ECONOMIC CONDITIONS, HEALTH AND HEALTH BEHAVIOURS OF CANADIANS

THREE ESSAYS ON THE ASSOCIATION OF ECONOMIC CONDITIONS WITH THE HEALTH AND HEALTH BEHAVIOURS OF CANADIANS

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Abstract

This thesis comprises of three chapters that study the association of economic conditions with the health and health behaviours of adults and the health outcomes of infants.

The first chapter examines the impact of economic conditions on modifiable health behaviours, weight-related health (proxied by BMI), self-assessed mental health, life stress and general health of Canadians using data from the first cycle of the Canadian Community Health Survey (CCHS) to the year 2013. More specifically, using variation in unemployment rates at the Census Metropolitan Area (CMA) level, we estimate two-way fixed effect models to investigate how local labour market changes affect these health outcomes. Results suggest that most estimates are small and not statistically significant but that important exceptions exist which imply that recessions pose threats to the health status of the population and need to be appropriately considered by health planners and practitioners alike.

In the second chapter we use the Canadian Vital Statistics Birth and Death database over the 1976 to 2011 period to investigate how economic conditions are associated with infant mortality, neonatal mortality (death within the first 28 days of life), postneonatal mortality (death from 28 days onward to less than 365 days), the crude birth rate, birth weight, the percentage of babies born weighing less than 2500 gram, and the percentage of babies born weighing less than 1500 grams. A model with province and year fixed effects, clustered at the provincial level, is estimated. This model differences out time invariant unobserved heterogeneity over the period studied and provides unbiased coefficient estimates. For ex-

ample, some geographic areas may experience both poor health and high unemployment but a causal relationship does not exist. If individuals within provinces have similar unobservable characteristics errors may be correlated - clustering addresses this to provide robust standard errors. The results of this study suggest that worse economic times negatively impact the health of infants.

The third chapter re-examines the relationship between infant health outcomes and economic conditions studied in chapter 2 undertaking a sensitivity analysis related to the choice of economic proxy, model specification and the time frame of analysis. This study confirms that worse economic times are not good for infant health, however, we find that using the employment rate there is a robust relationship between good economic times and infant health.

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Dedication

To my mom and dad. You inspired me to dream and achieve, you showed me that hard work conquers all. Because of you, I accomplished this.

Contents

List of Tables

List of Figures

Introduction

This dissertation consists of three papers that examine the impact of labour market fluctuations on the health and health behaviours of adults and infants in Canada. Chapter 1 examines the working age population while Chapter 2 and Chapter 3 use the infant population as the sample for study. The focus of this dissertation is the Canadian context, as there is a paucity of research using Canadian data to examine the relationships of interest. This dissertation helps to fill that gap.

The first chapter examines the association of economic conditions with the health and health behaviours of the working age population of Canadians. Economic conditions, used interchangeably with local labour market conditions, are proxied by the changes in the Census Metropolitan Area unemployment rates and health behaviours are defined as both health-promoting and health-comprising behaviours.

Health behaviours are an important determinant of health outcomes and are often associated with the belief that they are modifiable, so that with proper incentives or disincentives, individuals can be induced to improve their health behaviours in order to achieve better health outcomes. A well known fact is that after the Surgeon General's report on the negative impacts of smoking on health, there was a reduction in smoking that led to improved health outcomes overall (U.S. Department of Health and Health Services, 2014). Recent literature has suggested that economic conditions are in fact good for the health of individuals (Ruhm, 2000, 2005; Ruhm & Black, 2002; Neumayer, 2004; Granados, 2005; Dehejia

& Lleras-Muney, 2004), while others find conflicting evidence (Charles & DeCicca, 2008; Latif, 2013). As will be discussed in the chapters, it is not the unemployment rate itself that affects health, rather it is the various pathways (e.g. time use, income, or economic stress) through which economic conditions may affect health.

Chapter 1 informs the literature in the following way. We use the Canadian Community Health Survey over the 2000 to 2013 period and examine how a comprehensive set of health behaviours and health outcomes including smoking, alcohol use, physical activity, diet, self-assessed general health, self-assessed mental health, and life stress, change with fluctuations in the unemployment rate. Note that the majority of this research has used data collected in the United States, and has examined health behaviours such as smoking and alcohol use. We pool all the cycles/years of the Canadian Community Health Survey (CCHS) to create a repeated cross sectional dataset and we employ variants of a two-way fixed effects methodology. This methodology can account for heterogeneity and omitted variable bias that may cause spurious regression results. We use within-area variation in unemployment rates at the Canadian Census Metropolitan Area (CMA) level to measure the impact of changes in local labour market conditions. The CMA is likely the appropriate labour market as it allows individuals to travel some distances to work but is not too large (e.g. provincial rates which may obscure more local variation in economic conditions) as to be unrepresentative. Moreover, more than two-thirds of Canada's population lives in these areas and there is substantial heterogeneity among economic outcomes across the CMAs (Heisz, LaRochelle-Cote, Bordt, & Das, 2005; Health Canada, 2014).

Our results suggest that few health outcomes and health behaviours have a relationship with economic conditions of the working age Canadian population, with an important exception being fruit and vegetable consumption. Fruit and vegetable consumption varies significantly for the total sample, for both males and females, and by level of education. Overall, we find that as economic conditions get worse, the fruit and vegetable consump-

tion of Canadians decreases. To the extent that fruit and vegetable consumption affects short and long run health, this finding may represent a meaningful health impact. At the very least, it represents a change in a potentially important health input.

The second chapter examines the relationship between economic fluctuations and infant health outcomes. Infant health outcomes are important in many respects, notably low birth weight is an important indicator of a newborn's chances of survival (Canadian Institute for Health Information, 2004, 2009). Similarly, it is widely recognized as a risk factor for perinatal and infant mortality, physical and cognitive disabilities, and other problems that can persist into childhood and even adulthood (Canadian Institute for Health Information, 2009). Although low birth weight babies comprise a small proportion of all births, these infants account for more than three-quarters of infant deaths (Paneth, 1995). Furthermore, low birth weight babies and preterm babies account for a disproportionately high percentage of health care costs among all newborns (Canadian Institute for Health Information, 2009).

In the relevant literature, evidence has suggested that poor economic conditions have improved the health outcomes of infants (Dehejia & Lleras-Muney, 2004). That is, for a one percentage point increase in the unemployment the percentage of babies born with low (weighing less than 2500 grams) and very low (weighing less than 1500 grams) birth weight decrease by 0.26 to 0.5 percent. For infant mortality and postneonatal mortality, there is also an evident significant negative relationship with the unemployment rate (Dehejia & Lleras-Muney, 2004). Existing evidence for Canada suggests that there is no relationship between infant mortality and economic conditions (Ariizumi & Schirle, 2012) however, these authors define infant mortality using a broader age range (0 – 4 years) than is standard in the literature (i.e. less than 365 days). We focus on this more standard definition of infant mortality.

We use administrative data from the Canadian Vital Statistics Birth and Death databases to investigate whether fluctuations in economic conditions, measured by provincial level

unemployment rates, impact infant health outcomes measured by the crude birth rate, birth weight, the percentage of babies born weighing less than 2500 grams, the percentage of babies born weighing less than 1500 grams, infant mortality, neonatal mortality and post-neonatal mortality. Our time frame of analysis is from 1976 to 2011 inclusive. We also undertake analysis of two other time frames. First analogous to seminal work by Dehejia and Lleras-Muney (2004) we examine the period 1976 to 1999. Furthermore, we more narrowly focus on three recessionary periods more specifically to examine how different shocks might affect the resulting estimates. These recessionary periods are those of the early 1980s, early 1990s and the Great Recession of the late 2000s. Employing a fixed effects methodology we find that infant health outcomes get worse during economic contractions, a finding at odds with Dehejia and Lleras-Muney (2004). This chapter contributes Canadian estimates to the literature and it extends the pediatric and child health literature because few studies in the literature have looked at the association of labour market outcomes on the impact on infant health, and none in the Canadian context.

The third chapter is a comprehensive analysis of measurement and sample issues in the relationship between infant health outcomes and economic conditions. It extends the research on labour market dynamics and impact on health by examining how different measures of economic proxies affect the relationship between economic conditions and infant birth and mortality outcomes. To date, the unemployment rate has been the gold standard proxy of economic conditions when studying these relationships of interest, but more recently it appears that it may be an incomplete reflection of true underlying economic conditions (Shierholz, 2012; Zmitrowicz & Khan, 2014). Thus examining the sensitivity of relevant estimates to changes in the definition is potentially important. Furthermore, studies examining that association of economic conditions with the health outcomes of adults have found varying results and this may be an artifact of differing sample periods and differing times frames of analysis. Ruhm (2015) undertakes a type of analysis to examine this

time-varying relationship further and finds that in fact, the relationship may be sensitive to start and end dates.

In this study we again use the Vital Statistics Birth and Death databases to examine how different definition of economic proxies are associated with infant health outcomes. Furthermore, we use fixed effects methodology and undertake an analysis to better understand how model specification and choice of time frames impact the resulting estimates and final outcomes. Finally we examine the time-varying relationship between economic conditions and infant health outcomes. Overall, we find that infant health outcomes get worse during worse economic times and that these findings are sensitive to the start and end dates of the time period under study. Furthermore, our results are also sensitive to choice of economic proxy with the employment rate providing robust estimates to the relationship of economic conditions with infants born with low birth weight (weighing less than 2500 grams) or with very low birth weight (weighing less than 1500 grams).

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Chapter 1

Do Health and Health Behaviours get worse during economic downturns? Evidence from Canada

1.1 Introduction

There is a growing literature that examines the effects of economic conditions in developed countries on health and health behaviours, where the latter is defined as any action or deliberate inaction by an individual that affects his or her own health or the health of others (Cawley & Ruhm, 2011). Health behaviours represent an important determinant of premature death (Cawley & Ruhm, 2011) and health-compromising behaviours can induce certain chronic conditions such as diabetes, cardiovascular disease, and hypertension. It is thus important to better understand how health behaviours and health outcomes are associated with local labour market conditions in developed countries since about one-third of morbidity and mortality in these countries can be attributed to modifiable health-related

behaviours[1] such as smoking, use of alcohol and illicit drugs, lack of exercise (and obesity), and poor diet (Hurley, 2010).

Studies using U.S. data, and some European ones, have predominantly focused on the association of labour market conditions with health behaviours. These studies show that when the economy is not doing well health compromising behaviours decrease and health promoting ones increase - people behave healthier during bad times. Existing studies focus especially on behaviours such as alcohol use, but other studies examine various behaviours and include smoking, physical activity, illicit drug use, and dietary behaviours. Some studies examine the association of general health and mental health with economic fluctuations, since both are predictors of mortality. These studies find, in general, that both general health and mental health get worse with economic downturns.

This study contributes to the existing literature in the following way. We examine the association of economic conditions with the health and health behaviours of working age Canadians over the 2000 to 2013 time frame, by pooling all the cycles/years of the Canadian Community Health Survey (CCHS) and use a fixed effects methodology. Our outcomes of interest include population smoking, alcohol use, physical activity, diet, self-assessed general health, self-assessed mental health, life stress, and weight-related health. In the relevant literature, there are many studies that examine alcohol use and smoking, but there are few studies that examine variables like physical activity, weight-related health, dietary behaviour, mental health and general health. We use within-area variation in unemployment rates at the Canadian Census Metropolitan Area (CMA) level to measure the impact of changes in local labour market conditions. The CMA is likely the appropriate labour market as it allows individuals to travel some distances to work but is not too large (for example provincial rates which may obscure more local variation in economic conditions).

[1] A modifiable health-related behaviour implies that individuals are able to take action to change that behaviour. The author does not imply that this is easy to do.

Moreover, more than two-thirds of Canada's population lives in these areas and there is substantial heterogeneity among economic conditions across the CMAs (Heisz et al., 2005).

Few previous studies that use Canadian data fit into this scope but are substantially different. Ariizumi and Schirle (2012) examine age and gender specific mortality rates, Piérard and Grootendorst (2014) study gender specific suicide rates, while Latif (2013) models individual level weight-related health (measured by Body Mass Index (BMI)), and Latif (2014) examines at individual level alcohol drinking and smoking behaviour. These studies use annual provincial unemployment rates as the proxy for macroeconomic conditions and some verify results by using other proxies as well. Although annual unemployment rates are more often used than monthly rates, monthly rates may have an advantage by better accounting for variation in the labour market. That is, annual unemployment rates may mask variation within the unemployment rate. Moreover, monthly rates help to account for seasonality. Furthermore, to our knowledge there are currently no studies in the Canadian context that examine physical activity, dietary behaviour, self-reported mental health, self-reported general health and self-reported stress and this study begins to fill that gap. Finally, we contribute to the ongoing debate concerning the impact of economic fluctuations on health and health behaviours.

1.1.1 *Why might there be a relationship between economic conditions and health and health behaviours?*

Many mechanisms exist by which changes in economic conditions can affect health. Although the unemployment rate is the proxy for economic conditions, it is not the rate itself *per se* that affects health or health behaviours, rather it is changes in time use, income, and economic stress as a result of change in unemployment status that may affect health. Grossman's (1972) model of health production can be used to contextualize why a relationship

may exist between economic conditions and health. Health is both a consumption good and an investment good. As a consumption good health provides direct utility to an individual through improved health and well-being, while as an investment good it provides indirect utility through the increased amount of time available for work. In the Grossman (1972) model, health is a stock that – without investment in - worsens over time. However, producing health is costly – especially in the opportunity cost of time since the production of health is highly time intensive. Thus while there are many possible mechanisms for a relationship between economic fluctuations and health, two broad explanations discussed in the relevant literature are the opportunity cost of time and the economic stress hypothesis. It is salient to note that while we provide two broad explanations of the mechanisms through which health and health behaviours are associated with economic conditions - these are independent of each other but are not always mutually exclusive.

The opportunity cost of time It is clear that during recessions unemployment increases. As a result, some individuals may now have more time (leisure time) to allocate to health-producing activities and behaviours. Time-intensive health producing activities are now less costly to undertake since the opportunity cost of time is lower. Individuals may find it utility enhancing to undertake time-intensive health-producing activities like making home made meals or physical activity. Because of this, it is assumed individuals improve health related choices during economic downturns. In addition, although more time is available to allocate to health-producing behaviours, individuals may become more sedentary and decrease level of physical activity due to stress[2]. Note that we do not aim to specifically disentangle these mechanisms within the study, because of constraints imposed by the data.

It is important to note that in this study we focus on transitory (short term) shocks in the labour market because it is these shocks that affect individuals and lead to changes in their

[2]Stress here is related to stress on a general scale. It is not isolated to "work-related" stress.

health behaviours (in the long term the relation may be different). Studies using U.S. data have predominantly exhibited health promoting behaviours increase when the economy is in a downturn and people behave healthier. And so, if investment in health promoting activities improves health and does so during the transitory change, then there will be a positive relationship between the unemployment rate and health (Charles & DeCicca, 2008).

Economic stress hypothesis Labour market conditions may affect health through the economic stress hypothesis (Charles & DeCicca, 2008). Stress can affect an individual regardless of their employment status. A weaker economy may lead to increase in stress due to the greater uncertainty of present and future income receipt which in turn leads to a reduction in health (Charles & DeCicca, 2008). Moreover, as the unemployment rate rises mental health worsens and this is evident in outcomes such as suicides and suicide attempts (Ruhm, 2000; Pierard & Grootendorst, 2014). Income constraints due to job loss and crisis-induced changes in relative prices also impact individuals' health and health behaviours (Asgeirsdottir, Corman, & Noonan, 2014). Lower income means that individuals now have less money to allocate to either health promoting or health comprising behaviours. It is also not clear how individuals use their remaining income as investment into health - some individuals may choose to allocate money to self-medicate (using cigarettes or alcohol) while some may get a membership to the gym in order to increase physical activity. If stress is operative and if greater stress reduces health during transitory downturn, then there will be an inverse relationship between the unemployment rate and health (Charles & DeCicca, 2008).

1.1.2 *Why might we care?*

As mentioned about one-third of morbidity and mortality in high-income countries can be attributed to modifiable health-related behaviours (Hurley, 2010). In these countries,

health behaviours are of particular importance because morbidity and mortality are primarily related to chronic rather than infectious diseases (Hurley, 2010). Both health-compromising and health-promoting lifestyle choices, like smoking, physical activity and dietary behaviour affect health outcomes. Health-compromising behaviours can induce certain chronic conditions such as diabetes, cardiovascular disease, and hypertension. Thus, these modifiable health-related behaviours can make an impact on the health of individuals and although these choices are made on an individual level, they can implicitly affect the society as a whole.

In Canada, health care spending is a major concern. Chronic disease has an increasing prevalence and thus leading to a larger portion of health care spending. Improving population health through lifestyle choice is a way to address onset and maintenance of chronic disease but falling within the "health promotion and disease prevention" domain, funding is often contentious because it is politically difficult to invest in the future while denying the immediate needs of individuals (Conference Board of Canada, 2015). Understanding Canadian health behaviours and health outcomes during economic fluctuations can inform policymakers when making decisions for improving population health, especially in times of fiscal restraint. Yet, both economic booms and busts affect the health status and health behaviours and so conditions and responses need to be appropriately considered by health planners and practitioners alike.

The rest of the chapter is organized as follows. Section two provides a discussion of the previous literature on the association of economic fluctuations with health and health behaviours. Section three summarizes the data. Section four establishes the methodology used. Section five summarizes the results and section six concludes.

1.2 Background

One of the first studies to specifically examine the effects of unemployment on health behaviours using fixed effects methodology is Ruhm (1995). Ruhm uses two main outcomes of alcohol consumption and highway fatalities from 1975 to 1988 for the 48 contiguous U.S. states. Unemployment rates, the employment-to-population ratio, and gross state product, are used as proxies for macroeconomic conditions. Ruhm's major contribution was to update the methodological approach established by Brenner (1979) by using a fixed effect model with time and location dummies. Up to that time, studies used time series models with lags, but these kinds of models had error from autocorrelation and omitted variable bias, and general model misspecification (Brenner, 1979; Gravelle, Hutchison, & Stern, 1981; Adams, 1981; Nelson & Plosser, 1982). Controlling for state and time fixed effects, Ruhm finds that as the unemployment rate increases, alcohol consumption and highway vehicle fatalities decrease. This relation was robust to choice of macroeconomic proxy. Freeman (1999) criticized Ruhm for the use of the - at the time unconventional methodology - fixed effect methodology because the data may be non-stationary. Thus, Freeman expands the panel to 50 states and the District of Columbia for years 1970 to 1995 and re-examines Ruhm (1995) in order to replicate and confirm the findings. Freeman states that this is an improvement on Ruhm's analysis since the time frame incorporates four business cycles and he uses variable growth rates rather than levels. Freeman replicates Ruhm's results but suggests that the model specification that uses logarithmic first differences is better suited for estimation.

Ruhm (2000) takes a more comprehensive approach to examining the association of macroeconomic conditions and health and health behaviours. This study has been highly influential in the literature and laid the groundwork for studying the relation of health and health behaviours with macroeconomic conditions. In the first part of the study, Ruhm finds

that mortality – as proxied by 10 specific causes for mortality that represent 80 percent of all fatalities - exhibit an inverse relationship for eight of the ten sources of mortality with suicide being an important exception and cancer. In the second part of the study, Ruhm considers what may be a mechanism for this inverse pattern, i.e. why health worsens when the economy improves. He finds that lifestyle changes that stem from health behaviours are consistent with fluctuations in health. Since health behaviours are an input into health, it makes sense that they would affect health outcomes. Using the Behavioural Risk Factor Surveillance System (BRFSS) for the 1987 to 1995 period for the 50 states and the District of Columbia, Ruhm examines the association of average state unemployment rates with smoking, alcohol consumption, Body Mass Index (BMI), physical activity, diet, and preventive medical care. Controlling for a variety of features he finds that smoking and BMI vary positively with economic conditions while alcohol use and physical activity vary inversely, diet becomes less healthy and preventive medical care increases (although often insignificant).

Following Ruhm (2000), Dee (2001) uses different measures of alcohol use and abuse from the BRFSS for the years 1984 to 1995. He finds limited evidence that recessions generate reductions in drinking participation but significant results for generating decreases in drinks per month and chronic drinking participation. Most importantly, he finds that binge drinking decreased when the unemployment rate increased, but that binge drinking for those who remained employed increased. This suggests that this recession-induced increase in binge drinking may be a result of increases in stress and not just the increase in leisure time available (Dee, 2001). On the contrary, using the BRFSS from 1987 to 1999, Ruhm and Black (2002) find that overall drinking increases. Ruhm and Black suggest that studies by Dee (2001) and Ruhm (2000) suffer from several shortcomings. The first, Dee (2001) uses the BRFSS from 1984, in which year only 15 states participated, and so within-state variation estimation becomes a problem; the second, the data are not weighted to

account for differences in sampling probabilities; the third, the set of explanatory variables is limited and excludes important ones such as information on education and marital status (Ruhm & Black, 2002).

Ruhm (2005) provides further evidence on the cyclicality of tobacco use, obesity, physical activity, and multiple health risks (a person with two or more of the risk factors of current smoking, severe obesity, or physical inactivity) using data from BRFSS for 1987 to 2000. He finds as the percentage of population employed decreases so too does the prevalence of smoking, obesity, physical inactivity and multiple health risks. Dave and Kelly (2012) use the BRFSS from 1990 to 2009 to study the association of economic fluctuations with dietary behaviours. They find that consumption of fresh produce decreased while consumption of fat foods, like snacks and fast foods, increased during economic downturns.[3] An and Liu (2012) use the BRFSS from 1990 to 2009 and county level unemployment rates and confirm that physical activity decreases during an economic recession.

At the same time, other studies have introduced varying results. Using the National Health Interview Survey (NHIS) from 1997 to 2001, Charles and DeCicca (2008) show that weight-related health (proxied by BMI) and mental health for men with low ex ante employment probabilities vary positively with the unemployment rate. An important factor contributing to their result is that Charles and DeCicca (2008) use the metropolitan statistical area (MSA) as their unit of analysis rather than the state. Using the MSA, increases the variation in the unemployment rate and it may increase the probability that the changes in the unemployment rate are more related to what is happening in the economy because of the size. Latif (2013) uses individual level data from the National Population Household Survey (NPHS) for Canada from seven cycles that span 1994 to 2007. The study

[3]Note that Dave and Kelly (2012) is the second study to Ruhm (2000) to examine how economic downturns are associated with dietary behaviour specifically. Ruhm (2000) found no statistically significant relationship between economic downturns and dietary behaviour, however, the relationship he did find was a positive one so that as the unemployment rate increased so too did the predicted consumption of fruits and vegetables while the intake of dietary fat decreased.

shows as the provincial unemployment rates increase, the probability of being severely obese ($BMI \geq 35$) increases. Latif also finds that the unemployment rate significantly increased BMI, but no significant impact of the unemployment rate on the probability of being overweight or obese. Latif (2014) uses the NPHS from 1994 to 2009 and finds a significant positive impact of provincial level unemployment rates on weekly alcohol consumption, the probability of being a binge drinker and the number of cigarettes smoked by daily smokers. But no impact on the probability of being a smoker. Finally, Colman and Dave (2013) use the American Time Use Survey from 2003 to 2010 and find that as the employment-to-population rate decreases recreational exercise, television watching, sleeping, childcare and housework increase.

Although it has been thoroughly explored in the US context (for certain health behaviours and outcomes), evidence for Canada is limited and it is not clear whether the findings from the US can be generalized to the Canadian context. A thorough review of databases revealed a total of four studies that use Canadian data. Two studies that examine the association of economic fluctuations with the mortality of Canadians (Ariizumi & Schirle, 2012; Pierard & Grootendorst, 2014) and two that examine the association of economic fluctuations with weight-related health (as proxied by BMI), smoking and alcohol use (Latif, 2013, 2014). In their study, Ariizumi and Schirle (2012) use provincial data over the period 1977 to 2009 to estimate the effect of unemployment rates on Canadian age and gender specific mortality rates. Their discussion considers modified health behaviours during economic downturns as a mechanism for the changes in mortality, but they do not formally study the question due to data limitations. Similarly, Piérard and Grootendorst (2014) study gender specific mortality rates and suggest that suicide rates increase during economic downturns, and although they do not test it explicitly they suggest that the inverse relationship between the unemployment rate and suicide rates can be a result of deteriorating mental health. As mentioned earlier, Latif (2013) uses individual level data

from the NPHS to study how variation in provincial unemployment rates impact BMI and Latif (2014) uses the same to examine the impact on smoking and alcohol use.

Given the mixed results about the association of health and health behaviours with economics conditions and a lack of consensus as to the effects of local labour market fluctuations on health and health behaviours, it is important to understand what kind of association the health behaviours and health of Canadians exhibit with changes in local labour market conditions. This study uses data from the CCHS (from year 2000/2001[4] to year 2013, inclusive) and Census Metropolitan Area (CMA) specific unemployment rates to measure the association of fluctuations with alcohol use, smoking and weight-related health, and extends the analysis to include physical activity, dietary behaviour, self-reported mental health, self-reported life stress, and self-reported general health. In the relevant literature, there are many studies that examine alcohol use and smoking, but there are few studies that examine variables like physical activity, weight-related health, dietary behaviour, mental health, life stress, and general health. In fact, to our knowledge there are currently no studies in the Canadian context that examine physical activity, dietary behaviour, self-reported mental health, self-reported general health and self-reported stress and this study begins to fill that gap.

Since Canada has universal health care coverage, and generally more generous unemployment benefits and training programs, it may imply less variation in health behaviours and health outcomes compared with the existing evidence on the U.S. context. But job loss can lead to loss of supplemental health insurance which provides coverage for prescription drugs, and more comprehensive mental health and dental health care. Moreover, it is not clear how economic fluctuations and the subsequent fluctuations in health and health behaviours affect health care use and whether it may be an impact thus on the sustainabil-

[4]Note that the first six years of the CCHS data was released every two years and the survey was given a "cycle" name rather than being referred to it by the year. So that the years 2000/2001 is cycle 1.1, 2003 cycle 2.1, 2005 cycle 3.1, 2007 cycle 4.1.

ity of the health care system which is a major concern for Canada. Although we cannot speak directly to these issues, it is important to keep in mind and interesting to note that the two countries reviewed have differing institutional features, including different governing principles of their health care systems and thus it is not clear how generalizeable results are.

1.3 Data

We use the Canadian Community Health Survey (CCHS) for this study. The CCHS is a rich data set that provides information related to health behaviours and health outcomes. We also use the Labour Force Survey (LFS), accessed through CANSIM (Canadian Socio-Economic Information Management System, Statistics Canada) which provides information related to macroeconomic conditions. The time frame for analysis is years 2000/2001 (cycle 1.1) to 2013, inclusive. The following introduces the CCHS data, the unemployment data, describes the variables of interest, and establishes the sample selected for study.

1.3.1 The Canadian Community Health Survey (CCHS)

The CCHS is a repeated cross-sectional survey conducted by Statistics Canada, that collects information related to the health status, health care utilization, and health determinants for the Canadian population (Statistics Canada, 2007). Collection of data for the first three cycles of the CCHS was designed as a two-year data collection cycle that started in 2000. Starting in 2007, the data collection design changed to collect data every year – with annual releases, in order to improve the survey's efficiency and flexibility (Statistics Canada, 2007).

The CCHS data is collected for individuals aged 12 and older, living in private dwellings in the 115 health regions covering all provinces and territories (Statistics Canada, 2011a). Individuals living on Indian Reserves and on Crown Lands, institutional residents, full-time members of Canadian Forces, and residents of certain remote regions are excluded from

the sampling frame (Statistics Canada, 2011a). Overall, the CCHS covers approximately 98 percent of the Canadian population aged 12 and over (Statistics Canada, 2011a).

There is a wide range of demographic data available in the CCHS. The demographic data that we use as controls that are of interest in this study and available for all cycles/years are: age, sex, education, marital status and race. In general, a series of dummy variables are created for each of these covariates in order to implement a flexible functional form to the model. Furthermore, in some models we control for socioeconomic status as measured by total household income or total personal income.[5] Similar to the demographic control variables, we create a series of dummy variables for these measures.

The following describes questions asked about education, marital status and race. For education, the question asks: "What is the highest degree, certificate or diploma you have obtained?". Legitimate responses are: no post secondary degree/certificate/diploma, trades certificate or diploma, diploma/certificate (college/cegep), university certificate below bachelor's level, bachelor's degree, university degree or certificate above bachelor level. We estimate models stratified by two levels of education defined as - "less than bachelor degree" or "bachelor degree or higher". We define individuals with less than a bachelor degree as those who have no post secondary degree/certificate/diploma, a trades certificate or diploma, a diploma/certificate (college/cegep), a university certificate below bachelor level. We define individuals who have a bachelor degree or higher as those who have a bachelor degree, a university degree or certificate above bachelor level. Marital status provides the current marital status as: married, divorced, widowed, separated, single. We include a series of dummy variables to control for marital status. Race has information on those that are White, Black, Korean, Filipino, Japanese, Chinese, South Asian, Southeast Asian,

[5]Note however, that socioeconomic status can behave as a potential mechanism through which changes in the unemployment rate impact changes in the health behaviours. In that case, we estimate these models, but do not find significantly different estimates from our baseline and furthermore we do not report these estimates in the study.

Arab, West Asian, Latin American, Native and Other racial/cultural origin, Multiple/Racial Cultural origin. We include a series of dummy variables in order to control for race. In models that control for socioeconomic status, a series of dummy variables is created to represent each level of total household income and total personal income.

1.3.2 Measuring economic conditions

We use unemployment rates at the Canadian Metropolitan Census Area (CMA) to identify and measure the impact of changes in local labour market conditions. The unemployment rate is defined as the number of unemployed persons expressed as a percentage of the labour force (Statistics Canada, 2014a).[6] In the relevant literature, studies have typically used state level or province level unemployment rates to examine the effects of changes in macroeconomic conditions on health and health behaviours. More recently however, there has been a shift to examine more specific, or narrow definitions of unemployment rates - local labour market rates – like Metropolitan Statistical Areas (Charles & DeCicca, 2008). CMA rates are a good choice for this study because the area is large enough to capture changes, yet small enough so that we can capture variation across CMAs in a given province. Perhaps this more precise measure of economic conditions is even more relevant in the Canadian context because the provinces are so large geographically. The data that we use in this study come from the Labour Force Survey done by Statistics Canada and downloaded from CANSIM.[7] We use monthly data from 2000 to 2013, inclusive, on 25 CMAs.

[6]Statistics Canada defines unemployed persons as those who, during the reference week: were on temporary layoff during the reference week with an expectation of recall and were available for work, or were without work, had looked for work in the past four weeks, and were available for work, or had a new job to start within four weeks from reference week, and were available for work. The labour force is comprised of employed persons (those who are supplying services in the reference period, regardless of the quantity supplied) and unemployed persons (those who provide evidence that they are offering their labour services to the market (again regardless of quantity)). Note, those neither currently supplying nor offering their labour services, are not in the labour force. (Statistics Canada, 2014a)

[7]CANSIM. TABLE NUMBER 282 0110 - LFS estimates, by census metropolitan area based on 2006 census boundaries, sex and age group,

A CMA is defined as a large urban area, of one or more neighbouring municipalities (also referred to as urban and rural fringe) situated around an urban core, with a population of at least 100,000 of which 50,000 or more live in the core (Statistics Canada, 2011b). There is a high degree of social and economic integration of the areas within the CMA (Statistics Canada, 2011b). In 2013, there were 37 CMAs across Canada that represent Canada's most urbanized cities (Statistics Canada, 2011b). More than 2/3 of the population of Canada lives within these CMAs (Statistics Canada, 2011b). CMAs are delineated using adjacent municipalities as building blocks and are included in the CMA if they follow a specific set of rules that are defined on the basis of commuting patterns.[8] Once a CMA is defined, it cannot be retired. Furthermore, in 1996 Statistics Canada re-defined the historical comparability rule to maintain comparability of CMAs over time and preserve data comparability over time.[9] In this study, we use the 25 CMAs that are defined by the 1996 Census so that the sample is consistent and exclude any new CMAs defined thereafter (i.e.

annual. TABLE NUMBER 282 0109 - LFS estimates, by census metropolitan area based on 2006 census boundaries, sex and age group, 3-month moving average, unadjusted for seasonality,
monthly. TABLE NUMBER 282 0116 - LFS estimates, by census metropolitan area based on 2006 census boundaries, 3-month moving average, seasonally adjusted and unadjusted, monthly.

[8] A CMA is defined using adjacent municipalities (census subdivisions - CSDs) as building blocks. These CSDs are included in a CMA if they meet at least one of the following rules: 1) the CSD falls completely or partly inside the core; 2) forward commuting rule: Given a minimum of 100 commuters, at least 50 percent of the employed labour force living in the CSD works in the delineation core (at least 75 percent of the CSD's population resides within the core), as determined from commuting data based on the place of work question in the previous census; 3) reverse commuting flow rule: Given a minimum of 100 commuters, at least 25 percent of the employed labour force working in the CSD lives in the delineation core; 4) spatial contiguity rule: CSDs that do not meet a commuting flow threshold may be included in a CMA or CA, and CSDs that do meet a commuting flow threshold may be excluded from a CMA or CA. Grouping CSDs to generate commuting flow and include in CMA; 5) historical comparability rule: To maintain historical comparability for CMAs and larger CAs (those with census tracts in the previous census), CSDs are retained in the CMA or CA even if their commuting flow percentages fall below the commuting flow thresholds (rules 2 and 3). Exception is made in case where CSDs have undergone changes to their boundaries. (Statistics Canada, 2011b)

[9] In 1996, Statistics Canada developed a historical comparability rule that involved two changes to the CMA/CA delineation rules in order to preserve data comparability over time. These two changes are: (1) CMAs could be consolidated with CAs, but they could not be consolidated with other CMAs; (2) A primary census agglomeration could not be retired from a consolidated CMA or CA (with census tracts at the previous census) even if its total commuting interchange percentage dropped below the consolidation threshold of 35 percent. Exceptions to this rule could occur due to changes in the physical structure of the urban areas used to determine the urban cores. (Statistics Canada, 2011b)

2001, 2006 and 2011).[10] Using the historical comparability rule, and having examined the historical changes of CMA/CA over the 2000 to 2013 period, few changes have taken place but these changes do not compromise the integrity and comparability of our sample over this time frame of analysis.

Our strategy relies on the existence of considerable heterogeneity in economic conditions across the CMAs and over our time frame of analysis (2000 to 2013). To check this, we test the variability by regressing the unemployment rate on the CMA, month and year dummies. We find that the coefficient of determination $R^2 = 0.6958$, which suggests that there is considerable independent variation in the unemployment rate across the CMAs and over time. Note that, by regressing the unemployment rate only on CMA dummies, an $R^2 = 0.5730$ is obtained, again suggesting that there is reasonably large independent variation in the unemployment rate across CMAs. Figure 1 and Figure 2 show the variation in the seasonally adjusted national quarterly and annual unemployment rates, respectively, for both sexes, 15 years of age and older.[11] From the figures it appears as though Canada experienced two economic expansions and contractions with one well-defined recession: the Great Recession (which lasted from October 2008 to July 2009 (Cross & Bergevin, 2012)). This reiterates that there appears to be enough variation in our data for meaningful analysis.

[Insert Figure 1.1] [Insert Figure 1.2]

[10] With the change to the 2001 census boundaries, two new CMAs were added (Kingston, Ontario and Abbotsford, British Columbia), and with the change to the 2006 census boundaries, six new CMAs were added (Moncton, New Brunswick; Peterborough, Ontario; Brantford, Ontario; Barrie, Ontario; Guelph, Ontario; Kelowna, British Columbia). Also, the boundaries of seven CMAs were modified (Québec, Québec; Sherbrooke, Québec; Montréal, Québec; Ottawa-Gatineau, Québec part; Ottawa-Gatineau, Ontario/Québec; London, Ontario; Winnipeg, Manitoba. (Statistics Canada, 2011b)

[11] Data for Figure. 1. are from CANSIM Table 282-0087 Labour Force Survey estimates (LFS), seasonally adjusted, quarterly. Data for Figure. 2. are from CANSIM Table 282-0116 Labour Force Survey estimates (LFS), by Census Metropolitan Area based on 2006 census boundaries, 3-month moving average, seasonally adjusted, annual.

1.3.3 Outcomes of interest

1.3.3.1 Health Behaviours

Health behaviours are often described as "lifestyle" factors that affect health and are defined as any action or deliberate inaction by an individual that affects his or her own health or the health of others. Behaviours can be defined as "health compromising" or "health promoting" (Cawley & Ruhm, 2011). Health comprising behaviours are health behaviours that affect an individual negatively. Health promoting behaviours are ones that impact an individual positively. Health comprising behaviours that are examined in this study include: smoking, and alcohol use, while health promoting behaviours include physical activity and consumption of fruits and vegetables.

Smoking Smoking is among the most important preventable causes of disease and death in Canada and is linked to more than two dozen diseases and conditions, including cancer and heart disease (Government of Canada, 2012). Tobacco use has been widely studied in this context, and studies have found that as the unemployment rate increases smoking prevalence decreases. Since tobacco use varies with price and income (Chaloupka & Warner, 2000), as the economy weakens and individuals are faced with higher income constraints a decrease in consumption may help to explain why health improves (Ruhm, 2000). Following the literature, a dichotomous variable is created that categorizes respondents of the CCHS as follows: an individual is a smoker if they smoke daily, and a nonsmoker otherwise. Two additional measures are included in this study to gauge the consumption of cigarettes of individuals who are already smokers: conditional on being an (i) occasional or (ii) daily current smoker the number of cigarettes smoked per day. These measures may provide some information on consumption of cigarettes to deal with uncertainty or stress, that is to self-medicate.

