would be their alcohol consumption had they lived 'close' to mines.

the respondent resides close to at least one mine. Clearly, place of residence decisions are complex ones. We consider a model where location decisions of individuals are a function of several socio-economic factors shown in table 4.1.

The individual-level data available in the CCHS contain information about wealth and employment, such as: annual household income; a dummy that equals 1 if the respondent was unemployed and looking for work at the time of the survey (0 otherwise); a dummy indicating home ownership; and a dummy variable for whether the household is food secure.[12]

For human capital, the CCHS data groups individuals into categories of highest level of education completed (e.g. grade 8 or lower, grade 9-10, etc.). To calculate years of education, we follow a method similar to that of Lemieux and Card (2001) and Gunderson (1979) and use the midpoint value of each category as a measure of years of education.[13] Community Belonging is a dummy variable for whether the respondent feels a very strong or somewhat strong sense of belonging in the local community. To account for lifestyle we use a dummy variable for whether the respondent is considered physically active.[14] To control for seasonality, we create a summer dummy variable that indicates whether the respondent was interviewed for the survey during June, July, or August. Our dataset also includes demographic variables such as age (in years), and dummy variables for whether the respondent is married, male, born in Canada, and has Aboriginal ethnic origin. We also have information on the number of individuals living in the respondent's household.

[12]The CCHS food security assessment is adapted from that of the United States Department of Agriculture. The assessment is based on food availability for adults and children in the household. Details are available at https://www.canada.ca/en/health-canada/services/food-nutrition/food-nutrition-surveillance/health-nutrition-surveys/canadian-community-health-survey-cchs/canadian-community-health-survey-cycle-2-2-nutrition-2004-income-related-household-food-security-canada-health-canada-2007.html#metho25.

[13]We assign 4 years of education for grades 8 and lower, 9.5 years for grades 9-10, 12 years for grades 11-13, 13 years for secondary school graduate, 14 years for some post secondary education, trades certificate or diploma, 15 years for college diploma or certificate, university certificate below bachelor's level, 17 years for bachelor's degree, 20 years for university degree or certificate above bachelor's level.

[14]This indicator is based on average daily energy expended during leisure time, calculated from reported leisure activities and their durations.

Chapter 5: Results and Discussion

We estimate the ATE of mine proximity on alcohol using several models that differ by the radius r that defines treatment. We consider r between 10 and 200 km, in intervals of 10 km. Figure 5.1 plots these ATE estimates, along with their 95% confidence interval based on Abadie and Imbens (2016) standard errors. Table 5.1 shows ATE estimates for models with $r \in \{10, 20, 30, 40, 50, 100\}$ km. First stage propensity score estimation results are available in table A1 (Appendix A).

Table 5.1: ATE Estimates

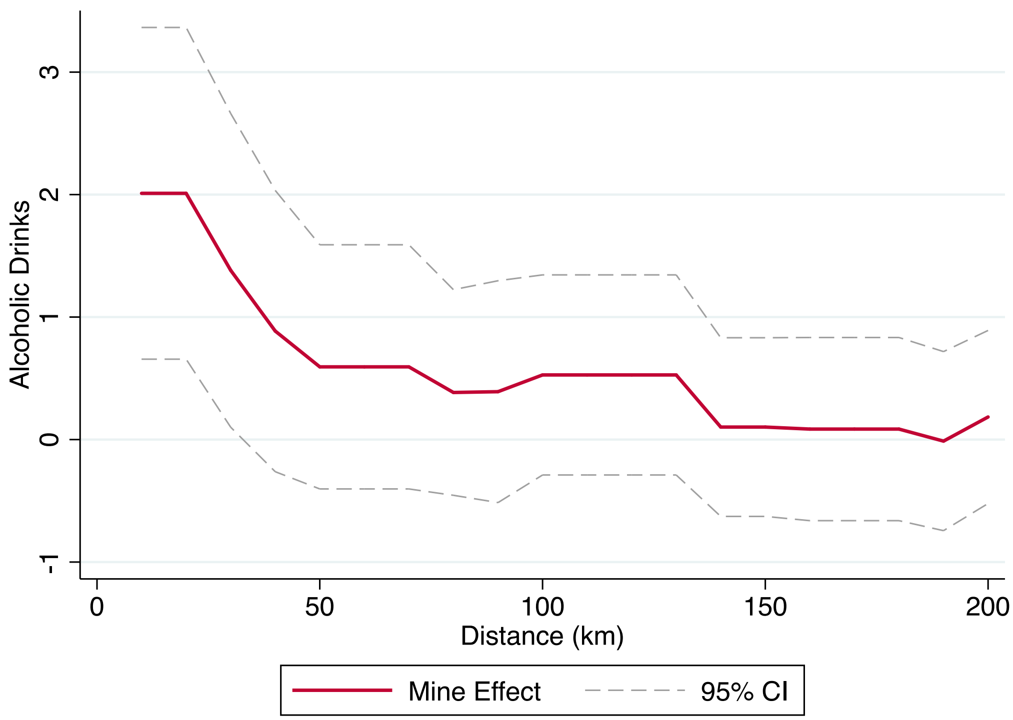
	10 km	20 km	30 km	40 km	50 km	100 km
ATE	2.010***	2.010***	1.382**	0.886	0.594	0.527
	(0.691)	(0.691)	(0.654)	(0.586)	(0.509)	(0.417)

Sample Size: N=3928. *** $P < 0.01$, ** $P < 0.05$, *$P < 0.1$. Abadie and Imbens (2016) standard errors are reported in parentheses.

We find a positive and statistically significant effect of mine proximity on alcohol consumption. Specifically, individuals who live within 10 km from a mine have, on average, 2 additional alcoholic drinks per week when compared with those in the control group ($p < 0.01$). This effect decreases to 1.4 additional drinks when we consider a radius of 30 km ($p < 0.05$).

Figure 5.1 shows that the effect of mine proximity on alcohol consumption sharply decreases with distance when residents live within 50 km from a mine. The ATE estimates are relatively constant (at around 0.5 drinks) for individuals that live within 50–130 km from a mine, and drops to zero beyond this distance. Note, however, that the ATE is not statistically significant for $r \geq 40$ km (table 5.1).

Figure 5.1: ATE Estimates (10km $\leq r \leq$ 200km)



We also examine the effect of proximity to a specific type of mine: non base metal mines.[15] This is important because different mining practices are used for the extraction of different mineral types, which may vary in their environmental and social effects. For example, a common practice of stripping the tops of mountains to mine coal can be especially polluting to streams nearby (Gilbert, 2010), while certain precious/base metal (e.g copper, gold, zinc) mining practices can result in high concentrations of arsenic released into tailings (Wang and Mulligan, 2006).[16]

Table 5.2 shows the estimates of the ATE of proximity to non base metal mines.[17] When we consider a radius of up to 20km, all mines are non base metal mines and the first two ATE estimates (i.e. 10 and 20 km) of tables 5.2 and 5.1 are identical. Beyond this radius, however, when compared to the total ATE, the effects of non base metal mines become larger and more persistent. Non base metal mines within 30 km increase alcohol consumption by

[15] Non base metal mines include those that extract iron ore, diamonds, precious metals (e.g. silver, gold, tungsten), and quartz. Base metal mines produce metals such as nickel, copper, zinc, and lead.

[16] Arsenic is linked with major health concerns throughout the world (Ng et al., 2003) and in some incidents exposure through mining practices can be fatal (Jamieson, 2014).

[17] First stage results are available in Appendix B.

1.7 drinks ($p < 0.01$) in the week before the survey, and continue to have the same effect ($p < 0.05$) within 40 km.

Table 5.2: ATE Estimates: Excluding Base Metal Mines

	10 km	20 km	30 km	40 km	50 km
ATE	2.010***	2.010***	1.738***	1.736**	1.012
	(0.691)	(0.691)	(0.671)	(0.674)	(0.628)

Sample Size: N=3928-3810. There is a small variation in sample size between models. As a result, we cannot disclose the exact number of observations of each model as it would violate Statistics Canada's confidentiality policy. *** $P < 0.01$, ** $P < 0.05$, *$P < 0.1$. Abadie and Imbens (2016) standard errors are reported in parentheses.

The results are consistent with what many qualitative studies have found – that the existence of mines often leads to an increase in alcohol use (Shandro et al., 2011; Mactaggart et al., 2016; Parkins and Angell, 2011). Individuals living closest to the mines are affected the most, and the effect decreases as individuals live farther away from the mines. We are not aware of other quantitative studies examining the effect of mines on the alcohol consumption of individuals living in their proximity, therefore we cannot directly compare our empirical results with others. However, there are studies that estimate the effect of other factors on alcohol consumption. These studies and their findings are summarized in table 5.3.