Alcohol Use Alcohol use is an important indicator of health behaviour since heavy drinking has been associated with negative health and social consequences such as increased risk of cardiovascular disease, hypertension, all-cause mortality, unintentional injuries, unprotected sex, drunk driving and illicit drug use (Statistics Canada, 2010a). Moreover, high risk drinking[12] has been linked to motor vehicle accidents, Fetal Alcohol Spectrum Disorder and other health issues, family problems, crime and violence (Health Canada, 2014). Following the literature, we use two measures of alcohol use: heavy drinking and binge drinking. Heavy drinking is defined as having 5 or more drinks on one occasion at least once a month during the past year (or 12 or more times over the past year) (Statistics Canada, 2013). Binge or heavy episodic drinking is defined as having 5 or more drinks on a single occasion (Statistics Canada, 2013). In the literature, alcohol use has been found to have both a positive and inverse association with macroeconomic conditions, variation depends on the definition, data and time frame (Pacula, 2011). We thus use three variables for analysis of alcohol use (i) heavy drinking (dichotomous - you are either a heavy drinker or not) (ii) binge drinking (dichotomous - you are either a binge drinker or not) and (iii) daily alcohol consumption (measure of frequency).

Physical Activity Regular physical activity is associated with improved health and well-being by reducing stress, strengthening the heart and lungs, increasing energy levels, and helping to maintain and achieve a healthy body weight (Health Canada, 2011). Physical activity also improves an individuals outlook on life (Health Canada, 2011). In order to promote increased physical activity, Health Canada encourages Canadians to integrate physical activity into their everyday life: at home, at school, at work, and at play (Health Canada, 2011). Research shows that physical inactivity is associated with premature death, chronic disease and disability (Health Canada, 2011). Using several derived variables of

[12]Note that high risk drinking is most often associated with binge drinking and heavy drinking.

physical activity, we create the following measures. Based on the physical activity index an individual is (i) active, (ii) moderately active or (iii) inactive (based on energy expenditure values which are calculated using the frequency and time per session of the physical activity as well as its metabolic energy cost) and (iv) daily exercise (Participated in daily physical activity lasting over 15 minutes (i.e. at least 30 days per month)).

It may be important to note that although exercise may increase during a recession due to more time available, some studies show that this increase may be counteracted by a decrease in work-related physical activity due to job loss and an increase in sedentary activities like watching television (Colman & Dave, 2013). Thus, although there may be an increase in exercise during a recession, it may not imply that overall the individual is more physically active and thus gaining the benefits of physical exercise. Due to data constraints with the CCHS, we do not have the available information to include this in the model, but note its importance here.

Consumption of fruits and vegetables Fruits and vegetables are important components of a healthy diet. Diet can be affected through, at least, two channels during local labour market fluctuations: the time constraint and the income constraint. During economic downturns, individuals may have more time to input into preparing nutritious meals at home which is a labour intensive activity. However, individuals may also be constrained by lower income and thus find it difficult to purchase nutritious options, like fruits and vegetables. Fruit and vegetables can help prevent major diseases, such as cardiovascular diseases and certain cancers (World Health Organization (WHO), 2004). Dave and Kelly (2013) find that as the unemployment rate increases, consumption of fruits and vegetables decreases. Moreover, happiness and mental health rise in an approximately dose-response way with the number of daily portions of fruit and vegetables (Blanchflower, Oswald, & Stewart-Brown, 2013).

We use the following measures to indicate consumption of fruits and vegetables[13]: (i) total number of times per day respondent eats fruits and vegetables, (ii) (s)he eats fruits and vegetables less than 5 times per day, (iii) (s)he eats fruits and vegetables 5 to 10 times per day, and (iv) (s)he eats fruits and vegetables more than 10 times per day.

Given that consumption of fruits and vegetables are an important input into health, we report findings of the association of local labour market changes regardless that information is not available for consumption of less healthy foods including high fat foods, sugary drinks, or unhealthy snacks. Although it is not a comprehensive understanding of the dietary patterns during economic fluctuations, understanding fruit and vegetable consumption is an important consideration.

1.3.3.2 Weight-related health

Weight status is an important health outcome and obesity is a strong predictor of morbidity. Obesity increases the risk of developing chronic diseases such as type 2 diabetes, hypertension and liver disease, cancer and cardiovascular disease (Public Health Agency of Canada, 2011). The increased risk of illness increases the probability and the amount of health care service use. To examine the impact of local labour market changes on weight status, we use the general and widely accepted measure for weight status, body mass index (BMI). BMI is calculated as an individual's weight in kilograms (kg) divided by their height in squared meters $\left(BMI = \frac{kg}{m^2}\right)$. Adults are classified into categories: underweight (if $BMI \leq 18.5$), normal (if $18.6 \leq BMI < 25$), overweight (if $25 \leq BMI < 29$) and obese (if $BMI \geq 30$). We also consider three additional categories that are used to address the systematic misreporting of BMI and to understand where in the distribution of BMI we see the effects happening. These categories are intentionally overlapping categories in order to help in the

[13]Note that (i) is a frequency measure while (ii)-(iv) are dichotomous variables that suggest that an individual either consumes fruits in the specified range, or does not.

analysis and are defined as: healthy 1 (if $18.6 \leq BMI < 30$), healthy 2 (if $20 \leq BMI < 25$), and healthy 3 (if $20 \leq BMI < 30$).

Although the BMI is a widely accepted way of defining the weight status of individuals, it is not a perfect indication of an individual's weight-related health. Some issues related to the use of BMI include the bias due to self-report in most surveys and it's generalizability due to body weight distribution of an individual, like body type/composition (Charles & DeCicca, 2008; Shields, Connor Gorber, & Tremblay, 2008; Shields, Connor Gorber, Janssen, & Tremblay, 2011). Shields et al. (2008) note that self-reported height is often overestimated while self-reported weight is often underestimated which can lead to overall underestimation of the prevalence of obesity as measured by the BMI. Furthermore, studies in the medical literature suggest that BMI is not an adequate measure of morbidity overall - for example an individual who is classified as overweight or obese may not have worse health status or health outcomes than an individual classified as normal weight. Finally, although BMI fluctuates during transitory economic shocks, moving to "healthier" BMIs in the short run does not necessarily suggest that individuals will remain at these levels in the long run. It is possible that individuals return to previous BMI levels or may in turn lead to higher BMI and worse health status in the long run. Having said that, although we recognize the limitations of the BMI, it is still important to consider the fluctuations in weight-related health induced by changes in economic conditions and based on our data availability it is our best option.

1.3.3.3 Self-perceived Mental Health and self-perceived life stress

In this study, we use two measures for mental health: self-assessed mental health[14], and self-perceived life stress. Self-assessed mental health has a strong and consistent associ-

[14]The data on self reported mental health is available beginning in cycle 2.1 (year 2003/2004) to 2013. Thus, we restrict our sample accordingly for this specification.

ation with a wide range of mental morbidity measures and thus it is potentially a useful indicator for monitoring general mental health (Mawani & Gilmour, 2010). In addition, it captures individuals' perceptions of their mental health, which may have implications for service use and treatment compliance (Mawani & Gilmour, 2010). Thus, although it is not a widely used measure of mental health it is a measure of health and it does provide the capacity to study the association of economic fluctuations with mental health. Self-perceived mental health may be highly correlated with (or reflect) more objective measures of heath but it includes valuable information that objective measures do not. At the individual level, there is a strong correlation between job loss and subclinical depression, anxiety, and substance abuse (Murphy & Athanasou, 1999). Few studies are able to incorporate measures for mental health due to lack of data availability, but provide evidence through specific outcomes like suicide. Three studies find that mental health gets worse when the unemployment rate increases (Ruhm, 2000; Charles & DeCicca, 2008; Pierard & Grootendorst, 2014). Ruhm (2000) suggests that mental health deteriorates since suicide rates increase while Charles and DeCicca (2008) use a measure of mental health that ranks individuals based on feelings of sadness, hopelessness, worthlessness, restlessness and nervousness and find that as local labour market conditions deteriorate, so too does mental health. Finally, Piérard and Grootendorst (2014) find that suicide rates increase with increases in the unemployment rate, suggesting that mental health deteriorates - but not explicitly testing the association.

Furthermore, stress is an important input into mental health. Stress can be a result of both good or bad things that happen to individuals (Centre for Addiction and Mental Health, 2010). The deterrent health effect of stress results from the inability of individuals to handle an event or a situation (Centre for Addiction and Mental Health, 2010). Both acute stress (for example sudden emotional stress) and chronic stress (prolonged stress that interferes with an individuals ability to live a normal life) pose threats to the health of

individuals (American Psycoholgical Association, 2013). It is not clear whether economic fluctuations induce acute stress, chronic stress or both. Individuals who are unemployed may face the economic stress of constrained financial resources and looking for new work, while individuals who maintain their jobs may have increased work-related stress as a result of increased responsibilities (over-worked because fewer co-workers) and fears of job-loss. Since we are not able to disentangle the type or source of stress for an individual that is a result of economic fluctuations, we study the general level of stress and suggest that higher levels of stress may lead to worse health outcomes.

The two outcomes are defined as follows. Note that for each outcomes we create three, somewhat overlapping measures in order to better assess from which category of mental health or life stress the individual is moving.[15] For mental health the question asks: in general, would you say your mental health is: excellent, very good, good, fair, or poor? The three measures we create that are somewhat overlapping are: (i) poor mental health (an individual reports being in poor or fair mental health), good mental health (an individual reports good, very good, and/or excellent mental health), and very good mental health (an individual reports very good, and/or excellent mental health). For stress, the question asks: thinking about the amount of stress in your life, would you say that most days are: not at all stressful, not very stressful, a bit stressful, quite a bit stressful, and extremely stressful. Again, we create three overlapping variables: (i) stressful (if an individual reports being extremely stressful, and/or quite a bit stressful), (ii) somewhat stressful (if an individual reports a bit stressful, not very stressful, and/or not at all stressful), and not stressful (not very stressful, and/or not at all stressful).

[15]For this reason, the summary statistics in Table 1.1 for these measures will not sum to 1.

1.3.3.4 Self perceived health

Self-assessed health is a subjective measure of overall health status (Statistics Canada, 2010b). Self-assessed health is a predictor of mortality and it is an important general health outcome measure that can be used to inform how individuals assess their health during economic downturns. Studies have shown that self-assessed health is a reliable and valid measure associated with and can predict functional decline, morbidity and mortality (Statistics Canada, 2010b) and it is widely used in studies as a measure of general health. Moreover, this measure may be more effective than clinical measures for predicting help-seeking behaviours and health service use (Statistics Canada, 2010b).

In the CCHS, the question regarding self-assessed health asks: in general, would you say that your health is: excellent, very good, good, fair, or poor? Because we are interested to better understand whether individuals are moving from poor health to good health, or good health to very good health, or vice versa,[16] we dichotomize this measure as: (i) poor health (if an individual reports being in poor, and/or fair health), (ii) good health (if an individual reports good, very good, and/or excellent health) and (iii) very good health (if an individual reports very good, and/or excellent health).

1.3.4 Sample construction and characteristics

The sample for study is constructed in the following way. All cycles/years of the CCHS (2000/2001 to 2013 inclusive) are pooled in order to generate a repeated cross-section dataset for analysis. This creates a total sample size of 726,000. We define the general sample for analysis as "prime-working age" individuals – age 25 to 59 - since these individuals would be affected most by economic downturns. It also avoids major lifecycle

[16]Note that the three measures are somewhat overlapping measures in order to better assess from which category of general health the individual is moving, and so the summary statistics pertaining to this measure will not sum to 1 in Table 1.1.

decisions such as schooling (individuals aged 18 to 24 may make decisions about education and work based on how the labour market is doing) and retirement (individual aged 60 to 64 may face decisions based on early retirement or continuing to work). Furthermore, it is these extensive margins that are more socially acceptable responses to a downturn, that is stay in school, retire, and they may not have the same effects on health. We follow these criteria: i) drop individuals that are younger than 25 years of age and older than 59 years of age; ii) include only individuals that live in the 25 CMAs (as defined by the 1996 Census) since we are measuring economic conditions at the metropolitan area. Limiting the sample by the above criteria results in a sample size of 248,646.

We undertake subsample analysis and estimate the models stratified by sex (male, female) and education level (less than a bachelor degree, bachelor degree and higher). Note that sample size may vary across model specification depending on the missing values of some outcome measures. Moreover, in models of weight-related health we exclude females that are breastfeeding or pregnant since this status can affect weight-related outcomes measured by BMI. Furthermore, we include dummy variables for missing information on variables that are used as control variables in order to preserve sample size.[17]

Table 1.1 summarizes the general sample. Considering first health compromising behaviours. Approximately 18 percent of the sample report being smokers. Of individuals who report being smokers, those who are conditional smokers smoke on average 3.5 cigarettes per day while those who are daily smokers smoke 15 cigarettes per day. More males report being smokers compared with females and conditional on being smokers, males smoke more cigarettes than females. In terms of alcohol consumption, approximately 8 percent of the sample report being heavy drinkers while 23 percent of the sample report being binge drinkers. Moreover, 7.7 percent of the sample reports being daily drinkers. In

[17]To be more clear, rather than dropping observations that have missing data on the control variables, we specify dummy variables for missing information on control variables as "1" if information is missing and "0" otherwise.

general, men report higher prevalence of heavy drinking, binge drinking and daily drinking compared to females. Considering next health promoting behaviours, approximately 24 percent report being active while 25 percent report being moderately active and 51 percent report being inactive. In general, more males report being active while females dominate being moderately active or inactive. Individuals report, on average, consuming a total of 4.8 servings of fruits and vegetables per day. In terms of self-assessed mental health and general health, 27 percent report being in poor health, while 39 percent report being in good health and 24 percent in very good health. The sample under study has an average age of approximately 42, with an equal proportion of male and female respondents. The average CMA unemployment rate is approximately 7 percent. A significant portion of the sample is married (51 percent) with single, common law, divorced, separated and widowed having smaller prevalence at 29 percent, 11 percent, 5.1 percent, 2.9 percent, and 1 percent, respectively. Males have a slightly higher prevalence of each status except for widowed and divorced for which females have slightly higher prevalence. Furthermore, about 71 percent of respondents are white. While Asians represent 17 percent of respondents, and Black, Native, Other, Latin America represent 3.3 percent, 1.9 percent, 2.5 percent, 1.75 percent, respectively. Finally, about 42 percent of the sample have less than a bachelor degree while 28 percent have a bachelor degree or higher.

[Insert Table 1.1]

1.4 Empirical Strategy

We estimate models with location and time fixed effects, using a linear probability model, in order to explore the impact of the unemployment rate with health and health behaviours.

The model is specified as:

$$H_{ijmt} = \tau U_{jmt} + \beta X_{ijmt} + \mu_j + \theta_m + \gamma_t + \varepsilon_{ijmt} \tag{1.1}$$

where i indexes the individual, j is the CMA of residence, m is the month surveyed, t is the year surveyed; H represents the relevant measure of health or health behaviour; U is the CMA-specific unemployment rate; X a set of individual and CMA specific covariates; μ is a vector of CMA fixed effects; θ is a set of monthly fixed effects; γ represents year effects, and ε captures unobserved determinants of health.

The fixed effects model in this context provides advantages for estimation because it can deal with unobserved heterogeneity that is time invariant. Such heterogeneity may lead to omitted variable bias. In the context of this study, we are concerned there may be time invariant unobserved labour market characteristics that are correlated with the unemployment rate and exert independent influence on health. If this is true it would lead to biased coefficient estimates, perhaps omitted variable bias could lead to saying there is no relationship when one exists. For example, some geographic areas may experience both poor health and high unemployment but a causal relationship does not exist (Charles & DeCicca, 2008). Their perceived link is a result of their correlation with another exogenous variable, or a result of a spurious correlation. Using the repeated cross-section structure of the CCHS, we exploit within-CMA variation in the unemployment rate, which effectively differences out any unobserved heterogeneity if it is time-invariant over the period of study.

Following the literature, the vector X includes controls for age, sex, race, educational attainment, and marital status.[18] A series of dummy variables is created for each of these controls in order to implement a flexible functional form and we include a dummy for missing information in order to preserve sample size. We also perform subsample analyses

[18] We also include dummies for household income, personal income, and employment status as robustness checks, but leave them out of our main models since they represent possible mechanisms through which the association of economic conditions and health are linked.

where models are stratified by the demographic characteristics of sex and education. Note that sample size may vary across model specification depending on the degree of missing data in our outcome measures. All models include CMA and time fixed effects as specified in eq. 3.1 and we report robust standard errors clustered at the CMA level to account for potential non independence of individuals within a given CMA [19]. This is important because variation in the unemployment rate is derived from only 25 sources.

Weights In order for estimates produced from our study to be representative of the covered population and not just the sample itself, we incorporate survey weights into our calculations (Statistics Canada, 2011a). Master weights are provided by Statistics Canada in each of the survey cycles/years. There are two methods by which data from the different surveys can be combined: the separate approach or the pooled approach (Thomas & Wannell, 2009). The pooled approach simply divides the weight by the number of pooled surveys making the implicit assumption that the sample is from one population, while the separate approach requires adjusting the weight to consider the population under study. That is, estimates are calculated for each survey separately and then combined. This approach creates an average of estimates calculated from the different CCHS cycles/years. We report estimates using the separate approach since by definition it is a better representation of the sample under study accounting for changes in population size over time and changes in the dependent variables thus providing a more precise measure of variance.

1.5 Results

In what follows we describe the results. This section is organized with the results related to health behaviours reported first followed by results related to self-rated health,

[19] This important because even after controlling for CMA, year, and month fixed effects, it is possible that observations within each CMA are not independent (Bertrand, Duflo, & Mullainathan, 2004).

self-rated mental health and self-rated stress, and finally results related to weight-related health. Within each of those subsections we describe results for the general model, then models stratified by sex and then by education.

1.5.1 Health behaviours

Briefly, when referring to how the unemployment rate (or macroeconomic conditions) are associated with health behaviours, if there is a positive relation between the two, then we say there is a countercyclical relationship, that is *countercyclical*: UR $\uparrow \rightarrow$ health behaviour $\uparrow$. In other words, when the economy gets worse, we see more of the health behaviour in question whether it is a "good" or "bad" behaviour. [20] If there is an inverse relationship between the two, then there is a procyclical relationship, that is: *Procyclical*: UR $\uparrow \rightarrow$ health behaviour $\downarrow$. In other words, when the economy contracts, we see less of the health behaviour in question. [21]

Estimates of the association of negative and positive health behaviours are summarized in Table 1.2. The upper portion of the table summarizes negative health behaviours (smoking and alcohol use) while the lower portion of the table summarizes estimates for positive health behaviours (physical activity and fruit and vegetable consumption). Consider first the negative health behaviours. Smoking does not have a statistically significant relationship with the unemployment rate. However, the predicted number of individuals who report smoking does exhibits a countercylical pattern which is different from Ruhm (2000) who finds a procyclical relationship. But, considering frequency of smoking and how much current smokers consume - daily smokers in fact decrease the number of cigarettes they smoke per day and this is consistent with Ruhm (2000). If our estimates were statistically significant, we could suggest that since the number of predicted smokers increases by 0.22

[20] Similarly, countercyclicality implies that when the economy expands, we see less of the behaviour.
[21] Similarly, procyclicality implies that when the economy improves, we see more of the behaviour.

percentage points for an increase of one percentage point in the CMA unemployment rate, it would lead to a 1.3 percent increase in the number of smokers (considering that 18 percent of our sample smokes - see Table 1.1).

In contrast to smoking, the general pattern of alcohol use is procyclical. Yet estimates for the association of the unemployment rate with those who report being heavy drinkers or binge drinkers are not statistically significant. There is however a statistically significant relationship between labour market conditions and daily alcohol consumption. For a one percentage point increase in the unemployment rate, there is an increase of 0.39 percent daily drinks. Roughly 7.9 percent of the sample are daily drinkers, and thus a one percentage point increase in the unemployment rate leads to a 4 percent decrease in the number of people that drink daily. Thus, the evidence for Canada is consistent with that of other regions - that alcohol use is procyclical. In other words, as the economy contracts (the unemployment rate increases), we see less binge drinking and heavy drinking. These results suggest that individuals decrease alcohol consumption during worse economic conditions.

Considering next positive health behaviours. Physical activity exhibits a procyclical pattern so that when the economy is not doing well physical activity decreases. The CCHS ranks individuals as active, moderately active (moderate) and inactive in their leisure time based on the average daily energy (calorie) expended during leisure time activities by respondents in the past three months. The coefficient estimates suggest that overall individuals decrease physical activity during bad economic times but the results are not statistically significant except for the fraction of individuals who report being inactive. For a one percentage point increase in the unemployment rate the fraction of individuals who report being inactive increases by 0.39 percent. Roughly 50 percent of our sample report being inactive thus there is an approximate increase of 0.77 percent of inactive individuals. These results suggest that individuals decrease physical activity during economic downturns. Overall, these results differ from Ruhm (2005) and Colman and Dave (2013) who

find that recreational exercise tends to increase as the unemployment rate increases. It is not clear why there are differences here, but perhaps the Canadian climate may hinder recreational exercise or Canadians may find higher barriers to joining a gym where they could undertake physical activity.

Finally, overall, fruit and vegetable consumption exhibits a procyclical pattern. The number of times that an individual consumes fruit and vegetables in a day (the frequency of consumption) is summarized by three derived variables in the CCHS: less than 5 times per day, between 5 and 10 times per day, and more than 10 times per day. About 59 percent of individuals consume fruits and vegetables less than 5 times per day. A one percentage point increase in the unemployment rate leads to a 0.65 percentage point increase in the fraction of our sample who consume less than 5 servings of fruit and vegetables per day. This means that with a one percentage point increase in the unemployment rate, approximately 1.1 percent more individuals will consume fruits and vegetables less than 5 times per day. However, when the unemployment increases, individuals who report eating a total of 5 to 10 and 10 or more total times per day decreased (0.53 and 0.12, respectively). Approximately 36.8 percent of the sample report consuming 5 to 10 times, while 3.85 percent report consuming 10 or more times. Thus, there is an approximate decrease of 1.4 percent and 3.1 percent of individuals who report eating between 5 and 10, or 10 or more times of fruits and vegetables. Overall, this suggests that when the economy is not doing well, consumption of fruits and vegetables decreases suggesting the dietary behaviour may be less healthy. These results are consistent with those of Dave and Kelly (2012) who find that an increase in the unemployment rate is associated with reduced consumption of fruits and vegetables. However, the picture of dietary behaviour is incomplete because lack of comprehensive data that include consumption of unhealthy foods.

[Insert Table 1.2]

Overall, these results suggest that individuals take on some health-promoting behaviours like reducing alcohol consumption, during economic downturns but these healthier behaviours may be offset by negative health behaviours and decreases in health-promoting behaviours, so that the net effect in health is unclear.

It is possible and well-documented that changes in the labour markets conditions may not affect males and females equally and so we estimate models that are stratified by sex to explore whether the changes in unemployment rates are associated with different patterns in estimates for males and females. Table 1.3 summarizes estimates of the impact of changes in unemployment rates on the positive and negative health behaviours stratified by sex. Considering negative health behaviours (the upper portion of Table 1.3), the pattern of coefficient estimates reiterates that the number of males and females who report smoking is countercyclical and not statistically significant, as established earlier while consumption of cigarettes for daily smokers is procyclical. The main result here is that females who are occasional smokers actually increase the number of cigarettes that they smoke per day. For a one percentage point increase in the unemployment rate there is an increase in the fraction of cigarettes smoked of 9.22 and since occasional female smokers consume 3.1 cigarettes per day this increase represents an approximate increase of 3 cigarettes per day for females. The increase in occasional smoking indicates that females may in fact use cigarette smoking as a means of self-medicating the worse economic conditions or uncertainty about their economic well-being, and this has been documented in the literature (Frone, Cooper, & Russell, 1994).

Estimates for alcohol use are procyclical while the estimates for the fraction of individuals that report binge drinking or heavy drinking are not statistically significant. In contrast however, the fraction of males and females who report daily drinking decreases and is statistically significant. Approximately 9 percent of the male population and 5.5 percent of the female population report being daily drinkers. With a one percentage point increase in the

unemployment rate there is a decrease of 0.39 percent and 0.22 percent of daily drinkers and so this corresponds to a decrease of 3.93 percent males and 4.02 percent females.

Considering next positive health behaviour, the coefficient estimates for good health behaviours are similar in size and in sign to those of the general population. In general there is no statistically significant relationship between physical activity and the unemployment rate, but the estimates do confirm that physical activity for both males and females exhibits a procyclical pattern. Furthermore, considering fruit and vegetable consumption both males and females exhibit a procyclical pattern in consumption of fruit and vegetables. For a one percentage point increase in the unemployment rates total fruit and vegetable consumption decreases by 3.8 and 2.4 percentage points for males and females, respectively. This translates to a decrease of 0.87 percent and 0.47 percent for males and females respectively. This pattern is consistent and evident when considering the number of servings per day that individuals consume. Evidently, those who report consuming 10 or more servings, or 5 to 10 servings decreases while those who report consuming less than 5 servings increases. We can assume that in fact individuals are moving to other categories of consumption. More specifically, about 66 percent of males and 52 percent of females consume fruits and vegetables less than 5 times per day. A one percentage point increase in the unemployment rate leads to a 0.74 and 0.54 percentage point increase in the fraction of our male and female sample, respectively, who consume less than 5 servings of fruit and vegetables per day. This means that with a one percentage point increase in the unemployment rate, approximately 1.12 percent and 1.03 percent more males and females, respectively, will consume fruits and vegetables less than 5 times per day. However, when the unemployment increases, individuals who report eating a total of 5 to 10 and 10 or more times of fruits and vegetables per day decreases. The estimates are statistically significant for females who consume 5 to 10 servings per day and for males who consume 10 or more servings per day. Overall, this reiterates as suggested earlier, that when the economy is not doing well, consumption of

fruits and vegetables decreases suggesting the dietary behaviour may be less healthy.

[Insert Table 1.3]

In the relevant literature it is well-documented that changes in labour market conditions can affect individuals with different levels of education differently (Hoynes, 1999). Hoynes (1999) finds consistent results that individuals with lower levels of education and low skill women experience greater cyclical fluctuation than high skill men. As a result, one might assume that individuals with higher levels of education are able to make better decisions about the allocation of their time and resources and experience a lower level of income insecurity when faced with income constraints. Table 1.4 summarizes the association of the unemployment rates with the health behaviours of individuals stratified by level of education.

From the table, similar to the overall estimates, smoking does not exhibit a statistically significant association with the unemployment rate considering individuals with different education levels with the coefficient sign are consistent with the procyclical pattern exhibited earlier. A difference to note however is that for individuals with less than a bachelors degrees there is a statistically significant relationship between the unemployment rate and alcohol use. Overall, individuals with less than a bachelor's degree exhibit a procyclical pattern of alcohol consumption while individuals with a bachelor's degree or higher exhibit a countercyclical pattern (although not statistically significant). Heavy drinking among the less educated decreases by 0.36 percentage points for a one percentage point increase in the unemployment rate which translates to an overall decrease of 3.9 percent in the fraction of individuals who report heavy drinking. The fraction of less educated individuals who report binge drinking decreased by 2.87 percent for a one percentage point increase in the unemployment rate. Finally, with a one percentage point increase in the unemployment rate the fraction of less educated individuals who reported being daily drinker decreased by 4.85

percent.

Estimates of the association of physical activity and the unemployment rate by education level is not statistically significant. But, considering the coefficient sign, those with less than a bachelor degree show a consistent procyclical pattern of physical activity while it isn't clear what kind of pattern prevails for those with a bachelor degree or higher since there is an increase daily exercise, but fewer individuals report being active while more individual report being moderately active or inactive.

The lower half of Table 1.4 summarizes the estimates for fruit and vegetable consumption stratified by education. Overall, fruit and vegetable consumption exhibits a procyclical pattern for both levels of education. Total fruit and vegetable consumption decreases for individuals with both levels of education. Individuals that fall within the consumption of less than 5 servings per day increase by 1.1 percent while those consuming between 5 and 10 or 10 and more servings decrease by 1.5 percent and 1.77 percent, respectively. Those with a bachelor's degree or higher are more likely to consume less than 5 servings which increases by 2.1 percent while those falling within the 5 to 10 range or 10 or more range decrease by 2.67 percent and 5.3 percent, respectively.

[Insert Table 1.4]

Table 1.5 summarizes these estimates of the association of the CMA unemployment rate with health behaviours of individuals stratified by education and by sex. There is a statistically significant decrease in the number of less educated females who report being smokers. For a one percentage point increase in the unemployment rate there is a decrease of 0.35 percentage point of females who report being smokers. This is a decrease of 1.96 percent of females. There is a statistically significant relationship between less educated male occasional smokers. Males decrease consumption by roughly 0.12 cigarettes with a one percentage point increase in the unemployment rate. On average, male occasional

smokers with less than a bachelor degree smoke about 3 cigarettes. This means that there is a decrease of approximately 4 cigarettes. Consider alcohol consumption, less educated males and females exhibit a procyclical pattern of consumption while those more educated a countercyclical pattern. More specifically, with a one percentage point increase in the unemployment rate the fraction of less educated males who report heavy drinking decreased by 0.37 percentage points while for females decreased by 0.34 percentage points. Roughly 14 percent of the sample of males who are less educated report heavy drinking and 4 percent less educated females. Thus, it translates to a 2.68 percent decrease of less educated males who report heavy drinking while less educated females who report heavy drinking decreased by 8.27 percent. In contrast, there is no systematic relationship among an increase in the unemployment rate with the fraction of more educated males who report being heavy drinkers. The effect of local labour market conditions are strong for females with less than a bachelor's degree and males with a bachelor's degree or more. the model by both education level and sex.

Looking next at positive health behaviours, although estimates are not statistically significant it appears that less educated males and females exhibit a procyclical pattern of activity while it isn't clear for more educated respondents. Finally, considering dietary behaviour, although most estimates are not statistically significant, the pattern of the estimates suggests that regardless of education level individuals follow a procyclical pattern of fruit and vegetable consumption. More specifically, more educated males show a strong and statistically significant negative relationship between the consumption of fruits and vegetables and the unemployment rate. While the same is true for less educated females.

[Insert Table 1.5]

1.5.2 Self-rated health, self-rated mental health, and self-rated life stress

Table 1.6 summarizes estimates from models estimating the relationship between economic conditions and self-rated health, self-rated mental health and self-rated stress. Overall, general and mental health exhibit a procyclical pattern. Closer inspection shows, however, that there is no systematic relationship between the unemployment rate and general health for the sample. Considering mental health, although not statistically significant, there is a procyclical pattern of mental health - mental health gets worse as the unemployment rate increases. Finally, consider the last section of Table 1.6 which exhibits coefficient estimates for the relationship between local labour market conditions and life stress. There is no evident systematic relationship between the fraction of individuals who report stress and no stress, though the fraction of individuals who report somewhat stressful life situations increases. With a one percentage point increase in the unemployment rate, there is a 1.3 percent increase in the fraction of individuals who report a somewhat stressful life situation.

[Insert Table 1.6]

Consider next Table 1.7 which summarizes models stratified by sex. First consider health outcomes for males. Although not statistically significant, the pattern of general health exhibits a procyclical pattern so that males are in worse health as the unemployment rate decreases. Similarly, considering the coefficient estimates for the relationship between local unemployment rates and mental health suggest that with a 1 percentage point increase in the unemployment rate there is a 5.4 percent increase in males who report poor mental health. Finally, there is no apparent systematic relationship between the unemployment rate and life stress. Consider next health outcomes for females. There appear to be no systematic relationships between the unemployment rate and estimates of general health, mental health, and life stress for females.

[Insert Table 1.7]

Tables 1.8 and 1.9 summarize estimates of models for self-rated health, self-rated mental health and stress, stratified by education. The first section shows estimates associated with general health. Overall, individuals with less than a bachelor's degree exhibit deteriorating general health. Looking first at Table 1.8, with a one percentage point increase in the unemployment rate, there is a 3.1 percent increase in the number of individuals reporting poor general health. For individuals with a bachelor's degree or higher, there is no evident systematic relationship between local labour market conditions and general health. The second part of Table 1.8 provides coefficient estimates of the association of local unemployment rates with self-rated mental health and estimates are not statistically significant. It appears that there is no systematic relationship between local labour market conditions and individuals with less than a bachelor's degree who report poor or good mental health. However, there is a positive relationship for very good mental health (albeit very small). In contrast, although not statistically significant, more educated individuals exhibit a deteriorating mental health pattern. Finally, the lower portion of Table 1.8 summarizes estimates for life stress. For individuals with less than a bachelor's degree, there appears to be a positive association with labour market conditions and somewhat stressful life situation. A one percentage point increase in the unemployment rate is associated with an increase in the fraction of individuals who report somewhat stressful life situation by 0.66 percent. This estimate is driven by males, with an increase of 1.4 percent while there is no evident systematic relationship for females. There appears to be no systematic relationship between local labour market conditions and stress for the general sample of individual with a bachelor's degree or higher. Consider next Table 1.9 which summaries models stratified by both education and sex. Consider first outcomes for males. Overall, for less educated males there appears to be a procyclical pattern of general health and no systematic relationship between

economic conditions and mental health or life stress. Their more educated counterparts also follow a procyclical pattern in general health. In contrast, however, there is a statistically significant estimate of a decrease in more educated males who report being in very good mental health. Considering next the health outcomes of females by education level, the results are not clear and most are statistically insignificant with the exception of life stress. There is an increase the fraction of more educated females who reported being in good life stress. It isn't clear whether they are moving from very good life stress or poor life stress, but considering the sign of coefficient estimates, it seems as females are moving from very good to good suggesting that, in fact, worse economic conditions negatively impact how respondents perceive life stress.

[Insert Table 1.8] [Insert Table 1.9]

1.5.3 Weight-related health

Table 1.10 summarizes the estimated effects of local labour market conditions on weight-related health. Although there appears to be no statistically significant relationship between economic conditions and the weight-related health of Canadians, the estimates suggest that body mass index (BMI) increases as the local unemployment rate increases. Although the coefficient estimates are statistically insignificant, they represent an average effect of labour market conditions on body weight and if increases in the unemployment rate lead to weight gains for some individuals and losses for others, the average effect will be weakened. Rather than looking at the BMI itself, we consider well-developed clinical thresholds defined by: underweight ($BMI \leq 18.5$), overweight ($BMI \geq 25$), and obese ($BMI \geq 30$). Considering these clinical thresholds rather than the BMI itself helps use to better understand how local labour market conditions are effecting weight-related health. The coefficient estimates suggest that there is no systematic relationship between increases in the unemployment rate

and the fraction of individuals falling within the underweight and obese threshold, while the fraction of individuals that fall within the overweight threshold decrease. Considering Table 1.11, this relationship is also true for females, but for males - although estimates are statistically insignificant - the coefficient estimates suggest that the fraction of individual who fall within the underweight threshold decrease while those that fall within the obese threshold increase and this is consistent with females estimates as well. Males, however, exhibit the opposite pattern and in fact BMI decreases as the local unemployment rate increases. Back to Table 1.10, considering the four ranges of BMI that represent healthy body weights[22], all corresponding estimates are positive and statistically insignificant. Moreover, because there is no evident systematic relationship for health ranges BMI between 18.5 and 30 and BMI between 20 and 30, we suggest that the fraction of individuals who are moving out of the overweight threshold fall into the threshold of BMI between 20 and 25 (which is clinically considered to represent normal weight). Similarly the relationship holds for males and for females, see Table 1.11. Finally, in general there is no evidence of a relationship at the $BMI \geq 35$ and $BMI \geq 40$ thresholds, see Table 1.10, but there is the exception for males, see Table 1.11. The fraction of males that fall in the $BMI \geq 35$ threshold decrease. Although statistically insignificant, this coefficient estimate is consistent with other estimates that suggest that individuals are falling into a healthier BMI threshold. Our results are consistent with Ruhm (2005) who finds that as the unemployment rate increased the proportion of severely obese respondents decreased. However, it contradicts results from Charles and DeCicca (2008) and Latif (2013) who find that increases in unemployment rates lead to increases in weight status.

[Insert Table 1.10] [Insert Table 1.11]

[22]Please refer to section 1.3.3.2 for detailed discussion.

Tables 1.12 and 1.13 summarize the regression estimates of weight-related health, stratified by education and education and sex. Consider first Table 1.12. The estimates suggest that BMI increases as local labour market conditions worsen for individuals with less than a bachelor's degree. Considering individuals with less than a bachelor's degree, there is statistically significant evidence that the fraction of individuals that fall within the underweight threshold decrease, suggesting that these individuals move into a healthier weight threshold (suggesting weight gain, but these weight gains imply better weight related health). The coefficient estimates suggest that there is a 6.9 percent decrease of individuals falling within this threshold. The general pattern also suggests that individuals tend to fall into "healthier" weight status as the unemployment rate increases. Thus, in general weight-related health appears to be improving for individuals. Consider next Table 1.13. The estimates suggest that BMI increases as local labour market conditions worsen for males with a bachelor's degree or more. The coefficient estimates suggest that there is a 13.2 percent decrease of males and 4.7 percent decrease of females falling within the threshold of underweight. The general pattern also suggests that males with less than a bachelor degree tend to fall into "healthier" weight status as the unemployment rate increases, however, the pattern is not that clear for female counterparts. It appears that some females with less than a bachelor's degree may in fact fall into less healthy BMI thresholds. As mentioned, males with a bachelor's degree or higher in fact have a positive association of BMI with the unemployment rate. There is a decrease in the fraction of males that fall in the overweight threshold but an increase in the obese threshold and $BMI \geq 35$ threshold. Thus, in general, the improvement in weight-related health appears to be driven by females while males in fact appear to be falling into worse BMI thresholds.

[Insert Table 1.12] [Insert Table 1.13]

1.6 Conclusion

In this study, we used repeated cross sectional Canadian data combined with fixed effects methodology to study the association of health and health behaviours with local labour market fluctuations. We used variation in macroeconomic conditions in the 25 Census Metropolitan Areas (CMAs), as defined by the 1996 Census, over the period of 2000 to 2013 to proxy for local labour market fluctuations. Moreover, we defined the working age population as those between 25 and 59 in order to restrict the sample to those for whom labour market conditions are most relevant. We estimate full sample models, and also models that are stratified by sex and by education level.

Most estimates are small and many statistically insignificant but important exceptions exist. Of particular note is the pattern of association of fruit and vegetable consumption with changes in economic conditions. There is consistent evidence across all models that the association of fruit and vegetable consumption with the unemployment rate suggests that individuals respond to changes in local labour market conditions by changing their consumption patterns. In general, when economic conditions get worse, that is the unemployment rate increases, fruit and vegetable consumption decreases. More specifically, with a one percentage point increase in the unemployment rate, the fraction of individuals who report consuming 10 or more servings of fruits and vegetables decreases by 3.1 percent, 5 to 10 servings decreases by 1.4 percent, and the fraction of individuals who report consuming less than 5 servings of fruit and vegetables increases by 1 percent.[23] This evidence is consistent with U.S. evidence where Dave and Kelly (2013) find that fruit and vegetable consumption decreases as the unemployment rate increases. This result thus, is of particular note because diets that consist of good fruit and vegetable consumption may reduce the risk of chronic diseases, cardiovascular disease, and cancer. Furthermore, it has been

[23] Similar evidence is apparent for models stratified by sex and education.

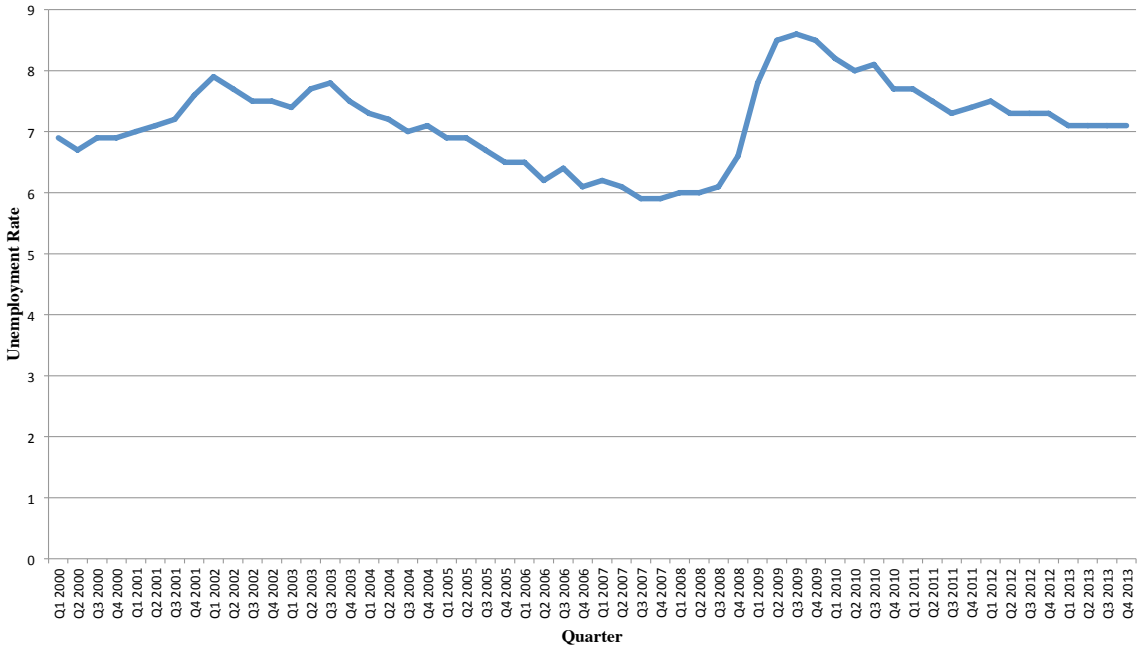
documented that the consumption of fruit and vegetables can impact mental well-being. Blanchflower et al. (2013) show that happiness and mental health rise with the number of daily portions of fruit and vegetables, and well-being peaks at 7 portions of fruits and vegetables per day. Taking this evidence together with Pierard and Grootendorst (2014), who find that gender specific mortality rates of Canadians varied positively with changes in the unemployment rate suggesting that suicide rates increase during economic downturns, perhaps implies that one input into improving the mental well-being of Canadians can be to increase fruit and vegetable consumption. And so, our results in this study suggest that the consumption of fruits and vegetables by Canadians is particularly sensitive to changes in economic conditions and needs to be considered accordingly.

Furthermore, although estimates are mainly not statistically significant, our results are illustrative of the patterns that the average health and health behaviours of Canadians take on with economic conditions. Thus they warrant a brief summary here. For the overall sample we find that smoking exhibits a countercyclical pattern, so that as economic conditions worsen there is an increase in the fraction of individuals who report smoking; But daily smokers decrease the number of cigarettes that they smoke daily. In contrast, we find that alcohol use exhibits a procyclical pattern and there is a statistically significant relationship between the increase in the unemployment rate and the decrease in the number of drinks for a daily drinker. Physical activity exhibits a procyclical pattern which is in contrast to U.S. pattern of coefficient estimates (Colman & Dave, 2013). General health and mental health diminish with an increase in the unemployment rate. In regards to stress, few coefficient estimates show a systematic relationship. There is a statistically significant increase in the fraction of individuals who report somewhat stressful life stress, but it is not clear whether that fraction of individuals is increasing due to a decrease in individuals reporting stress or individuals reporting no stress. Finally, the fraction of individuals falling within the normal weight range based on clinical thresholds of BMI increase, suggesting that overall

weight-related health improves.

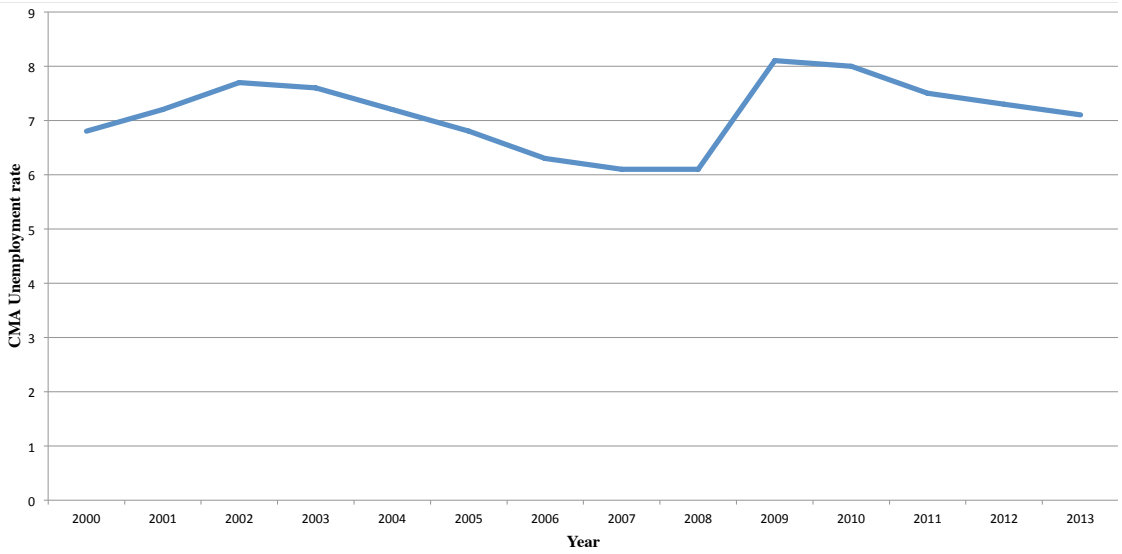
The above summary of results illustrates some discrepancy with the earlier Canadian studies that examine limited health behaviours of smoking, alcohol use and weight-related health. Latif (2013) and Latif (2014) use individual level Canadian data over the 1994 to 2009 period and finds that the unemployment rate was not statistically significantly associated with the probability of being a smoker but that as the unemployment rate increases the probability of being a binge drinker increases and so too does weekly alcohol consumption for Canadians. Perhaps the discrepancy in findings is a result of different time frames of analysis, different data sets, different levels of geographic aggregation of the unemployment rate and final different model specifications. Such discrepancies have been documented in the literature of alcohol consumption (c.f. Pacula 2011). In sum, although we find that alcohol use decreases and more individuals fall within a lower BMI threshold, one might suggest that Canadians overall take on less healthy behaviours and have worse health outcomes when the unemployment rate rises. There is a significant and strong association between economic conditions and decreases in fruit and vegetables consumption and similarly with those who report being daily smokers, those who report being physically inactive and stress.

Figure 1.1: Quarterly unemployment rate, 2000 to 2013



Source: Data are from CANSIM Table 282-0087 Labour Force Survey estimates (LFS), seasonally adjusted, quarterly.

Figure 1.2: Unemployment rate, 2000 to 2013



Source: Data are from CANSIM Table 282-0116 Labour Force Survey estimates (LFS), by Census Metropolitan Area based on 2006 census boundaries, 3-month moving average, seasonally adjusted, annual.

Table 1.1: Descriptive Statistics

Variable	mean	(std. dev.)	mean	(std. dev.)	mean	(std. dev.)
Outcomes:	All		Male		Female	
Smoking:						
Smoker	0.1828	(0.3865)	0.2078	(0.4057)	0.1568	(0.3636)
Occasional smoker	3.4284	(3.2911)	3.6783	(3.6755)	3.1073	(2.6847)
Daily smoker	15.1507	(8.6569)	16.2198	(9.0590)	13.6802	(7.8364)
Alcohol Use:						
Heavy drinking	0.0836	(0.2768)	0.1233	(0.3288)	0.0383	(0.1920)
Binge drinking	0.2238	(0.4168)	0.3038	(0.4599)	0.1325	(0.3390)
Daily drinking	0.0785	(0.2689)	0.0993	(0.2990)	0.0547	(0.2275)
Physical Activity:						
Daily exercise	0.3473	(0.4761)	0.3388	(0.4733)	0.3561	(0.4789)
Active	0.2413	(0.4279)	0.2625	(0.4400)	0.2194	(0.4138)
Moderate	0.2529	(0.4347)	0.2490	(0.4324)	0.2570	(0.4370)
Inactive	0.5058	(0.5000)	0.4886	(0.4999)	0.5236	(0.4994)
Consumption of fruits and vegetables:						
Less than 5 times/day	0.5931	(0.4913)	0.6601	(0.4737)	0.5236	(0.4994)
5 to 10 times/day	0.3684	(0.4824)	0.3077	(0.4616)	0.4314	(0.4953)
10 or more time/day	0.0385	(0.1923)	0.0322	(0.1765)	0.0450	(0.2073)
Total fruits and vegetables	4.7982	(2.5926)	4.4433	(2.5280)	5.1664	(2.6073)
Self-assessed Health						
poor	0.0882	(0.2836)	0.0810	(0.2729)	0.0956	(0.2941)
good	0.9118	(0.2836)	0.9190	(0.2729)	0.9044	(0.2941)
very good	0.6357	(0.4812)	0.6414	(0.4796)	0.6296	(0.4829)
Self-assessed mental health						
poor	0.0559	(0.2298)	0.0498	(0.2175)	0.0623	(0.2418)
good	0.9441	(0.2298)	0.9502	(0.2175)	0.9377	(0.2418)
very good	0.7360	(0.4408)	0.7515	(0.4322)	0.7199	(0.4490)
Life Stress						
stressful	0.7344	(0.4416)	0.7237	(0.4472)	0.7457	(0.4355)
somewhat stressful	0.2911	(0.4543)	0.2791	(0.4485)	0.3036	(0.4598)
not stressful	0.2656	(0.4416)	0.2763	(0.4472)	0.2543	(0.4355)
Weight-related health						
BMI	30.95	(42.8901)	28.23	(24.1470)	33.79	(55.9435)
lbmi	3.2609	(0.4153)	3.2697	(0.2919)	3.2518	(0.5129)
BMI between 18.5 and 25	0.4604	(0.4984)	0.3861	(0.4869)	0.5375	(0.4986)
BMI between 18.5 and 30	0.7921	(0.4058)	0.8014	(0.3989)	0.7825	(0.4126)
BMI between 20 and 25	0.4085	(0.4916)	0.3652	(0.4815)	0.4535	(0.4978)
BMI between 20 and 30	0.7401	(0.4386)	0.7804	(0.4140)	0.6983	(0.4590)
Underweight (BMI ≤ 18.5)	0.0349	(0.1836)	0.0197	(0.1389)	0.0507	(0.2195)
Overweight (BMI ≥ 25)	0.5047	(0.5000)	0.5942	(0.4910)	0.4117	(0.4921)
Obese (BMI ≥ 30)	0.1730	(0.3782)	0.1789	(0.3833)	0.1668	(0.3728)
BMI ≥ 35	0.0591	(0.2359)	0.0447	(0.2066)	0.0742	(0.2620)
BMI ≥ 40	0.0295	(0.1692)	0.0170	(0.1294)	0.0425	(0.2016)
CMA Rate:						
unemployment rate	6.9931	(1.7006)	6.9820	(1.7018)	7.0047	(1.6992)
Individual Characteristics:						
single	0.2021	(0.4016)	0.2170	(0.4122)	0.1867	(0.3897)
married	0.5736	(0.4946)	0.5807	(0.4935)	0.5663	(0.4956)
common law	0.1226	(0.3280)	0.1300	(0.3363)	0.1150	(0.3190)
widow	0.0094	(0.0966)	0.0040	(0.0630)	0.0151	(0.1219)
seperated	0.0342	(0.1818)	0.0267	(0.1611)	0.0420	(0.2007)
divorced	0.0562	(0.2304)	0.0403	(0.1967)	0.0728	(0.2598)
unknown marital status	0.0017	(0.0414)	0.0014	(0.0368)	0.0021	(0.0457)
male	0.5096	(0.4999)				
female	0.4904	(0.4999)				
age	42.0492	(9.7489)	41.7626	(9.7603)	42.3470	(9.7282)
White	0.7106	(0.4535)	0.7149	(0.4514)	0.7062	(0.4555)
Black	0.0325	(0.1774)	0.0308	(0.1727)	0.0343	(0.1821)
Latin American	0.0178	(0.1322)	0.0187	(0.1353)	0.0169	(0.1289)
Native	0.0181	(0.1334)	0.0178	(0.1324)	0.0184	(0.1344)
Asian	0.1701	(0.3758)	0.1674	(0.3733)	0.1730	(0.3782)
Other race	0.0228	(0.1491)	0.0219	(0.1465)	0.0236	(0.1518)
Unknown race	0.0280	(0.1651)	0.0284	(0.1662)	0.0276	(0.1639)
Less than a bachelor degree	0.4219	(0.4939)	0.4209	(0.4937)	0.4231	(0.4940)
Bachelor degree or higher	0.3153	(0.4646)	0.3178	(0.4656)	0.3126	(0.4636)

Data are for noninstitutionalized adults from the Canadian Community Health Survey (CCHS) and cover cycle 1.1 (year 2000/2001) to year 2013. Information on Census Metropolitan Area (CMA) unemployment rates is from Statistics CANSIM *(Canadian Socio-Economic Information Management System http://www5.statcan.gc.ca/cansim/home-accueil?lang=eng)*. CCHS sample weights are used in calculating the mean and standard deviations. The unemployment rate refers to civilians aged 15 and over.

Table 1.2: Estimates of the association of the CMA unemployment rate on selected health behaviours both negative and positive

Outcome	Coefficient estimates	Sample size
Negative Health Behaviours		
Smoking		
Smoker	0.0022	189548
	(0.0014)	
Occasional smoker	0.0560	10157
	(0.0374)	
Daily smoker	-0.0325	37956
	(0.0808)	
Alcohol use		
Heavy drinker	-0.0004	156644
	(0.0012)	
Binge drinker	-0.0016	156644
	0.0018	
Daily drinker	**-0.0031*****	156997
	(0.0009)	
Positive Health Behaviours		
Physical activity		
Daily exercise	-0.0009	186816
	(0.0019)	
Active	-0.0021	186816
	(0.0021)	
Moderate	-0.0190	186816
	(0.0016)	
Inactive	**0.0039***	186816
	(0.0021)	
Fruit and Vegetable Consumption		
Less than 5 servings	**0.0065*****	171607
	(0.0018)	
5 to 10 servings	**-0.0053****	171607
	(0.0021)	
10 or more servings	-0.0012	171607
	(0.0009)	
Total fruit and vegetable consumption	**-0.0317*****	171524
	(0.0101)	

Notes: all specifications include vectors of CMA, year, and month dummy variables and control for race (white, black, Asian, Latin American, Native, other, race not reported), marital status (single, married, common law, divorced, widowed, separated and marital status not reported), education (no post secondary, trade, diploma, university certificate, bachelor degree and above bachelor degree, and education not reported), sex, and age (series of dummy for each age). Robust standard errors, clustered at the CMA level are reported in the parenthesis. Data are from the CCHS (2000/2001 to 2013) with CMA unemployment rates merged from Statistics Canada CANSIM table number 282-0110 (Labour Force Survey (LFS) estimates by census metropolitan area based on 2006 census boundaries, sex and age group). Sample includes both males and females aged 25-29. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level.

Table 1.3: Estimates of the association of the CMA unemployment rate on selected health behaviours both negative and positive, by sex

Outcome	Male	Female
Negative Health Behaviours		
Smoking		
Smoker	0.0026	0.0021
	(0.0021)	(0.0016)
Occasional smoker	0.0036	**0.0922***
	(0.0632)	(0.0457)
Daily smoker	-0.0562	-0.0021
	(0.1110)	(0.0648)
Alcohol use		
Heavy drinker	-0.0004	-0.0007
	(0.0022)	(0.0010)
Binge drinker	-0.0029	-0.0007
	0.0028	0.0026
Daily drinker	**-0.0039****	**-0.0022***
	(0.0014)	(0.0012)
Positive Health Behaviours		
Physical activity		
Daily exercise	-0.0013	-0.0003
	(0.0028)	(0.0024)
Active	-0.0020	-0.0021
	(0.0029)	(0.0030)
Moderate	-0.0020	-0.0017
	(0.0019)	(0.0020)
Inactive	0.0040	0.0039
	(0.0033)	(0.0023)
Fruit and Vegetable Consumption		
Less than 5 servings	**0.0074****	**0.0054*****
	(0.0032)	(0.0018)
5 to 10 servings	-0.0049	**-0.0055*****
	(0.0036)	(0.0019)
10 or more servings	**-0.0025***	0.0000
	(0.0013)	(0.0010)
Total fruit and vegetable consumption	**-0.0388****	**-0.0242***
	(0.0145)	(0.0139)

Notes: all specifications include vectors of CMA, year, and month dummy variables and control for race, marital status, education. Robust standard errors, clustered at the CMA level are reported in the parenthesis. Data are from the CCHS (2000/2001 to 2013) with CMA unemployment rates from CANSIM table number 282-0110. Sample includes both males and females aged 25-29. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level. (For more detail see notes to table 2). No. of observations: male: smoker 87547, occasional smoker 5196, daily smoker 19915, heavy drinker and binge drinker 75179, daily drinker 75428, physical activity 85787, fruit and vegetable consumption servings 79060, total fruit and vegetable consumption 79027. No. of observations: female: smoker 102001, occasional smoker 4961, daily smoker 18041, heavy drinker and binge drinker 81465, daily drinker 81569, physical activity 101029, fruit and vegetable consumption servings 92547, total fruit and vegetable consumption 92497.

Table 1.4: Estimates of the association of the CMA unemployment rate on selected health negative and positive health behaviours, by education

Outcome	Less than a bachelor degree	Bachelor degree or higher
Negative Health Behaviours		
Smoking		
Smoker	-0.0012	0.0033
	(0.0018)	(0.0021)
Occasional smoker	-0.0017	0.1149
	(0.0479)	(0.0934)
Daily smoker	0.0234	-0.0657
	(0.0797)	(0.1965)
Alcohol use		
Heavy drinker	**-0.0036***	0.0010
	(0.0019)	(0.0017)
Binge drinker	**-0.0066****	0.0029
	(0.0025)	0.0026
Daily drinker	**-0.0038***	0.0002
	(0.0016)	(0.0012)
Positive Health Behaviours		
Physical activity		
Daily exercise	-0.0030	0.0032
	(0.0028)	(0.0023)
Active	-0.0022	-0.0041
	(0.0033)	(0.0032)
Moderate	-0.0022	0.0028
	(0.0026)	(0.0029)
Inactive	0.0043	0.0013
	(0.0034)	(0.0025)
Fruit and Vegetable Consumption		
Less than 5 servings	**0.0063****	**0.0121*****
	(0.0027)	(0.0043)
5 to 10 servings	**-0.0056****	**-0.0100***
	(0.0025)	(0.0050)
10 or more servings	-0.0007	-0.0021
	(0.0012)	(0.0018)
Total fruit and vegetable consumption	**-0.0319****	**-0.0488***
	(0.0135)	(0.0241)

Notes: all specifications include vectors of CMA, year, and month dummy variables and control for race, marital status, education. Robust standard errors, clustered at the CMA level are reported in the parenthesis. Data are from the CCHS (2000/2001 to 2013) with CMA unemployment rates from CANSIM table number 282-0110. Sample includes both males and females aged 25-29. Sample size for those with less than a bachelor degree and bachelor degree or higher, respectively: smoker 82747, 56698; occasional smoker 4841, 2901; Daily smoker 18098, 4372; Heavy drinker 70512, 48297; Binge drinker 70512 48297, Daily Drinker 70668, 48342; Physical activity all measures 81833, 56054; Fruit and vegetable consumption less than 5 servings, 5 to 10 servings, and 10 or more servings, 74767, 51859; Total fruit and vegetable consumption 74721, 51850. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level. (For more detail see notes to table 2).

Table 1.5: Estimates of the association of the CMA unemployment rate on selected health negative and positive health behaviours, by education and sex

	Male		Female	
Outcome	Less than a bachelor degree	Bachelor degree or higher	Less than a bachelor degree	Bachelor degree or higher
Negative Health Behaviours				
Smoking				
Smoker	0.0011	0.0045	**-0.0035***	0.0022
	(0.0031)	(0.0028)	(0.0020)	(0.0024)
Occasional smoker	**-0.1225***	0.1295	0.0640	0.0416
	(0.0666)	(0.1555)	(0.0696)	(0.0464)
Daily smoker	0.0391	-0.2852	-0.0107	0.1960
	(0.1223)	(0.2536)	(0.0754)	(0.1688)
Alcohol use				
Heavy drinker	-0.0037	0.0004	**-0.0034***	0.0011
	(0.0036)	(0.0027)	(0.0016)	(0.0018)
Binge drinker	**-0.0091****	0.0033	-0.0041	0.0009
	(0.0045)	0.0045	(0.0043)	0.0022
Daily drinker	**-0.0059***	0.0009	-0.0011	-0.0005
	(0.0022)	(0.0023)	(0.0020)	(0.0019)
Positive Health Behaviours				
Physical activity				
Daily exercise	-0.0022	0.0031	-0.0033	0.0033
	(0.0047)	(0.0036)	(0.0020)	(0.0042)
Active	-0.0018	-0.0055	-0.0023	-0.0030
	(0.0044)	(0.0054)	(0.0032)	(0.0049)
Moderate	-0.0041	0.0029	-0.0004	0.0030
	(0.0035)	(0.0035)	(0.0033)	(0.0046)
Inactive	0.0059	0.0026	0.0027	0.0000
	(0.0053)	(0.0042)	(0.0028)	(0.0041)
Fruit and Vegetable Consumption				
Less than 5 servings	0.0030	**0.0178*****	**0.0090****	0.0069
	(0.0034)	(0.0060)	(0.0033)	(0.0044)
5 to 10 servings	-0.0009	**-0.0130***	**-0.0098*****	-0.0072
	(0.0035)	(0.0066)	(0.0032)	(0.0045)
10 or more servings	-0.0021	**-0.0048***	0.0008	0.0003
	(0.0021)	(0.0025)	(0.0013)	(0.0019)
Total fruit and vegetable consumption	-0.0243	**-0.0852*****	**-0.0372****	-0.0142
	(0.0222)	(0.0281)	(0.0150)	(0.0269)

Notes: all specifications include vectors of CMA, year, and month dummy variables and control for race, marital status, education. Robust standard errors, clustered at the CMA level are reported in the parenthesis. Data are from the CCHS (2000/2001 to 2013) with CMA unemployment rates from CANSIM table number 282-0110. Sample includes both males and females aged 25-29. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level. (For more detail see notes to table 2). No. of observations: male: less than bachelor degree: smoker n= 38279, occasional smoker n=2386, daily smoker n=9305, heavy drinker and binge drinker n=33698, daily alcohol n=33801, physical activity n=37648, fruit and vegetable consumption servings n=34548, total fruit and vegetable consumption n=34530; No. of observations: male: bachelor degree or higher: smoker n=25652, occasional smoker n=1474, daily smoker n=2426, heavy drinker and binge drinker n=22482, daily alcohol n=22521, physical activity n=25231, fruit and vegetable consumption servings n=23397, total fruit and vegetable consumption n=23392; No. of observations: female: less than bachelor degree: smoker n= 44468, occasional smoker n=2455, daily smoker n=8793, heavy drinker and binge drinker n=36814, daily alcohol n=36867, physical activity n=44185, fruit and vegetable consumption servings n=40219, total fruit and vegetable consumption n=40191; No. of observations: female: bachelor degree or higher: smoker n=31046, occasional smoker n=1427, daily smoker n=1946, heavy drinker and binge drinker n=25815, daily alcohol n=25821, physical activity n=30823, fruit and vegetable consumption servings n=28462, total fruit and vegetable consumption n=28458.

Table 1.6: Estimates of the association of the CMA unemployment rate on self-rated health, mental health, and life stress

Outcome	**General health**	**Mental health**	**Life stress**
Poor	0.0007	0.0013	-0.0001
	(0.0010)	(0.0011)	(0.0017)
Good	-0.0007	-0.0013	**0.0037****
	(0.0010)	(0.0011)	(0.0016)
Very good	-0.0005	-0.0014	0.0001
	(0.0027)	(0.0016)	(0.0017)

Notes: all specifications include vectors of CMA, year, and month dummy variables and control for race, marital status, education. Robust standard errors, clustered at the CMA level are reported in the parenthesis. Data for General health and Life stress are from the CCHS (2000/2001 to 2013) while data for Mental health are from the CCHS (2003/2004 to 2013) with CMA unemployment rates from CANSIM table number 282-0110. Sample includes both males and females aged 25-29. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level. (For more detail see notes to table 2). Sample size for models esitimate general health (N=190295); for mental health (N=159737); and for Life stress (N=189857).

Table 1.7: Estimates of the association of the CMA unemployment rate on self-rated health, mental health, and life stress, stratified by sex

Outcome	Male	Female
General health		
Poor	0.0014	0.0000
	(0.0010)	(0.0017)
Good	-0.0014	0.0000
	(0.0010)	(0.0017)
Very good	-0.0011	0.0003
	(0.0035)	(0.0037)
Mental health		
Poor	**0.0027***	-0.0001
	(0.0015)	(0.0014)
Good	**-0.0027***	0.0001
	(0.0015)	(0.0014)
Very good	-0.0032	0.0006
	(0.0022)	(0.0025)
Life stress		
Poor	0.0000	-0.0002
	(0.0022)	(0.0024)
Good	0.0048	0.0028
	(0.0035)	(0.0022)
Very good	0.0000	0.0002
	(0.0022)	(0.0024)

Notes: all specifications include vectors of CMA, year, and month dummy variables and control for race, marital status, education. Robust standard errors, clustered at the CMA level are reported in the parenthesis. Data for General health and Life stress are from the CCHS (2000/2001 to 2013) while data for Mental health are from the CCHS (2003/2004 to 2013) with CMA unemployment rates from CANSIM table number 282-0110. Sample includes both males and females aged 25-29. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level. (For more detail see notes to table 2). No. of observations: male general health n=87911, female general health n=102384; male mental health n=87692, female mental health n=86287, male life stress n=73450, female life stress n=102165.

Table 1.8: Estimates of the association of the CMA unemployment rate on self-rated health, mental health, and life stress, stratified by education

Outcome	less than bachelor degree	bachelor degree or higher
General health		
Poor	**0.0027***	-0.0002
	(0.0015)	(0.0016)
Good	**-0.0027***	0.0002
	(0.0015)	(0.0016)
Very good	0.0004	0.0003
	(0.0028)	(0.0029)
no. of observations	82857	56790
Mental health		
Poor	0.0003	0.0013
	(0.0018)	(0.0012)
Good	-0.0003	-0.0013
	(0.0018)	(0.0012)
Very good	0.0016	-0.0042
	(0.0033)	(0.0028)
no. of observations	70219	49283
Life stress		
Poor	0.0007	0.0000
	(0.0027)	(0.0036)
Good	0.0019	0.0038
	(0.0025)	(0.0027)
Very good	-0.0007	0.0000
	(0.0027)	(0.0036)
no. of observations	82721	56716

Notes: all specifications include vectors of CMA, year, and month dummy variables and control for race, marital status, education. Robust standard errors, clustered at the CMA level are reported in the parenthesis. Data for General health and Life stress are from the CCHS (2000/2001 to 2013) while data for Mental health are from the CCHS (2003/2004 to 2013) with CMA unemployment rates from CANSIM table number 282-0110. Sample includes both males and females aged 25-29. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level. (For more detail see notes to table 2).

Table 1.9: Estimates of the association of the CMA unemployment rate on self-rated health, mental health, and life stress, stratified by education and sex

	Male		Female	
Outcome	less than bachelor degree	bachelor degree or higher	less than bachelor degree	bachelor degree or higher
General health				
Poor	0.0029	-0.0005	0.0024	-0.0001
	(0.0019)	(0.0019)	(0.0020)	(0.0019)
Good	-0.0029	0.0005	-0.0024	0.0001
	(0.0019)	(0.0019)	(0.0020)	(0.0019)
Very good	-0.0013	-0.0015	0.0025	0.0031
	(0.0041)	(0.0040)	(0.0036)	(0.0046)
Mental health				
Poor	0.0002	0.0009	0.0003	0.0016
	(0.0020)	(0.0013)	(0.0022)	(0.0021)
Good	-0.0002	-0.0009	-0.0003	-0.0016
	(0.0020)	(0.0013)	(0.0022)	(0.0021)
Very good	0.0024	**-0.0081****	0.0010	-0.0010
	(0.0041)	(0.0034)	(0.0037)	(0.0045)
Life stress				
Poor	0.0006	-0.0021	0.0007	0.0019
	(0.0039)	(0.0047)	(0.0023)	(0.0038)
Good	0.0038	-0.0020	-0.0003	**0.0096****
	(0.0038)	(0.0053)	(0.0046)	(0.0036)
Very good	-0.0006	0.0021	-0.0007	-0.00193
	(0.0039)	(0.0047)	(0.0023)	(0.0038)

Notes: all specifications include vectors of CMA, year, and month dummy variables and control for race, marital status, education. Robust standard errors, clustered at the CMA level are reported in the parenthesis. Data for General health and Life stress are from the CCHS (2000/2001 to 2013) while data for Mental health are from the CCHS (2003/2004 to 2013) with CMA unemployment rates from CANSIM table number 282-0110. Sample includes both males and females aged 25-29. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level. (For more detail see notes to table 2). No. of observations: less than bachelor degree: male general health n=38337, female general health n=44520; male mental health n=32488, female mental health n=37731, male life stress n=38263, female life stress n=44458. No. of observations: bachelor degree or higher: male general health n=25696, female general health n=31094; male mental health n=21910, female mental health n=27373, male life stress n=25665, female life stress n=31051.

Table 1.10: Estimates of the association of the CMA unemployment rate with BMI

Outcome	coefficient estimate
log BMI	0.0007
	(0.0017)
BMI	0.1416
	(0.2429)
Normal weight	
(BMI between 18.5 and 25)	0.0027
	(0.0019)
Healthy range 1	
(BMI between 18.5 and 30)	0.0002
	(0.0016)
Healthy range 2	
(BMI between 20 and 25)	0.0025
	(0.0018)
Healthy range 3	
(BMI between 20 and 30)	0.0000
	(0.0021)
Underweight (BMI ≤ 18.5)	-0.0006
	(0.0009)
Overweight (BMI ≥ 25)	-0.0021
	(0.0019)
Obese (BMI ≥ 30)	0.0004
	(0.0013)
BMI ≥ 35	-0.0004
	(0.0010)
BMI ≥ 40	0.0004
	(0.0010)
n=185063	

Notes: all specifications include vectors of CMA, year, and month dummy variables and control for race, marital status, education. Robust standard errors, clustered at the CMA level are reported in the parenthesis. Data are from the CCHS (2000/2001 to 2013) with CMA unemployment rates from CANSIM table number 282-0110. Sample includes both males and females aged 25-29. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level. (For more detail see notes to table 2).

Table 1.11: Estimates of the association of the CMA unemployment rate with BMI, by sex

Outcome	Male	Female
log BMI	0.0002	0.0012
	(0.0015)	(0.0034)
BMI	-0.0061	0.2937
	(0.1683)	(0.3974)
Normal weight		
(BMI between 18.5 and 25)	0.0038	0.0016
	(0.0028)	(0.0018)
Healthy range 1		
(BMI between 18.5 and 30)	0.0000	0.0005
	(0.0016)	(0.0024)
Healthy range 2		
(BMI between 20 and 25)	0.0031	0.0020
	(0.0027)	(0.0020)
Healthy range 3		
(BMI between 20 and 30)	-0.0008	0.0008
	(0.0020)	(0.0030)
Underweight (BMI ≤ 18.5)	-0.0012	-0.0002
	(0.0011)	(0.0011)
Overweight (BMI ≥ 25)	-0.0026	-0.0014
	(0.0030)	(0.0020)
Obese (BMI ≥ 30)	0.0012	-0.0003
	(0.0018)	(0.0021)
BMI ≥ 35	-0.0015	0.0008
	(0.0010)	(0.0016)
BMI ≥ 40	0.0002	0.0007
	(0.0008)	(0.0016)
n	87969	97094

Notes: all specifications include vectors of CMA, year, and month dummy variables and control for race, marital status, education. Robust standard errors, clustered at the CMA level are reported in the parenthesis. Data are from the CCHS (2000/2001 to 2013) with CMA unemployment rates from CANSIM table number 282-0110. Sample includes both males and females aged 25-29. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level. (For more detail see notes to table 2).

Table 1.12: Estimates of the association of the CMA unemployment rate with BMI, by education

Outcome	less than a bachelor degree	bachelor degree or higher
log BMI	0.0043	-0.0014
	(0.0030)	(0.0027)
BMI	0.3857	-0.0644
	(0.3447)	(0.3309)
Normal weight (BMI between 18.5 and 25)	0.0021	0.0031
	(0.0024)	(0.0029)
Healthy range 1 (BMI between 18.5 and 30)	0.0007	-0.0018
	(0.0023)	(0.0026)
Healthy range 2 (BMI between 20 and 25)	0.0015	0.0044
	(0.0021)	(0.0029)
Healthy range 3 (BMI between 20 and 30)	0.0001	-0.0007
	(0.0026)	(0.0028)
Underweight (BMI ≤ 18.5)	**-0.0024****	0.0011
	(0.0009)	(0.0009)
Overweight (BMI ≥ 25)	0.0002	-0.0042
	(0.0024)	(0.0032)
Obese (BMI ≥ 30)	0.0017	0.0007
	(0.0019)	(0.0025)
BMI ≥ 35	-0.0003	0.0002
	(0.0014)	(0.0014)
BMI ≥ 40	0.0007	-0.0009
	(0.0012)	(0.0013)
n	80850	54336

Notes: all specifications include vectors of CMA, year, and month dummy variables and control for race, marital status, education. Robust standard errors, clustered at the CMA level are reported in the parenthesis. Data are from the CCHS (2000/2001 to 2013) with CMA unemployment rates from CANSIM table number 282-0110. Sample includes both males and females aged 25-29. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level. (For more detail see notes to table 2).

Table 1.13: Estimates of the association of the CMA unemployment rate with BMI, by education and sex

	Male		Female	
Outcome	less than a bachelor	bachelor degree or higher	less than a bachelor	bachelor degree or higher
log BMI	0.0025	0.0028	0.0057	-0.0054
	(0.0025)	(0.0013)	(0.0051)	(0.0057)
BMI	0.1546	0.0501	0.5768	-0.1769
	(0.2789)	(0.1265)	(0.4944)	(0.6434)
Normal weight (BMI between 18.5 and 25)	0.0039	0.0026	0.0008	0.0041
	(0.0041)	(0.0040)	(0.0044)	(0.0039)
Healthy range 1 (BMI between 18.5 and 30)	0.0007	-0.0034	0.0013	0.0000
	(0.0024)	(0.0036)	(0.0032)	(0.0027)
Healthy range 2 (BMI between 20 and 25)	0.0020	0.0059	0.0016	0.0034
	(0.0043)	(0.0048)	(0.0046)	(0.0042)
Healthy range 3 (BMI between 20 and 30)	-0.0011	-0.0001	0.0022	-0.0010
	(0.0025)	(0.0045)	(0.0043)	(0.0031)
Underweight (BMI ≤ 18.5)	**-0.0026***	-0.0003	**-0.0024****	0.0020
	(0.0014)	(0.0012)	(0.0011)	(0.0015)
Overweight (BMI ≥ 25)	-0.0013	-0.0023	0.0016	-0.0062
	(0.0043)	(0.0038)	(0.0043)	(0.0046)
Obese (BMI ≥ 30)	0.0019	0.0037	0.0010	-0.0021
	(0.0020)	(0.0034)	(0.0029)	(0.0028)
BMI ≥ 35	-0.0023	0.0015	0.0018	-0.0009
	(0.0016)	(0.0017)	(0.0020)	(0.0024)
BMI ≥ 40	0.0003	-0.0005	0.0009	-0.0014
	(0.0012)	(0.0009)	(0.0021)	(0.0022)
n	38360	25711	42490	28625

Notes: all specifications include vectors of CMA, year, and month dummy variables and control for race, marital status, education. Robust standard errors, clustered at the CMA level are reported in the parenthesis. Data are from the CCHS (2000/2001 to 2013) with CMA unemployment rates from CANSIM table number 282-0110. Sample includes both males and females aged 25-29. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level. (For more detail see notes to table 2).

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Chapter 2

Infant health outcomes and economic fluctuations: evidence from Canada

2.1 Introduction

Child health and well-being can affect adult health and well-being as well as schooling, labour force participation and earnings. Furthermore, these effects could be intergenerational; the health of today's adults may affect the health and well-being of the next generation of children, and so on. Thus children's health may have long-term impacts on population health and productivity as adults (Currie, 2000). As such, a better understanding of the association of infant health and economic conditions can contribute to a better understanding of the impact economic conditions have on subsequent health.