Table 5.3: Comparison of Various Effects on Alcohol Consumption

Source	**Type of Effect**	**Average Effect on Alcohol Consumption**
Our Findings	*Mines within 10 km*	*64.5% Increase*
Mathes (2014)	Casino Opening	11% Increase
Picone et al. (2010)	Bar within 0.5 km	1.5% Increase
Saffer and Dave (2002)	Advertising Ban	8% Decrease
Baltagi and Goel (1990)	1% Increase in Price	0.7% Decrease
Manning et al. (1995)	1% Increase in Price	0.8% Decrease

In a recent study, Mathes (2014) uses a difference-in-difference approach and finds that the opening of a Native American casino in the United States increases binge drinking of non-Native Americans living in the same county by 11 percent. Picone et al. (2010)

study alcohol consumption in four large U.S. cities. They estimate the number of additional alcoholic drinks consumed by individuals who live in close proximity to a bar. They find that an additional bar within a half km to the location of residence increases the number of alcoholic drinks consumed in a week by 0.072 drinks, i.e. equivalent to 1.5 percent of the sample mean of 4.7 weekly drinks. Saffer and Dave (2002) use data from 20 countries to analyze the effect a ban on alcohol advertising has on alcohol consumption. They find that a ban on all alcohol advertising decreases alcohol consumption by 8 percent.

Moreover, the price elasticity of demand for alcohol has been well studied in the literature. Using a quasi-experimental design Baltagi and Goel (1990) estimate the price elasticity of alcohol to be -0.7. This suggests that a one percent increase in the price of alcohol decreases the amount of alcohol consumed by 0.7 percent. Manning et al. (1995) use a two-equation approach to account for selection into drinking and find a price elasticity of -0.8.

Relative to these other studies, our estimate of the effect of a mine is surprisingly large. The mean number of drinks consumed in a week in our sample for northern Canada is 3.1. Through PSM we find that individuals have 2 additional weekly drinks due to living within 10 km from a mine, which represents 64.5 percent of our sample's mean. Using the price elasticity estimated by Manning et al. (1995), the price of alcohol would need to decrease by 92.2 percent in order to achieve the same increase in alcohol consumption as that from a mine.

Chapter 6: Unconditional Quantile Analysis

6.1 Motivation and Model Specification

Manning et al. (1995) find that individuals categorized into light, moderate, or heavy drinkers respond differently to changes in the price of alcohol. This suggests factors that influence the amount of alcohol individuals consume should be examined at multiple points along the distribution of alcohol consumption. We use unconditional quantile regressions to estimate the effect mines have on the number of alcoholic drinks consumed at different points along the distribution of alcohol consumption.

Unconditional quantile regressions (UQRs) are less restrictive than quantile regressions because they allow for the estimate of marginal effects at different points along the actual distribution of the outcome variable. Quantile regressions, on the other hand, always estimate marginal effects along an outcome distribution that is conditional on an explanatory variable, which would be very different from estimates along the true outcome distribution. We use the approach developed by Firpo et al. (2009) to estimate the unconditional quantile regressions using recentered influence functions.

Note that we must use a regression approach to estimate the effect of mines along the distribution of drinking, therefore deviating from the PSM strategy. To minimize selection issues, we include several additional variables in the regression model. We estimate the following regression:

$$Y_i = \alpha + \beta M_i + X_i \Lambda + \gamma f(L_i) + Z_{jt}\Gamma + \lambda_j + \mu_t + \varepsilon_i, \tag{6.1}$$

where Y is the weekly alcohol consumption of individual i, M is a binary treatment indicator for living close to a mine, X represents individual characteristics, Z represents time-varying characteristics of the Forward Sortation Areas (FSA) of our sample[18], with j indexing an FSA and t indexing a survey cycle. The term $f(L_i)$ is a fourth-order polynomial on latitude of the location of residence of individual i, λ is a FSA fixed effect, μ is a survey cycle fixed effect, and ε is an error term.

The individual characteristics X includes a dummy variable for whether the respondent lives in a rural area.[19] To account for communities that prohibit the consumption of alcohol in northern Canada, we use a dummy variable that indicates whether the consumption, sale, purchase or transportation of liquor is prohibited in the respondent's community. Communities that prohibit alcohol are identified following a procedure similar to Davison et al. (2011). For communities in Northwest Territories and Nunavut we use the 1980 and 1990 Revised Regulations of the Northwest Territories (Government of Northwest Territories, 1980, 1992b), Part II of the Northwest Territories monthly Territorial Gazette Indices for 1990 to 2012 (Government of Northwest Territories, 1990, 1991, 1992a, 1993, 1994),[20] and Part II of the Nunavut monthly Territorial Gazette Indices for 1999 to 2012.[21] For communities in Yukon, Labrador, and northern Quebec we use information directly from researchers in the area. To control for possible effects of temperature on alcohol consumption, we specify a fourth-order polynomial of mean annual temperature of the location of residence of consumers. Temperature data are from Environment and Climate Change Canada and are the mean annual temperature for the closest climate station to each respondent.[22]

Access to alcohol may depend on the distance between northern consumers and the south of Canada. To control for how far north respondents live, we specify a fourth-order polynomial of latitude of the residence of individual i. A similar approach is used by Chen

[18]FSAs are the first three characters of the Canadian postal code and represent a geographical area (Statistics Canada, 2016).

[19]Rural areas include areas with a population concentration less than 1000 and population density less than 400 persons per square kilometer. Details are available at `http://www12.statcan.gc.ca/census-recensement/2006/ref/dict/overview-apercu/pop6-eng.cfm`.

[20]Years 1995 to 2012 are accessed online through the Government of Northwest Territories website, available at `https://www.justice.gov.nt.ca/en/northwest-territories-gazette/`.

[21]Nunavut Gazettes are accessed online through the Government of Nunavut website, available at `http://www.nunavutlegislation.ca/en/nunavut-gazette/2017`.

[22]Data are accessed online through Monthly Climate Summaries, available at `http://climate.weather.gc.ca/prods_servs/cdn_climate_summary_e.html`.

et al. (2013) to examine pollution generated in south China and how it varies with degrees of latitude.

We use two variables in Z to control for the level of development and infrastructure in the region where the respondent lives; FSA population and the percent of FSA residents using public transit.[23] Finally, the regression models also include FSA and survey cycle fixed effects to control for time-invariant regional characteristics and temporal fluctuations in the consumption of alcoholic beverages.

We estimate the effect mines have on the amount of alcohol consumed for individuals who live within 10 km from a mine. We use OLS regressions to estimate the effect at the mean, and unconditional quantile regressions to estimate the effect of mines on 75th, and 90th quantiles of the alcohol consumption distribution.

6.2 UQR Estimates

Table 6.1 shows the regression estimates of the effects of mines on alcohol consumption, at the mean, 75th and 90th quantiles. We find that mines have a larger effect on the number of alcoholic drinks individuals consume for those who are higher on the distribution of alcohol consumption. Specifically, regression estimates indicate that mines operating within 10 km from an individual's residence cause an increase in 2.3 drinks per week at the mean ($p < 0.01$), 2.8 drinks per week at the 75th quantile ($p < 0.05$), and 6.6 drinks per week at the 90th quantile ($p < 0.1$). These results suggest that heavier drinkers are the most susceptible to disruptions that may be caused by resource development near the community.

Table 6.1: Effect of Mines at Mean, 75th, and 90th Quantiles

	Mean	75th Quantile	90th Quantile
Mines within 10 km	2.299***	2.815**	6.609*
	(0.809)	(1.433)	(3.548)

Sample Size: N=3928. Robust standard errors are reported in parentheses. *** $P < 0.01$, ** $P < 0.05$, *$P < 0.1$. Mean effect is estimated using OLS.

[23] The FSA data are from the Canadian Census Area Profiles and the National Household Survey.

Table C1 (Appendix C) shows complete results for the unconditional quantile resgressions. We find statistical evidence of several control variables influencing the consumption of alcohol, namely: income, age, marital status, gender, the number of people living in the household, being born in Canada, living in a rural area, summer, FSA population, and FSA percent using public transit. For most variables, the effect increases at higher quantiles along the distribution, but so does the standard error. At the 75th quantile, an increase in 10 thousand dollars increases the consumption of alcohol by 0.2 drinks ($P < 0.01$). This is not a surprise since other studies also report that income may have a positive relationship with the amount of alcohol individuals consume (Chonviharnpan and Lewis, 2015; Harris et al., 2006; Pan et al., 2006). However, we cannot reject the null of no income effect at the mean or 90th quantile.