Overall, in a group of 17 peer countries, Canada ranks second-to-last in terms of infant mortality.[1] In 2011, the crude birth rate in Canada was 11 per 1,000 people,[2] while the

[1] Please see report by the Conference board of Canada, titled "Infant mortality rate" for further details (Conference Board of Canada, 2012).

[2] Data retrieved from CANSIM TABLE NUMBER: 102-4505.

infant mortality rate was 5 per 1,000 live births[3]. Worse health outcomes at birth and in childhood have been shown to have adverse long-run health and well-being effects.[4] Infants and children with worse health have lower income over their lifetime, lower education achievement and other socioeconomic challenges. Many studies find positive effects of birth weight, weight, height, head circumference, and absence of abnormalities on the cognitive development (measured using test scores) of children of various ages. (c.f. Currie, 2000). Furthermore, low birth weight can lead to cognitive deficits that impair children's school performance, which can increase the costs for special education and possibly for social programs down the road,[5] and the risk of abnormal neurodevelopmental impairment is three times higher among low birth weight infants (those less than 2,500 grams) and ten times higher among infants of very low birth weight (those less than 1,500 grams) (Chaikind & Corman, 1991). For example, Currie and Moretti (2005) show that differences in the birth weight of sisters can predict differences in education and median income at the time the sisters give birth to their own children many years later. Finally, Currie and Madrian (1999) show that health affects wages and labour force participation and so poor health in childhood can lower future well-being by directly affecting future health and indirectly by lowering future wages and participation.

Prenatal and postnatal care are inputs into the health of infants and can impact infant and neonatal mortality (Ruhm, 2000). Currie (2000) suggests that the best way to reduce infant mortality is to reduce the incidence of low birth weight and pre-term delivery through appropriate use of preventive prenatal care. In the U.S. there is a concern that when the economy worsens, individuals may lose access to health insurance plans and thus women

[3]Data retrieved from CANSIM TABLE NUMBER: 102-0504.

[4]The following provides a brief summary of these effects and we refer the reader to Currie (2000) for a very detailed discussion of the literature.

[5]For example, Chaikind and Corman (1991) find that babies born with low birth weight are fifty percent more likely to be enrolled in special education classes, in addition to any extra medical costs incurred due to low birth weight.

may face challenges to getting the pre- and post-natal care that they need. But, although women and infants in Canada may not face the same challenges of access to health care due to the universal health care insurance plan, it is still of importance to better understand the association of short run fluctuations in the unemployment rate with infant health outcomes. For example, constraints may change systematically with economic conditions or perhaps the behaviour of expectant mothers changes.

We use Canadian data to study the relationship between the unemployment rate and health outcomes at birth and infant mortality measures. This study is motivated by seminal work in the area by Dehejia and Lleras-Muney (2004) who study the relationship between the unemployment rate at the time of a baby's conception and health outcomes at birth. They find that infant health improves as the unemployment rate goes up and they show that changes in labour market conditions affect parental behaviours and thus child health outcomes at birth.

Our study contributes to the existing literature in the following ways. We use the Canadian Vital Statistics Birth and Death data from the 1976 to 2011 period to examine how province-level changes in the unemployment rate are associated with infant health outcomes. Infant health outcomes are measured by the crude birth rate, birth weight, low (less than 2500 grams) and very low (less than 1500 grams) birth weight, as well as infant mortality, neonatal mortality and postneonatal mortality. We examine three time frames: 1976 to 2011, 1976 to 1999, and 2000 to 2011 and extend the analysis to consider three specific recessionary periods: the 1980s (January 1980 to June 1980 & June 1981 to October 1982), the 1990s (March 1990 to April 1992), and the "Great Recession" (October 2008 to May 2009). Applying a fixed effects methodology, we use within-area variation in the unemployment rates at the province level to measure the impact of changes in labour market conditions. To our knowledge, there is one previous study that uses Canadian data that fits into this scope but differs substantially. Ariizumi and Schirle (2012) use province level

unemployment rates to examine how age and gender specific mortality rates are associated with economic fluctuations. They group infants into the age group 0 to 4 and find that there is no statistically significant relationship between the changes in the unemployment rate and infant mortality. Our study differs from their work because we examine infant mortality specifying the age group as 0 to 1, and extend to examine other infant health outcomes.

Thus our contributions to the literature are as follows. First, we provide Canada-specific estimates for the association of infant health outcomes with economic fluctuations. We employ a fixed effects methodology and estimate models with year and province fixed effects, and extend the model specification to include province specific time trends. Furthermore, we estimate time frames that are analogous to U.S. studies by Dehejia and Lleras-Muney (2004) and Lindo (2015) in order to make reasonable comparison to existing study results. We extend our base analysis and consider three separate and specific recessionary periods over the time frame of analysis. Finally, we contribute to the ongoing debate concerning the impact of economic conditions on infant health.

2.1.1 Why might there be a relationship?

In the following we outline several broad mechanisms by which economic fluctuations can affect the health of infants. Three separate, but possibly overlapping, mechanisms are the health-related behaviours of pregnant women, the institutional environment of the health care system(s), and selection into fertility.

Health-related behaviours of pregnant women The relationship between infant health outcomes and economic conditions can partially be explained by the changes in health-related behaviours of pregnant women. It is well established that the lifestyle behaviours that pregnant women undertake can affect their newborn infants (see for example:(Dow-Clarke, MacCalder, & Hessel, 1994; Connor & McIntyre, 1999; Dehejia & Lleras-Muney,

2004; Almond, Chay, & Lee, 2005; Abrevaya, 2006; Key et al., 2007)). Dehejia and Lleras-Muney (2004) suggest that lower infant mortality is partially due to the changes in health behaviours of women during pregnancy. The opportunity cost of women's time may be an important determinant of health behaviour during pregnancy[6], and changes in own-income as well. Investment in health is time-intensive. If women have an increase in availability of time then the relative cost of health-related activities would be lower. For example, home production of nutritious meals is time intensive. Undernutrition of the mother during pregnancy at certain critical gestation points may lead to adult health disorders of the infant like heart disease (Barker & Martyn, 1992), in which case improving nutrition and dietary behaviours during pregnancy would be an obvious improvement to child health. Furthermore, because of own-wage decreases, it is not clear whether women would undertake health-producing activities because of the necessary income investment in some. But, lower income may imply that there would be a decrease in negative health behaviours like smoking and alcohol use. There is strong evidence in the U.S. that adults decrease negative health behaviours during economic downturns (Ruhm & Black, 2002).

Moreover, if there is an increase in the availability of time then women can sleep more and may be under less stress - implying that their health would improve and that they can invest more time into their infants' health and health during pregnancy. But, it is not clear whether women's stress may in fact increase.

Institutional environment A major concern during economic downturns is access to medical care. Institutional arrangements, like the structure of the health care system, inadvertently affect all citizens and their access to medical care. In Canada, health care insurance is universal and individuals may be better able to seek medical care because they

[6]This might be a good mechanism to consider for policy because it is a way of improving health outcomes – i.e. giving women more time to devote to their newborns/children.

are not hindered by lack of monetary resources to pay for physician visits.[7] However, in areas where access to care is already an issue, due perhaps to physician shortages, or other system constraints, it may be of concern.

Selective fertility Various factors can influence the decisions by women of fertile age to bear children and those include a mother's level of education and access to reproductive health services (Dehejia & Lleras-Muney, 2004). In general, the literature on fertility in economics and demography[8] has established that the number of children born decreases in recessions, suggesting that fertility exhibits a procyclical pattern[9]. More importantly the fertility response to temporary shocks in income differs substantially by socioeconomic status and by race. Dehejia and Lleras-Muney (2004) show that there is a change in the composition of women having babies during economic downturns in the U.S.. They find that, on average, when unemployment is high, the average health of Black babies improves because less-educated single Black mothers are less likely to have babies. In contrast however, the average health of White babies gets worse because less-educated White mothers are more likely to have babies. The concern is that these less-educated White mother's are more likely to be uninsured and face constraints to access medical care - suggesting that selective fertility may give rise to procyclical infant mortality (Dehejia & Lleras-Muney, 2004). In essence - women are choosing whether or not to become pregnant or whether or not to take the pregnancy to term.

An alternate reason related to selection into fertility and the timing of fertility decisions is that of skills depreciation during pregnancy and childbirth (Dehejia & Lleras-Muney, 2004). Two ways of thinking about the decision-making process for women related to

[7] This does not imply that individuals are not hindered by costs associated with transportation or excessive wait times.

[8] Fertility is defined as the number of children that a woman bears, rather than how likely or how easy it is for her to become pregnant and bear children. (Alsan, Bloom, Canning, & Jamison, 2008)

[9] For a non-exhaustive list of readings please see: (Yule, 1906; Galbraith & Thomas, 1941; Becker, 1960; Silver, 1965; Ben-Porath, 1973)

this are to consider the extent to which skill depreciation happens and (im)perfect capital markets. On the one hand, if capital markets are perfect (the woman's fertility decisions do not depend on the path of wages of other members of the household) and if the absence from the labour force does not lead to the depreciation of skills - women will substitute fertility into periods in which their own-wage is low (Dehejia & Lleras-Muney, 2004). However, if the absence from the labour force leads to skill depreciation (which is inadvertently a loss of income) it is not clear whether women will in fact choose to substitute fertility into periods in which their own-wage is low. On the other hand, if capital markets are imperfect and absence from labour force does not lead to skills depreciation - women will postpone fertility to periods when their partner's income is high. Yet again, if women's skills do depreciate with absence from the labour force, it is not clear what the best option for fertility would be. Furthermore, we estimate models of the impact of the unemployment rate on the crude birth rate to assess whether compositional changes are likely an issue with our data. In general as is discussed later on, we find that they are not.

The rest of the chapter is organized as follows. Section two provides a discussion of the previous literature on the association of economic fluctuations with infant health. Section three summarizes the data. Section four establishes the methodology and section five summarizes the results. Section six concludes.

2.2 Background

The literature on the relationship between mortality[10] and business cycles is extensive and there has been a proliferation of these studies especially since the year 2000. These studies predominantly assess the relationship between adult mortality of different types and business cycles. A few examples include: (Ariizumi & Schirle, 2012; Gerdtham & Ruhm, 2006;

[10]Different measures of mortality have been considered but total mortality, age-adjusted mortality, and cause specific mortality are the most common.

Granados, 2005; Granados & Ionides, 2008; Lindo, 2015; Neumayer, 2004; Ruhm, 2000, 1995; Ruhm & Black, 2002) though far fewer include or focus on infant health (Dehejia & Lleras-Muney, 2004; Neumayer, 2004; Ariizumi & Schirle, 2012; Lindo, 2015; Gerdtham & Ruhm, 2006).

Research motivated by Ruhm (2000) led to a proliferation of studies in the U.S. and internationally that examine how economic conditions affect health. In general, they find a procyclical pattern in mortality rates. Ruhm looks at a variety of causes of mortality, while the most relevant to this study are infant mortality (deaths within the first year), and neonatal mortality (deaths within the first 28 days).[11] Using a fixed effects methodology, Ruhm (2000) estimates models of aggregate data using U.S. Natality files that cover the 50 states and the District of Columbia over the 1972 to 1991 period and augments the linear probability model with time and place dummies in order to account for the across state variation. This method can control for unobserved time invariant characteristics while estimating the relationship between mortality and economic fluctuations. Ruhm finds a procyclical pattern in infant mortality rates and neonatal mortality rates - that is when there are short-term downturns there is a decline in infant mortality rates.

Following Ruhm (2000), Dehejia and Lleras-Muney (2004) use U.S. Vital Statistics Natality[12] records from 1975 to 1999 and confirm these findings. In contrast to Ruhm (2000) however, Dehejia and Lleras-Muney examine a wider range of infant health outcomes that include low and very low birth weight measures - percent born below 2500

[11] In Ruhm (2000) the outcomes of interest are total mortality rates, fatalities for three age groups (20-44, 45-64, and >=65 years old), and deaths due to ten diseases (cancer (malignant neoplasms), major cardiovascular diseases, pneumonia or influenza, chronic liver diseases and cirrhosis of the liver, motor vehicle accidents, other accidents and adverse effects, suicide, homicide and legal interventions), infant mortality (deaths within the first year), and neonatal mortality (deaths within the first 28 days).

[12] The U.S. birth certificate data provides information on parents' characteristics including age, marital status and education, mother's behaviour during pregnancy (such as prenatal care information, and information about smoking and drinking) and child health outcomes including birth weight, congenital malformation and the 5-minute Apgar score (The Apgar score is a 10-point scale that is used to assess the health of newborns based on five criteria (appearance, pulse, grimace, activity, and the respiration) that are rated between 0 and 2). (Dehejia & Lleras-Muney, 2004)

grams and percent born below 1500 grams, percent with Apgar score 5 or below, infant mortality per 1000 live births, neonatal mortality per 1000 live births, postneonatal mortality per 1000 live births, and congenital defects. Furthermore, Dehejia and Lleras-Muney use the unemployment rate in the mother's state of residence during the year of conception[13] to match average infant health outcome, parental characteristics[14] and behaviours[15]. Their approach assumes that a shock to economic conditions takes time to affect the health outcome of an infant, and assumes that matching the unemployment rate with the date of conception, rather than the date of birth, better captures the impact of economic conditions and infant health outcomes. The primary measure of unemployment is the state and year specific unemployment rate. Dehejia and Lleras-Muney (2004) estimate two reduced-form model specifications one with state and year fixed effects, and one that allows for a state-specific time trend. Moreover, data is weighted by the number of births by state. Dehejia and Lleras-Muney restrict their sample for study to all live births to mothers aged 18 and older.[16] Their results suggest that babies conceived in the times of high unemployment have a reduced incidence of low and very low birth weight, a reduced rate of neonatal and postneonatal mortality, and fewer congenital malformations. Moreover, they find that when the unemployment rate is high, all mothers tend to increase their use of prenatal care.

In contrast to Ruhm (2000) and Dehejia and Lleras-Muney (2004), Neumayer (2004) uses state level German data over the period 1980 to 2000 and shows that infant mortality

[13]Dehejia and Lleras-Muney use the date of the last menstrual period to determine the date of conception. They drop observations for some states that did not report this information in the early years of the panel.

[14]Parental characteristics include: percent mothers who are high school dropouts, percent mothers with high school, percent mothers with some college, percent mothers with college or more, percent mothers less than age 25, percent mothers between age 25 and 35, percent mothers greater than 35, father's eduction, percent moms married.

[15]Behaviours include: number of prenatal care visits, percent with fewer than 5 prenatal visits, percent had prenatal care in the first trimester, smoked any time during pregnancy, drank any time during pregnancy.

[16]The rationale that Dehejia and Lleras-Muney (2004) provide for limiting the sample to those mothers aged 18 and older is that teen mothers fertility decisions are potentially complicated by other factors such as the involvement of parents in fertility decisions. Furthermore, they suggest that since the labour market participation of this group is limited, it may complicate predictions of the effect of temporary changes in the unemployment rate.

and neonatal mortality in Germany is not related to economic conditions. Neumayer estimates both a static fixed effects model (with contemporaneous effects only) and a dynamic model (which allows for lagged effects of unemployment on mortality) and finds consistent results that there is no association of the unemployment rate with infant mortality and neonatal mortality. Similarly, in a study that uses country-level data from the 23 Organization for Economic Cooperation and Development (OECD) countries over the 1960 to 1997 period, Gerdtham and Ruhm (2006) also find that there is no statistically significant relationship between economic conditions and infant mortality.

More directly related to our study, Ariizumi and Schirle (2012) use Canadian Vital Statistics data for the 10 provinces over the period 1977 to 2009 to estimate the effect of province-level unemployment rates on total mortality, age specific mortality and gender specific mortality. They specify their regression model including province effects, Canada-wide year effects, and province-specific time trends and the data is weighted by the population in each age-province-year group. Ariizumi and Schirle cluster standard errors at the province level and recognize that the inherent trouble with Canadian provincial analysis is the low number of clusters.[17] They implement a bootstrap correction[18], outlined in Cameron, Gelbach and Miller (2008) to obtain standard errors and do not find differences in their conclusions. Finally, Ariizumi and Schirle group children and infants into the age category of 0 to 4 years, and in contrast to U.S. evidence find no statistically significant cyclical pattern in the mortality rates of infants. By contrast, we look directly at infant mortality (i.e. from ages 0 to 1).

Considering the lack of consensus and the limited evidence from the literature pertaining to the association of the infant health outcomes and economic conditions, it is not clear what the association of infant health outcomes is with economic declines and so further

[17] In Canada there are 10 provinces thus 10 clusters.

[18] The wild cluster-bootstrap percentile-t bootstrap procedure.

analysis is warranted. The studies outlined above have different time frames, different control variables, different model specifications, and different aggregation levels. Any and/or all of these can contribute to the varying results across or within studies. Lindo (2015) revisits Ruhm (2000) and Dehejia and Lleras-Muney (2004) to examine how disaggregating the level of economic fluctuations[19] affects the health and health outcomes of individuals. Considering his work regarding infants, like Dehejia and Lleras-Muney, Lindo also matches unemployment rates to the year of conception[20] of the infant and uses the same time frame as Dehejia and Lleras-Muney (2004), but also extends the analysis to examine 2000 to 2010. In general, regardless of the level of aggregation for the economic measure Lindo finds results that are comparable to Dehejia and Lleras-Muney but an important exception noted is that when the data is extended from the 1976 to 1999 period to the 1976 to 2006 period the estimated effect of unemployment increases by approximately 80 percent.

Considering the studies described above, differing suggested explanations for the results have been given. Dehejia and Lleras-Muney (2004) use the richness of the U.S. data and try to disentangle whether health improvements are attributable to selective fertility (the differences in the type of mother who conceives during a recession) and to the health behaviours of pregnant women. They find infant health improves because mothers' health-related behaviours (such as smoking and drinking) improve when the unemployment rate increases. They also find that the fertility response to temporary shocks in income differs substantially by socioeconomic status and by race. Black mothers tend to be higher socioeconomic status (as measured by education and marital status) when the unemployment rate is high, whereas White mothers are less educated. Lindo (2015) suggests that this increase in the effect of economic conditions on newborn health suggests that impact of economic

[19]Lindo (2015) considers five different levels of geographic aggregation from counties to regions.

[20]Different from Dehejia and Lleras-Muney Lindo (2015) defines the year of conception as nine months prior to the birth of the baby and thus includes in the analysis children born to mothers for whom information on the last menstrual cycle is missing.

conditions on newborn health has grown over time. Ariizumi and Schirle (2012) suggest that this difference in results between the U.S. and Canada might be explained by the institutional environment - the differing structure of health care insurance and thus access to health care. Canada has universal health insurance coverage and thus prenatal care may not be of great concern as compared to the U.S. Especially considering Dehejia and Lleras-Muney (2004) found that the compositional differences of mothers who conceive in worse economic times exists and so access to the appropriate medical care for pregnant women and children may be limited. However, in their study they find that there is a statistically significant association between the use of prenatal care and the unemployment rate. Overall, the average number of prenatal care visits increases, the proportion of mothers with inadequate prenatal care decreases, and the proportion of mothers who use prenatal care in the first trimester increases. This aligns directly with Cawley and Simon (2005) who find that changes in the unemployment rate are not significantly associated with insurance coverage through any source for women or children and that these results may be due to women and children enrolling in Medicaid and State Children's Health Insurance Program during periods of high unemployment.

In this study, we aim to contribute more comprehensive evidence about the health and health outcomes of infants in Canada. Using the Vital Statistics Birth and Death data from 1976 onward to 2011, we match average infant health outcomes with the unemployment rate in the mothers' province of residence during the year of conception or the infants' province of residence during the year prior to death in order to better understand how economic conditions are related to the health and health outcomes at birth or death. Our outcomes of interest include the crude birth rate, birth weight, low and very low birth weight, infant mortality, neonatal mortality and postneonatal mortality. To our knowledge, this is the first paper to study the relationship between these infant health outcomes and economic

conditions using Canadian data.[21] More specifically, we examine three time frames: 1976 to 2011, 1976 to 1999, and 2000 to 2011. Our time frames for analysis are analogous to Dehejia and Lleras-Muney (2004) and Lindo (2015) and so we can make comparisons of our results from the Canadian context with results from the U.S. context. Furthermore, to better understand how economic recessions may be related to health outcomes of infants in Canada, we examine four Canadian recessions separately and assess how the different characteristics of the recessions may explain some of the variation in results: recessionary periods of the 1980s (January 1980 to June 1980 & June 1981 to October 1982), recessionary period of the 1990s (March 1990 to April 1992), and the Great Recession (October 2008 to May 2009).

2.3 Data

We use the Vital Statistics Birth (VSB) and Vital Statistics Death (VSD) administrative datasets for this study. The VSB and VSD provide information related to all births and deaths of all individuals across Canada. For information related to economic conditions and control variables, we use the Labour Force Survey (LFS), accessed through Statistics Canada's CANSIM (Canadian Socio-Economic Information Management System). The following introduces the VSB and VSD, and the unemployment data, describes the variables of interest, and establishes the sample selected for study.

2.3.1 The Vital Statistics Birth and Death Databases

The Vital Statistics Birth Database (VSB) is an administrative database that collects demographic information annually from all provincial and territorial vital statistics registries

[21] The study by Ariizumi and Schirle (2012) examine infant mortality but infant mortality is grouped into age group 0 to 4. Thus, our study significantly differs from theirs because we examine infant mortality specifically as those aged less than 1 year (or less than 365 days).

on all live births in Canada (Statistics Canada, 2014b). Since 1944, births, stillbirths, and deaths have been classified by area of reported residence, with births and stillbirths according to the residence of the mother. The main form for the registration of a live birth is completed by the parents, who are responsible for filing it with the local registrar. Most provinces also require physicians (or other birth attendants) to report all births. The central Vital Statistics Registry in each province and territory provides data from birth registrations to Statistics Canada. The following are of interest to this study reported for each birth by all provinces for inclusion in the Canadian Vital Statistics system (non-exhaustive list): date and place of birth, child's sex, birth weight and gestational age, parents' age and marital status, mother's place of residence, and type of birth (single or multiple). In comparison to the U.S. natality files, Canadian Vital Statistics birth data do not include detailed birth or demographic information on parents.

The Vital Statistics Death Database (VSD) is an administrative database that collects demographic and medical (cause of death) information annually from all provincial and territorial vital statistics registries on all death in Canada (Statistics Canada, 2014c).[22] Death refers to the permanent disappearance of all evidence of life at any time after a live birth has taken place (stillbirths are excluded). Since 1944, births, stillbirths, and deaths have been classified by area of reported residence. The central Vital Statistics Registry in each province and territory provides data from death registrations to Statistics Canada (Statistics Canada, 2014c). Of interest to this study are the following, reported for each death: age, sex, marital status, place of residence and birthplace of the deceased, date of death, and province or territory of occurrence of death. As mentioned earlier, in comparison to the U.S. natality files, Canadian Vital Statistics death data collects a more limited set of data, with far less information available to control for in comparison to the U.S. natality files or

[22]Note that Nunavut became officially a Territory of Canada on April 1, 1999 and the name Northwest Territories applies to a Territory with different geographic boundaries before and after April 1, 1999. (Statistics Canada, 2014c)

even the Canadian Vital Statistic birth data.

2.3.2 Data from the Labour Force Survey

The unemployment data that we use in this study come from the Labour Force Survey done by Statistics Canada and downloaded from CANSIM.[23] We use annual data from 1976 to 2011, inclusive, on 10 provinces. We use unemployment rates at the province level to identify and measure the impact of changes in labour market conditions. The unemployment rate is defined as the number of unemployed persons expressed as a percentage of the labour force (Statistics Canada, 2014a).[24] In the relevant literature, studies have typically used place-specific measures such as state level or province level unemployment rates to examine the effects of changes in economic conditions on health and health behaviours. We match infant health outcomes with unemployment rates at the time of conception or year prior to death. By matching outcomes with the unemployment rate at the time of conception, we hope to gain a better understanding of the effect of economic fluctuations because a transitory/short-term shock in the economy might take some time to affect the health and health behaviours of individuals. This is also consistent with prior work (Dehejia and Lleras-Muney 2004; Lindo 2015).

We exploit variation in unemployment rates across and within provinces over time and so our strategy relies on the existence of considerable heterogeneity in economic conditions across the provinces and over our time frame of analysis. In order to identify recessions,

[23]CANSIM TABLE NUMBER 282-0001 - LFS estimates, by sex and detailed age group, monthly, unadjusted for seasonality (averaged to get an annual rate).

[24]Statistics Canada defines unemployed persons as those who, during the reference week: were on temporary layoff during the reference week with an expectation of recall and were available for work, or were without work, had looked for work in the past four weeks, and were available for work, or had a new job to start within four weeks from reference week, and were available for work. The labour force is comprised of employed persons (those who are supplying services in the reference period, regardless of the quantity supplied) and unemployed persons (those who provide evidence that they are offering their labour services to the market (again regardless of quantity)). Note, those neither currently supplying nor offering their labour services, are not in the labour force. (Statistics Canada, 2014a)

Figures 2.1 and 2.2 show the variation in the national quarterly and annual unemployment rates, respectively, for both sexes, 15 years of age and older.[25] In the time frame for analysis, 1976 to 2011, Canada experienced four official recessions: (i) January 1980 to June 1980; (ii) June 1981 to October 1982; (iii) March 1990 to April 1992; and (iv) October 2008 to May 2009 (Cross & Bergevin, 2012).

[Insert Figure 2.1] [Insert Figure 2.2]

2.3.3 Outcomes of interest

In this study, we examine the following outcomes: i) crude birth rate; ii) total average birth weight; iii) percent born less than 2500 grams (approximately 5.5 lbs); iv) percent born less than 1500 grams (approximately 3.5 lbs); v) Infant mortality (death within the first year); vi) Neonatal mortality (death within the first 28 days); vii) Postneonatal mortality (death later than 28 days to 364 days). The following describes these outcomes, how they are measured and why they are important.

2.3.3.1 Birth data

Crude birth rate The crude birth rate (CBR) is an important measure because it is often used to better understand variations in the broad fertility of a nation. The crude birth rate compares the average annual number of live births[26] during a given year per 1,000 persons

[25] Data for Figure 2.1. are from CANSIM TABLE NUMBER: 282-0087 Labour Force Survey estimates (LFS), seasonally adjusted, quarterly. Data for Figure 2.2. are from CANSIM TABLE NUMBER: 282-0001 Labour Force Survey estimates (LFS), by sex and detailed age group, unadjusted for seasonality, annual.

[26] A live birth is defined as any infant who displays signs of life outside of the womb. Note that the Health Statistics Division monitors developments in the field of assisted reproductive technology and medical technology as they relate to the reporting of extremely low birth weight and/or low gestation babies. There is some inconsistency in the practice of registering these babies, even though there is a legal requirement to do so. For this reason, public use data provided by Statistics Canada has resulted in alternative indicators for infant mortality being calculated where the denominator is composed of live births weighing 500 g or more. In this study, we use the confidential VSD and VSB data accessed through the McMaster RDC and include all live births as defined initially, regardless of weight. (Statistics Canada, 2014b)

in the population at midyear:

$$CBR_{pt} = \frac{\#\,of\ live\ births_{pt}}{population\ midyear_{pt}} * 1,000$$

If the birth rate is sensitive to economic conditions, we might be concerned that marginal/additional children are somehow different from the average. At the very least, studying this outcome will allow us to see if overall fertility is affected by changes in the unemployment rate.

Birth weight Birth weight is an important outcome because it is an indicator of the general health of newborns and is considered one of the most important indicators of a newborns chances of survival. Low birth weight is defined as babies born weighing less than 2500 grams and very low birth weight less than 1500 grams. Low birth weight babies are at a higher risk of dying during the first year of life, they are at a higher risk of being hospitalized after birth and are more likely to develop chronic health problems and experience health and developmental problems later in life such as learning difficulties, and hearing and visual impairments (Cole, Hagadorn, Kim, et al., 2002; Matsuo, 2005; Currie, 2000). In this study, we use the well-established way of calculating low birth weight:

$$Percent\ born\ less\ than\ x\ grams = \frac{\#\,of\ babies\ born\ less\ than\ x\ grams}{total\ number\ of\ live\ births} * 100$$

where $x = 2500$ or $x = 1500$. There are various risk factors that are associated with low birth weight that include: socioeconomic disadvantage, poor health and nutrition of women during pregnancy, and health-compromising behaviours like smoking, using drugs, and drinking alcohol while pregnant (Almond et al., 2005; Abrevaya, 2006; Barker & Martyn, 1992; Dow-Clarke et al., 1994; Connor & McIntyre, 1999; Key et al., 2007). Although it is often expected that low birth weight babies are born prematurely this has changed over recent years due to the increased use of assisted reproductive fertility options leading

to a higher number of babies born with low birth weight (Canadian Institute for Health Information, 2004, 2009). As such, it is not clear from where the increase in the number of low birth weight babies stems (Canadian Institute for Health Information, 2009), but in this paper we are not able to disentangle these due to data constraints. That said, we limit our analysis to singleton births to avoid these issues.[27]

2.3.3.2 Death data

We examine three different measures related to infant mortality using the Vital Statistics Death database: the infant mortality rate, the neonatal mortality rate and the postneonatal mortality rate. The infant mortality rate (IMR) is defined as the rate at which infants less than one year of age (less than 365 days) die and is usually measured per 1,000 live births.[28] The infant mortality rate is an important measure as it reflects the economic and social conditions for the health of the mother and infants as well as the effectiveness of health systems. The infant mortality measure used in this study includes all infant death less than one year of age.[29] It is calculated as follows:

$$IMR = \frac{\#\,of\,infant\,death\,below\,one\,year}{total\,number\,of\,live\,births} * 1,000$$

We estimate separately models that examine neonatal death (NMR) and postneonatal death (PNMR). Those are calculated as:

$$NMR\,(or\,PNMR) = \frac{\#\,of\,infant\,deaths\,less\,x}{total\,number\,of\,live\,births} * 1,000$$

[27] Note that we estimate models that include multiple births, estimates are similar. The main difference is that, including multiple births rendered some significant variation in the babies born weighing less than 2500 grams, which was not apparent when multiple births are excluded.

[28] A live birth is defined as any infant who displays signs of life outside of the womb.

[29] The infant mortality rate in this study includes all infant death, that is infant deaths include neonatal deaths (those that occur less than 28 days after birth) and postneonatal deaths (those that occur between 28 and 364 days of age).

where for neonatal mortality $x = less\,than\,28\,days$ for postneonatal mortality $x = 28\,days\,to\,364\,days$. In Canada, the provinces are consistent in their classification for registrations of low birth weight and live and still births (Statistics Canada, 2014b).

2.3.4 Sample construction and characteristics

The sample for study is constructed in the following way. Since the VSB and VSD are collected separately and matching births to deaths is not directly possible, two datasets are created. One for birth outcomes with a time span of 1976 to 2011 and one for death outcomes that includes the time span of 1977 to 2011. We follow Dehejia and Lleras-Muney (2004) and estimate models that include births to mothers of age 18 years or older.[30] Our main sample of analysis includes babies aged less than 12 months (or less than 365 days). We include only individuals from the 10 provinces. Furthermore, we aggregate the birth and death data into cells that are defined by the province of residence of the mother and year of conception or province of residence of the infant and year prior to death.

Table 2.1 summarizes the general sample.[31] The upper portion of the table summarizes the data from the Vital Statistics Birth data. The crude birth rate suggests that approximately 12 babies are born per 1,000 people and the average birth weight is about 3400 grams. Approximately 4.7 percent of babies born are born weighing less than 2500 grams and about 0.7 percent of babies are born weighing less than 1500 grams. The average age of mothers is about 28 years old and about 73 percent of mothers are married. There is an

[30] Females aged less than 18 years may make decisions about having a baby depending on other factors possibly leading to spurious results. Dehejia and Lleras-Muney (2004) note three factors of influence that can play a role in teenage fertility decisions. Those are: 1) the involvements of parents in fertility decisions (as cited in Dehejia and Lleras-Muney: Hao, Hotz, and Jin [2000] suggest that "parents have, under certain conditions, the incentive to penalize teenage (and typically out-of-wedlock) childbearing of older daughters, in order to get the younger daughters to avoid teenage childbearing."; 2) Labour force participation of females aged less than 18 is limited which may complicate the prediction of the association of temporary changes in the unemployment rate; 3) “Debate about the extent to which teenagers make rational decisions”, with suggested reading by Levine (2001).

[31] Note that appropriate rounding procedures as specified by Statistics Canada have been applied to the generation of these summary statistics.

even distribution of male and female babies born.

The central part of the table summarizes the data from the Vital Statistic Death data. Over the time frame of analysis, the infant mortality rate is about 7.6 per 1,000 live births. The neonatal mortality rate and the postneonatal mortality rate are approximately 5 per 1,000 live births and 2.6 per 1,000 live births, respectively. About 47 percent of sample are females and 53 percent are males. Finally, considering control data external to the VSB and VSD, downloaded from Statistics Canada we can see that about 16.5 percent of the population work in manufacturing jobs and the female to male earnings ratio is about 70. Over the time frame of analysis the average unemployment rate is 9.71.

In the following section, we describe the empirical specification.

2.4 Empirical specification

We estimate a two-way fixed effects model, using a linear probability model, in order to explore the association of the unemployment rate with infant health outcomes. The model is specified as follows:

$$Y_{pt} = \alpha + \gamma U_{pt} + \beta X_{pt} + \rho_p + \theta_t + \phi_p(\rho_p * T) + \varepsilon_{pt} \tag{2.1}$$

where p indexes the province of residence and t denotes the year of conception or death; Y represents a measure of infant health;[32] U is the province- and year-specific rate of unemployment; the vector X includes a set of control variables [Note that the same demographic data is not available from both the birth and death data. For models using birth data we control for the sex of infant, age of mother, and marital status of mother; while for models using the death data we control for the sex of infant. Control variables are province- and time-specific averages corresponding to our outcomes variables. We also include a set

[32]Note that all outcomes are logged.

of control variables that are external to the collection of the vital statistics that have the potential to be mediating determinants of economic effects. Those are the male to female earnings ratio[33], and the percent manufacturing jobs[34]. In order to code the correct average, we use the existing data and a series of dummy variables is created and the province- and time-specific average is taken.]; ρ_p is a vector of province fixed effects; θ is a vector of year fixed effects; $\rho_p * T$ represents province-specific trends, and T represents a year trend. We match outcomes at time t with unemployment rates at the time of a baby's conception or the year prior to death.[35] Note that, in order to determine the year of conception we use the number of weeks of gestation and the date of birth of the baby to determine the date (year) of conception.[36] All models report robust standard errors clustered at the province level to account for serial correlation by province.[37] This is important because variation in the unemployment rate is derived from only 10 sources.

We consider two specifications of equation (1). In the first, we include province and year effects, but ignore province specific time trends, that is we impose $\phi_p = 0$. By excluding the time trend, this specification ignores permanent differences in trend between provinces and national fluctuations which are absorbed by the province and year dummies and the model identifies the effects of changes in the province-level unemployment rate within provinces over time.[38] The fixed effects model in this context can account for unobserved heterogeneity that is time invariant, for instance there may be time invariant unobserved labour market

[33]Data for the male to female earnings ratio is accessed through CANSIM TABLE NUMBER 202-0104.

[34]Data for the percent of manufacturing jobs is accessed through CANSIM TABLE NUMBER: 202-0008.

[35]The models were estimated by matching the unemployment rate with the year of death, results were very similar.

[36]This is similar to Dehejia and Lleras-Muney (2004) and Lindo (2015) because we aim to get the date/year of conception but also different from Dehejia and Lleras-Muney (2004) who use the woman's last menstrual cycle to determine the year of conception and Lindo (2015) who uses the unemployment rate nine months prior to the birth of the baby.

[37]This is important because even after controlling for province and year fixed effects, it is possible that observations within each province are not independent (Bertrand et al., 2004).

[38]National trends are very likely to be correlated with other national trends such as female labour force participation, but theoretically there is no reason to ignore them (Dehejia & Lleras-Muney, 2004).

characteristics that are correlated with the unemployment rate and exert independent influence on health, leading to omitted variable bias. If this is the case, it would lead to biased coefficient estimates. In the second specification, we allow for the province specific trends to be different from zero, that is $\phi_p \neq 0$. This specification will account for trends that are specific to provinces, as opposed to just a national trend as in specification (1).

Furthermore, we use the total number of births in a given year and province as weights in order to account for heteroskedasticity. Heteroskedasticity may arise from provincial differences in the number of births. Finally, as mentioned, we specify cluster robust (clustered at the province level) standard errors in the models and we assume that doing so accounts for within-group dependence and within-cluster error correlation. However, as Cameron, Gelbach and Miller (2008) point out, this correction is true when the number of clusters is large - that is when the number of clusters is above thirty. When the number of clusters is few, that is between five to thirty, standard asymptotic tests can still lead to over-rejection by t-tests (Cameron, Gelbach, & Miller, 2008). In that case Cameron, Gelbach, and Miller (2008) suggest the bootstrap procedure of "wild cluster-bootstrap percentile-t procedure"[39] to correct for this and obtain more accurate cluster-robust t-statistics and p-values that are adjusted for few clusters. We undertake this correction, but the resulting estimates do not change our analysis and conclusion.[40]

2.5 Results

We start by providing a summary of the estimates from models of the three times frames: i) 1976 to 2011, ii) 1976 to 1999, and iii) 2000 to 2011. We then move on to summarize

[39]Dr. Doug Miller graciously provides the Stata code to this procedure on his website and available for anyone to use at: http://faculty.econ.ucdavis.edu/faculty/dlmiller/statafiles/

[40]Note that because our resulting estimates do not change, we do not include the tables specifying these estimates.

the estimates considering the specific recessionary periods: i) the 1980s ((i) January 1980 to June 1980; (ii) June 1981 to October 1982), ii) the 1990s (March 1990 to April 1992) and iii) the Great Recession (October 2008 to May 2009).

2.5.1 General results

Table 2.2 summarizes the effect of the provincial unemployment rate on the birth rate and the health outcomes of infants at birth. The table reports estimates for the association of the unemployment rate with the crude birth rate, birth weight, low birth weight (those born weighing less than 2500 grams), and very low birth weight (those born weighing less than 1500 grams). Three time frames are reported: 1976 to 2011, 1976 to 1999 and 2000 to 2011 and two specifications: (1) province and year fixed effects, (2) province and year fixed effects as well as a province specific time trend. Robust standard errors clustered at the province level are reported in the parentheses, while p-values are reported in brackets.

Consider in the first row the crude birth rate. Without the province specific time trend, the association of the birth rate is positive, although not statistically significant for any of the time periods. With province specific time trends, however, although the estimates are statistically insignificant the effect is negative for 1976 to 2011 and 1976 to 1999 , while for 2000 to 2011 it is positive. Our estimates for the 1976 to 1999 period align with Dehejia and Lleras-Muney (2004) who also find the same pattern - that the crude birth rate is not statistically significantly associated with changes in the unemployment rate. We interpret this as suggesting that compositional changes due to selective fertility are not a major issue.

Looking next at row two - the birth weight of infants. With and without province specific time trends there is a negative association between the unemployment rate and the birth weight of infants. The fourth column, representing the estimates over the time period of 2000 to 2011, suggest that without province specific time trends, for a one percentage point

increase in the unemployment rate there is a 0.17 percent decrease in the birth weight of infants. In general, thus, statistically significant or not, the association of the unemployment rate with the birth weight of infants implies that the health of infants gets worse, though the estimated effect is very small.

The third and fourth rows of Table 2.2 summarize the estimates for the association of the unemployment rate with babies born weighing less than 2500 grams or 1500 grams. Without province specific time trends (i.e. Model 1) the estimates suggest that more babies are born with low birth weight and very low birth weight as the unemployment rate increases. Furthermore, the effect is strong for babies born weighing less than 1500 grams, as is evident with bigger coefficient estimates. From 1976 to 2011, for a one percentage point increase in the unemployment rate the fraction of babies born weighing less than 1500 grams increased by 1.87 percent and from 1976 to 1999 by 2.35 percent. With province specific time trends included in the specification, the signs of the coefficients are maintained for 1976 to 2011 and from 1976 to 1999 but changes to an inverse relationship for 2000 to 2011. These estimates suggest that the health outcomes of babies get worse as the unemployment rate rises. This is in contrast to Ruhm (2000), Dehejia and Lleras-Muney (2004) and Lindo (2015) who find that the fraction of babies born with low and very low birth weight decreases as the unemployment rate increases. Of note however, is that from 2000 to 2011 the estimates of the association are different. For a one percentage point increase in the unemployment rate there is a decrease of the fraction of babies born weighing less than 2500 grams or 1500 grams. This may suggest that infant health may in fact improve as economic conditions deteriorate. At the very least, this estimate suggests a very different relationship than in other periods examined.

In general, we can see that there is a small decrease in the average weight of babies and a larger increase in the proportion of babies being born with low and very low birth weight. We next consider infant mortality outcomes, and whether the relationship is consistent with

the exhibited negative relationship between unemployment rates and the health of infants.

[Insert Table 2.2]

Table 2.3 summarizes the estimates of the association of the unemployment rate with infant mortality. The table reports estimates for the association of the unemployment rate with the infant mortality (death within the first 365 days of life), neonatal mortality (death up to, but not including, 28 days) and postneonatal mortality (death 28 days to less than 365 days). Again, three time frames are reported: 1977 to 2011, 1977 to 1999 and 2000 to 2011 and two specifications: (1) province and year fixed effects, (2) province and year fixed effects and a province specific time trend. Robust standard errors clustered at the province level are in parentheses, while p-values and the sample size are also reported.

Consider the first specification without the province specific time trend (that is, model 1). There is a strong statistically significant relationship exhibiting a countercyclical pattern between the unemployment rate and infant mortality and postneonatal mortality over the 1977 to 2011 period. For a one percentage point increase in the unemployment rate infant mortality and postneonatal mortality increase by 2.86 percent and 3.38 percent, respectively. Although not statistically significant, the estimate for neonatal mortality also exhibits a countercyclical pattern that suggests for a one percentage point increase in the unemployment rate, neonatal mortality increases by 2.25 percent. From the 1977 to 1999 period, the estimates are smaller, but the pattern of the sign and statistical significance are the same. These estimates suggest then that more babies die between 28 to 365 days of life, regardless of model specification. These estimates are in contrast to Dehejia and Lleras-Muney (2004) who find that from 1976 to 1999 infant mortality, neonatal mortality and postneonatal mortality decreased as the unemployment rate increased. Looking again at Table 2.3. from 2000 to 2011, the sign of the estimates change, and statistical significance is lost for both infant mortality and postneonatal.

When the province specific time trend is added to the model specification, overall the size of estimated coefficients decreases and also the statistical significance decreases. For the 1977 to 2011 time frame postneonatal mortality maintains its statistical significance and for a one percentage point increase in the unemployment rate postneonatal mortality increases by 1.76 percent. Over the 1977 to 1999 period, postneonatal mortality shows a consistent statistically significant relationship with the unemployment rate implying that for a one percentage point increase in the unemployment rate postneonatal mortality increases by 2.24 percent, while statistical significance is lost for infant mortality. Finally, over the 2000 to 2011 period, estimates are not statistically significant although the sign of the coefficient estimates remains positive for infant mortality and postneonatal mortality but changes to a negative for neonatal mortality.

Clearly from the estimates of Table 2.3, we can see that, in general, there is a counter-cyclical pattern in infant mortality, neonatal mortality and postneonatal mortality, which is different from Ariizumi and Schirle (2012) who find no statistically significant relationship between infant mortality and the unemployment rate using Canadian data. Furthermore, our results differ when compared with the U.S. literature where evidence has suggested that economic downturns are good for infant health (Lindo, 2015; Ruhm, 2000; Dehejia & Lleras-Muney, 2004). We next examine how infant health outcomes are associated with specific recessionary periods.

[Insert Table 2.3]

2.5.2 Distinct recession results[41]

In the relevant literature, recent studies have focused on "the Great Recession" of 2008/2009 to study how a discrete shock in the labour market may impact the health outcomes of

[41] Note that the summary of the characterization of the distinct recessionary periods is extensively based on the study by Cross and Bergevin (2012), and we give credit to their report accordingly.

individuals. Furthermore in Canada, note that although the recession of 2008/2009 has been defined as "the Great Recession", some economists have dubbed this recession of 1981/1982 as "the Great Recession" because it shows the largest peak-to-trough decline of any downturn since the Great Depression (Cross & Bergevin, 2012).

In our time frame for analysis, 1976 to 2011, Canada experienced four recessions: (i) January 1980 to June 1980; (ii) June 1981 to October 1982; (iii) March 1990 to April 1992; and (iv) October 2008 to May 2009 (Cross & Bergevin, 2012). We group (i) and (ii) into one recessionary period because they are so close in time and motivated by the same factors as described below and so, in total, we examine the three different recessionary periods to better understand how the economic downturns were associated with infant health outcomes. We describe below how these recessions were characterized and then describe the results from our regression analysis.

The recessions of the 1980s There were two recessions in the early 1980's: (i) January 1980 to June 1980; (ii) June 1981 to October 1982. Of the four recessions under analysis, the recession from January 1980 to June 1980 was characterized by the greatest drop in employment (Gilmore & LaRochelle-Cote, 2011). The 1980 recession was the reverberation from the U.S. economy where credit controls that were introduced in 1980 to control accelerating inflation caused a very large decrease in the market for Canada's housing and auto exports (Cross & Bergevin, 2012). This recession showed more pronounced impact on the Gross Domestic Product (GDP) rather than employment and it had a relatively small impact on some industries[42] (Cross & Bergevin, 2012). The recession of 1981/1982 was characterized by six quarters of GDP decline and both output and jobs declined sharply as well (Cross & Bergevin, 2012). For example, the unemployment rate for Canada was 7.2

[42]In the 1980 recession, there was a stagnation in real GDP in the first quarter and a drop in the second quarter of 1980 while employment rose steadily but at a lower pace (0.3 percent versus 1 percent before and after the recession) (Cross & Bergevin, 2012).

percent in June of 1981 and it increased to 12.9 percent in October of 1982.[43] GDP fell from the second quarter of 1981 at 799,478 to 758,823 in the fourth quarter of 1982.[44] Because the recessions of 1980 and 1981/1982 are so close together by date and motivated by the same event - which was to slow inflationary pressure - we group them into one broader recessionary period. The time frame for analysis of the recession of the 1980s is 1977 to 1984 inclusive. That is a total of 80 province-year observations.

The recession of the 1990s The recession of the 1990s started in March 1990 and ended in April 1992. This recession started with cutbacks in manufacturing which led to decreases in employment and decreases in GDP, however, employment did not drop as steeply as it did during the recessions in the 1980s (Cross & Bergevin, 2012; Gilmore & LaRochelle-Cote, 2011). The economic contraction was worst in the first quarter of 1991 with the combination of the Gulf War and the introduction of the goods and services tax (GST) which sharply decreased consumer spending. Following this, it appeared that things would improve, but there was little or no change in real GDP in the following year, while employment was still decreasing and industries continued to decrease output (Cross & Bergevin, 2012). The economy started to improve following April 1992. The time frame for analysis of the recession of the 1990s is 1987-1993 and it captures 70 province-year observations.

The "Great Recession" (recession of 2008/09) The Great Recession of 2008/2009 was characterized by a very steep drop in employment – like that of the 1980s – but this drop and the recovery were also speedier. The economic decline started with the closing of several auto plants in December of 2007 – leading to decreases in output (Cross & Bergevin, 2012). Output struggled through the winter with record snowfalls in parts of eastern Canada

[43]Data retrieved from CANSIM TABLE NUMBER 282-0087 Labour force survey estimates (LFS), by sex and age group, seasonally adjusted, monthly.

[44]Data retrieved from CANSIM TABLE NUMBER 380-0064 Gross domestic product, expenditure-based, quarterly (dollars x 1,000,000).

to disruptions in the oil patch in western Canada (Cross & Bergevin, 2012). However, a majority of industries raised output through this, and employment rose steadily. The reverberation from the United States, however, was the main cause of this recession. In September 2008, a U.S. investment bank failed leading to a freeze in credit flows within the U.S. The onset of the recession in Canada however, was delayed by a record crop[45] in September and then by national elections in October (Cross & Bergevin, 2012). But in November, there was a rapid decline in both output and jobs due to decreases in export demand from around the world and a collapse in commodity prices. This continued until spring. Overall output and employment continued to fall into May of 2009 (May is the trough), although parts of the economy began to recover. The time frame for analysis of this recession is 2005-2010 and it captures 60 province-year observations.

Tables 2.4 and 2.5 report the estimates for the relationship between infant health outcomes and the specific recessionary periods. Table 2.4 reports estimates of the association of the unemployment rate with estimates of the crude birth rate, birth weight, low birth weight (those born weighing less than 2500 grams), and very low birth weight (those born weighing less than 1500 grams). Most estimates are statistically insignificant but considering the 1980s, there is a statistically significant association between the crude birth rate, birth weight and the fraction of babies born weighing less than 2500 grams. The relationship between the unemployment rate and the crude birth rate may signal that there are in fact some compositional changes in births over that time period driving the coefficient estimates. Furthermore, the coefficient estimate on birth weight, although statistically significant, is so small that it may be meaningless. Finally, consider the second column, for a one percentage point increase in the unemployment rate, there is an increase of 0.83 percent in the fraction of babies born weighing less than 2500 grams.

[45] A record crop, suggesting highest yields recorded, was evidenced for spring wheat, barley, canola, oats, dry field peas and soybeans (Statistics Canada, 2008).

Although many of the other estimates are not statistically significant for the sake of completeness, we summarize the coefficient estimates. Regardless of model specification, it appears that the infant health outcomes are worse in regards to the recessions of the 1980s and 1990s. In contrast however, for the Great recession, it appears that the health outcomes of infants may in fact get better. But overall, because of the insignificant nature of estimates with specific recessionary periods, we can assume that infant health outcomes are not associated more intensely with these periods, or the period of estimation may be too short to render plausible estimates. We consider next how infant mortality outcomes are associated with specific recessionary periods.

[Insert Table 2.4]

Table 2.5 summarizes the estimates of the relationship between infant mortality, neonatal mortality and postneonatal mortality and specific recessionary periods. Few estimates are statistically significant, similar to the estimates of Table 2.4, and this can imply that these specific recessionary periods do not impact infant mortality outcomes or that the time frame of analysis may be to short to draw plausible conclusions. Consider first the 1980s. With or without the province specific time trend, it appears that infant mortality and neonatal mortality decrease as the unemployment rate increases, while postneonatal mortality increased. The pattern of coefficient estimates is different for the recession of the 1990s. Both model specifications render positive coefficient estimates for infant mortality and postneonatal mortality while for neonatal mortality the coefficient estimate is negative when province specific time trends are included. Furthermore, looking at column 3, for a one percentage point increase in the unemployment rate postneonatal death increased by 4.7 percent. Suggesting that more babies died between 28 to 364 days during the recession of the 1990s. Finally, for the Great Recession, coefficient estimates suggest that infant mortality and neonatal mortality increase as the unemployment rate increases but neonatal

mortality decreases.

[Insert Table 2.5]

2.6 Discussion and Conclusion

In this paper we examined the relationship between the provincial unemployment rate and infant health outcomes in Canada. We looked at three broad and overlapping time frames (1976 to 2011, 1976 to 1999, 2000 to 2011), and we looked at three more specific recessionary periods (the 1980s, the 1990s, and the Great Recession). Using the Vital Statistics Birth and Death data we find evidence that, in fact, there is a statistically significant relationship between economic fluctuations and infant health. Considering that our study focuses on the Canadian experience, our major finding is that there is in fact a statistically significant relationship between the changes in the unemployment rate and the change in infant health outcomes. This finding is in contrast to the current evidence from Ariizumi and Schirle (2012) who also examine the relationship between the unemployment rate and infant mortality and find no statistically significant relationship. That said, substantial differences in the focus of our study and theirs could easily drive observed differences.

More specifically, we find that the fraction of babies born weighing less than 1500 grams increases, and although not statistically significant, this pattern of estimates is true for the fraction of babies born weighing less than 2500 grams. These results are different from Dehejia and Lleras-Muney (2004) and Lindo (2015) who find that the percent of babies born weighing less than 2500 grams and below 1500 grams decreases. In models where we consider specific recessionary periods, we find that during the 1980s there was a statistically significant increase in the proportion of babies born weighing less than 2500 grams. Furthermore, there is a statistically significant relationship between the increase in the unemployment rate and postneonatal mortality during the recession of the 1990s. We

provide some suggestions to the reason we see these differences, however, it is difficult to disentangle what is really driving these differences. The increase in the fraction of babies born weighing less than 1500 grams may be related to the advances in medical technology. Babies that are born with very low birth weight may need the support of these advances from medical technology.

What are the implications of these findings? It is difficult to disentangle what effects are happening behind these estimates. In Section 2.1.1 we suggested three reasons why a relationship may exist. Access to care in the U.S. may be of larger concern to certain groups. Health insurance is not universal and a non-trivial fraction of citizens do not have health insurance. Moreover, when the economy worsens, the number of individuals uninsured increases[46] (Cawley & Simon, 2005; Dorn, Garrett, Holahan, & Williams, 2008). Those that are uninsured are more likely to have relatively low household income and may not be eligible for Medicaid[47] (DeNavas-Walt, Proctor, & Smith, 2009). This implies that there may be a constraint on access to health care for children and prenatal care for pregnant women. However, it is not clear that women and children remain affected by the economic recession because Cawley and Simon (2005) find that changes in the unemployment rate are not significantly associated with insurance coverage through any source for women or children. They suggest that these results may be due to women and children enrolling in Medicaid and the State Children's Health Insurance Program during periods of high unemployment, though there may still be access issues since Medicaid is not uniformly accepted by providers. Universal health coverage thus may be an input into the health of a baby because mother's may be better able to access prenatal care and medical care for their child. The evidence to date suggests that the health of Canadian babies is not associated with economic fluctuations (Ariizumi & Schirle, 2012) while it improves for U.S. babies

[46] Substantial progress for poor via Medicaid and CHIP (Children's Health Insurance Program).

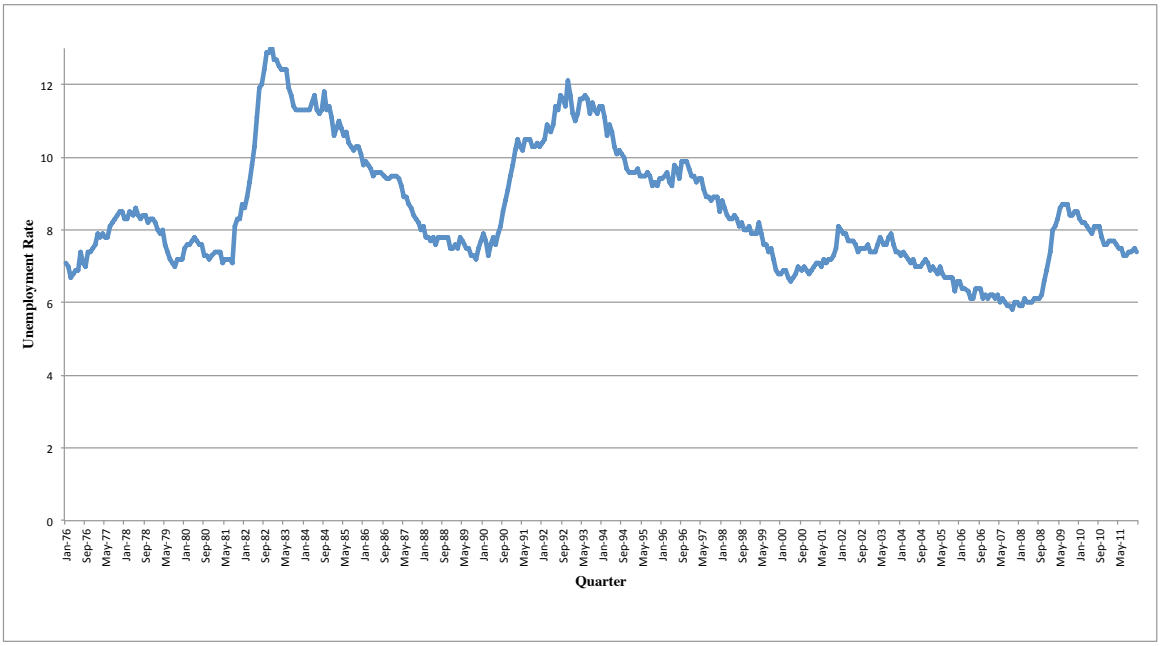
[47] It is true that some may not be eligible for Medicaid, but it is also true that Medicaid spending increases when there is an economic downturn (Dorn et al., 2008).

(Ruhm, 2000; Dehejia & Lleras-Muney, 2004; Lindo, 2015). And so, since the health of infants improves during recessions in the U.S. it is possible that health insurance and access to care may not be a factor responsible for this difference. So, although there is a constraint to access of medical care in the U.S. mother's may have more time available to allocate to taking care of their own health and the health of their babies thus leading to better health outcomes (Ariizumi & Schirle, 2012; Dehejia & Lleras-Muney, 2004). That said, it is difficult to pin down which of these features dominates.

In the U.S. the major finding is that there is evidence of intertemporal fertility decisions and that the pattern of substitution into fertility by low-skill women suggests that skill depreciation plays an important role in fertility decisions (Dehejia & Lleras-Muney, 2004). Furthermore, the difference in race (the difference in Black and White women having babies) suggests that low-skill Black women are likely to be credit constrained and thus substitute out of fertility in bad times (Dehejia & Lleras-Muney, 2004). The Canadian Vital Statistics Data does not provide the depth of socio-demographic and socio-economic data in order to address these issues as in the U.S. studies by Dehejia and Lleras-Muney (2004) and Lindo (2015). But, if we consider the difference in the estimates for baby's born weighing less than 1500 grams, we might speculate that the fertility decisions of women in Canada are different from women in the U.S. and that institutional factors (that of reduced insecurity related to prenatal and postnatal care due to universal health insurance) play a role in the making of fertility decisions for women in the U.S. while they do not for women in Canada. Furthermore, the unemployment rate may exert a different impact on the health behaviours of women in Canada. It may be salient to suggest that as the unemployment increases pregnant women and mother's increase the negative health behaviours like smoking and drinking alcohol and decrease time they allocate to taking care of themselves and their newborns. Considering infant mortality and postneonatal mortality in Table 2.3, there is a clear change in coefficient estimates for specification (1) for the time period 2000 to 2011.

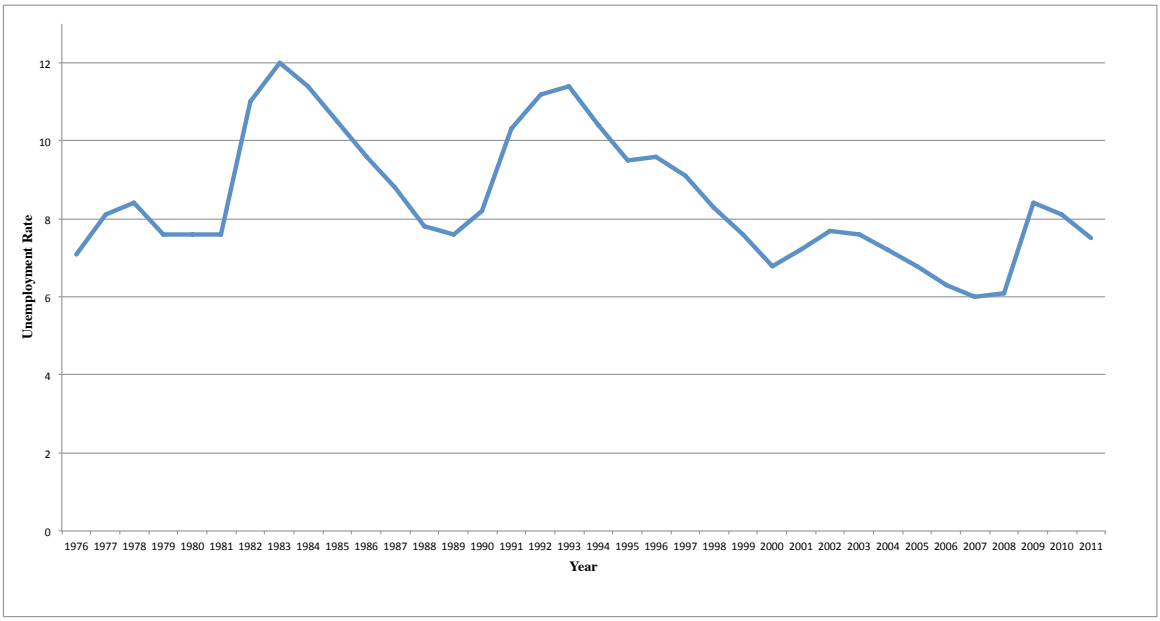
In sum, knowing whether a relationship exists between economic conditions and infant health outcomes can then be addressed policy-wise and investment into policies that impact infant health outcomes would render an increased well-being for society. From our analysis, we can make a broad conclusion that since we have shown that a relationship between economic fluctuations and infant health exists and if improving birth outcomes is a policy objective because of the negative effects associated with infant health outcomes then policies, as suggested by Dehejia and Lleras-Muney (2004), that are aimed at attenuating the effect of taking time off from work to attend prenatal care, and to attend to health more generally are particularly important.

Figure 2.1: Quarterly unemployment rate, 1976 to 2011



Source: Data are from CANSIM TABLE NUMBER: *282-0087 Labour Force Survey estimates (LFS), seasonally adjusted, quarterly.*

Figure 2.2: Unemployment rate, 1976 to 2011



Source: Data are from CANSIM TABLE NUMBER: *282-0001 Labour Force Survey estimates (LFS), by sex and detailed age group, unadjusted for seasonality, annual.*

Table 2.1: Descriptive statistics

Outcome	Mean (std deviation)
Birth	
Crude birth rate	12.438
	(1.9425)
Birtweight	3434.692
	(48.9897)
% less than 2500 grams	4.677
	(0.4201)
% less than 1500 grams	0.703
	(0.1289)
Mother's age	27.727
	(2.4931)
Female	48.656
	(0.2654)
Male	51.341
	(0.2657)
Married status	73.244
	(14.7697)
Mortality	
Infant mortality	7.569
	(2.5118)
Neonatal mortality	5.057
	(1.5687)
Postneonatal mortality	2.641
	(1.1034)
Female	47.033
	(2.7179)
Male	52.966
	(2.7179)
Other controls	
% manufacturing jobs	16.50
	(4.6488)
Female to male earnings ratio	69.97
	(6.3372)
Unemployment rate	9.71
	(3.7383)

Notes: Data are aggregated by province and year of conception for birth, and province and year of death for death. The numbers of observation in each cell are used as weights. Infant mortality data are by province and year for 1977 to 2011, N=350. Birth outcomes data are by province and year from 1976 to 2011. N=360. Data for other controls are retrieved from CANSIM: Unemployment rate Table number 282-0001 - LFS estimates, by sex and detailed age group, monthly, unadjusted for seasonality (averaged to get an annual rate). Female to male earnings ratio Table number 202-0104, and the percent manufacturing jobs Table number: 202-0008.

Table 2.2: Estimates of the association of infant health outcomes and the province unemployment rate

	1976-2011		1976-1999		2000-2011	
Outcome	(1)	(2)	(1)	(2)	(1)	(2)
Crude birth rate	0.0044	-0.0041	0.0050	0.0094	0.0009	-0.0034
	(0.0061)	(0.0069)	(0.0049)	(0.0080)	(0.0059)	(0.0042)
p-value	0.4821	0.5629	0.3354	0.2730	0.8799	0.4423
Birthweight	-0.0008	-0.0007	-0.0002	-0.0003	**-0.0017****	0.0003
	(0.0007)	(0.0004)	(0.0006)	(0.0003)	(0.0007)	(0.0006)
p-value	0.2829	0.1048	0.7202	0.3872	0.0313	0.6446
% less than 2500grams	0.0091	0.0018	0.0079	0.0022	0.0056	-0.0045
	(0.0054)	(0.0040)	(0.0055)	(0.0066)	(0.0067)	(0.0071)
p-value	0.1243	0.6602	0.1846	0.7487	0.4216	0.5391
% less than 1500 grams	**0.0187***	0.0086	**0.0235****	0.0134	0.0209	0.0179
	(0.0091)	(0.0071)	(0.0082)	(0.0103)	(0.0178)	(0.0196)
p-value	0.0706	0.2558	0.0182	0.2284	0.2717	0.3862
Sample size	360	360	240	240	120	120

Notes: Dependent variables are logged. Specification (1) include vectors of province and year dummy variables, specification (2) adds a province specific time trend. Both specifications include controls for mother's age, marital status of the mother (married), sex of infant, percent manufacturing jobs (CANSIM table number 282-0008), and female to male earnings ratio (CANSIM table number 202-0104). Robust standard errors, clustered at the province level are reported in the parenthesis. Data are from the Vital Statistics Birth and Death Registry and CANSIM tables as noted above with province level unemployment rates merged from Statistics Canada CANSIM table number 282-0001. Sample includes infants aged less than 365 days and excludes multiple births. Mother's age is restricted to 18 years of age and the unemployment rate is matched to the year of conception. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level.

Table 2.3: Estimates of the association infant mortality outcomes and the province unemployment rate

	1977-2011		1977-1999		2000-2011	
Outcome	(1)	(2)	(1)	(2)	(1)	(2)
Infant mortality	**0.0286****	0.0056	**0.0177***	0.0132	-0.0071	0.0084
	(0.0124)	(0.0071)	(0.0095)	(0.0081)	(0.0123)	(0.0233)
p-value	0.0471	0.4506	0.0960	0.1384	0.5777	0.7273
Neonatal mortality	0.0225	-0.0029	0.0101	0.0060	0.0073	-0.0057
	(0.0134)	(0.0089)	(0.0088)	(0.0084)	(0.0214)	(0.0318)
p-value	0.1285	0.7516	0.2841	0.4952	0.7396	0.8627
Postneonatal mortality	**0.0338****	**0.0176****	**0.0274***	**0.0224****	-0.0465	0.0428
	(0.0110)	(0.0056)	(0.0127)	(0.0093)	(0.0280)	(0.0488)
p-value	0.0134	0.0120	0.0597	0.0400	0.1319	0.4031
Sample size	350	350	230	230	120	120

Notes: Dependent variables are logged. Specification (1) include vectors of province and year dummy variables, specification (2) adds a province specific time trend. Both specifications include controls for sex of the infant, marital status (CANSIM table number 051-0042), percent manufacturing jobs (CANSIM table number 282-0008), and female to male earnings ratio (CANSIM table number 202-0104). Robust standard errors, clustered at the province level are reported in the parenthesis. Data are from the Vital Statistics Birth and Death Registry and CANSIM tables as noted above with province level unemployment rates merged from Statistics Canada CANSIM table number 282-0001 and matched to year prior to mortality. Sample includes infants aged less than 365 days. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level.

Table 2.4: Estimates of the provincial level unemployment rate with infant health outcomes, specific recessionary periods

	1980s		1990s		the Great Recession	
Outcome	(1)	(2)	(1)	(2)	(1)	(2)
Crude birth rate	**0.0064***	**-0.0123****	0.0027	0.0073	**-0.0119*****	0.0020
	(0.0030)	(0.0048)	(0.0029)	(0.0091)	(0.0036)	(0.0056)
p-value	0.0653	0.0289	0.3751	0.4421	0.0096	0.7327
Birthweight	**-0.0006***	**-0.0007****	0.0000	-0.0006	-0.0008	0.0013
	(0.0003)	(0.0003)	(0.0007)	(0.0004)	(0.0008)	(0.0008)
p-value	0.0660	0.0267	0.9876	0.2245	0.3426	0.1465
% less than 2500grams	0.0058	**0.0083***	-0.0001	0.0052	0.0019	-0.0206
	(0.0058)	(0.0037)	(0.0074)	(0.0071)	(0.0179)	(0.0281)
p-value	0.3389	0.0546	0.9943	0.4805	0.9172	0.4826
% less than 1500 grams	0.0159	0.0158	0.0064	0.0109	-0.0117	-0.0550
	(0.0087)	(0.0183)	(0.0083)	(0.0188)	(0.0477)	(0.1253)
p-value	0.1017	0.4110	0.4604	0.5774	0.8125	0.6709
Sample size	80	80	70	70	60	60

Notes: Dependent variables are logged. Specification (1) include vectors of province and year dummy variables, specification (2) adds a province specific time trend. Both specifications include controls for mother's age, marital status of the mother (married), sex of the infant, percent manufacturing jobs (CANSIM table number 282-0008), and female to male earnings ratio (CANSIM table number 202-0104). Robust standard errors, clustered at the province level are reported in the parenthesis. Data are from the Vital Statistics Birth and Death Registry and CANSIM tables as noted above with province level unemployment rates merged from Statistics Canada CANSIM table number 282-0001. Sample includes infants aged less than 365 days, multiple births are excluded. Mother's age is restricted to 18 years of age and the unemployment rate is matched to the year of conception. The recession of 1980s refers to the time frame 1977-1984, 1990s refers to 1987-1993 and the Great Recession refers to 2005-2010. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level.

Table 2.5: Estimates of the association of the province level unemployment rate with infant mortality, specific recessionary periods

	1980s		1990s		the Great Recession	
Outcome	(1)	(2)	(1)	(2)	(1)	(2)
Infant mortality	-0.0050	-0.0119	0.0185	0.0017	0.0023	0.0040
	(0.0148)	(0.0118)	(0.0135)	(0.0142)	(0.0295)	(0.0469)
p-value	0.7455	0.3421	0.2028	0.9071	0.9393	0.9335
Neonatal mortality	-0.0175	-0.0305	0.0047	-0.0146	-0.0067	-0.0033
	(0.0191)	(0.0247)	(0.0219)	(0.0239)	(0.0396)	(0.0541)
p-value	0.3829	0.2481	0.8345	0.5568	0.8690	0.9531
Postneonatal mortality	0.0146	0.0180	**0.0470*****	0.0367	0.0297	0.0173
	(0.0112)	(0.0204)	(0.0122)	(0.0309)	(0.0565)	(0.0957)
p-value	0.2229	0.3996	0.0039	0.2653	0.6117	0.8604
Sample size	80	80	70	70	60	60

Notes: Dependent variables are logged. Specification (1) include vectors of province and year dummy variables, specification (2) adds a province specific time trend. Both specifications include controls for sex of the infant, marital status (CANSIM table number 051-0042), percent manufacturing jobs (CANSIM table number 282-0008), and female to male earnings ratio (CANSIM table number 202-0104). Robust standard errors, clustered at the province level are reported in the parenthesis. Data are from the Vital Statistics Birth and Death Registry and CANSIM tables as noted above with province level unemployment rates merged from Statistics Canada CANSIM table number 282-0001 and matched to year prior to mortality. Sample includes infants aged less than 365 days. The recession of 1980s refers to the time frame 1977-1984, 1990s refers to 1987-1993 and the Great Recession refers to 2005-2010. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level.

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Chapter 3

Exploring measurement and sample issues in the relationship between infant health outcomes and economic conditions

3.1 Introduction

The unemployment rate has become the *gold standard* when studying the impact of labour market conditions on health. More recently however, there has been some thought that it may have become outdated (Zmitrowicz & Khan, 2014; Shierholz, 2012). In particular, is it still a good reflection of labour market activity and thus economic conditions or is an alternative measure more relevant? Its advantages have been ease of access and the belief that it provides an accurate reflection of the economic situation, however, more recently the labour market composition and demographics have changed. In other words, there is concern that the unemployment rate is no longer a good proxy for true underlying labour

market conditions (Devereaux, 1992; Danson, 1999; Shierholz, 2012; Bernard & Usalcas, 2014).

As a measure itself, the unemployment rate has an inherent measurement error, especially when economic downturns lead to more discouraged workers[1] who are not counted in the unemployment rate. This is a major shortcoming of the unemployment rate because, for the purposes of establishing the association between economic conditions and health, a measure that captures both the individuals unemployed and the labour force would be preferred.

As robustness checks, some studies use the employment rate (i.e., the employment-to-population ratio) and generally find that their main results do not change.[2] Of main importance however, is that because we are interested in the relationship between health and economic conditions, there is a possibility that estimates are biased by changes in the relationship between unemployment rates and true underlying economic conditions.

In the relevant literature, studies have predominantly found that there is a procyclical relationship between economic conditions and health. That is - as the unemployment rate increases, mortality decreases. This can be conceptualized in a different way, and if we consider that mortality represents a health outcome *per se* then improved health means that mortality decreases. In that case, to re-conceptualize the negative relationship between the unemployment rate and mortality we can say that in other words - health outcomes improve (since mortality decreases) when economic conditions worsen (unemployment rate increases).

Very few studies do extensive sensitivity analysis. One exception is Ruhm (2015) which examines whether the procyclical relationship predominantly found in the results is sensi-

[1]Discouraged workers are defined as individuals who reported wanting to work and are available to work but give up searching because they believe that suitable opportunities are not available (Statistics Canada, 2014a).

[2]More recently, Ruhm (2015) estimates specifications that control for non-employment rather than unemployment rates and finds similar results while the estimates using non-employment are slightly larger.

tive to a number of factors - differing start year, differing end year, and duration under study. He re-examines the U.S. data over the 1976 to 2010 period and finds that the relationship between economic conditions and health has in fact shifted from being strongly procyclical to being weakly related or even countercyclical over recent years.

In this chapter, we re-examine the relationship between infant health outcomes and macroeconomic fluctuations studied in Chapter 2. In Chapter 2, we used the unemployment rate as our measure for economic conditions and found evidence of a countercyclical relationship between infant health outcomes and economic conditions. This evidence is in contrast to Ariizumi and Schirle (2012) who also used Canadian data and found no statistically significant relationship between infant mortality and economic conditions. Having said that, this study explores how different proxies of economic conditions and different model specifications impact the resulting estimates of the association of infant health outcomes with economic conditions. We use Canadian data over the period 1976 to 2011, inclusive and define alternate measures using the set of supplementary unemployment rate measures[3], and the employment rate. Our outcomes of interest are the crude birth rate, birth weight, low birth weight (less than 2500 grams) and very low birth weight (less than 1500 grams), infant mortality, neonatal mortality and postneonatal mortality. Finally, alternate specifications of the base two-way fixed effects model include an interaction term between the unemployment rate and the time trend to examine whether the effects of macroeconomic conditions on mortality have changed over time. Ultimately, we are interested in examining the robustness of estimates by choice of proxy for economic conditions and by choice of model specification, specifically how these effects may have changed over time.

The paper is organized as follows. Section Two provides a discussion of the previous literature on issues surrounding the measure of economic conditions and their association

[3]These supplementary rates are defined as the R1 unemployment rate through the R8 unemployment rate and we discuss them in more detail below.

with health. Section Three summarizes how we define macroeconomic proxies and the data more generally. Section Four establishes the methodology used, focusing on a model which allows us to trace out the impacts of economic conditions over time. Section Five summarizes the results while Section Six is a discussion of the findings. Finally, Section Seven concludes.

3.2 Background

Considering the evolution of estimating the relationship between economic conditions and health, model specification issues are relevant. Estimating the relationship between economic conditions and health dates back to seminal work by Brenner (1973, 1975, 1979) whose results became collectively known as the "Brenner Hypothesis". He found that at the aggregate level, mortality exhibits a countercyclical pattern with economic conditions - as the unemployment rate increased mortality increased as well.[4] The Brenner Hypothesis became "conventional wisdom" but subsequent studies failed to replicate the findings and his empirical strategy was criticized for not accounting for issues often associated with time series data (e.g., unit roots which lead to spurious regression coefficient estimates). Subsequent studies in fact found the opposite relationship - mortality exhibits procyclical properties - in this context, procyclical refers to the inverse relationship between short-term downturns and mortality rates (c.f. (Gravelle et al., 1981; Joyce, 1993; McAvinchey, 1988)). And so, using a time series approach to studying how aggregate levels of health are associated with the unemployment rate was inconclusive and burdened with data and modeling issues (c.f. (Gravelle et al., 1981; Joyce, 1993; McAvinchey, 1988)).