As respondents age they drink more alcohol at a decreasing rate for all three points estimated along the distribution of alcohol consumption. Married respondents drink 1.2 less drinks than those not married at the mean ($p < 0.01$), 1.4 less at the 75th quantile ($p < 0.05$), and 4.4 less at the 90th quantile ($p < 0.01$). Males drink 2.7 more drinks than females at the mean ($p < 0.01$), 4.4 more at the 75th quantile ($p < 0.01$), and 9.4 more at the 90th quantile ($p < 0.01$). These results are all consistent with other studies; Harris et al. (2006) find a positive relationship between age and alcohol consumption, Chonviharnpan and Lewis (2015) find married individuals drink less alcohol than those who are not married, and multiple studies find males to drink more alcohol than females (Chonviharnpan and Lewis, 2015; Harris et al., 2006; Pan et al., 2006; Nayga Jr et al., 1994).

An additional person living in the respondent's household decreases alcohol consumption by 0.2 drinks at the mean ($p < 0.05$), 0.5 drinks at the 75th quantile ($p < 0.01$), and 0.8 drinks at the 90th quantile ($p < 0.05$). Respondents born in Canada consume 0.9 more alcoholic drinks than immigrants at the mean ($p < 0.05$), and 2.1 more drinks at the 75th quantile ($p < 0.05$). This effect is not statistically significant at the 90th quantile. The results for both of these variables are consistent with other studies. The number of people living in a household is commonly found to have a negative relationship with alcohol consumption (Harris et al., 2006; Nayga, 1996; Nayga Jr et al., 1994). This may be since children are more likely to live in a household with more people, and children are also negatively related to the amount of alcohol consumed in a home (Harris et al., 2006; Nayga, 1996). Lower alcohol consumption is an interesting characteristic of immigrants in Canada, however immigrants in Norway are also found to drink less alcohol than those born in the country (Amundsen et al., 2005).

It is worth noting that we do not find community alcohol prohibition or Aboriginal ethnicity to affect drinking in northern Canada. This is interesting because it seems to contradict the notion that indigenous peoples in Canada and the US are more prone to struggle with alcohol abuse than the rest of the population (Spillane et al., 2012; Szlemko et al., 2006; Frank et al., 2000). Additionally, these results support claims that community prohibitions passed into effect to lower alcohol abuse do not actually decrease the amount of alcohol consumed.[24]

Respondents living in rural areas consume 0.6 less alcoholic drinks than those living in urban areas at the mean ($p < 0.1$), and 1.4 less drinks at the 75th quantile ($p < 0.1$). The effect is not statistically significant at the 90th quantile. During summer months respondents consume 1.2 more alcoholic drinks than other months at the mean ($p < 0.01$), 1.5 more drinks at the 75th quantile ($p < 0.05$), and 4.3 more drinks at the 90th quantile ($p < 0.05$). The results for neither of these variables are surprising. Individuals living in urban areas are commonly found to drink more alcohol than those living in rural areas (Nayga Jr et al., 1994; Chonviharnpan and Lewis, 2015). Studies also find that alcohol consumption is often seasonal (Nayga, 1996) – that individuals tend to drink more alcohol when the weather is nice and they can be outdoors (Silm and Ahas, 2005).

Results for FSA control variables show that time varying regional characteristics do affect alcohol consumption, which is consistent with findings from other studies (Pan et al., 2006; Nayga, 1996; Nayga Jr et al., 1994). For every additional 1000 people living in their FSA, respondents consume 0.2 less alcoholic drinks at the mean ($p < 0.05$). The effect however, is only statistically significant at the mean. For every additional one percent increase in the percentage of people using public transit in their FSA, respondents consume 0.4 less alcoholic drinks at the mean ($p < 0.1$), and 1.3 less drinks at the 75th quantile ($p < 0.05$). This effect is also not statistically significant at the 90th quantile. At first this may seem to contradict the effect of living in a rural area. However, FSAs are often larger regions that cover both

[24] Article accessed online through Maclean's website. Available at `http://www.macleans.ca/news/canada/the-end-of-the-dry-reserve/`.

rural and urban locations. Since these variables are capturing regional characteristics, the effects may be very different. While earlier findings show respondents drink more alcohol in urban centres, the FSA control variables suggest individuals drink less alcohol in more developed regions of the north.

Chapter 7: Concluding Remarks

7.1 Summary of Main Findings

We find a positive and significant ($p < 0.05$) relationship between mining and alcohol use by individuals living nearby. Mines operating within 10 km from respondent's residence increase the individual's alcohol consumption by 2 drinks per week. We also examine the spatial reach of such an effect, a dimension previously unexplored in the literature. The effect of mines on alcohol consumption decreases as mines get farther from respondents, showing the importance of accounting for spatial differentiation. Nevertheless, we find that mines located 30 km away from the place of residence can still have an impact on drinking. Interestingly, non base metal mines have a larger effect on individuals than all mine types combined, and the effect of mines is greater for individuals higher on the distribution of alcohol consumption. Using unconditional quantile regressions, we find that the presence of a mine increases weekly alcohol consumption by 2.8 and 6.6 drinks at the 75th and 90th quantiles of the drinking distribution, respectively. Other factors that affect alcohol consumption are income (to a very small extent), age, marital status, gender, the number of people living in a household, being born in Canada, living in a rural area, the season, and time varying FSA characteristics.

7.2 Policy Implications

An increase in alcohol consumption does not necessarily lead to negative impacts on the wellbeing of individuals in the community. The sociology literature on social and environmental impact assessments distinguishes between social change processes and social impacts

(Slootweg et al., 2001; Vanclay, 2002). Social change processes are started by project activities or policies, but only lead to social impacts in certain situations (Vanclay, 2002). An example of a social change process could be the influx of new transient workers into a resource community due to a new mining project. This doesn't necessarily lead to any impacts in the community, but has the potential to cause an increase in crime (Freudenburg and Jones, 1991), which would be a negative social impact. Given the possible negative consequences of excessive alcohol consumption (Baltagi and Goel, 1990; Carpenter, 2005a,b; Ruhm, 1996; McCambridge et al., 2011), and the comparative size of the effect, this could be considered a social change process with the potential to lead to negative social impacts in the community.

Alcohol consumption in northern Canada has been a long standing concern and the number of communities with some form of regulation increased dramatically in the 1970s (Davison et al., 2011). However, we are not able to find statistical evidence in support of the efficacy of alcohol regulation policies, i.e. consumption of alcohol in communities with and without regulation are not statistically different. This result suggests that direct alcohol regulation in mining communities would not be a viable avenue to counter the mining impacts estimated in this paper. We also do not find statistical evidence that individuals with Aboriginal ethnicity have different consumption behavior when compared to individuals of other ethnicities (e.g. English, French, or Chinese). This contrasts with previous research suggesting that indigenous peoples may be more prone to struggle with alcohol abuse than the rest of the population (Spillane et al., 2012; Szlemko et al., 2006; Frank et al., 2000).

Our estimate of a positive effect of mines on alcohol consumption is an example of one of the many possible social changes and effects that communities in close proximity to a mine may face (see discussion in chapter 2). Many of these small rural communities already struggle with poor social conditions, but the conditions are often made worse by the mine (Mactaggart et al., 2016; Parkins and Angell, 2011). Studies show that many times the benefits realized from mining never make it to those experiencing the greatest negative social effects (Carrington et al., 2011). In situations where these communities don't already enjoy their fair share of the benefits that come from mining, it seems fair for them to receive some form of compensation to make up for the social costs incurred. Literature seems to support this compensation through the creation of better services and systems within the community that can help improve social conditions (Shandro et al., 2011; Parkins and Angell, 2011; Veiga et al., 2001). One method to provide these services within the community is through a direct redistribution of benefits by the government. Governments like those in Canada already receive revenues from various mining taxes[25], however these revenues should be used in a manner that will effectively benefit the communities affected by the mining operations (Shandro et al., 2011).

Mining companies can also be encouraged to be more involved in helping the community by establishing adequate infrastructure (Veiga et al., 2001), and investing more strategically in the community's social development (Parkins and Angell, 2011). While ideally the companies would see the long term advantages and take these initiatives voluntarily, chances are that without the proper regulatory framework firms won't be interested in such long-term commitments. It may be necessary for the government to be more involved in regulating how companies invest in the communities. When working with Aboriginal communities, concrete plans of how communities will receive their share of the benefits from mining operations to avoid (or at least compensate) for negative effects and improve their social conditions should be carefully included in Impact and Benefit Agreements (IBAs).[26] Community leaders can also be more proactive in calling for change at the industry and social organization levels (Parkins and Angell, 2011). While policies and changes at the community or organizational level can definitely be beneficial, Freudenburg (1992) suggests the most important decisions may need to be made at a much broader level.

Since literature suggests that many social problems connected to mining in rural communities are due to disruptions in existing social, cultural, and economic systems (see chapter 3), investment in areas that will facilitate a smoother transition during resource development could be very beneficial. Among other possibilities to lower alcohol and substance abuse, Parkins and Angell (2011) suggest that prevention and treatment programs could be developed specifically for rural, resource based communities, employment conditions could be implemented that facilitate healthier lifestyles, and workshops could be offered in the workforce or community on topics such as stress reduction. The estimates of this thesis

[25] Refer to Statistics Canada's website for details. Available at `https://www.nrcan.gc.ca/mining-materials/taxation/8876`.