Ruhm (2000) was first to approach the question of the association of mortality with

[4]Brenner finds a countercyclical pattern for infant mortality rates, cause specific mortality rates: deaths due to cardiovascular disease, cirrhosis, suicide and homicide, and admissions to mental hospitals (Brenner, 1975, 1979, 1987a, 1987b).

macroeconomic fluctuations using a more credible, fixed effects methodology. He estimates models of aggregate data that cover the 50 states and the District of Columbia over the 1972 to 1991 period and augments the linear probability model with time and space dummies in order to account for the across state heterogeneity. This fixed effects methodology was a path-breaking approach to studying the relationship between macroeconomic fluctuations and health. Ruhm introduced location (State) and time (year) fixed effects, which can account for unobserved time invariant characteristics while estimating the relationship between mortality and economic fluctuations. This methodology may render more valid coefficient estimates and avoid spurious regression results if the heterogeneity in question is time invariant. Ultimately, in contrast to Brenner, Ruhm finds that mortality decreases as the unemployment rate increases. Since Ruhm (2000), a version of this fixed effects methodology has been used to study the same question using data from different countries, different time frames, and different types of data. Ruhm (2000) and subsequent studies, in general, have used state-level proxies to study the impact of economic recessions on health.

Laporte (2004) revisited the Brenner Hypothesis to examine ways in which the empirical modeling could be modified in order to best account for the issues that times series data pose. She applies an error correction model specification to U.S. data for the period 1948 to 1996 and finds that when the unemployment rate increases, mortality decreases, but paradoxically when there is economic growth - that is when the unemployment rate decreases - mortality decreases.

To examine whether the effects of macroeconomic conditions have changed over time, Ruhm (2015) estimates an extension to the basic fixed effects specification by including an interaction term between the unemployment rate and a linear time trend. This specification provides a summary of long-term changes in economic effects. He finds that mortality has become less procyclical, even perhaps countercyclical in more recent years. Ruhm finds

that the estimated relationship between economic conditions and health has in fact changed and that the significance of estimates might be sensitive to the start and end dates of the time frame under analysis. In that case, he estimates models that account for different start and end dates and finds that some can reject the null hypothesis of no macroeconomic effects while some fail to reject the null hypothesis.[5]

Finally, as mentioned earlier, the most common measure of economic conditions used in this literature is the unemployment rate, typically measured at the state or province level. At this level of aggregation, it is possible that errors tend to average out (Angrist & Krueger, 1999), and so measurement error of economic indicators at this level is not of great concern.[6] Having said that however, we use all supplementary measures for the standard unemployment rate available in order to examine the differences that the choice of proxy has on the resulting relationship of interest. Although the alternate proxies may move in tandem, the size of the coefficient estimate and the statistical significance may result in a slightly different relationship. Furthermore, we extend our analysis to consider differences in the pattern of estimates using the provincial level employment rates rather than unemployment rates since the employment rate is based solely on administrative data, it may be preferable as a proxy for economic conditions, in so far as it is subject to measurement error (Lindo, 2015).

[5] In general, models that use 15 years of data or less may thus find estimates that are not a reflection of the true relationship between economic conditions and health (Ruhm, 2015).

[6] Lindo (2015) studies how different levels of aggregation of the unemployment rate affects the estimates of the association of economic fluctuations and health. His results suggest that estimates remain statistically significant, regardless of aggregation level, but the magnitude of the effect decreases as the level of aggregation decreases. He suggests that as one considers smaller areas there is more concern for measurement error in the unemployment rate since they are based on household surveys.

3.3 Data

3.3.1 Defining macroeconomic proxies

The unemployment data that we use in this study come from the Labour Force Survey done by Statistics Canada and downloaded from CANSIM.[7] We use annual data from 1976 to 2011, inclusive, on 10 provinces. In the relevant literature, studies have typically used place-specific measures such as state level or province level unemployment rates to examine the effects of changes in macroeconomic conditions on health and health behaviours. We use unemployment rates at the province level to identify and measure the impact of changes in labour market conditions. The unemployment rate is defined as the number of unemployed persons expressed as a percentage of the labour force (Statistics Canada, 2014a).[8] Labour force participation is a major component of the unemployment rate and the calculation of other relevant labour market activity measures. There are cyclical and structural differences in labour force participation. Cyclical changes in labour force participation are temporary and arise from short-term changes in the economic situation. However, structural changes in labour force participation are more long term and arise from actual changes to the economy. As a measure itself, the unemployment rate is not able to elicit the kind of change that is happening in the labour market. In and of itself, the unemployment rate provides a very broad picture of the health of the economy but lacks more precise reflection of the actual changes that are taking place.

[7] CANSIM TABLE NUMBER 282-0001 - LFS estimates, by sex and detailed age group, monthly, unadjusted for seasonality (averaged to get an annual rate) and TABLE NUMBER 282-0086 Labour force survey estimates (LFS), supplementary unemployment rates by sex and age group, annual.

[8] Statistics Canada defines unemployed persons as those who, during the reference week: were on temporary layoff during the reference week with an expectation of recall and were available for work, or were without work, had looked for work in the past four weeks, and were available for work, or had a new job to start within four weeks from reference week, and were available for work. The labour force is comprised of employed persons (those who are supplying services in the reference period, regardless of the quantity supplied) and unemployed persons (those who provide evidence that they are offering their labour services to the market (again regardless of quantity)). Notes, those neither currently supplying nor offering their labour services, are not in the labour force. (Statistics Canada, 2014a)

Further to the unemployment rate Statistics Canada has established a set of supplementary unemployment rates.[9] These rates provide a different picture of labour market activity and are defined as the R1 unemployment rate through the R8 unemployment rate and we introduce them as follows.

Table 3.1: Supplementary unemployment rates

Supplementary unemployment rate	Definition
R1 (Long-term rate)	Takes into account the duration of unemployment of persons who have been unemployed 1 year or more
R2	Takes into account those who have been unemployed 3 months or more
R3	Comparable to the United States rate (working age population starts at age 16)
R4 (Official rate)	Working age population starts at age 15
R5	Adds discouraged searchers to the calculation of the official rate (R4)
R6	Adds a waiting group to the unofficial rate and those are: recall, replies, long-term future starts
R7	Adds involuntary part-timers (in full-time equivalents)
R8	Adds discouraged searchers, waiting group, portion of involuntary part-timers

Notes: The definitions for the supplementary unemployment rates are retrieved from: Gilmore & LaRochelle-Cote, 2011.

The R2 unemployment rate through to the R4 unemployment rate is available from 1976 onward while the R1 unemployment rate through to the R8 unemployment rate is available starting from 1997.

Due to the possibility of measurement error, many studies have used the employment rate as an alternate to test the robustness of results. The employment rate measures the total portion of individuals who are employed to the total population and may provide a more relevant picture to the economic conditions at hand, yet, it too is not immune to measurement error.

[9]Please see Gilmore and LaRochelle-Cote (2011) for more detail about each measure.

3.3.2 Vital Statistics Birth and Death Databases

The data related to infant health outcomes is from the Canadian Vital Statistic Birth Database (VSB) and the Canadian Vital Statistics Death Database (VSD). Both the birth database and the death database record administrative data on demographic information annually from all provincial and territorial vital statistics registries on all live births in Canada (VSB) and medical (cause of death) information on all death[10] in Canada (VSD) (Statistics Canada, 2014b, 2014c).[11] Since 1944, deaths have been classified by area of reported residence, with births and stillbirths according to the residence of the mother. For live births, the main form for the registration is completed by the parents, who are responsible for filing it with the local registrar. Most provinces also require physicians (or other birth attendants) to report all births. The central Vital Statistics Registry in each province and territory provides data from birth registrations and from death registrations to Statistics Canada.

Since the VSB and VSD are separate administrative datasets and for our outcomes of interest we are not able to link the births and deaths, we use the following data available for each birth in each province: Date and place of birth, Child's sex, birth weight and gestational age, Parents' age and marital status, Mother's place of residence, Type of birth (single or multiple). We use the following data available for each death in each province: age, sex, place of residence of the deceased, date of death, and province or territory of occurrence of death. Note that in comparison to the U.S. natality files, Canadian Vital Statistics birth data do not include as detailed birth or demographic information on parents and the Canadian Vital Statistics death data collects a more limited set of data, with far less information available in comparison to the U.S. natality files or even the Canadian Vital

[10]Death refers to the permanent disappearance of all evidence of life at any time after a live birth has taken place (stillbirths are excluded).

[11]Note that Nunavut became officially a Territory of Canada on April 1, 1999 and the name Northwest Territories applies to a Territory with different geographic boundaries before and after April 1, 1999 (Statistics Canada, 2014c).

Statistic birth data.

3.3.3 Outcomes of interest and analysis sample

In this study, we examine four birth outcomes and three death outcomes as follows:[12] i) Crude birth rate;[13] ii) Total average birth weight; iii) Percent born less than 2500 grams (approximately 5.5lbs);[14] iv) Percent born less than 1500 grams (approximately 3.5lbs); v) Infant mortality (death within the first year);[15] vi) Neonatal mortality (death within the first 28 days); vii) Postneonatal mortality (death later than 28 days to 364 days).[16]

The sample for study is constructed in the following way. Since the Vital Statistics Data for Canada is collected separately for the birth database and the death database, two datasets are created, one for birth outcomes and one for death outcomes that covers the time span of 1976 to 2011. Using the Vital Statistics Birth data we follow Dehejia and Lleras-Muney (2004) and estimate models that include births to mothers of age 18 years or older.[17] We

[12]For a more detailed description, please see Chapter 2, section 2.3.3.

[13]The crude birth rate compares the average annual number of live births during a given year per 1,000 persons in the population at midyear:

$$CBR_{pt} = \frac{\#\,of\,live\,births_{pt}}{population\,midyear_{pt}} * 1,000$$

[14]In this study, we use the well-established way of calculating low birth weight babies:

$$percent\,born\,less\,than\,x\,grams = \frac{\#\,of\,babies\,born\,less\,than\,x\,grams}{total\,number\,of\,live\,births} * 100$$

where $x = 2500$ or $x = 1500$.

[15]The infant mortality measure used in this study includes all infant death less than one year of age. It is calculated as follows:

$$IMR = \frac{\#\,of\,infant\,death\,below\,one\,year}{total\,number\,of\,live\,births} * 1,000$$

[16]We estimate separately models that examine neonatal death (NMR) and postneonatal death (PNMR) which are calculated as:

$$NMR\,(or\,PNMR) = \frac{\#\,of\,infant\,deaths\,less\,than\,x\,days}{total\,number\,of\,live\,births} * 1,000$$

where for neonatal mortality $x = less\,than\,28\,days$ for postneonatal mortality $x = 28\,days\,to\,364\,days$.

[17]Females aged less than 18 years may make decisions about having a baby depending on other factors.

include only individuals from the 10 provinces and aggregate the birth data into cells that are defined by mother's province of residence and year of conception. The main time frame of analysis is 1976 to 2011, which implies 360 observations in the main sample.

Using the Vital Statistics Death data our main sample of analysis includes babies aged less than 12 months (or less than 365 days). Similar to the birth data, we include only individuals from the 10 provinces and we aggregate the death data into cells that are defined by the province of residence of the deceased infant and year of death. The main time frame of analysis is 1977 to 2011, which implies 350 observations in the main sample.

3.4 Model specification

We estimate four specifications of a two-way fixed effects model in order to explore the association of the unemployment rate (and alternate measures of economic conditions) with infant health outcomes. We start with a basic two-way fixed effects model and then extend it to include province specific time trends. We then extend the base model by adding an interaction term between the unemployment rate and a linear time trend and estimate it with and without province specific time trends. For all four specifications we match outcomes at time t with unemployment rates at the time of a baby's conception or the year prior to death when examining birth and mortality outcomes, respectively.[18] Note that, in order to determine the year of conception we use the number of weeks of gestation and the date

Dehejia and Lleras-Muney (2004) note three factors of influence that can play a role in teenage fertility decisions. Those are: 1) the involvements of parents in fertility decisions (as cited in Dehejia and Lleras-Muney: Hao, Hotz, and Jin [2000] suggest that "parents have, under certain conditions, the incentive to penalize teenage (and typically out-of-wedlock) childbearing of older daughters, in order to get the younger daughters to avoid teenage childbearing."; 2) Labour force participation females aged less than 18 is limited which may complicated prediction of the association of temporary changes in the unemployment rate; 3) "Debate about the extent to which teenagers make rational decisions", with suggested reading by Levine (2001).

[18] By matching outcomes with the unemployment rate at the time of conception, we hope to gain a better understanding of the effect of economic fluctuations because a transitory/short-term shock in the economy might take some time to affect the health and health behaviours of individuals. This is also consistent with prior work (Dehejia & Lleras-Muney, 2004; Lindo, 2015).

of birth of the baby to determine the date (year) of conception.[19] All model specifications report robust standard errors clustered at the province level in order to account for serial correlation by province - we assume that doing so accounts for within-group dependence and within-cluster error correlation.[20] The base two-way fixed effects model is specified as follows:

$$Y_{pt} = \alpha + \gamma U_{pt} + \beta X_{pt} + \rho_p + \theta_t + \varepsilon_{pt} \tag{3.1}$$

where p indexes the province of residence and t denotes the year of conception or death; Y represents a measure of infant health;[21] U is the province- and year-specific rate of unemployment; the vector X includes a set of control variables[22] [Note that the same demographic data is not available from both the VSB and VSD. For models using data from the VSB we control for sex of infant, age of mother, and marital status of mother; while for models using data from the VSD we control for sex of infant. We also include a set of control variables that are external to the collection of the vital statistics and that have the potential to be mediating determinants of economic effects. Note that, in order to code the correct average, we use the existing data and a series of dummy variables is created and the province- and time-specific average is taken. Those are the male to female earnings ratio[23], and the percent manufacturing jobs[24].]; ρ_p is a vector of province fixed effects; and θ is a vector of year fixed effects. This specification (equation 3.1), includes province and year effects, but ignores province specific time trends and the interaction term. Note that

[19]This is similar because we aim to get the date/year of conception but also different from Dehejia and Lleras-Muney (2004) who use the woman's last menstrual cycle to determine the year of conception and Lindo (2015) who uses the unemployment rate nine months prior to the birth of the baby.

[20]This important because even after controlling for province and year fixed effects, it is possible that observations within each province are not independent (Bertrand et al., 2004), especially when not allowing for province specific time trends.

[21]Note that for all outcomes we take the natural log.

[22]Control variables are province- and time-specific averages corresponding to our outcomes variables.

[23]CANSIM TABLE NUMBER 202-0104

[24]CANSIM TABLE NUMBER: 202-0008

inclusion of province specific trends relaxes the assumption of time invariant heterogeneity at the provincial level.

We extend the base model as specified by equation 3.1 to include a province-specific time trend. The model is specified as:

$$Y_{pt} = \alpha + \gamma U_{pt} + \beta X_{pt} + \rho_p + \theta_t + \phi_p(\rho_p * T) + \varepsilon_{pt} \tag{3.2}$$

where $\rho_p * T$ represents the province-specific trend; and T represents a general year trend. In this second specification (equation 3.2), we allow for the province specific trends to be different from zero, that is $\phi_p \neq 0$. This modification will account for trends that are specific to provinces, as opposed to just a national trend as in the base specification.

We next estimate extensions to specifications of equation 3.1 and equation 3.2 by including an interaction term between the unemployment rate and a linear time trend. The model is specified as:

$$Y_{pt} = \alpha + \gamma U_{pt} + \beta X_{pt} + \rho_p + \theta_t + \delta(U_{pt} * T_t) + \varepsilon_{pt} \tag{3.3}$$

$$Y_{pt} = \alpha + \gamma U_{pt} + \beta X_{pt} + \rho_p + \theta_t + \phi_p(\rho_p * T) + \delta(U_{pt} * T_t) + \varepsilon_{pt} \tag{3.4}$$

where $U_{pt} * T_t$ represents the interaction term; T_t is a linear trend taking the value of zero in the first sample year and one in the last one – for example then, if using data from 1976 to 2011, $T_t = \frac{(t-1976)}{35}$. This third specification (equation 3.3) allows for the interaction term between the unemployment rate and a time trend to be different from zero, that is $\delta \neq 0$. The macroeconomic effect can then be estimated as $\hat{\gamma}$ in 1976 and $\hat{\gamma} + \hat{\delta}$ in 2011, with the p-value on $\hat{\delta}$ indicating whether the relationship has changed significantly over time (Ruhm 2015).

3.5 Results

This section starts by providing a summary of the sensitivity of estimates by choice of proxy for economic conditions. We then examine how estimates of the relationship between the unemployment rate and infant health outcomes change by choice of model specification, followed by an analysis of how effects have changed over time.

3.5.1 Estimates of the relationship between economic conditions and infant health using alternate proxies

In the first step of our sensitivity analysis related to choice of alternate proxies for economic conditions, we examine how the various economic proxies are associated with each other. The premise here is that if alternate proxies are highly correlated, then it may not be fruitful to undertake further estimation of model specifications using these alternate measures as they do not contain any additional information about labour market conditions. As mentioned earlier, the unemployment rate has recently been criticized that it may not reflect economic conditions accurately and that it may no longer be a useful indicator of economic conditions, suggesting that alternate measures be investigated. Yet, even if alternate proxies move in tandem and are highly correlated, we might get a different precision of coefficient estimate or even magnitude of coefficient estimate. If proxies are perfectly correlated we will get the same result. But, if the independent variation conditional on the covariates is different then even highly correlated proxies may (sometimes) give different results.

To look at the correlation between measures, we regress the standard unemployment rate (our baseline unemployment rate which is the seasonally unadjusted official unemployment rate, and refer to it accordingly going forward) on alternate measures of economic conditions. Table 3.2 summarizes the coefficient of determination, that is the R^2, resulting from each regression for the time periods (i) 1976 to 2011 - limited choice of alternate proxies -

the R2 unemployment rate through to the R4 unemployment rate[25] and the employment rate and (ii) 1997 to 2011 - wider range of choice for alternate proxies - the R1 unemployment rate through to the R8 unemployment rate and the employment rate.

We now briefly summarize findings from Table 3.2. Consider the first row which displays the estimates of the R^2 over the 1976 to 2011 period. Moving to the right along the row the R^2 increases in magnitude resulting $R^2 = 1.00$ between the baseline rate and R4 suggesting that the two measures move in exact tandem. But, considering the employment rate, the $R^2 = 0.74$ which suggests that there is substantial variation between the two proxies to warrant investigation of the difference of the effect of each proxy on health outcomes. Looking next at the second row which displays estimates of the R^2 over the 1997 to 2011 period, a similar pattern is evident as we move along the row to the right and get to the R4 unemployment rate. From the R1 unemployment rate to the R4 unemployment rate, the R^2 gets bigger in magnitude. From the R5 unemployment rate to the R8 unemployment rate the R^2 varies between $R^2 = 0.97$ to $R^2 = 0.99$, suggesting that there is little variation between the baseline rate and these alternate measures. Note also that $R^2 = 0.82$ for the employment rate which suggests that over this shorter time frame, the baseline rate and the employment rate show less variation in movement than over the 1976 to 2011 period, but similar to the longer time frame the R^2 suggests that there is some variation and warrants further investigation to its association with health outcomes. Note that based on the implied variability of the employment rate above, we explore the employment rate as an alternative measure in the analysis.

[Insert Table 3.2]

From the summary above, it appears that the implied overlap of the movement of al-

[25]Note again that the R4 unemployment rate is the official unemployment rate and it ever slightly different from the seasonally unadjusted unemployment rate and we include it in our estimation as a check of robustness.

ternate measures of the unemployment rate might suggest that no additional information would be gained from using these alternate measures in regression analysis. But, this is not completely true for the R1 unemployment rate and the employment rate. Having said that, we are interested in better understanding which measure is more highly associated with health outcomes and thus better suited as a proxy for economic conditions for this kind of study. Thus, the second step of our sensitivity analysis uses each alternate proxy for economic conditions and estimates its association with infant health outcomes. We then compare these estimates to those generated using the baseline unemployment rate.

The first set of tables, Tables 3.3 and 3.4, summarize estimates for five proxies for economic conditions: the baseline rate, the R2 unemployment rate through to the R4 unemployment rate, and the employment rate. These tables examine the coefficient estimates over the 1977 to 2011 period for mortality outcomes and 1976 to 2011 period for birth outcomes.[26] Tables 3.3 and 3.4 are organized as follows. For each economic proxy we estimate the two models specified by equations 3.1 and 3.2. Specification (1) includes province and year fixed effects (equation 3.1), and specification (2) includes province and year fixed effects as well as a province specific time trend (equation 3.2). Robust standard errors clustered at the province level are reported in the parentheses below coefficient estimates, and p-values below them. The first two columns report estimates from specifications using the baseline unemployment rate as the proxy for economic conditions. The next two columns report estimates from specification using the R2 unemployment rate as the proxy for eco-

[26]In Chapter 2 we examined a two specific period of 1976/1977 to 1999 period which is analogous to the seminal paper by Dehejia and Lleras-Muney (2004) and 2000 to 2011. We estimated these time periods using the alternate proxies. For the 1976/1977 to 1999 period, the estimates are remarkably consistent with the estimates from summarized for the 1976/1977 to 2011 period. Similarly, the estimates over the 2000 to 2011 are relatively consistent with those estimates over the 1997 to 2011, with very few marginal exceptions. These exceptions are related to the sign change of estimates for few estimates which may suggest that the relationship between economic conditions and infant health outcomes may have changed over time. Furthermore, comparing estimates with the employment rate does not verify the robustness of results because some estimates are of the same sign. We examine the time-varying relationship in more detail in subsequent sections and so having said that, in order to maintain flow and structure, we refrain from including the tables of more specific time periods in the study, but they are available upon request.

nomic conditions. Columns five and six report estimates from specifications using the R3 unemployment rate as the proxy. The next two columns report estimates from specifications using the R4 unemployment rate as the economic proxy and we include it as a robustness check and for completeness. The last two columns report estimates from specifications using the employment rate.

For all three measures, as we move along Table 3.3 from left to right, the magnitude of the estimated relationship goes up and then gets smaller. Starting with the general results, postneonatal mortality is the only outcome for which statistical significance is robust to measure and to specification. Infant mortality is robust to measure but not to specification. That is, when the province-specific time trend is included, it loses significance for all measures. Neonatal mortality is sensitive to measure, and specification: it is never significant when the province specific time trend is included (specification (2)) and only sometimes for specification (1). It appears that for both infant mortality and neonatal mortality province-specific time trends wipe out the statistical relationship evident from specification (1). When we include the province specific time trend in the model specification, it takes into consideration permanent differences between provinces and national fluctuations. The fact that our results are not robust to province-specific time trends may be a result a lack of variation in the unemployment rate so that when the province specific trends are included in the model there is not enough variation in the unemployment rates to support it. But regardless of this, the analysis suggests that economic fluctuations have had an impact on infant mortality outcomes. Furthermore, we noted that as we move to the right in the table to the R2 unemployment rate and beyond the coefficient estimates first get bigger then smaller. For instance, the coefficient estimates for the R2 unemployment are approximately 1.5 times bigger than that of the coefficient estimates for the R4 unemployment rate. The pattern of variation in the magnitude of estimates is similar across the unemployment rate measures for all three outcomes considering both specifications (1) and (2).

Looking next at Table 3.4. Overall, the most striking finding of this table is that there is evidently a much weaker relationship between the different measures of the unemployment rate and infant birth outcomes. Considering the crude birth rate and birth weight, there are no statistically significant estimates and weak significance for babies born with low birth weight. There is a statistically significant relationship between the unemployment rate measures and babies born with very low birth weight, but the relationship is not robust to the inclusion of state-specific time trends. Similar to the patterns in coefficient estimates evident in Table 3.3 summarized above, coefficient estimates get smaller from the R2 unemployment rate to the R3 unemployment rate with the employment rate confirming the estimated relationship and the pattern of variation in the magnitude of estimates is similar across the unemployment rate measures for all three outcomes. Examining the results in more detail for babies born with low birth weight and very low birth weight the general observation is that as the unemployment rate goes up the percentage of babies born weighing less than 2500 grams or less than 1500 grams increases and this relationship is confirmed by the inverse relationship suggested by the employment rate coefficient estimate. Overall, these estimates suggest that good economic conditions are in fact good for infant health and it confirms the findings from Table 3.3 which suggest that worse economic conditions increase infant mortality.

[Insert Table 3.3][Insert Table 3.4]

The next set of tables, Tables 3.5 and 3.6, report estimates from the association of economic proxies with infant health outcomes for the time period of 1997 to 2011. The tables are organized in the same fashion as Tables 3.3 and 3.4 and include the R1 unemployment rate, and the R5 unemployment rate through the R8 unemployment rate as measures. The R1 unemployment rate includes individuals that have been unemployed for twelve months or more, the R5 unemployment rate are broader definitions of unemployment (please see

section 3.3.1 for more detail about each measure). Note again that specification (1) denotes inclusion of province and year fixed effects (equation 3.1), while specification (2) denotes inclusion of province and year fixed effects as well as a province specific time trend (equation 3.2), robust standard errors clustered at the province level are reported in the parentheses, and p-values below them.

Looking first at Table 3.5, a quick overview of the estimates suggests that for all alternatives we fail to reject the null hypothesis of no effects. However, because the main aim is to better understand how the measures change, if at all, the association and magnitude of estimates of the relationship of interest - we summarize going forward. Consider first the R1 unemployment rate. There is a negative association of this proxy with infant mortality. This might suggest that long term (being unemployed more than 12 months) may be good for infant health. Considering neonatal mortality and postneonatal mortality, the coefficient estimates suggest that as the unemployment rate increases neonatal mortality decreases but postneonatal mortality increases when province specific trends are excluded, while the opposite is true for upon inclusion of province specific trends. A similar pattern is evident with the R2 unemployment rate, another measure of long term unemployment (being unemployed more than 3 months). Considering next the R3 unemployment rate, the U.S. comparable rate, most estimates are larger in magnitude, similar to the analysis earlier of 1977 to 2011. The official rate, the R4 unemployment rate, in general supports the baseline unemployment rate estimates but when province specific trends are included the association is wiped out for infant mortality and postneonatal mortality. For neonatal mortality, there is quite a bit of variation in the sign of the estimates when provinces specific trends are included. Similar evidence is suggested with postneonatal mortality. Finally, consider the employment rate, in general it supports the resulting coefficient estimates from the unemployment rate. But, if you have a look at postneonatal mortality, when province specific trends are included it appears that the association is opposite.

Looking next at Table 3.6, similar to Table 3.5, few estimates suggest that there is an association between economic conditions and infant health outcomes. Most estimates follow a similar pattern as summarized above. There is a statistically significant relationship between the employment rate, the R1 unemployment rate and the R2 unemployment rate and babies born with low birth weight. But, when we include the province specific time trend in the model, this relationship is wiped out, except for the employment rate. The estimate is marginally smaller in magnitude, but maintains the sign pattern. Comparing the unemployment rate with the employment rate, for both model specifications the employment relationship suggests that as the employment rate increases infant health outcomes get better (that is the percentage of babies born low birth weight or very low birth weight decreases). This is not completely true with the relationship implied by the unemployment rate. When province specific trends are excluded (specification (1)), as the unemployment rate increases the percentage of babies born low birth weight and very low birth weight, suggesting that worse economic times are worse for infant birth outcomes - this supports that results summarized for the employment rate association. But paradoxically, when province specific trends are included the opposite relation prevails which suggests that as the unemployment rate increases the percentage of babies born with low birth weight or very low birth weight decreases - suggesting that worse economic times are good for infant birth outcomes. There appears to be some discrepancy about the association of economic conditions with infant birth outcomes, and this might reflect that notion that this time period is too short in order to provide estimates that are precise (Ruhm, 2015).

[Insert Table 3.5][Insert Table 3.6]

There are a couple of implications from the analysis above. The first is that it appears that the employment rate has a strong association with infant health outcomes of those born with low birth weight or very low birth weight. This is different from the relationship be-

tween unemployment rate and low and very low birth weight which was not statistically significant. Based on this difference, it is not clear which measure is a more relevant measure of economic conditions when studying these relationships. Second, we have demonstrated that there is a sensitivity of coefficient estimates to the time period under analysis and the choice of economic proxy. It is important, to consider this so that the resulting discussion about the association of economic conditions with infant health outcomes is a more accurate one. We next consider in more detail the choice of model specification and the possibility of a time varying relationship.

3.5.2 Model specification and the time varying relationship

Tables 3.7 and 3.8 summarize the estimates for the association of the infant health outcomes over the full time frame of analysis taking into consideration different model specifications as described in equations 3.1, 3.2, 3.3, and 3.4. Table 3.7 summarizes the estimates for mortality while Table 3.8 summarizes the estimates for birth outcomes. The tables are organized in the same fashion. The upper panel of each table shows estimates for models that do not control for province-specific time trends while the lower panel shows estimates for models that do control for province-specific time trends. Note that we use province-year number of births as the weights in order to account for heteroskedasticity. Heteroskedasticity may arise from provincial differences in the number of births. If we consider the Canadian context more specifically, since provinces differ in size substantially, adding weights to model specification adjusts for the heterogeneous influence of small versus large provinces. If we left the data unweighted, then the influence of smaller provinces would be over emphasized and since we are concerned with the overall average treatment effect, it is important to include the weights. Specification (a) excludes the interaction term between the unemployment rate and the linear time trend and is specified by equations 3.1 or 3.2 while specification

(b) includes the interaction term and is specified by equations 3.3 or 3.4. Note again that the trend variable in this specification takes the value of zero in 1976 and one in 2011, and so if using data from 1976 to 2011, $T_t = \frac{(t-1976)}{35}$. In that case, the predicted effect can be summarized from $\hat{\gamma}$ in 1976 and $\hat{\gamma} + \hat{\delta}$ in 2011, with the p-value on $\hat{\delta}$ indicating whether the relationship has changed significantly over time (Ruhm 2015).

Consider first Table 3.7, comparing the upper half to the lower half. The magnitude of estimates is smaller when the province specific trend is included - lower half of table. Some statistical significance is lost - infant mortality is no longer statistically significant. Looking next at Table 3.8, a similar pattern is evident, with the magnitude of estimates being smaller. A distinction however, is that with the province specific trends included the estimate for the crude birth rate becomes statistically significant. Having said that, we note that controlling for province-specific time trends is important because there may be time-varying unobservables that may be correlated with economic conditions and exert an independent influence on outcomes. This becomes more likely as the period of time under analysis lengthens. Furthermore, it is also important because most mortality rates have trended sharply downward (Ruhm 2015).

We now summarize the estimates from the table for model specifications that include a province specific time trend, that is, the lower half of Tables 3.7 and 3.8. Looking first at Table 3.7 which describes mortality outcomes, a one percentage point increase in the unemployment rate is associated with an increase in the infant mortality rate of 0.56 percent. But note that we fail to reject the null hypothesis of no economic effects. When the unemployment rate-time trend interaction term is included, a one percentage point increase in the unemployment rate is associated with a statistically significant increase in the infant mortality rate of 2.42 percent in 1977 but is associated with a statistically significant decrease in infant mortality rate of 2.19 percent in 2011. We reject the null hypothesis because the p-value is = 0.095, suggesting that the relationship between economic condi-

tions and infant mortality has in fact changed over time - from a countercyclical one to a procyclical one. Looking next at neonatal mortality, a one percentage point increase in the unemployment rate is associated with a decrease in neonatal mortality rate of 0.29 percent. When the unemployment rate-time trend is included, a one percentage point increase in the unemployment rate is associated with an increase of 1.41 percent in 1977 but a decrease of 2.81 percent in 2011. Note however, for these specifications we fail to reject the null hypothesis since the p-value = 0.230. Finally, considering postneonatal mortality, one percentage point increase in the unemployment rate leads to a statistically significant increase of 1.76 percent in the postneonatal mortality rate. When the interaction term is included, a one percentage point increase in the unemployment rate leads to an increase of 3.36 percent in 1979 but a decrease of 0.6 percent in 2011. Using the p-value, we find that the relationship has not changed over time (p-value = 0.801). In other words, individual estimates are imprecise and the tests of significance suggest that only the relationship between infant mortality and economic conditions has changed over time. That is, it has shifted from being a countercyclical one to a procyclical one.

Consider next Table 3.8 which summarizes the same for infant birth outcomes. Looking first at the crude birth rate, for a one percentage point increase in the unemployment rate there is a 0.41 decrease in the crude birth rate. When the unemployment time trend interaction term is included a one percentage point increase in the unemployment rate is associated with an increase of 1.14 percent in 1976 but a decrease of 2.39 percent in 2011. The p-value suggests that there is a change in the relationship between economic conditions and the crude birth rate (p-value = 0.074). Looking next at birth weight, there is virtually no relationship between the unemployment rate and average birth weight, as expected. Note however, that similar to the results for the crude birth rate, there is a significant change over time of the relationship between birth weight and economic conditions (p-value = 0.024). We next consider low birth weight and very low birth weight and report findings although

we fail to reject the null hypothesis of no effects. Consider first low birth weight specification (a), for a one percentage point increase in the unemployment rate there is an increase of 0.18 percent in the fraction of babies that are born with low birth weight. When the interaction term is included in the model, for a one percentage point increase in the unemployment rate there is an increase of 0.45 percent in 1976 but a decrease of 0.16 percent in 2011, but the estimate of change over time is imprecise (p-value = 0.881). Finally, consider very low birth weight. For a one percentage point increase in the unemployment rate, there is a 0.86 percent increase in the percentage of babies born with very low birth weight. When the interaction term is included, for a one percentage point increase in the unemployment rate there is an increase of 1.43 percent in 1976 and a decrease of 0.13 percent in 2011 and similar to the estimate for low birth weight the estimate of change over time is imprecise (p-value = 0.906).

[Insert Table 3.7][Insert Table 3.8]

From the above analysis, there appears to be evidence that the relationship between economic conditions and infant health outcomes may have changed over time. In order to gauge this further, the following analysis estimates specifications of 20-year sample windows starting from 1977 to 1996 (mortality) or 1976 to 1995 (birth) and ending with 1992 to 2011 for both models specified by equations 3.1 and 3.2.[27] We follow Ruhm (2015) in this approach and the aim is to better understand how the results of point estimates for these 20-year windows have changed over time, if at all. Estimates from the output of these 20-year windows using equations 3.1 and 3.2 are displayed in corresponding figures below. By looking at a figure of the two model specifications at one time, we can better visualize how the relationship of interest responds to the different specifications. Figures 3.1 and 3.2

[27]Note that because it does not provide any additional information to our approach, we do not estimate models specified by equations 3.3 and 3.4 which incorporate the interaction term.

display how the coefficient estimates change with the different specifications for the different outcomes. Each point on the line represent the point estimate for a 20-year window. For example, the first point in Figure 3.1 corresponds to 1977 to 1996, the second point corresponds to 1978 to 1997, the third point to 1979 to 1998, and so on to the last point 1992 to 2011. On the vertical axis thus is the point estimate from the relationship between the infant mortality outcome and economic conditions as measured by the unemployment rate. In that case, a positive value indicates that infant mortality increases as the unemployment rate increases.

Consider first Figure 3.1. From Figures 3.1a, 3.1b, and 3.1c , it appears that the estimated change in the relationship between economic conditions and infant mortality is sensitive to controlling for the province specific linear time trend. Both specifications suggest an evident decrease in the countercyclicality of infant mortality over time with most of the changes starting around the mid-1980s. When the time trend is included, the point estimates suggest that a strong procyclical relationship starts in 1991, but this is not as clear for infant mortality and neonatal mortality. By excluding a time trend, the data overstates the countercyclicality of the relationship between the unemployment rate and infant mortality.

Looking next collectively at Figures 3.2a, 3.2b, 3.2c, and 3.2d it appears that with or without province specific time trends the estimates move in the same pattern while the relationship is overstated when no time trend is included considering babies born with low birth weight (Figure 3.2c) or very low birth weight (Figure 3.2d). Thus, by excluding the province specific time trend, our resulting analysis overstates the relationship between unemployment rate and health outcomes, in general. Considering the Figures 3.1 and 3.2, we support that the model of choice should include a time trend.

[Insert Figure 3.1] [Insert Figure 3.2]

Having described the changes of the relationship over time and model specifications,

we choose to focus on weighted estimates for specifications that include a province specific time trend, and report those accordingly going forward. The model specification that includes a time trend and adds weights shows a change over time in the association of the unemployment rate with infant mortality outcomes, generally changing from a countercyclical relationship to a procyclical one around 1990. A similar pattern is evident for the birth outcomes of the percentage of babies born with very low birth weight. Having said that, in subsection 3.5.1 we found that there was a significant relationship between the employment rate and infant health outcomes. In the following analysis we explore this relationship further by comparing the estimates from both the employment rate and the unemployment rate.

Table 3.9 reports estimates of the time varying relationship between both the unemployment rate and the employment rate. Specification (a) reports estimates that exclude the interaction term between the linear time trend and economic conditions proxy (equations 3.1 and 3.2) and specification (b) includes the interaction term (equations 3.3 and 3.4). In the earlier analysis, we found that a statistically significant shift in the relationship over time between economic conditions and infant mortality exists- that is, infant mortality shifted from being countercyclical to being procyclical. Using the employment rate however, it appears that the relationship between economic conditions and infant mortality is different. In both 1977 and in 2011 there appears to be a negative association between the employment rate and economic conditions. This suggests that as the employment rate increases, infant mortality decreases - a consistent procyclical relationship. The coefficient estimates are statistically significant and also note that the standard errors are more precise for estimates using the employment rate. Furthermore, if we consider the p-value we reject the null hypothesis of no change over time (p-value = 0.047). Looking next at neonatal mortality the estimates suggest a shift from being statistically significant to no significance and also the magnitude of the estimates are smaller using the employment rate as the eco-

nomic proxy. Finally, similar to neonatal mortality, when the interaction term is included in the model specification, the relationship between the employment rate and postneonatal mortality has shifted from being a significant one to no significance, although the sign of the estimate is maintained. Overall, the estimates suggest that the employment rate confirms the unemployment rate findings from Chapter 2, but it is not so clear about the time-varying relationship.

The model specification summary in Table 3.10 between economic conditions and infant birth outcomes is particularly interesting, especially for low birth weight estimates. Looking first at the crude birth rate and birth weight suggests that for the crude birth rate the estimated relationship is smaller and not statistically significant using the employment rate, but it is the same (but with opposite sign) for birth weight. Of particular interest, however, is the relationship between the employment rate and the percentage of babies born with low birth weight and the percentage of babies born with very low birth weight. Consider first low birth weight. Without the interaction term, there appears to be a positive effect of good economic times on the percentage of babies with low birth weight. For a one percentage point increase in the employment rate there is a decrease of 0.2 percent in the number of babies born with low birth weight. When we include the interaction term, for a one percentage point increase in the employment rate there is a decrease of 1.77 percent of babies born with low birth weight in 1977 and this grows in absolute value to a decrease of 4.24 percent in 2011. Looking at the p-value, we find that in fact we reject the null hypothesis of no effect implying a stronger procyclical relationship over time (p-value = 0.003). A similar pattern is evident for babies born with very low birth weight. Without the interaction term, the relationship between the employment rate and the percentage of babies born with very low birth weight decreases, although it is not statistically significant. But when we include the interaction term, there is a statistically significant negative relationship that is strengthened over time. In 1976, for a one percentage point increase in the unemployment rate

there is a decrease in the percentage of babies born with very low birth weight of 2.25. This grows in absolute value to a decrease of 4.44 percent in 2011. Note that the p-value suggests that the relationship is statistically significant at conventional levels (p-value = 0.063). The particularly interesting finding that the employment rate is significantly associated with the percentage of babies born with low birth weight motivates further investigation into the differences in the relationship between infant health outcomes and choice of employment rate as a proxy for economic conditions, and we do this in the following analysis. We next consider the time varying relationship in more detail.

3.5.3 Estimates of the association of infant health outcomes with the unemployment rate over different time periods

Taken together, the evidence in the previous two subsections suggests that the relationship of infant health outcomes with economic conditions has changed over time and that estimates are sensitive to choice of the length of time, starting and end years, and proxy choice. We next consider several different approaches collectively to summarize the pattern of association of infant outcomes with the unemployment rate.[28] In the first approach we fix the start year at 1976 (or 1977) and vary the end year from 1985 (or 1986) to 2011. This means that, for example, if we fix the start year at 1976 the first point on the line in the corresponding figure represents the estimate from the end year 1985 (10-year window), the second point end year 1986 (11-year window), and so on to end year 2011 (36-year window). In the second approach, we fix the end year at 2011 and vary the start year from 1976 (or 1977). The first point in the corresponding figure represents the start year 1976 (36-year window), the second point represent start year 1977 (35-year window), third point represents start year 1978 (34-year window) and so on until 2002 (10-year window). Fol-

[28]Note this is similar to the approach taken in Ruhm (2015) looking at the time varying relationship of adult mortality in the U.S.

lowing this, we estimate separately windows of 20-years, 15-years, 10-years, and 5-years, with each point on the line representing a point estimate corresponding to the start year of that time interval. We use the baseline rate as our proxy for economic conditions and report results in the corresponding figures below. The analysis going forward is separated into two sections one for infant mortality outcomes and one for infant birth outcomes.

3.5.3.1 Estimates of the association of infant mortality outcomes with the unemployment rate over different time periods

Figure 3.3 (Figures 3.3a through 3.3c) displays estimates from fixing the start year at 1977 and varying the ending year between 1986 and 2011 for the infant mortality outcomes. The solid line shows point estimates and the dotted line the 95-percent confidence interval. Consider Figure 3.3a. The association of infant mortality with economic conditions is procyclical for the ending years 1985 to 1991 because the coefficient estimate is negative. The magnitude of the estimated association of the unemployment rate with infant mortality decreases initially from -0.0178 in 1985 to the peak in -0.0020 in 1991 and from 1985 to 1990 we reject the null hypothesis of no economic effects. In 1991, there is a shift in the sign of the association and the relationship becomes countercyclical with an increase in the magnitude of estimates. The coefficient estimates peak at 0.0145 in 1998 at which point there is little fluctuation or sensitivity to estimates. The estimate in 1998 has a statistical significance, but thereafter we fail to reject the null hypothesis of no economic effects. This figure clearly suggests that the relationship between economic conditions starting at a 10-year interval is a procyclical one and shifts to one that is countercyclical in nature starting in 1992 (17-year interval), and then suggesting a decreasing countercyclicality as the time frame of analysis lengthens.

Consider next Figure 3.3b which summarizes the relationship of economic conditions with neonatal mortality by fixing the start year. A similar pattern is evident to infant mor-

tality. Estimates are statistically significant for ending year 1986 through to 1991 and they get smaller in magnitude. In 1986 the coefficient estimate is -0.0239 which decreases to -0.0007 in 1996. In 1997 there is a shift in sign and the relationship becomes countercyclical with a peak in 1998 of 0.0080 and thereafter a slow decrease but little sensitivity. Furthermore, we fail to reject the null hypothesis of no economic effects following 1990 through to 2011 end years. Similar to infant mortality, neonatal mortality exhibits a procyclical relationship which changes to a decreasing countercyclical one as the time for analysis is extended. Finally looking at Figure 3.3c, which summarizes the relationship between economic conditions and postneonatal mortality, it appears that the coefficient estimate first increases and then decreases from -0.0059 in 1986 to -0.0129 in 1987 and then decreases and there is a shift in sign in 1990. Thereafter, the magnitude of the estimate gets bigger to a peak of 0.0257 in 1997. Following 1997, the estimates start to decrease and there is little sensitivity to changes in estimates. Furthermore, different from the coefficient estimates for infant mortality and neonatal mortality, from 1997 onward to 2011 postneonatal mortality is statistically significant over this period.

Overall, considering collectively the three figures summarized above, there is evidence that the shorter time interval suggests a procyclical relationship between economic conditions and infant mortality outcomes. As the length of time increases the relationship shifts to a countercyclical one that is decreasing over time.

[Insert Figure 3.3]

To further explore the sensitivity of results to the choice of sample periods, we fix the final sample year to 2011 and vary the start years from 1977 onward to 2002. Figure 3.4 (Figures 3.4a through 3.4c) summarize coefficient estimates. Looking first at Figure 3.4a, the coefficient for unemployment is not very sensitive to the start year until about 1987 (25-year interval) at which point it increases and then sharply decreases. In 1977 the coefficient

estimate is 0.0056 until it reaches a peak in 1988 of 0.0089 and starts to decline. Note also that we fail to reject the null hypothesis of economic effects for all estimates. Looking next at neonatal mortality, Figure 3.4b, a similar pattern to infant mortality is evident with little sensitivity to estimates until about 1987. The coefficient estimate is -0.0029 in 1977 and decreases to -0.0011 in 1987. Following 1987 the estimates suggest more sensitivity to start years and shorter time periods, while there is little sensitivity between 1991 and 1997. Similar to infant mortality, we fail to reject the null hypothesis for all start years. Finally looking at Figure 3.4c, the estimates for postneonatal mortality are similar to those of infant and neonatal mortality and suggest that there is relatively little sensitivity of the estimates until about 1987. The coefficient estimate is 0.0176 in 1976 and 0.0174 in 1988. Thereafter the estimates start to decrease and the sign changes in year 1991 (21 year period) but becomes positive again following 1997. Note in considerable contrast to the estimates of infant mortality and neonatal mortality, we reject the null hypothesis of no effect for the start years 1977 (35 year window) through to 1988 (24 year period), and thereafter fail to reject it. Fixing the ending year at 2011 and varying the start year supports the earlier evidence that there is a procyclical relationship between the unemployment rate and the infant mortality outcomes as the time frame under analysis gets longer. It also exhibits more clearly that the estimates are sensitive to the choice of sample periods. Having said that we now estimate different sample intervals to have a more comprehensive understanding of the sensitivity of estimates to the choice of time intervals.

[Insert Figure 3.4]

Figure 3.5 (Figures 3.5a through 3.5c) summarizes the estimates from 20-year sample windows, with the first point representing 1977 to 1996, second point 1978 to 1997, onward to the last point representing 1992 to 2011.[29] Consider Figure 3.5a. Infant mortality

[29]Note that this analysis differs from the 20-year windows analysis from Figure 3.1 which described the relationship between weighted and unweighted coefficient estimates.

is countercyclical up to and including the 20-year window starting in 1991. The estimate for 1977 to 1996 is 0.0069 and increases to 0.0092 in 1991. From 1991 onward there is a procyclical relationship, where the coefficient estimate for 1992 to 2011 is -0.0113. But we fail to reject the null hypothesis for all estimates. Consider Figure 3.5b. Neonatal mortality predominantly exhibits a countercyclical relationship with the unemployment rate, but like infant mortality after 1991 the relationship becomes a procyclical one. Similar to infant mortality, we fail to reject the null hypothesis of no economic effect. Finally, looking at Figure 3.5c, postneonatal mortality exhibits a countercyclical relationship with economic conditions until about 1991. It fluctuates more so than infant mortality and neonatal mortality. In 1977 the coefficient estimate is 0.0179 while in 1987 it is 0.0442. In contrast to infant mortality and neonatal mortality however, we reject the null hypothesis of no economic effects for estimates from the 20-year intervals with starting years of 1978 through to 1982 and again for starting years of 1986 through to 1988. After 1991, the relationship changes to a procyclical one. In general, it is clear from this set of figures that the relationship between economic conditions and infant mortality outcomes has changed from a countercyclical one to a procyclical one, with estimates being significant for postneonatal mortality.

[Insert Figure 3.5]

Consider again Figure 3.4. To the right hand side of all Figures, 3.4a through 3.4c, there is an increased countercyclical variation evident. Estimating these 20-year samples has been beneficial in that it provides supporting evidence to the previous findings (from fixing the start year at 1977 or fixing the end year at 2011) that towards the later years of the sample, there is a shift in the relationship between the unemployment rate and infant mortality outcomes. The choice of 20-year sample windows in Figure 3.5 is somewhat arbitrary however, because we use the start year as the start year of our data availability

and so these 20-year windows may in fact conceal an increase countercycilcal variation of mortality towards the end of the time period. To investigate this further, we replicate Figure 3.5 by estimating intervals of 5-years, 10-years, and 15-years, and note that few estimates are statistically significant for the outcomes over these intervals, but regardless summarize them.

Figure 3.6 summarizes estimates of 15-year sample windows. In general, all three mortality outcomes exhibit a similar pattern to 20-year sample estimates, but there is an evident increase in the sensitivity of estimates. Infant mortality exhibits a procyclical pattern in the mid 1980s - not evident in the 20-year sample, while the procyclical pattern is found for more periods for neonatal mortality compared with the 20-year sample. A similar pattern is evident with postneonatal mortality. Looking next at Figure 3.7, which summarizes estimates of 10-year sample windows, it is evident that the magnitude of coefficient estimates is more sensitive to these shorter time frames estimated and moreover the sign of the coefficient estimate is also sensitive to the shorter estimation period. Finally considering Figure 3.8 which summarizes the estimates for 5-year sample windows, coefficient estimates vary widely and there is clear evidence that the estimates are very sensitive to the short duration of estimation period and starting year as well.

[Insert Figure 3.6][Insert Figure 3.7][Insert Figure 3.8]

The next section is a summary of estimates for birth outcomes.

3.5.3.2 Estimates of the association of infant birth outcomes with the unemployment rate over different time periods

In contrast to mortality outcomes, the evidence so far for the cyclicality of infant birth outcomes suggests that the relationship between birth outcomes and economic conditions may not have changed over time or may be less sensitive to the time frame under analysis

compared with mortality outcomes. In the following analysis, we replicate the analysis above from the infant mortality outcomes in sub-subsection 3.5.3.1 to look more closely at the change over time of the relationship of infant birth outcomes with economic conditions and whether the estimates are sensitive to the choice of the length of time or starting and end years.

Figures 3.9 through 3.12 display collectively the results from the approach examining the time varying relationship for each relationship of interest related to infant birth outcomes. For example, Figure 3.9 displays all relevant figures related to the time varying relationship for the crude birth rate. Figure 3.9a displays the association of the crude birth rate with economic conditions when the starting year is fixed at 1976 and the ending year varies from 1985 onwards to 2011. Figure 3.9b displays the association of the crude birth rate with economic conditions when the ending year is fixed at 2011 and the start year varies from 1976 through to 2002. Figures display 3.9c through 3.9f the estimates from the relationship between the crude birth rate and economic conditions by varying the time interval from 20-years, 15-years, 10-years, and 5-years. The same approach to display estimates for each relationship of interest is taken. Note that for each figure the solid line shows point estimates and the dotted line the 95-percent confidence interval.

Consider first Figure 3.9. Looking at Figure 3.9a, the association of the crude birth rate with economic conditions is procyclical for years ending 1985 to 1989 and 2007 onward. For years ending 1989 to 2007 there is a countercyclical relationship. But we fail to reject the null hypothesis of no economics effects for all time periods with the exception of 1985 (result in a 10 year time window). If we fix the final year ending in 2011 and vary the starting year (see Figure 3.9b), we can see how the variation is affected by changing the start year. When the final year is fixed to 2011, we can see that the relationship is a procyclical one from 1976 to 1983 and then changes to a countercyclical relationship starting 1984 to 1988 but then again to a procyclical one. Looking next at Figures 3.9c through 3.9f

which estimate varying sample windows (20-year, 15-year, 10-year and 5-year). What is noticeable is that as the time period under analysis get shorter, the volatility of estimates increases and so too does the association of the unemployment rate with the crude birth rate. Thus, it appears that time frames of at least 20 years provide for more stability in the estimates (although none of the relationships are of statistical significance).

Looking next at Figure 3.10, which summarizes the relationship of average birth weight with economic conditions, in general, we can see that there is no relationship between the unemployment rate and birth weight, since estimates fluctuate around zero. But notably, consider the figures representing estimates from different time intervals for analysis (Figures 3.10c through to 3.10f). We can see that as the time period under analysis gets shorter, the volatility of estimates get larger. The next two figures summarize the relationship between economic conditions and the percentage of babies born with low birth weight and the percentage of babies born with very low birth weight.

Consider Figure 3.11 which summarizes the relationship between the unemployment rate and infants born with low birth weight. Looking first at Figure 3.11a, years ending 1985 to 1989 suggest that there is a countercyclical relationship between the percentage of babies born with low birth weight. This relationship changes to a procyclical one from 1989 to 1991, then back to a countercyclical one going forward after that. Consider next fixing the ending year at 2011 (Figure 3.11b). For starting year 1976 to 1989 there is a countercyclical relationship, but from 1989 to 1991 there is a procyclical one, and then again a countercyclical one which then becomes a procyclical one following. Looking at how this relationship varies with changes in the time interval under analysis, consider Figures 3.11c through 3.11f. The 20-year window samples suggest a predominantly countercyclical relationship however in years starting 1977 to 1989 and 1991 onward, there is a procyclical relationship. The sensitivity to the length of time frame under analysis is evident in the 15-year window where there is greater fluctuation in estimates based on the starting year

and finally the 10-year and 5-year even more so. Clearly the time frame and the starting and ending years are important considerations in the analysis.

Finally, consider Figure 3.12 that summarizes estimates for the association of the unemployment rate with the percentage of babies born with very low birth weight. Figure 3.12a, which looks at how the estimates change when we fix the starting year to 1976, suggests that there is a consistent, but decreasing, countercyclical relationship between the unemployment rate and the percentage of babies born with very low birth weight. That is, as the length of time period under analysis increases, the magnitude of the estimate of the association between economic conditions and the percentage of babies born with very low birth weight decreases. Looking next at Figure 3.12b, for years starting in 1976 through to 1991 there is a countercyclical relationship between the unemployment rate and babies born with very low weight. from 1991 onward there is increased sensitivity to the estimates suggesting both procyclical and countercyclical relationships. Finally, looking collectively at Figures 3.12c through 3.12f, the 20-year sample window (Figure 3.12c) consistently suggest that the relationship is a countercyclical one, until the starting year of 1991 and similar to the above summary, there is a change to a procyclical relationship. While Figures 3.12d through 3.12f suggest that there is an increasing sensitivity to the estimated relationship as the time-interval shortens.

3.5.3.3 The relationship between the employment rate and infant mortality and birth outcomes

In the following analysis we briefly summarize the relationship between the birth and mortality outcomes and the employment rate. Since we found that there was a statistically significant relationship the employment rate and various measures, it warranted further investigation. Figure 3.13 summarizes the point estimates for mortality measures when we fix the start year at 1977 and vary the end year from 1986 to 1992. Figure 3.14 summarizes

the point estimates of mortality measures when we fix the end year at 2011 and vary start year from 1977 to 2002. Overall, the employment rate suggests a similar relationship between economic conditions and mortality outcomes as the unemployment rate. But, some marginal differences are evident. Looking at Figure 3.13 we can see that until 2005 and later than 2011 as the employment rate increases infant mortality increases. Over this time frame an increase in the unemployment rate or an increase in the employment rate leads to an increase in infant mortality - a paradoxic relationship. Consider Figure 3.14, there appears to be less variation in the estimates using the employment rate compared to the unemployment rate. Based on this analysis, we refrain from going into further detail about the sensitivity analysis of time frames because it appears that mortality outcomes are not very sensitive to the time frame under analysis using the employment rate compared with the unemployment rate.

We now summarize findings from the estimates of the association of the employment rate with infant birth outcomes. Our regression output suggested that few, if any, coefficient estimates were statistically significantly associated with the employment rate for the crude birth rate and birth weight. Furthermore, inspection of the results suggested that estimates were not very sensitive to the choice of start year or end year. We thus focus on the percentage of babies born with low and very low birth weight. Figures 3.15 and 3.16 summarize the relationship between the employment rate and the percentage of babies born with low birth weight and very low birth weight, respectively. From the figures, it is apparent that many more estimates are statistically significant when compared to similar figures representing the relationship between the unemployment rate and the percentage of babies born with low birth weight and very low birth weight (see Figures 3.11 and 3.12).[30]

[30]That is, when the starting year is fixed at 1976, estimates for babies born with low birth weight resulted in statistically significant estimates from all years ending from 1991 to 2011, while no estimates were statistically significant considering use of the unemployment rate as the economic proxy. Fixing the ending year at 2011 and varying the starting year also produced many estimates that are statistically significant for the relationship between the employment rate and babies born with low birth weight (starting years: 1976, 1977, 1989 to 1999

Furthermore, regardless of the starting year, there is a negative relationship between the employment rate and the percentage of babies born with low and very low birth weight. This is different from estimates using the unemployment rate since these estimates suggest an increased variability to estimates in the later years that represent shorter time frames of analysis. Considering this brief summary, it would appear there is a significant association between babies born with low birth weight and very low birth weight and this suggests that as economic times get better infant birth outcomes get better.

3.6 Discussion

In this study we used administrative data from the Statistics Canada Vital Statistics Birth database and Death database, combined with data from the Labour Force Survey related to (un)employment, to examine the sensitivity of the relationship between economic conditions and infant health outcomes in Canada. We examined the 1976 to 2011 time frame, inclusive, and explored how the choice of alternate economic proxy, model specification, and time frame for analysis affect the resulting estimates of the relationships of interest. We summarize our findings going forward and consider first the sensitivity of estimates to the choice of economic proxy.

In the first part of our analysis, we examined the variability of the choice of alternate proxies for economic conditions with the baseline rate over two time frames, 1976 to 2011 and 1997 to 2011, followed with an analysis of the sensitivity of estimates related to the choice of these proxies. Overall, we find that there is an overlap in the movement of alternate measures of the unemployment rate, over both time frames examined. The magnitude of estimates varies depending on the definition of the economic proxy. For the R1 and R2 unemployment rates, that represent longer-term unemployment, there is an evident larger

inclusive), while no estimates were statistically significant using the unemployment rate as the economic proxy.

relationship between infant health outcomes and economic conditions. The comparable to U.S. rate also suggests a larger in magnitude relationship between infant health outcomes and economic conditions, compared with the baseline rate. The R5 through R8 unemployment rates, which expand the definition of the baseline rate, and as we move along the coefficient estimates get smaller compared with the baseline rate. Of distinct note is the employment rate. The employment rate is often included in the relevant studies in the literature as a robustness check of the relationship of interest. It is expected that the sign of the coefficient estimates for the employment rate is opposite to that of the sign of the coefficient estimates for the unemployment rate. In general, for the analysis, this has been the case. But note that, the coefficient of determination for the employment rate over both time frames suggested there is substantial variation to warrant further investigation of the association of the employment rate with infant health outcomes. Furthermore, in contrast to the relationship with the baseline rate, there is a consistent and significant relationship between the employment rate and the percentage of babies born with low birth weight or with very low birth weight, suggesting that it may provide a different picture about these relationships of interest.

In the second approach to our sensitivity analysis, we looked at the sensitivity of results to choice of model specification, combined with investigating whether there is a time varying relationship between economic conditions and infant health outcomes. Our general finding is that models that include a province specific time trend provide a better reflection of the relationship of interest because the coefficient estimates do not overstate the relationship. Furthermore, by including the interaction term in the model specification, we find that there is some evidence of a changing pattern in the cyclicality of mortality and birth outcomes for infants. To investigate this phenomenon in more detail, we follow an approach similar, but slightly different, to Ruhm (2015) and undertake a collective analysis of the sensitivity of the relationship of interest to (i) fixing the start year at 1976 (or 1977) and

varying the ending year 1985 (or 1986); (ii) fixing the end year at 2011 and varying the start year from 1976 (or 1977); (iii) fixing the time interval for samples for 20-years, 15-years, 10-years, and 5-years. Estimates from this collective approach are plotted on figures to better visualize the changes over time. Overall, we find that infant mortality outcomes exhibit a decrease in the countercyclicality of the relationship of interest over time with most of the changes starting around the mid-1980s. We also find that as the time-interval for study shortens, the volatility of estimates increases. In contrast to infant mortality outcomes, infant birth outcomes appear to be less sensitive to changes in the relationship of interest over time. Having said that, the estimates from infant birth outcomes do confirm that there is a decrease in the countercyclicality of the relationship and that as the time interval for study shortens, there is an increase in the volatility of estimates.

Overall, from the discussion above, it is clear that coefficient estimates may be sensitive to the choice of economic proxy, model specification, start and end years, and the time frame under analysis. An insight gained from this study is that it appears that the employment rate may provide a different picture of how economic conditions may impact infant birth outcomes specifically. Since the employment rate may provide a more accurate reflection of the changes in the labour force participation, it may provide an improved estimate for this relationship of interest compared to the unemployment rate.

3.7 Conclusion

Overall, considering the relationship of the baseline unemployment rate with infant health outcomes - the results suggest a declining countercylical relationship between infant health outcomes and economic conditions which may even become procyclical in more recent years. Furthermore, we find that the relationship is sensitive to the start and end date of the time frame for analysis, with at least a 20-year interval appearing to be an appropriate

time-interval for study. We examined the relationship between economic conditions and infant health outcomes using the employment rate and find that the employment rate may provide a stronger and more robust reflection of the relationship of interest compared to the unemployment rate, since the estimates are less sensitive to the time-varying relationship.

Overall, the employment rate provides by far many more estimates that are of statistical significance and which suggest that we reject the null hypothesis of no relationship between infant health outcomes and economic conditions. Furthermore, estimates vary considerably less when the starting and end years are fixed, and when the analysis periods are fixed but sample windows estimated. But, having said that, as the sample windows decrease in time frame under analysis, as one would expect there is an apparent increase in the sensitivity in results for all models. Finally, when we compare the results from estimates using the unemployment rate to those using the employment rate, we conclude that although estimates of the relationship between the unemployment rate and infant health outcomes suggest that bad economic times may be good for infant health, it appears that good economic times are "better" for infant health - in general, there is a paradoxic relationship over some time frames of analysis. Note that Laporte (2004) also found a paradoxic relationship between economic conditions and adult health outcomes. This means that although we find a relationship between infant health and economic conditions that use the unemployment rate as the proxy suggesting that infant health improves, many of the estimates are not statistically significant over time where the opposite is true for use of the employment rate.

Overall, it appears that it would be salient to always include the employment rate in analyses that study the relationships of interest as outlined above and examining cyclical fluctuations in economic conditions.

Table 3.2: Coefficient of determination, alternate proxies

	R1	R2	R3	R4	R5	R6	R7	R8	Employment rate
1976 to 2011									
Unemployment rate		0.92	0.99	1.00					0.74
1997 to 2011									
Unemployment rate	0.51	0.93	0.99	1.00	0.98	0.99	0.99	0.97	0.82

Notes: Dependent variables are the alternate proxies for economic conditions representing province level unemployment rates, employment rates, and supplementary unemployment rates. Data are retrieved from Statistics Canada CANSIM table numbers 282-0001 and 282-0086. The coefficient of determination is reported in each representative cell that is a result of regressing the standard unemployment rate on each alternate economic proxy.

Table 3.3: Estimates of the association of economic proxies with infant mortality outcomes, 1977 to 2011

	Unemployment rate		R2		R3		R4		Employment rate	
Outcome	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Infant mortality	**0.0286****	0.0056	**0.0414****	0.0086	**0.0311****	0.0057	**0.0285****	0.0056	**-0.0225*****	-0.0048
	(0.0124)	(0.0071)	(0.0144)	(0.0116)	(0.0119)	(0.0070)	(0.0124)	(0.0070)	(0.0063)	(0.0065)
	0.0471	0.4506	0.0184	0.4771	0.0282	0.4389	0.0466	0.4474	0.0060	0.4736
Neonatal mortality	0.0225	-0.0029	**0.0357***	-0.0041	**0.0259***	-0.0029	0.0227	-0.0026	**-0.0204***	0.0055
	(0.0134)	(0.0089)	(0.0164)	(0.0132)	(0.0130)	(0.0090)	(0.0134)	(0.0089)	(0.0095)	(0.0079)
	0.1285	0.7516	0.0567	0.7653	0.0776	0.7531	0.1248	0.7780	0.0598	0.4992
Postneonatal mortality	**0.0338****	**0.0176****	**0.0456****	**0.0282****	**0.0345****	**0.0179****	**0.0329****	**0.0167****	**-0.0241*****	**-0.0236*****
	(0.0110)	(0.0056)	(0.0159)	(0.0111)	(0.0108)	(0.0056)	(0.0109)	(0.0056)	(0.0073)	(0.0062)
	0.0134	0.0120	0.0187	0.0315	0.0111	0.0114	0.0148	0.0150	0.0095	0.0041
Sample size = 350										

Notes: Dependent variables are logged. Specification (1) include vectors of province and year dummy variables, specification (2) adds a province specific time trend. Both specifications include controls for sex of the infant, marital status (CANSIM table number 051-0042), percent manufacturing jobs (CANSIM table number 282-0008), and female to male earnings ratio (CANSIM table number 202-0104). Robust standard errors, clustered at the province level are reported in the parenthesis, and p-values below them. Data are from the Vital Statistics Birth and Death Registry and CANSIM tables as noted above. Province level unemployment rates, employment rates, and supplementary unemployment rates are merged from Statistics Canada CANSIM table numbers 282-0001 and 282-0086 and matched to the year prior to death – time frame 1977 to 2011. Sample includes infants aged less than 365 days. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level.

Table 3.4: Estimates of the association of economic proxies with infant birth outcomes, 1976 to 2011

	Unemployment rate		R2		R3		R4		Employment rate	
Outcome	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Crude Birth rate	0.0044	-0.0041	0.0058	-0.0058	0.0042	-0.0048	0.0043	-0.0042	-0.0006	0.0086
	(0.0061)	0.0069	0.0093	0.0112	0.0064	0.0070	0.0061	0.0069	0.0054	0.0056
	0.4821	0.5629	0.5482	0.6178	0.5227	0.5132	0.4959	0.5598	0.9146	0.1574
Birth weight	-0.0008	-0.0007	-0.0016	-0.0011	-0.0008	-0.0007	-0.0008	-0.0007	0.0010	0.0007
	(0.0007)	(0.0004)	(0.0011)	(0.0007)	(0.0007)	(0.0004)	(0.0007)	(0.0004)	(0.0007)	(0.0004)
	0.2829	0.1048	0.1914	0.1339	0.2876	0.1223	0.2826	0.1051	0.2209	0.1073
Low birth weight	0.0091	0.0018	**0.0203***	0.0062	0.0093	0.0017	0.0092	0.0018	**-0.0131****	**-0.0082****
	(0.0054)	(0.0040)	(0.0092)	(0.0061)	(0.0053)	(0.0041)	(0.0054)	(0.0040)	(0.0055)	(0.0034)
	0.1243	0.6602	0.0539	0.3309	0.1158	0.6834	0.1235	0.6603	0.0403	0.0370
Very low birth weight	**0.0187***	0.0086	**0.0317****	0.0197	**0.0180***	0.0076	**0.0186***	0.0083	**-0.0180***	-0.0141
	(0.0091)	(0.0071)	(0.0134)	(0.0110)	(0.0095)	(0.0074)	(0.0090)	(0.0070)	(0.0094)	(0.0087)
	0.0706	0.2558	0.0417	0.1067	0.0913	0.3311	0.0697	0.2653	0.0898	0.1391
Sample size = 360										

Notes: Dependent variables are logged. Specification (1) include vectors of province and year dummy variables, specification (2) adds a province specific time trend. Both specifications include controls for mother's age, marital status of the mother (married), sex of infant, percent manufacturing jobs (CANSIM table number 282-0008), and female to male earnings ratio (CANSIM table number 202-0104). Robust standard errors, clustered at the province level are reported in the parenthesis and p-values below them. Data are from the Vital Statistics Birth and Death Registry and CANSIM tables as noted above. Province level unemployment rates, employment rates, and supplementary unemployment rates are merged from Statistics Canada CANSIM table numbers 282-0001 and 282-0086. Sample includes infants aged less than 365 days and excludes multiple births. Mother's age is restricted to 18 years of age and the unemployment rate, employment rate and supplementary unemployment rates are matched to the year of conception – time frame 1976 to 2011. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level.

Table 3.5: Estimates of the association of economic proxies with infant mortality outcomes, 1997 to 2011

	Unemployment rate		R1		R2		R3		R4		R5		R6		R7		R8		Employment rate	
Outcome	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Infant mortality	0.0065	0.0014	-0.0222	-0.0011	-0.0058	-0.0070	0.0082	0.0051	0.0056	-0.0001	0.0068	0.0106	0.0080	0.0044	0.0055	0.0036	0.0056	0.0072	-0.0055	-0.0046
	(0.0123)	(0.0182)	(0.0529)	(0.0949)	(0.0266)	(0.0394)	(0.0120)	(0.0183)	(0.0121)	(0.0184)	(0.0116)	(0.0186)	(0.0129)	(0.0189)	(0.0091)	(0.0117)	(0.0094)	(0.0131)	(0.0132)	(0.0145)
	0.6108	0.9410	0.6839	0.9913	0.8335	0.8623	0.5095	0.7876	0.6534	0.9955	0.5719	0.5808	0.5528	0.8219	0.5633	0.7686	0.5615	0.5952	0.6886	0.7600
Neonatal mortality	0.0216	-0.0027	0.0071	-0.0195	0.0153	-0.0166	0.0244	0.0036	0.0217	-0.0027	0.0195	0.0110	0.0218	0.0015	0.0174	0.0050	0.0151	0.0082	-0.0079	0.0018
	(0.0186)	(0.0284)	(0.0855)	(0.1009)	(0.0410)	(0.0490)	(0.0184)	(0.0285)	(0.0186)	(0.0286)	(0.0188)	(0.0260)	(0.0189)	(0.0275)	(0.0131)	(0.0172)	(0.0144)	(0.0184)	(0.0205)	(0.0222)
	0.2752	0.9266	0.9358	0.8507	0.7174	0.7418	0.2172	0.9024	0.2735	0.9272	0.3251	0.6831	0.2777	0.9572	0.2186	0.7774	0.3233	0.6675	0.7081	0.9380
Postneonatal mortality	-0.0325	0.0053	-0.0789	0.0627	-0.0539	0.0144	-0.0335	0.0016	-0.0362	-0.0009	-0.0246	0.0067	-0.0270	0.0069	-0.0237	-0.0013	-0.0163	0.0061	-0.0056	-0.0261
	(0.0270)	(0.0358)	(0.0908)	(0.1712)	(0.0446)	(0.0683)	(0.0268)	(0.0392)	(0.0273)	(0.0372)	(0.0250)	(0.0373)	(0.0265)	(0.0394)	(0.0189)	(0.0251)	(0.0178)	(0.0265)	(0.0237)	(0.0272)
	0.2588	0.8847	0.4078	0.7225	0.2577	0.8373	0.2438	0.9674	0.2171	0.9822	0.3501	0.8612	0.3346	0.8647	0.2399	0.9587	0.3847	0.8242	0.8182	0.3634
Sample size =150																				

Notes: Dependent variables are logged. Specification (1) include vectors of province and year dummy variables, specification (2) adds a province specific time trend. Both specifications include controls for sex of the infant, marital status (CANSIM table number 051-0042), percent manufacturing jobs (CANSIM table number 282-0008), and female to male earnings ratio (CANSIM table number 202-0104). Robust standard errors, clustered at the province level are reported in the parenthesis, and p-values below them. Data are from the Vital Statistics Birth and Death Registry and CANSIM tables as noted above. Province level unemployment rates, employment rates, and supplementary unemployment rates are merged from Statistics Canada CANSIM table numbers 282-0001 and 282-0086 and matched to the year prior to death. Sample includes infants aged less than 365 days. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level.

Table 3.6: Estimates of the association of economic proxies with infant birth outcomes, 1997 to 2011

	Unemployment rate		R1		R2		R3		R4		R5		R6		R7		R8		Employment rate	
Outcome	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Crude Birth rate	-0.0015	-0.0017	-0.0160	0.0081	-0.0061	-0.0003	-0.0014	-0.0014	-0.0015	-0.0016	0.0017	-0.0018	-0.0014	-0.0011	-0.0036	-0.0012	-0.0010	-0.0013	0.0090	0.0027
	(0.0108)	(0.0024)	(0.0338)	(0.0093)	(0.0179)	(0.0026)	(0.0106)	(0.0023)	(0.0108)	(0.0024)	(0.0092)	(0.0024)	(0.0099)	(0.0020)	(0.0071)	(0.0018)	(0.0065)	(0.0016)	(0.0065)	(0.0022)
	0.8938	0.4839	0.6473	0.4098	0.7413	0.9180	0.8987	0.5744	0.8909	0.5106	0.8536	0.4635	0.8889	0.5848	0.6270	0.5038	0.8774	0.4498	0.1959	0.2570
Birth weight	**-0.0019**	0.0002	**-0.0077**	0.0009	**-0.0037**	0.0004	**-0.0019**	0.0003	**-0.0019**	0.0001	**-0.0015**	0.0002	**-0.0018**	0.0002	**-0.0016**	-0.0001	**-0.0012**	0.0002	**0.0016**	-0.0004
	(0.0008)	(0.0005)	(0.0030)	(0.0030)	(0.0012)	(0.0012)	(0.0007)	(0.0005)	(0.0008)	(0.0005)	(0.0008)	(0.0005)	(0.0008)	(0.0006)	(0.0007)	(0.0004)	(0.0006)	(0.0005)	(0.0007)	(0.0008)
	0.0354	0.7569	0.0293	0.7582	0.0122	0.7669	0.0261	0.5581	0.0349	0.7999	0.0983	0.7510	0.0470	0.6756	0.0413	0.8760	0.0879	0.6883	0.0445	0.6430
Low birth weight	0.0071	-0.0059	**0.0581**	0.0192	**0.0261**	0.0041	0.0076	-0.0065	0.0067	-0.0066	0.0071	-0.0040	0.0080	-0.0043	0.0064	-0.0036	0.0069	-0.0015	**-0.0191**	**-0.0119**
	(0.0076)	(0.0085)	(0.0142)	(0.0180)	(0.0094)	(0.0122)	(0.0073)	(0.0090)	(0.0079)	(0.0089)	(0.0061)	(0.0075)	(0.0068)	(0.0079)	(0.0052)	(0.0051)	(0.0044)	(0.0051)	(0.0036)	(0.0031)
	0.3758	0.5026	0.0027	0.3135	0.0211	0.7459	0.3308	0.4898	0.4146	0.4760	0.2732	0.6059	0.2708	0.6013	0.2487	0.4983	0.1524	0.7701	0.0005	0.0039
Very low birth weight	0.0060	-0.0037	0.0222	0.0077	0.0302	0.0210	0.0040	-0.0052	0.0046	-0.0055	0.0040	0.0013	0.0036	-0.0044	0.0027	-0.0023	0.0021	0.0009	-0.0205	-0.0260
	(0.0114)	(0.0129)	(0.0560)	(0.0605)	(0.0285)	(0.0276)	(0.0110)	(0.0130)	(0.0112)	(0.0126)	(0.0124)	(0.0116)	(0.0120)	(0.0125)	(0.0103)	(0.0111)	(0.0106)	(0.0101)	(0.0181)	(0.0233)
	0.6085	0.7832	0.7017	0.9019	0.3180	0.4660	0.7246	0.6992	0.6876	0.6715	0.7554	0.9113	0.7687	0.7347	0.8007	0.8387	0.8459	0.9273	0.2881	0.2945
Sample size = 150																				

Notes: Dependent variables are logged. Specification (1) include vectors of province and year dummy variables, specification (2) adds a province specific time trend. Both specifications include controls for mother's age, marital status of the mother (married), sex of infant, percent manufacturing jobs (CANSIM table number 282-0008), and female to male earnings ratio (CANSIM table number 202-0104). Robust standard errors, clustered at the province level are reported in the parenthesis and p-values below them. Data are from the Vital Statistics Birth and Death Registry and CANSIM tables as noted above. Province level unemployment rates, employment rates, and supplementary unemployment rates are merged from Statistics Canada CANSIM table numbers 282-0001 and 282-0086. Sample includes infants aged less than 365 days and excludes multiple births. Mother's age is restricted to 18 years of age and the unemployment rate, employment rate and supplementary unemployment rates are matched to the year of conception. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level.