[26] IBAs are formal contracts that outline the impacts of the mining project, the commitments and responsibilities of both the Aboriginal community and mining company, and how the community will share in the benefits generated by the mining operation. More information on IBAs is available at `http://www.miningfacts.org/Communities/What-are-Impact-and-Benefit-Agreements-(IBAs)/`.

provide statistical measurements to help design and calibrate such policies. Through the use of many control variables in our study, as well as accounting for the spatial reach of the mines, our findings can help direct these policies to where they are most needed.

Factors that produce a more cohesive social and cultural structure are very important when communities face large disruptions from the outside. First Nation communities in British Columbia are found to have substantially lower suicide rates when they invest in programs and services that will support cultural continuity (Chandler and Lalonde, 1998). Among other factors more specific to First Nation communities, these include better education services, police and fire services, health services, and cultural facilities. These are other areas where proper investment could help improve social conditions during a resource development project.

7.3 Limitations of the Study and Future Work

One of the challenges associated with research on mining proximity and social indicators is the lack of global positioning data paired with socio-economic information. Putting this cross-sectional datafile together from the multiple data sources is in fact a large contribution of this study. However, when using this datafile we are limited to only the variables available with sufficient observations for northern Canada. The datafile is also not a perfect representation of northern Canada, since there are no respondents from certain more remote areas of interest. Most respondents are from the main communities in northern Canada.

Naturally, more detailed data, such as panel data, would allow for additional empirical approaches. Therefore, there would be clear returns to efforts from data collection agencies, research institutions, and policymakers to design and collect detailed alcohol and substance use information paired with other socioeconomic indicators, including precise locations. These data would allow a deeper investigation of the effects of not only mines, but also other large development projects, on various outcomes (e.g. crime, mental health, domestic violence, productivity) in small communities around the country. This would benefit socioeconomic research in Canada far past just the effects of mining in northern Canada. Research in Canada is greatly limited with only cross-sectional datafiles available. Additional quantitative research on these topics, perhaps using more detailed data, would offer important contributions to the literature on communities and mining.

While we are able to build a unique dataset to examine alcohol consumption in northern Canada, our data also faces important limitations. First, our alcohol consumption measure does not differentiate between types of alcoholic drinks. The 'number of alcoholic drinks' is a fairly vague measure of alcohol consumption as it does not specify the type or size of the respondent's drink. This is important because the negative externalities associated with excessive alcohol consumption are likely correlated with the alcohol content consumed. This information could greatly benefit our research. Second, our measure of alcohol consumption may suffer from measurement error bias as it relies on self-reported consumption. The validity of data can be a concern when data involves stated behavior as opposed to observed/revealed behavior (Adamowicz et al., 1994). Some studies find respondents to under-report the amount of alcohol they consume (Midanik, 1988; Del Boca and Darkes, 2003), which is quite common when surveying information that might be associated with social stigma. Third, note that the consumption, sale, purchase, or transportation of liquor is heavily regulated and often prohibited in North Canada. This adds another layer of concern about self-reported alcohol consumption as the social stigma around alcohol may be heightened in regulated communities, which in turn may lead to under-stated consumption. In this sense, our estimates of the mining impact on drinking are conservative estimates and represent a lower bound on the true mining effect. A test of this hypothesis would be possible if data from alcohol sales paired with GPS coordinates are available. In practice, however, this is problematic as alcohol sales are illegal in several Northern communities.

While these findings are a significant contribution to the literature on the community effects of mining, there are several limitations to our study. One limitation is the data available and used in the analysis. We have cross-sectional data and use empirical techniques to overcome identification challenges. Often, the best approach to estimate average treatment effects is a randomized control trial (RCT). Unfortunately, it is basically impossible to implement a RCT where mines are exogenously built across the country, or the location of residence of families are exogenously chosen within northern Canada.

Bibliography

Abadie, A. and G. W. Imbens (2016). Matching on the estimated propensity score. *Econometrica 84*(2), 781–807.

Acuña, R. M. (2015). The politics of extractive governance: Indigenous peoples and socio-environmental conflicts. *The Extractive Industries and Society 2*(1), 85–92.

Adamowicz, W., J. Louviere, and M. Williams (1994). Combining revealed and stated preference methods for valuing environmental amenities. *Journal of Environmental Economics and Management 26*(3), 271–292.

Akudugu, M. A., E. S. Mahama, and E. H. Atami (2013). The welfare impact of small-scale mining in the Talensi–Nabdam District of Ghana. *Mineral Economics 25*(2-3), 97–106.

Alonso, E., A. M. Sherman, T. J. Wallington, M. P. Everson, F. R. Field, R. Roth, and R. E. Kirchain (2012). Evaluating rare earth element availability: A case with revolutionary demand from clean technologies. *Environmental Science & Technology 46*(6), 3406–3414.

Amundsen, E. J., I. Rossow, and S. Skurtveit (2005). Drinking pattern among adolescents with immigrant and norwegian backgrounds: A two-way influence? *Addiction 100*(10), 1453–1463.

Aragón, F. M. and J. P. Rud (2013). Natural resources and local communities: evidence from a Peruvian gold mine. *American Economic Journal: Economic Policy 5*(2), 1–25.

Arezki, R. and F. Van der Ploeg (2011). Do natural resources depress income per capita? *Review of Development Economics 15*(3), 504–521.

Atkinson, G., S. Fullick, C. Grindey, D. Maclaren, and J. Waterhouse (2008). Exercise, energy balance and the shift worker. *Sports Medicine 38*(8), 671.

Baltagi, B. H. and R. K. Goel (1990). Quasi-experimental price elasticity of liquor demand in the United States: 1960–83. *American Journal of Agricultural Economics 72*(2), 451–454.

Banerjee, S. B. (2000). Whose land is it anyway? National interest, indigenous stakeholders, and colonial discourses: The case of the Jabiluka uranium mine. *Organization & Environment 13*(1), 3–38.

Bebbington, A. J. and J. T. Bury (2009). Institutional challenges for mining and sustainability in Peru. *Proceedings of the National Academy of Sciences 106*(41), 17296–17301.

Betz, M. R., M. D. Partridge, M. Farren, and L. Lobao (2015). Coal mining, economic development, and the natural resources curse. *Energy Economics 50*, 105–116.

Black, D., T. McKinnish, and S. Sanders (2005). The economic impact of the coal boom and bust. *The Economic Journal 115*(503), 449–476.

Boschini, A. D., J. Pettersson, and J. Roine (2007). Resource curse or not: A question of appropriability. *The Scandinavian Journal of Economics 109*(3), 593–617.

Brown, R. B., S. F. Dorins, and R. S. Krannich (2005). The boom-bust-recovery cycle: Dynamics of change in community satisfaction and social integration in Delta, Utah. *Rural Sociology 70*(1), 28–49.

Buell, M. (2006). Resource extraction development and well-being in the north: A scan of the unique challenges of development in Inuit communities. *Ajunnginiq Centre, National Aboriginal Health Organization*.

Carpenter, C. (2005a). Youth alcohol use and risky sexual behavior: evidence from underage drunk driving laws. *Journal of Health Economics 24*(3), 613–628.

Carpenter, C. S. (2005b). Heavy alcohol use and the commission of nuisance crime: Evidence from underage drunk driving laws. *American Economic Review*, 267–272.

Carrington, K., R. Hogg, and A. McIntosh (2011). The resource boom's underbelly: Criminological impacts of mining development. *Australian & New Zealand Journal of Criminology 44*(3), 335–354.

Caxaj, C. S., H. Berman, C. Varcoe, S. L. Ray, and J.-P. Restoulec (2014). Gold mining on Mayan-Mam territory: Social unravelling, discord and distress in the Western highlands of Guatemala. *Social Science & Medicine 111*, 50–57.

Chandler, M. J. and C. Lalonde (1998). Cultural continuity as a hedge against suicide in Canada's First Nations. *Transcultural Psychiatry 35*(2), 191–219.

Chandler, M. J. and C. E. Lalonde (2008). Cultural continuity as a moderator of suicide risk among Canada's First Nations. *Healing Traditions: The Mental Health of Aboriginal Peoples in Canada*, 221–248.

Chen, Y., A. Ebenstein, M. Greenstone, and H. Li (2013). Evidence on the impact of sustained exposure to air pollution on life expectancy from China's Huai River policy. *Proceedings of the National Academy of Sciences 110*(32), 12936–12941.

Chonviharnpan, B. and P. Lewis (2015). The demand for alcohol in Thailand. *Economic Papers: A Journal of Applied Economics and Policy 34*(1-2), 23–35.

Dai, G., S. Ulgiati, Y. Zhang, B. Yu, M. Kang, Y. Jin, X. Dong, and X. Zhang (2014). The false promises of coal exploitation: How mining affects herdsmen well-being in the grassland ecosystems of Inner Mongolia. *Energy Policy 67*, 146–153.

Davis, G. A. (1995). Learning to love the Dutch disease: Evidence from the mineral economies. *World Development 23*(10), 1765–1779.

Davison, C. M., C. S. Ford, P. A. Peters, and P. Hawe (2011). Community-driven alcohol policy in Canada's northern territories 1970–2008. *Health Policy 102*(1), 34–40.

Del Boca, F. K. and J. Darkes (2003). The validity of self-reports of alcohol consumption: state of the science and challenges for research. *Addiction 98*(s2), 1–12.

Ding, N. and B. C. Field (2005). Natural resource abundance and economic growths. *Land Economics 81*(4), 496–502.

England, J. L. and S. L. Albrecht (1984). Boomtowns and social disruption. *Rural Sociology 49*(2), 230.

Firpo, S., N. M. Fortin, and T. Lemieux (2009). Unconditional quantile regressions. *Econometrica 77*(3), 953–973.

Fitzpatrick, L. and C. Parmeter (2017). Mines in the housing market. *Ohio University Working Paper*.

Frank, J. W., R. S. Moore, and G. M. Ames (2000). Historical and cultural roots of drinking problems among American Indians. *American Journal of Public Health 90*(3), 344–351.

Frederikson, A. and M. D. Kadenic (2016). Mining in Arctic and non-Arctic regions: A socioeconomic assessment. *IZA Discussion Papers* (9883), 1–27.

Freudenburg, W. R. (1992). Addictive economies: Extractive industries and vulnerable localities in a changing world economy. *Rural Sociology 57*(3), 305–332.

Freudenburg, W. R. and R. E. Jones (1991). Criminal behavior and rapid community growth: Examining the evidence. *Rural Sociology 56*(4), 619–645.

Gibson, G. and J. Klinck (2005). Canada's resilient north: The impact of mining on Aboriginal communities. *Pimatisiwin 3*(1), 116–139.

Gibson, R. B. (2006). Sustainability assessment and conflict resolution: Reaching agreement to proceed with the Voisey's Bay nickel mine. *Journal of Cleaner Production 14*(3), 334–348.

Gilbert, N. (2010). Mountain mining damages streams: study shows that stripping mountains for coal has a much greater impact than urban growth. *Nature 466*(7308), 806–807.

Gill, A. M. (1990). Women in isolated resource towns: an examination of gender differences in cognitive structures. *Geoforum 21*(3), 347–358.

Government of Northwest Territories (1980). *Revised Regulations of the Northwest Territories, 1980*. Government of Northwest Territories. Yellowknife: Territorial Printer.

Government of Northwest Territories (1990). *Northwest Territories Gazette Part 2*. Government of Northwest Territories. Yellowknife: Territorial Printer.

Government of Northwest Territories (1991). *Northwest Territories Gazette Part 2*. Government of Northwest Territories. Yellowknife: Territorial Printer.

Government of Northwest Territories (1992a). *Northwest Territories Gazette Part 2*. Government of Northwest Territories. Yellowknife: Territorial Printer.

Government of Northwest Territories (1992b). *Revised Regulations of the Northwest Territories, 1990*. Government of Northwest Territories. Yellowknife: Territorial Printer.

Government of Northwest Territories (1993). *Northwest Territories Gazette Part 2*. Government of Northwest Territories. Yellowknife: Territorial Printer.

Government of Northwest Territories (1994). *Northwest Territories Gazette Part 2*. Government of Northwest Territories. Yellowknife: Territorial Printer.

Gramling, R. and W. R. Freudenburg (1992). Opportunity-threat, development, and adaptation: Toward a comprehensive framework for social impact assessment. *Rural Sociology 57*(2), 216–234.

Greer, L. and K. Stokes (2011). Divorce and separation in the Australian mining sector: Is it what we expect. *Report for the Minerals Futures Collaboration Cluster in CSIRO Minerals Down Under National Research Flagship Regions in Transition: Social Impacts of Mining*.

Gunderson, M. (1979). Earnings differentials between the public and private sectors. *Canadian Journal of Economics*, 228–242.

Hannington, M., S. Petersen, and A. Krätschell (2017). Subsea mining moves closer to shore. *Nature Geoscience 10*(3), 158–159.

Harris, M. N., P. Ramful, and X. Zhao (2006). An ordered generalised extreme value model with application to alcohol consumption in Australia. *Journal of Health Economics 25*(4), 782–801.

Hendryx, M. and M. M. Ahern (2008). Relations between health indicators and residential proximity to coal mining in West Virginia. *American Journal of Public Health 98*(4), 669–671.

Hendryx, M., M. M. Ahern, and T. R. Nurkiewicz (2007). Hospitalization patterns associated with Appalachian coal mining. *Journal of Toxicology and Environmental Health, Part A 70*(24), 2064–2070.

Hilson, G. (2002). An overview of land use conflicts in mining communities. *Land Use Policy 19*(1), 65–73.

Jacobsen, G. D. and D. P. Parker (2014). The economic aftermath of resource booms: evidence from boomtowns in the American West. *The Economic Journal*.

Jamieson, H. E. (2014). The legacy of arsenic contamination from mining and processing refractory gold ore at Giant Mine, Yellowknife, Northwest Territories, Canada. *Reviews in Mineralogy and Geochemistry 79*(1), 533–551.

Kirmayer, L. J., G. M. Brass, and C. L. Tait (2000). The mental health of Aboriginal peoples: Transformations of identity and community. *The Canadian Journal of Psychiatry 45*(7), 607–616.

Kitula, A. (2006). The environmental and socio-economic impacts of mining on local livelihoods in Tanzania: A case study of Geita District. *Journal of Cleaner Production 14*(3), 405–414.

Kotey, B. and J. Rolfe (2014). Demographic and economic impact of mining on remote communities in Australia. *Resources Policy 42*, 65–72.

Kotsadam, A., A. Tolonen, et al. (2013). Mineral mining and female employment. *Oxcarre Research Papers 114*, 1–48.

Krannich, R. S. and T. Greider (1984). Personal well-being in rapid growth and stable communities: Multiple indicators and contrasting results. *Rural Sociology 49*(4), 541.

Lawrie, M., M. Tonts, and P. Plummer (2011). Boomtowns, resource dependence and socio-economic well-being. *Australian Geographer 42*(2), 139–164.

Lemieux, T. and D. Card (2001). Education, earnings, and the 'Canadian GI Bill'. *Canadian Journal of Economics/Revue Canadienne d'Économique 34*(2), 313–344.

Lindberg, T. T., E. S. Bernhardt, R. Bier, A. Helton, R. B. Merola, A. Vengosh, and R. T. Di Giulio (2011). Cumulative impacts of mountaintop mining on an Appalachian watershed. *Proceedings of the National Academy of Sciences 108*(52), 20929–20934.

Mactaggart, F., L. McDermott, A. Tynan, and C. Gericke (2016). Examining health and well-being outcomes associated with mining activity in rural communities of high-income countries: A systematic review. *Australian Journal of Rural Health*.

Manning, W. G., L. Blumberg, and L. H. Moulton (1995). The demand for alcohol: the differential response to price. *Journal of Health Economics 14*(2), 123–148.

Mathes, M. (2014). Effects of casinos on alcohol behaviors: Evidence from Native American casino openings. *Working Paper, Providence College*.

Mauthner, N. S., C. Maclean, and L. McKee (2000). 'My dad hangs out of helicopter doors and takes pictures of oil platforms': Children's accounts of parental work in the oil and gas industry. *Community, Work & Family 3*(2), 133–162.

McCambridge, J., J. McAlaney, and R. Rowe (2011). Adult consequences of late adolescent alcohol consumption: a systematic review of cohort studies. *PLoS Med 8*(2), e1000413.

Mehlum, H., K. Moene, and R. Torvik (2006). Institutions and the resource curse. *The Economic Journal 116*(508), 1–20.

Midanik, L. T. (1988). Validity of self-reported alcohol use: A literature review and assessment. *Addiction 83*(9), 1019–1029.

Moritz, T., T. Ejdemo, P. Söderholm, and L. Wårell (2017). The local employment impacts of mining: An econometric analysis of job multipliers in northern Sweden. *Mineral Economics 30*(1), 53–65.

Natural Resources Canada (2001). *Geological Survey of Canada, "A" Series Map 900A (ed. 51)*. Natural Resources Canada. Available at `http://geoscan.nrcan.gc.ca/starweb/`

geoscan/servlet.starweb?path=geoscan/shorte.web&search1=(%28WEBBI%3d%28%28%22900A%22%29%29+OR+R%3d%28%28%22900A%22%29%29%29).

Natural Resources Canada (2002). *Geological Survey of Canada, "A" Series Map 900A (ed. 52).* Natural Resources Canada. Available at http://geoscan.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/shorte.web&search1=(%28WEBBI%3d%28%28%22900A%22%29%29+OR+R%3d%28%28%22900A%22%29%29%29).

Natural Resources Canada (2007). *Geological Survey of Canada, "A" Series Map 900A (ed. 56, 2006).* Natural Resources Canada. Available at http://geoscan.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/shorte.web&search1=(%28WEBBI%3d%28%28%22900A%22%29%29+OR+R%3d%28%28%22900A%22%29%29%29).

Natural Resources Canada (2008). *Geological Survey of Canada, "A" Series Map 900A (ed. 57, 2007).* Natural Resources Canada. Available at http://geoscan.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/shorte.web&search1=(%28WEBBI%3d%28%28%22900A%22%29%29+OR+R%3d%28%28%22900A%22%29%29%29).

Natural Resources Canada (2013). *Geological Survey of Canada, "A" Series Map 900A (ed. 62, 2012).* Natural Resources Canada. Available at http://geoscan.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/shorte.web&search1=(%28WEBBI%3d%28%28%22900A%22%29%29+OR+R%3d%28%28%22900A%22%29%29%29).

Natural Resources Canada (2014). *Geological Survey of Canada, "A" Series Map 900A (ed. 63, 2013).* Natural Resources Canada. Available at http://geoscan.nrcan.gc.ca/starweb/geoscan/servlet.starweb?path=geoscan/shorte.web&search1=(%28WEBBI%3d%28%28%22900A%22%29%29+OR+R%3d%28%28%22900A%22%29%29%29).

Nayga, R. M. (1996). Sample selectivity models for away from home expenditures on wine and beer. *Applied Economics 28*(11), 1421–1425.

Nayga Jr, R. M., O. Capps Jr, et al. (1994). Analysis of alcohol consumption in the United States: Probability and level of intake. *Journal of Food Distribution Research 25*(2).

Neumayer, E. (2004). Does the "resource curse" hold for growth in genuine income as well? *World Development 32*(10), 1627–1640.

Ng, J. C., J. Wang, and A. Shraim (2003). A global health problem caused by arsenic from natural sources. *Chemosphere 52*(9), 1353–1359.

Nriagu, J. O. (1996). A history of global metal pollution. *Science 272*(5259), 223.

O'Connor, C. D. (2015). Insiders and outsiders: social change, deviant others, and sense of community in a boomtown. *International Journal of Comparative and Applied Criminal Justice 39*(3), 219–238.

Palmer, M. A., E. S. Bernhardt, W. H. Schlesinger, K. N. Eshleman, E. Foufoula-Georgiou, M. S. Hendryx, A. Lemly, G. Likens, O. Loucks, M. Power, et al. (2010). Mountaintop mining consequences. *Science 327*(5962), 148–149.

Pan, S., C. Fang, and J. Malaga (2006). Alcoholic beverage consumption in China: a censored demand system approach. *Applied Economics Letters 13*(15), 975–979.

Parkes, K. R., S. C. Carnell, and E. L. Farmer (2005). 'Living two lives' perceptions, attitudes and experiences of spouses of UK offshore workers. *Community, Work and Family 8*(4), 413–437.

Parkins, J. R. and A. C. Angell (2011). Linking social structure, fragmentation, and substance abuse in a resource-based community. *Community, Work & Family 14*(1), 39–55.

Parlee, B., J. O'Neil, and L. K. D. F. Nation (2007). "The Dene Way of Life": Perspectives on health from Canada's North. *Journal of Canadian Studies/Revue d'Études Canadiennes 41*(3), 112–133.

Pegg, S. (2006). Mining and poverty reduction: Transforming rhetoric into reality. *Journal of Cleaner Production 14*(3), 376–387.

Picone, G., J. MacDougald, F. Sloan, A. Platt, and S. Kertesz (2010). The effects of residential proximity to bars on alcohol consumption. *International Journal of Health Care Finance and Economics 10*(4), 347–367.

Plumlee, G. S. and S. A. Morman (2011). Mine wastes and human health. *Elements 7*(6), 399–404.

Prowse, T. D., C. Furgal, R. Chouinard, H. Melling, D. Milburn, and S. L. Smith (2009). Implications of climate change for economic development in northern Canada: Energy, resource, and transportation sectors. *AMBIO: A Journal of the Human Environment 38*(5), 272–281.

Robinson, J. A., D. Acemoglu, and S. Johnson (2003). *An African Success Story: Botswana*, pp. 80–119. Princeton: Princeton University Press.

Rolfe, J., B. Miles, S. Lockie, and G. Ivanova (2007). Lessons from the social and economic impacts of the mining boom in the Bowen Basin 2004-2006. *Australasian Journal of Regional Studies 13*(2), 134.

Rooney, R. C., S. E. Bayley, and D. W. Schindler (2012). Oil sands mining and reclamation cause massive loss of peatland and stored carbon. *Proceedings of the National Academy of Sciences 109*(13), 4933–4937.

Rosenbaum, P. R. and D. B. Rubin (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika 70*(1), 41–55.

Ruhm, C. J. (1996). Alcohol policies and highway vehicle fatalities. *Journal of Health Economics 15*(4), 435–454.

Sachs, J. D. and A. M. Warner (1995). Natural resource abundance and economic growth. Technical report, National Bureau of Economic Research.

Sachs, J. D. and A. M. Warner (1999). The big push, natural resource booms and growth. *Journal of Development Economics 59*(1), 43–76.

Saffer, H. and D. Dave (2002). Alcohol consumption and alcohol advertising bans. *Applied Economics 34*(11), 1325–1334.

Shandro, J. A., M. M. Veiga, J. Shoveller, M. Scoble, and M. Koehoorn (2011). Perspectives on community health issues and the mining boom–bust cycle. *Resources Policy 36*(2), 178–186.

Sharma, S. (2010). The impact of mining on women: lessons from the coal mining Bowen Basin of Queensland, Australia. *Impact Assessment and Project Appraisal 28*(3), 201–215.

Silm, S. and R. Ahas (2005). Seasonality of alcohol-related phenomena in Estonia. *International Journal of Biometeorology 49*(4), 215–223.

Slootweg, R., F. Vanclay, and M. van Schooten (2001). Function evaluation as a framework for the integration of social and environmental impact assessment. *Impact Assessment and Project Appraisal 19*(1), 19–28.

Smith, M. D., R. S. Krannich, and L. M. Hunter (2001). Growth, decline, stability, and disruption: A longitudinal analysis of social well-being in four western rural communities. *Rural Sociology 66*(3), 425–450.

Spillane, N. S., M. A. Cyders, and K. Maurelli (2012). Negative urgency, problem drinking and negative alcohol expectancies among members from one First Nation: A moderated-mediation model. *Addictive Behaviors 37*(11), 1285–1288.

Statistics Canada (2016). *Postal CodeOM Conversion File (PCCF).* Statistics Canada. Catalogue no. 92-154-X.

Stedman, R. C., J. R. Parkins, and T. M. Beckley (2004). Resource dependence and community well-being in rural Canada. *Rural Sociology 69*(2), 213–234.

Stern, D. I. (1995). The contribution of the mining sector to sustainability in developing countries. *Ecological Economics 13*(1), 53–63.

Suleman, D., S. Mariwah, and C. A. Mensah. Left to their fate? Effects of mining on the environment and wellbeing of residents in the Asutifi District, Ghana.

Swenson, J. J., C. E. Carter, J.-C. Domec, and C. I. Delgado (2011). Gold mining in the Peruvian Amazon: global prices, deforestation, and mercury imports. *PloS one 6*(4), e18875.

Szlemko, W. J., J. W. Wood, and P. J. Thurman (2006). Native Americans and alcohol: past, present, and future. *The Journal of General Psychology 133*(4), 435–451.

Temper, L. and J. Martinez-Alier (2013). The god of the mountain and Godavarman: Net present value, indigenous territorial rights and sacredness in a bauxite mining conflict in India. *Ecological Economics 96*, 79–87.

Trinkoff, A. M. and C. L. Storr (1998). Work schedule characteristics and substance use in nurses. *American Journal of Industrial Medicine 34*(3), 266–271.

Van der Ploeg, F. (2011). Natural resources: Curse or blessing? *Journal of Economic Literature 49*(2), 366–420.

Vanclay, F. (2002). Conceptualising social impacts. *Environmental Impact Assessment Review 22*(3), 183–211.

Veiga, M. M., M. Scoble, and M. L. McAllister (2001). Mining with communities. In *Natural Resources Forum*, Volume 25, pp. 191–202. Wiley Online Library.

Vodden, K. and H. Hall (2016). Long distance commuting in the mining and oil and gas sectors: Implications for rural regions. *The Extractive Industries and Society 3*(3), 577–583.

von der Goltz, J. and P. Barnwal (2017). Mines: the local wealth and health effects of mineral mining in developing countries. *Columbia University Working Paper*.

Walker, J. L., B. Mitchell, and S. Wismer (2000). Impacts during project anticipation in Molas, Indonesia: Implications for social impact assessment. *Environmental Impact Assessment Review 20*(5), 513–535.

Wang, S. and C. N. Mulligan (2006). Occurrence of arsenic contamination in Canada: sources, behavior and distribution. *Science of the Total Environment 366*(2), 701–721.

White, R. (2013). Resource extraction leaves something behind: Environmental justice and mining. *International Journal for Crime and Justice 2*(1), 50–64.

Wilkinson, R. G. and K. E. Pickett (2009). Income inequality and social dysfunction. *Annual Review of Sociology 35*, 493–511.

Wilson, N. (2012). Economic booms and risky sexual behavior: Evidence from Zambian copper mining cities. *Journal of Health Economics 31*(6), 797–812.

Appendix-A: Propensity Score

Table A1 shows the first and second stage results for the PSM approach. Each column corresponds to a model with a different definition of treatment based on the radius $r \in \{10, 20, 30, 40, 50, 100\}$ km. Results indicate interesting relationships between our covariates and the probability of living near a mine. The marginal effects of covariates on the probability of treatment are fairly consistent across regressions for different mine distances. As such, we focus on the estimates for the 10 km model.

We find statistical evidence of seven covariates influencing the location of residence decision, namely: income, home ownership, food security, marital status, Canadian born, Aboriginal ethnicity, and level of physical activity. On average, an increase of ten thousand dollars in household income decreases the probability of an individual living within 10 km from a mine by 0.2 percent ($p < 0.1$) – an economically small effect. It is interesting how this differs from some of the more common findings in other research (Black et al., 2005; Kitula, 2006), but chapter 2 does discuss how income can be either positively or negatively related to mining. Nicer neighbourhoods in the community are also probably not right next to the mines, causing individuals with higher incomes to choose to live farther away.

Respondents who live in a home owned by an individual in the household are 2.3 percent more likely to live within 10 km of a mine ($p < 0.05$), and individuals who live in a home that is food secure are 2.7 percent more likely to live within 10 km of a mine ($p < 0.05$). These relationships may be capturing some of the economic benefits of mining (Stedman et al., 2004; Black et al., 2005). Most communities in northern Canada struggle with food insecurity,[27] so positive economic gains from the mine could give them an advantage over other northern communities.

Married individuals are 2.6 percent more likely to live within 10 km of a mine ($p < 0.05$), and individuals born in Canada are 2.8 percent more likely to live within 10 km of a mine ($p < 0.05$). While many might picture mining communities full of young single males, it has been a priority of employers in these resource communities to stabilize the workforce with married individuals since the 1970s (Gill, 1990). If married individuals have more responsibilities in the family they may also feel an obligation to live in areas close to mines for better employment opportunities. Immigrants in Canada are more likely to live in large

[27] Refer to Statistics Canada's website for details. Available at `http://www.statcan.gc.ca/pub/75-006-x/2017001/article/14774-eng.htm`.

cities than individuals born in Canada,[28] and mines are usually not located in the centre of town or a large city. This could explain the higher probability of individuals born in Canada living close to mines.

Lastly, individuals with Aboriginal ethnic origin are 14.3 percent less likely to live within 10 km of a mine ($p < 0.01$), and individuals who are physically active are 1.9 percent less likely to live within 10 km of a mine ($p < 0.05$). As demonstrated by Voisey's Bay nickel mine (Gibson, 2006), gaining permission to mine on Aboriginal land can be an added challenge for mining companies. This could explain the substantially lower probability of individuals with Aboriginal ethnic origin living near a mine in northern Canada. Shift work, which is discussed in chapter 3 as a common characteristic of mining communities, often decreases the opportunities for individuals to exercise and participate in sports (Atkinson et al., 2008). This could explain why individuals who spend less time in leisure physical activity are more likely to live near a mine.

[28]Refer to Statistics Canada's website for details. Available at `http://www12.statcan.gc.ca/nhs-enm/2011/as-sa/99-010-x/99-010-x2011001-eng.cfm`.

Table A1: Propensity Score Matching: First and Second Stage Estimates

	10 km	20 km	30 km	40 km	50 km	100 km
First Stage Results						
Income and Employment						
Household Income	-0.002*	-0.002*	-0.002	-0.001	-0.002**	-0.003**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Unemployed	0.009	0.009	0.007	0.005	0.012	0.054*
	(0.022)	(0.022)	(0.022)	(0.023)	(0.024)	(0.029)
Home Owner	0.023**	0.023**	0.021**	0.022**	0.017*	0.031**
	(0.010)	(0.010)	(0.010)	(0.010)	(0.011)	(0.013)
Household Food Security	0.027**	0.027**	0.026**	0.024*	0.016	0.007
	(0.013)	(0.013)	(0.013)	(0.013)	(0.014)	(0.017)
Human Capital						
Years of Education	0.002	0.002	0.002	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Community Belonging	-0.000	-0.000	-0.001	-0.001	0.008	0.011
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.014)
Demographics						
Age	0.001	0.001	0.001	0.001	0.002	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Age Squared	-0.00002	-0.00002	-0.00003	-0.00002	-0.00004	-0.00004
	(0.00002)	(0.00002)	(0.00002)	(0.00002)	(0.00002)	(0.00003)
Married	0.026**	0.026**	0.026**	0.027**	0.026**	-0.003
	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)	(0.014)
Male	0.006	0.006	0.006	0.007	0.009	0.002
	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.012)
Household Size	-0.002	-0.002	-0.002	-0.002	-0.006	0.006
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Born in Canada	0.028**	0.028**	0.029**	0.028**	0.026*	0.030
	(0.012)	(0.012)	(0.012)	(0.012)	(0.014)	(0.019)
Aboriginal Ethnic Origin	-0.143***	-0.143***	-0.144***	-0.141***	-0.150***	-0.108***
	(0.011)	(0.011)	(0.011)	(0.012)	(0.012)	(0.014)
Physical Activity/Summer						
Physically Active	-0.019**	-0.019**	-0.018*	-0.017*	-0.016	-0.018
	(0.010)	(0.010)	(0.010)	(0.010)	(0.011)	(0.014)
Summer	-0.008	-0.008	-0.009	-0.008	-0.010	-0.016
	(0.010)	(0.010)	(0.010)	(0.010)	(0.011)	(0.014)
Second Stage Results						
ATE	2.010***	2.010***	1.382**	0.886	0.594	0.527
	(0.691)	(0.691)	(0.654)	(0.586)	(0.509)	(0.417)

Sample Size: N=3928. *** $P < 0.01$, ** $P < 0.05$, *$P < 0.1$. First stage: Panel reports marginal effects evaluated at the mean. Standard errors are reported in parentheses. Second stage: Abadie and Imbens (2016) standard errors are reported in parentheses.

Appendix-B: Propensity Score – Excluding Base Metal Mines

Table B1: Propensity Score Matching: First and Second Stage Estimates – Excluding Base Metal Mines

	10 Km	20 Km	30Km	40 Km	50 Km
First Stage Results					
Income and Employment					
Household Income	-0.002*	-0.002*	-0.002*	-0.002*	-0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Unemployed	0.009	0.009	0.009	0.009	0.008
	(0.022)	(0.022)	(0.022)	(0.022)	(0.023)
Home Owner	0.023**	0.023**	0.023**	0.023**	0.021**
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Household Food Security	0.027**	0.027**	0.027**	0.027**	0.015
	(0.013)	(0.013)	(0.013)	(0.013)	(0.014)
Human Capital					
Years of Education	0.002	0.002	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Community Belonging	-0.0003	-0.0003	-0.0005	-0.0005	0.0082
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Demographics					
Age	0.001	0.001	0.001	0.001	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Age Squared	-0.00002	-0.00002	-0.00002	-0.00002	-0.00004
	(0.00002)	(0.00002)	(0.00002)	(0.00002)	(0.00002)
Married	0.026**	0.026**	0.026**	0.026**	0.024**
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Male	0.006	0.006	0.006	0.006	0.007
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Household Size	-0.002	-0.002	-0.002	-0.002	-0.006
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Born in Canada	0.028**	0.028**	0.028**	0.028**	0.024*
	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)
Aboriginal Ethnic Origin	-0.143***	-0.143***	-0.143***	-0.143***	-0.156***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)
Physical Activity/Summer					
Physically Active	-0.019**	-0.019**	-0.019*	-0.019*	-0.019*
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Summer	-0.008	-0.008	-0.008	-0.008	-0.008
	(0.010)	(0.010)	(0.010)	(0.010)	(0.011)
Second Stage Results					
ATE	2.010***	2.010***	1.738***	1.736**	1.012
	(0.691)	(0.691)	(0.671)	(0.674)	(0.628)

Sample Size: N=3928-3810. There is a small variation in sample size between models. As a result, we cannot disclose the exact number of observations of each model as it would violate Statistics Canada's confidentiality policy. *** $P < 0.01$, ** $P < 0.05$, *$P < 0.1$. First stage: Panel reports marginal effects evaluated at the mean. Standard errors are reported in parentheses. Second stage: Abadie and Imbens (2016) standard errors are reported in parentheses.

Appendix-C: Unconditional Quantile Regressions

Table C1: Unconditional Quantile Regressions

	Mean	75th Quantile	90th Quantile
Mines within 10 km	2.299***	2.815**	6.609*
	(0.809)	(1.433)	(3.548)
Income and Employment			
Household Income	0.051	0.227***	0.080
	(0.034)	(0.081)	(0.149)
Unemployed	0.211	1.225	3.725
	(0.605)	(1.062)	(2.930)
Home Owner	0.475	0.696	2.603*
	(0.342)	(0.599)	(1.415)
Household Food Security	0.569	0.659	0.757
	(0.364)	(0.655)	(1.434)
Human Capital			
Years of Education	0.019	0.108	0.088
	(0.050)	(0.094)	(0.189)
Community Belonging	-0.214	-0.060	0.498
	(0.450)	(0.620)	(1.419)
Demographics			
Age	0.196***	0.280***	0.570**
	(0.062)	(0.104)	(0.260)
Age Squared	-0.003***	-0.004***	-0.008**
	(0.001)	(0.001)	(0.003)
Married	-1.157***	-1.446**	-4.423***
	(0.377)	(0.582)	(1.454)
Male	2.714***	4.386***	9.389***
	(0.322)	(0.565)	(1.348)
Household Size	-0.203**	-0.467***	-0.798**
	(0.092)	(0.140)	(0.326)
Born in Canada	0.864**	2.051**	1.934
	(0.405)	(0.981)	(1.926)
Aboriginal Ethnic Origin	0.043	-0.240	0.247
	(0.465)	(0.679)	(1.614)
Physical Activity/Location/Summer			
Physically Active	-0.327	-0.790	-1.905
	(0.416)	(0.638)	(1.493)
Rural	-0.607*	-1.374*	-0.405
	(0.343)	(0.718)	(1.620)
Community Prohibition	0.008	-1.464	2.714
	(0.663)	(1.078)	(3.080)
Summer	1.174***	1.467**	4.261**
	(0.382)	(0.709)	(1.779)
4 Polynomial Orders of Latitude			
Latitude 1st Polynomial Order	-155.291	459.788	-1983.657
	(347.306)	(745.729)	(1585.229)
Latitude 2nd Polynomial Order	4.343	-9.653	50.337
	(8.275)	(17.828)	(37.660)
Latitude 3rd Polynomial Order	-0.052	0.089	-0.560
	(0.087)	(0.189)	(0.396)
Latitude 4th Polynomial Order	0.0002	-0.0003	0.002
	(0.0003)	(0.001)	(0.002)
4 Polynomial Orders of Temperature			
Temperature 1st Polynomial Order	0.503	1.419	3.538
	(0.629)	(1.285)	(2.810)
Temperature 2nd Polynomial Order	0.085	0.441	0.535
	(0.162)	(0.313)	(0.725)
Temperature 3rd Polynomial Order	-0.002	0.034	-0.011
	(0.017)	(0.032)	(0.075)
Temperature 4th Polynomial Order	-0.00028	0.001	-0.002
	(0.001)	(0.001)	(0.003)
FSA Controls			
FSA Population	-0.173**	-0.272	-0.354
	(0.088)	(0.229)	(0.458)
FSA Percent Using Public Transit	-0.408*	-1.321**	-0.919
	(0.231)	(0.564)	(1.085)
Constant	1963.316	-8135.731	28845.824
	(5446.862)	(11641.851)	(24950.893)
R Squared	0.106	0.136	0.092

Sample Size: N=3928. Robust standard errors are reported in parentheses. *** $P < 0.01$, ** $P < 0.05$, *$P < 0.1$. All regressions include FSA and survey cycle fixed effects.

Appendix-D: Datafile Creation Procedure

The data file used for this analysis is created using multiple data sources. The first of these are the Master Data Files for the 2000-2001, 2005-2006, and 2011-2012 survey cycles of the Canadian Community Health Survey (CCHS). These are confidential micro-data files accessed through a Statistics Canada Research Data Centre (RDC) on the University of Alberta campus. The master data files differ from the public use micro-data files through the availability of more specific and precise variables (e.g. more precise data are available for income and location variables are as specific as postal code in the master files). There are multiple ways to gain access to data inside a Statistics Canada RDC depending on the type of research,[29] however as faculty research we completed an online application form on the Social Sciences and Humanities Research Council (SSHRC) webpage, which included a research proposal. The proposal is then evaluated by two academic peers and a Statistics Canada Subject Matter Expert before being approved. This process takes about 3 months. After the proposal is approved, researchers must complete a security screening process and orientation before working inside the RDC. The data approved for the project can only be accessed inside the RDC, where all analysis must take place.[30] All results must also go through a Statistics Canada vetting process before being released to ensure confidentiality is maintained. In order to obtain new data, amend the contract, or other related tasks, procedures need to be followed that are outlined in the Guide for Researchers under Agreement with Statistics Canada.[31]

Approved data can be uploaded into the RDC through the RDC analyst, however once data are uploaded they cannot be released. In order to conduct our analysis we uploaded multiple data files into the RDC. The first of these was a portion of Statistics Canada's Postal Code Conversion File (PCCF). The PCCF links all Canadian postal codes to standard geographic areas and GPS coordinates (longitude and latitude) of all postal code representative points.[32] Due to Statistics Canada's Data Liberation Initiative, access to the PCCF was

[29] Information on application process and guidelines for RDCs is available at `http://www.statcan.gc.ca/eng/rdc/process`.

[30] There is no internet access for researchers inside the RDC, and cell phone use is restricted. All additional data, packages for statistical software, or information of any kind must be brought into the RDC through the RDC analyst, a full-time employee of Statistics Canada stationed at the RDC. This significantly slows down the research process, but ensures all data are kept secure.

[31] The guide can be requested through Statistics Canada's website, available at `http://www.statcan.gc.ca/eng/rdc/process`.

[32] Additional information on the PCCF can be accessed through a Statistics Canada website, available at `http://www.statcan.gc.ca/pub/92-154-g/2013001/overview-apercu-eng.htm`.

gained through a data librarian at the University of Alberta. The PCCF then enabled us to link GPS coordinates to each of the CCHS respondents.

Additional data files uploaded into the RDC include data on mines from Natural Resources Canada (Natural Resources Canada, 2001, 2002, 2007, 2008, 2013, 2014), data on temperature from Environment and Climate Change Canada,[33] census data for FSAs from Statistics Canada,[34] and a data file on community alcohol regulations in northern Canada constructed from multiple sources.[35] Each of these data files were downloaded or constructed from their sources, cleaned, and prepared for analysis outside the RDC before being uploaded into the RDC for use. Data were then linked to the CCHS respondents through postal codes or nearest GPS coordinates (for temperature data), or used to create new variables that capture proximity (e.g. distance between respondent and mines). Combining these data creates a unique and rich data file with socio-economic information and precise location on individuals living across Canada.

[33]Data available at http://climate.weather.gc.ca/prods_servs/cdn_climate_summary_e.html.

[34]FSA data are from the Canadian Census Area Profiles and the National Household Survey. 2001 Census Area Profiles are available at http://www12.statcan.gc.ca/english/census01/products/standard/profiles/Rp-eng.cfm?LANG=E&APATH=1&DETAIL=0&DIM=0&FL=A&FREE=0&GC=0&GID=0&GK=0&GRP=1&PID=72850&PRID=0&PTYPE=56079&S=0&SHOWALL=0&SUB=0&Temporal=2001&THEME=57&VID=0&VNAMEE=&VNAMEF=. 2006 Census Area Profiles are available at http://www12.statcan.gc.ca/census-recensement/2006/dp-pd/prof/rel/Rp-eng.cfm?LANG=E&APATH=3&DETAIL=1&DIM=0&FL=A&FREE=1&GC=0&GID=0&GK=0&GRP=1&PID=94535&PRID=0&PTYPE=89103&S=0&SHOWALL=No&SUB=0&Temporal=2006&THEME=81&VID=0&VNAMEE=&VNAMEF=. 2011 National Household Survey data area available at http://dc1.chass.utoronto.ca/census/index.html.

[35]See Chapter 6.1 for more details.