Table 3.7: Estimates of model specification and the time-varying relationship between economic conditions and infant mortality outcomes

	Infant mortality		**Neonatal mortality**		**Postneonatal mortality**	
	(a)	(b)	(a)	(b)	(a)	(b)
No province-specific time trend						
unemployment rate	**0.0286****	**0.0429****	0.0225	**0.0419****	**0.0338****	**0.0382****
	(0.0124)	(0.0136)	(0.0134)	(0.0142)	(0.0110)	(0.0131)
unemployment rate x trend		**-0.0462***		**-0.0624****		**-0.0144****
		(0.0223)		(0.0240)		(0.0197)
With province-specific time trend						
unemployment rate	0.0056	**0.0242****	-0.0029	0.0141	**0.0176****	0.0336
	(0.0071)	(0.0102)	(0.0089)	(0.0125)	(0.0056)	(0.0200)
unemployment rate x trend		**-0.0461****		-0.0422		-0.0396
		(0.0168)		(0.0292)		(0.0420)

Notes: Dependent variables are logged. Specification (a) excludes the unemployment rate time trend interaction term, specification (b) includes the interaction term. The upper half reports estimates from specification with no province-specific trend and the bottom half reports estimates from specification that includes the province-specific trend. All specifications include controls for sex of the infant, marital status (CANSIM table number 051-0042), percent manufacturing jobs (CANSIM table number 282-0008), and female to male earnings ratio (CANSIM table number 202-0104). Robust standard errors, clustered at the province level are reported in the parenthesis, p-values below and the data is weighted by the number of live births. Data are from the Vital Statistics Birth and Death Registry and CANSIM tables as noted above. Province level unemployment rates are merged from Statistics Canada CANSIM table number 282-0001 and matched to the year prior to death. Sample includes infants aged less than 365 days. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level.

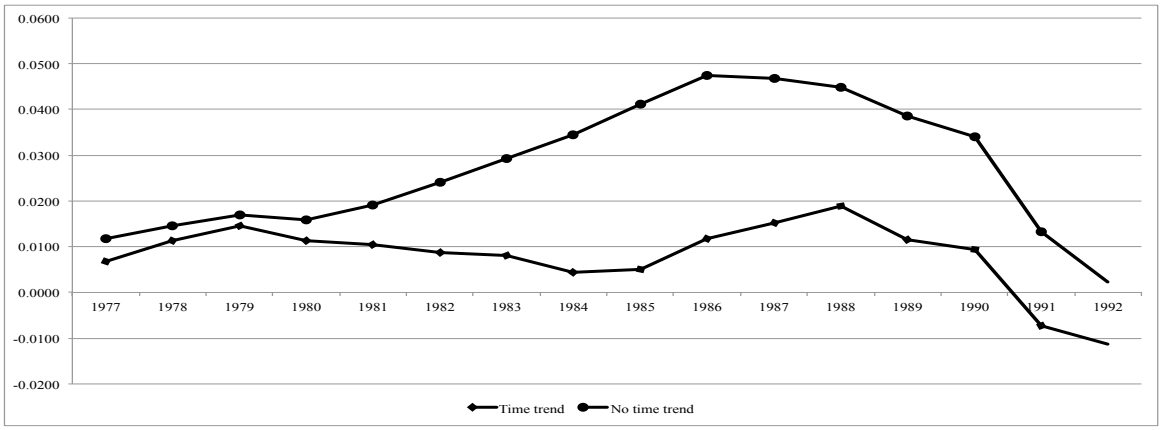
Table 3.8: Estimates of model specification and the time-varying relationship between economic conditions and infant birth outcomes

	Crude birth rate		Birthweight		Low birth weight		Very low birth weight	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
No province-specific time trend								
unemployment rate	0.0044	**0.0176****	-0.0008	-0.0001	0.0091	0.0101	**0.0187***	**0.0250***
	(0.0061)	(0.0060)	(0.0007)	(0.0007)	(0.0054)	(0.0079)	(0.0091)	(0.0122)
unemployment rate x trend		**-0.0446****		**-0.0024****		-0.0032		-0.0212
		(0.0168)		(0.0009)		(0.0122)		(0.0178)
With province-specific time trend								
unemployment rate	**-0.0041***	0.0114	-0.0007	0.0000	0.0018	0.0045	0.0086	0.0143
	(0.0069)	(0.0061)	(0.0004)	(0.0008)	(0.0040)	(0.0081)	(0.0071)	(0.0130)
unemployment rate x trend		**-0.0353****		-0.0017		-0.0061		-0.0130
		(0.0122)		(0.0012)		(0.0168)		(0.0194)

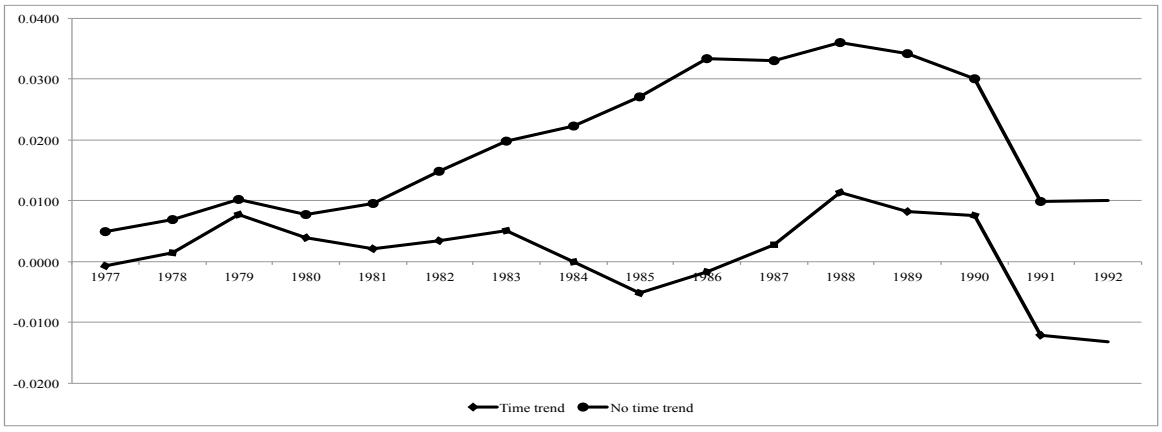
Notes: Dependent variables are logged. Specification (a) excludes the unemployment rate time trend interaction term, specification (b) includes the interaction term. The upper half reports estimates from specification with no province-specific trend and the bottom half reports estimates from specification that includes the province-specific trend. All specifications include controls for mother's age, marital status of the mother (married), sex of infant, percent manufacturing jobs (CANSIM table number 282-0008), and female to male earnings ratio (CANSIM table number 202-0104). Robust standard errors, clustered at the province level are reported in the parenthesis and the data is weighted by the number of live births. Data are from the Vital Statistics Birth and Death Registry and CANSIM tables as noted above. Province level unemployment rates and employment rates are merged from Statistics Canada CANSIM table number 282-0001. Sample includes infants aged less than 365 days and excludes multiple births. Mother's age is restricted to 18 years of age and the unemployment rate, employment rate and supplementary unemployment rates are matched to the year of conception. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level.

Figure 3.1: Summary of the estimates of the time-varying relationship between economic conditions and infant mortality outcomes, 20-year windows

(a) Infant mortality, 20-year sample estimates



(b) Neonatal mortality, 20-year sample



(c) Postneonatal mortality, 20-year sample

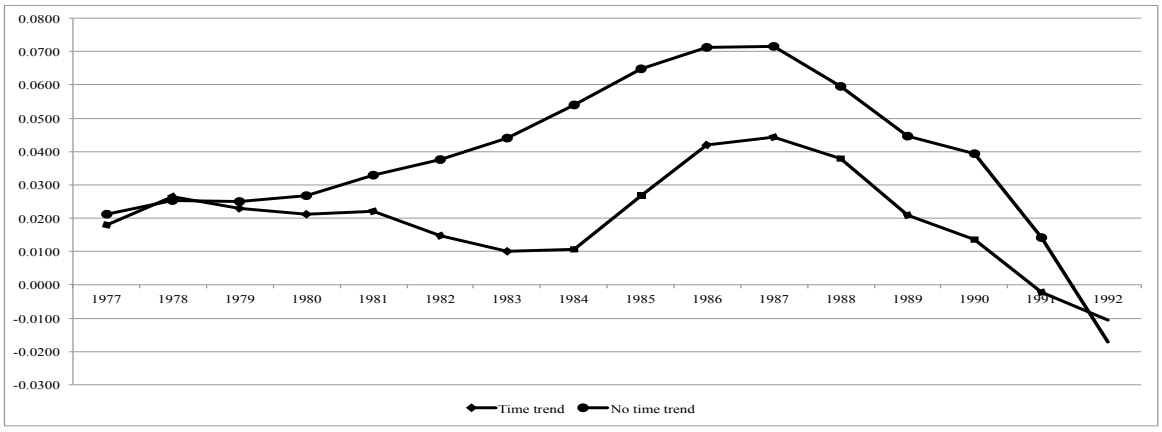
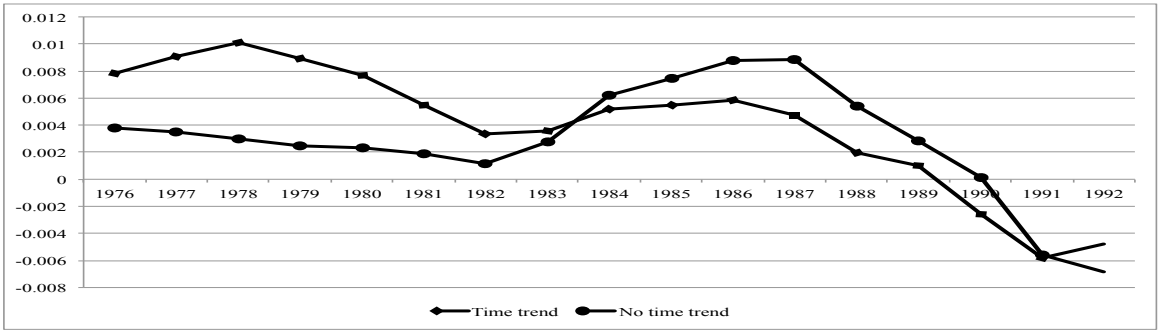
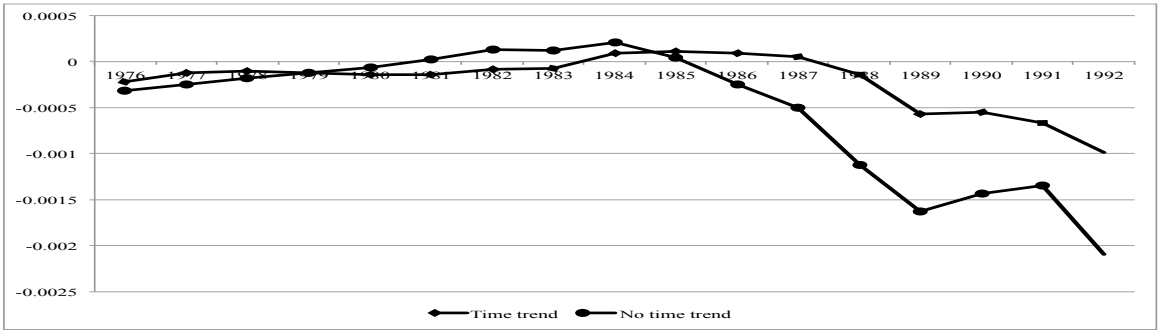


Figure 3.2: Time varying relationship between economic condition and infant mortality outcomes, 20-year windows

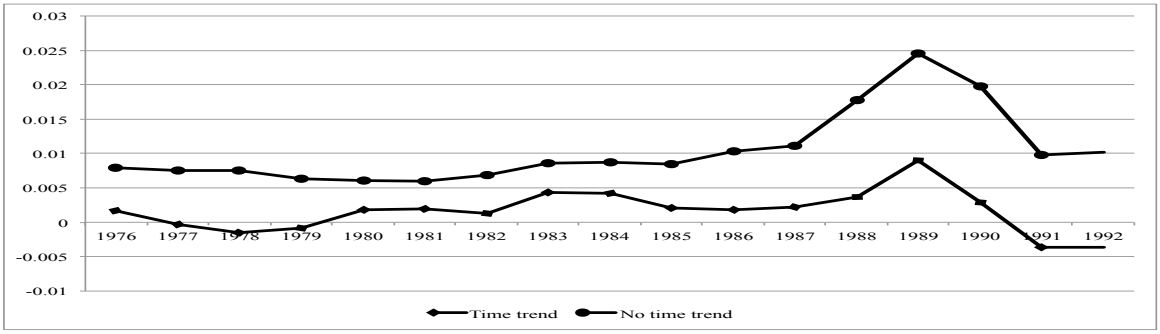
(a) Crude birth rate



(b) birth weight



(c) Low birth weight



(d) Very low birth weight

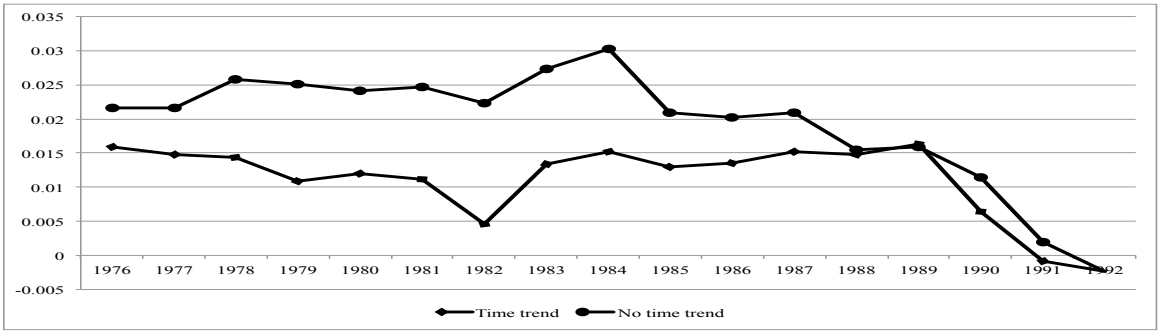


Table 3.9: Estimates of model specification and the time-varying relationship between economic conditions and infant mortality outcomes

	Infant mortality		**Neonatal mortality**		**Postneonatal mortality**	
	(a)	(b)	(a)	(b)	(a)	(b)
With province-specific time trend						
unemployment rate	0.0056	**0.0242****	-0.0029	0.0141	**0.0176****	0.0336
	(0.0071)	(0.0102)	(0.0089)	(0.0125)	(0.0056)	(0.0200)
unemployment rate x trend		**-0.0461****		-0.0422		-0.0396
		(0.0168)		(0.0292)		(0.0420)
With province-specific time trend						
employment rate	-0.0048	**-0.0145***	0.0055	-0.0017	**-0.0236*****	**-0.0384****
	(0.0065)	(0.0071)	(0.0079)	(0.0096)	(0.0062)	(0.0133)
employment rate x trend		**-0.0284***		-0.0213		-0.0437
		(0.0141)		(0.0273)		(0.0284)

Notes: Dependent variables are logged. Specification (a) excludes the unemployment rate time trend interaction term, specification (b) includes the interaction term. The upper half reports estimates from specification with no province-specific trend and the bottom half reports estimates from specification that includes the province-specific trend. All specifications include controls for sex of the infant, marital status (CANSIM table number 051-0042), percent manufacturing jobs (CANSIM table number 282-0008), and female to male earnings ratio (CANSIM table number 202-0104). Robust standard errors, clustered at the province level are reported in the parenthesis, p-values below and the data is weighted by the number of live births. Data are from the Vital Statistics Birth and Death Registry and CANSIM tables as noted above. Province level unemployment rates and employment rates are merged from Statistics Canada CANSIM table number 282-0001 and matched to the year prior to death. Sample includes infants aged less than 365 days. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level.

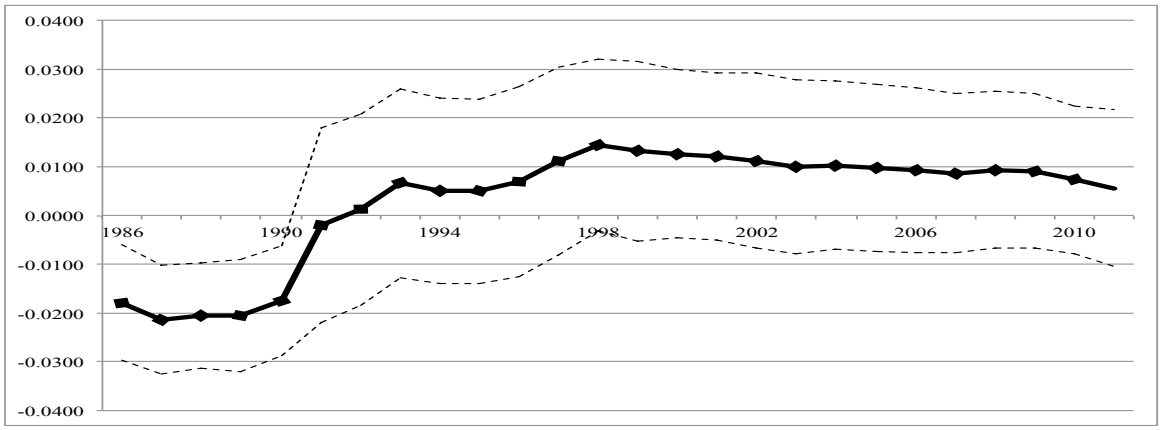
Table 3.10: Estimates of model specification and the time-varying relationship between economic conditions and infant birth outcomes

	Crude birth rate		Birthweight		Low birth weight		Very low birth weight	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
With province-specific time trend								
unemployment rate	**-0.0041***	0.0114	-0.0007	0.0000	0.0018	0.0045	0.0086	0.0143
	(0.0069)	(0.0061)	(0.0004)	(0.0008)	(0.0040)	(0.0081)	(0.0071)	(0.0130)
unemployment rate x trend		**-0.0353****		-0.0017		-0.0061		-0.0130
		(0.0122)		(0.0012)		(0.0168)		(0.0194)
With province-specific time trend								
employment rate	0.0086	0.0059	0.0007	0.0003	**-0.0082****	**-0.0177*****	-0.0141	**-0.0225***
	(0.0056)	(0.0056)	(0.0004)	(0.0005)	(0.0034)	(0.0038)	(0.0087)	(0.0111)
employment rate x trend		-0.0070		-0.0013		**-0.0247*****		**-0.0219***
		(0.0146)		(0.0008)		(0.0084)		(0.0111)

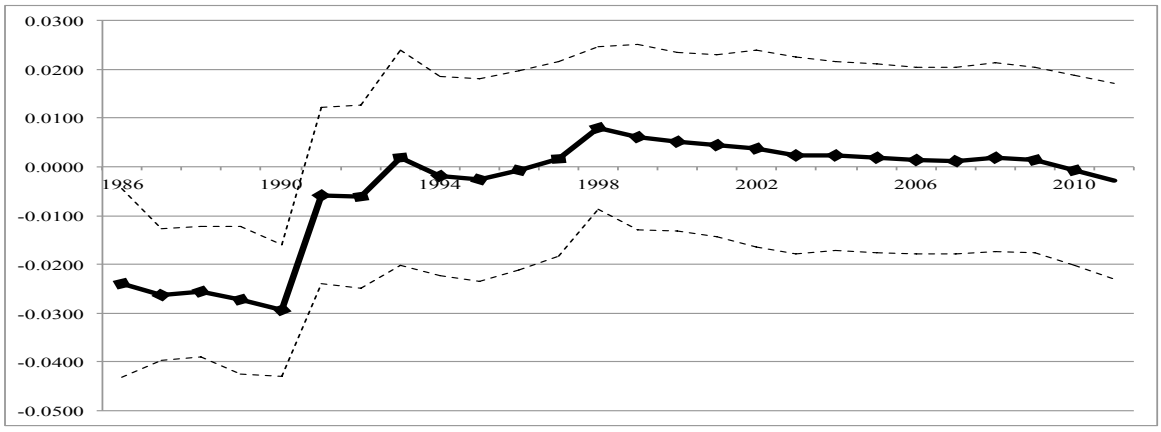
Notes: Dependent variables are logged. Specification (a) excludes the unemployment rate time trend interaction term, specification (b) includes the interaction term. The upper half reports estimates from specification with no province-specific trend and the bottom half reports estimates from specification that includes the province-specific trend. All specifications include controls for mother's age, marital status of the mother (married), sex of infant, percent manufacturing jobs (CANSIM table number 282-0008), and female to male earnings ratio (CANSIM table number 202-0104). Robust standard errors, clustered at the province level are reported in the parenthesis and the data is weighted by the number of live births. Data are from the Vital Statistics Birth and Death Registry and CANSIM tables as noted above. Province level unemployment rates and employment rates are merged from Statistics Canada CANSIM table number 282-0001. Sample includes infants aged less than 365 days and excludes multiple births. Mother's age is restricted to 18 years of age and the unemployment rate, employment rate and supplementary unemployment rates are matched to the year of conception. *** denotes significance at the 0.01 level, ** denotes significance at the 0.05 level and * denotes significance at the 0.1 level.

Figure 3.3: Estimates of the association of economic conditions with infant mortality outcomes, 1977 start year fixed - vary end year from 1986 onward to 2011

(a) Infant mortality



(b) Neonatal mortality



(c) Postneonatal mortality

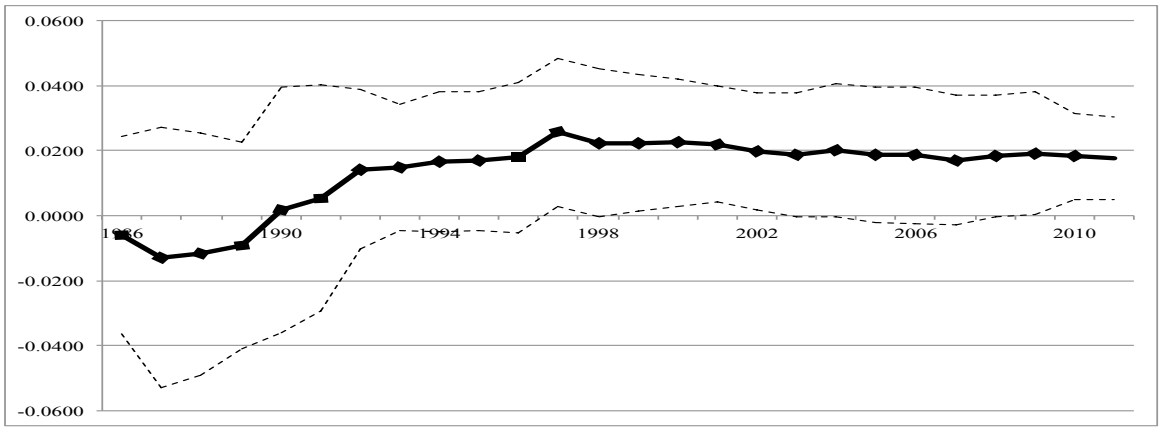
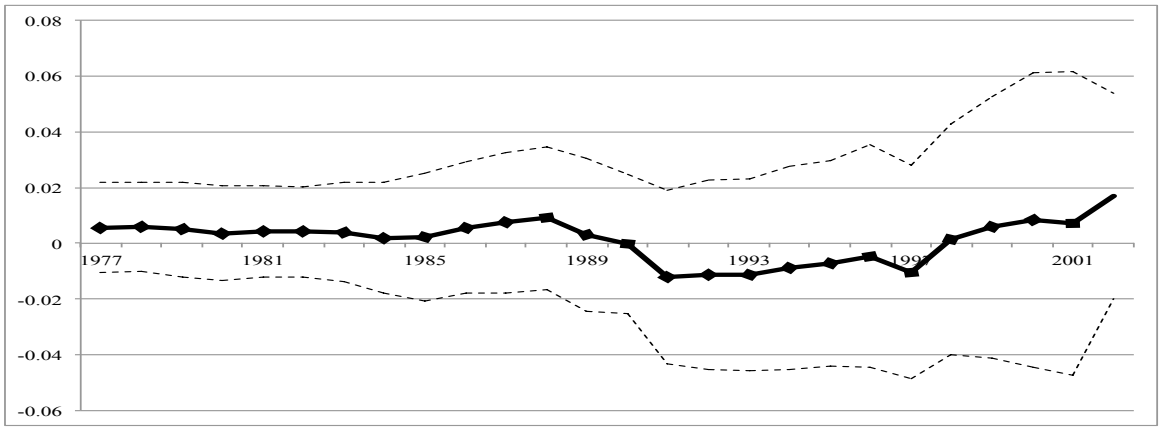
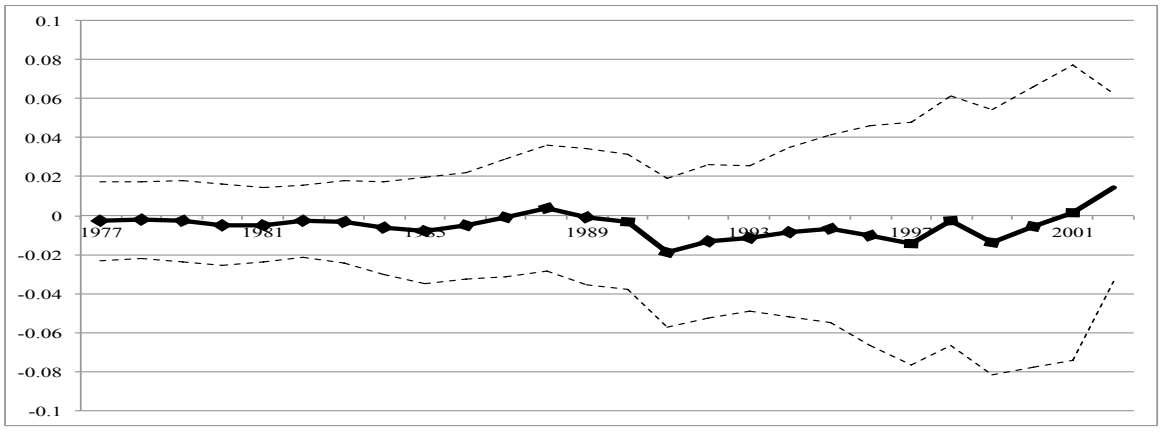


Figure 3.4: Estimates of the association of economic conditions with infant mortality outcomes, fix 2011 end year vary starting from 1977 onward to 2002

(a) Infant mortality



(b) Neonatal mortality



(c) Postneonatal mortality

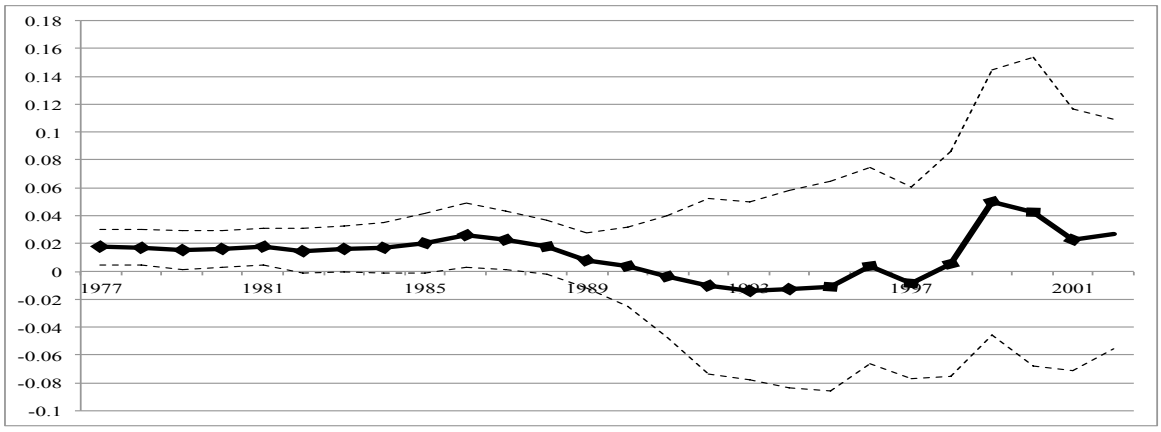
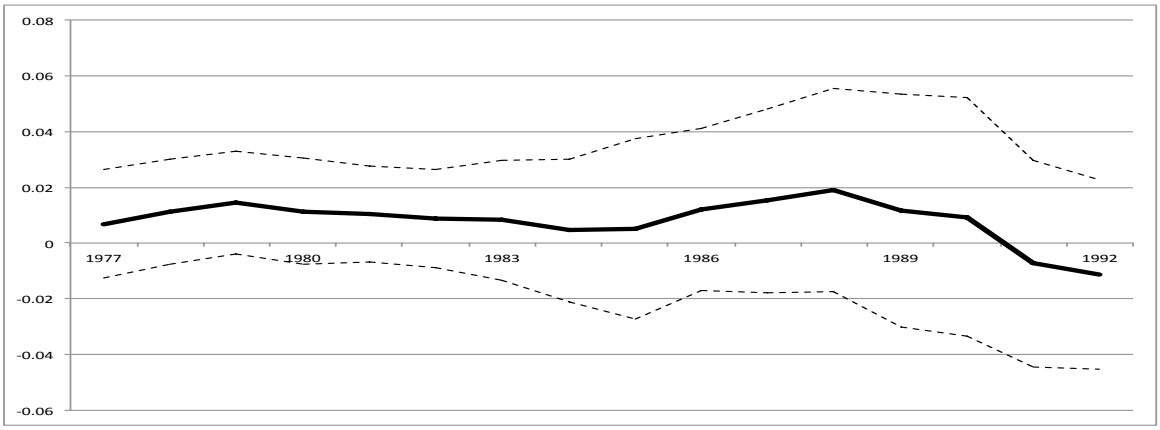
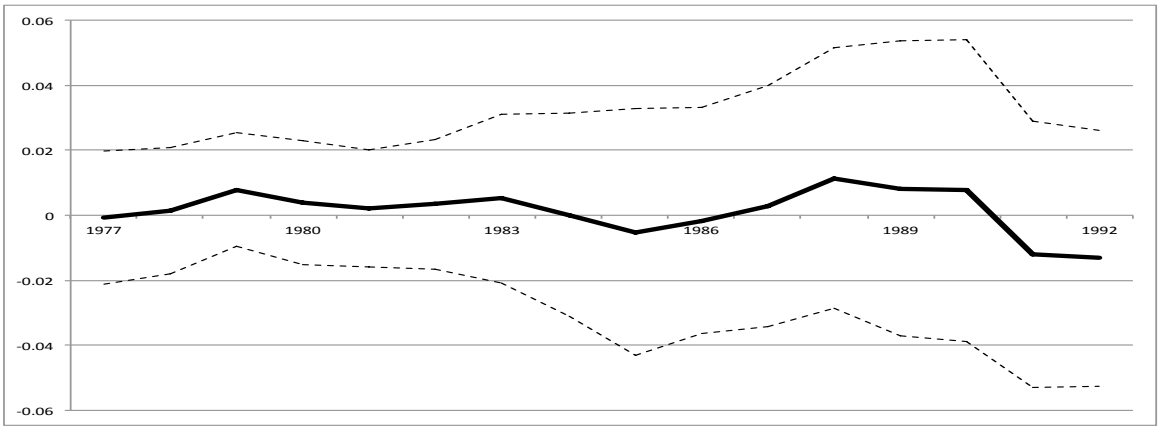


Figure 3.5: Estimates of economic effects, 20-year windows

(a) infant mortality



(b) neonatal mortality



(c) postneonatal mortality

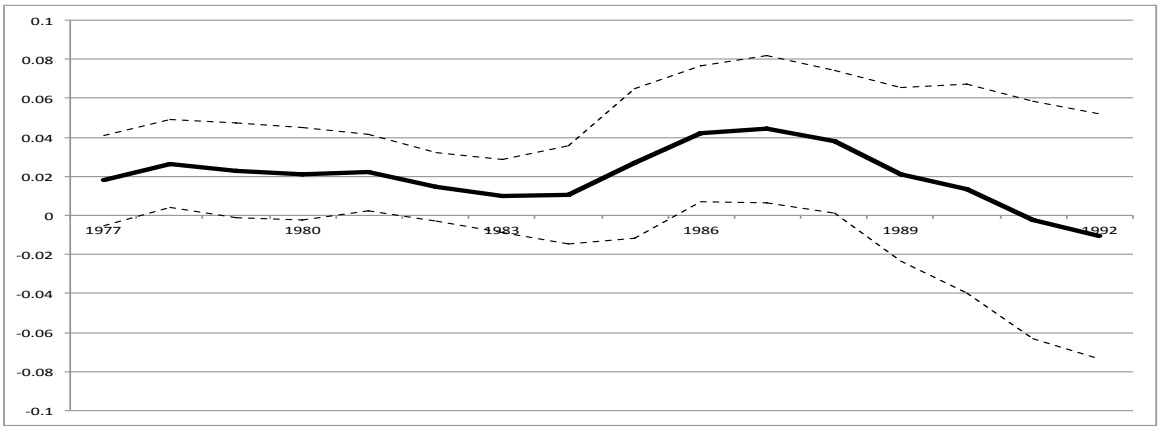
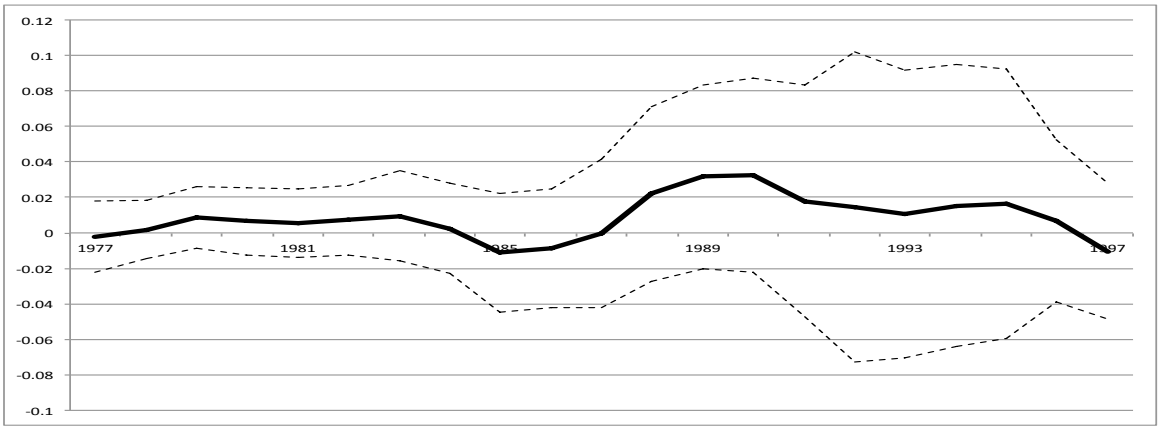
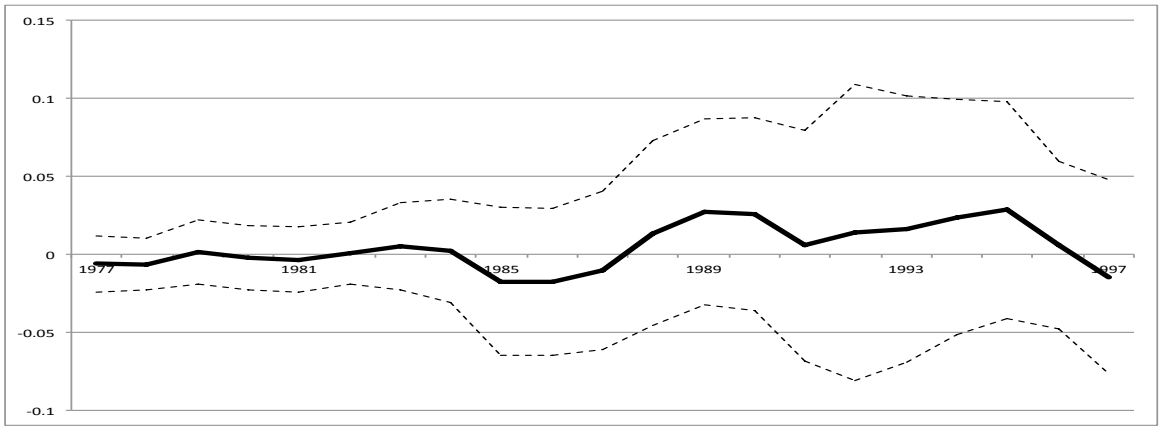


Figure 3.6: Estimates of economic effects, 15-year sample window

(a) Infant mortality



(b) Neonatal mortality



(c) Postneonatal mortality

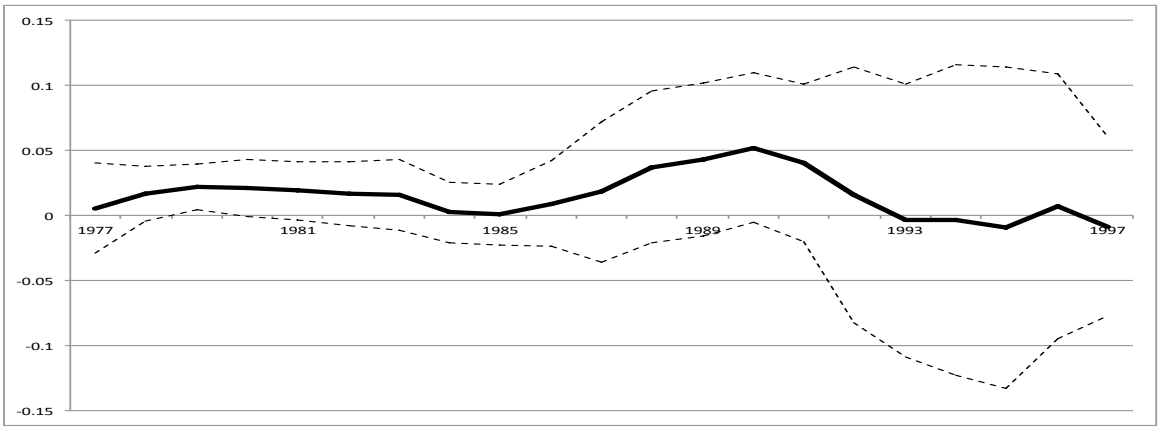
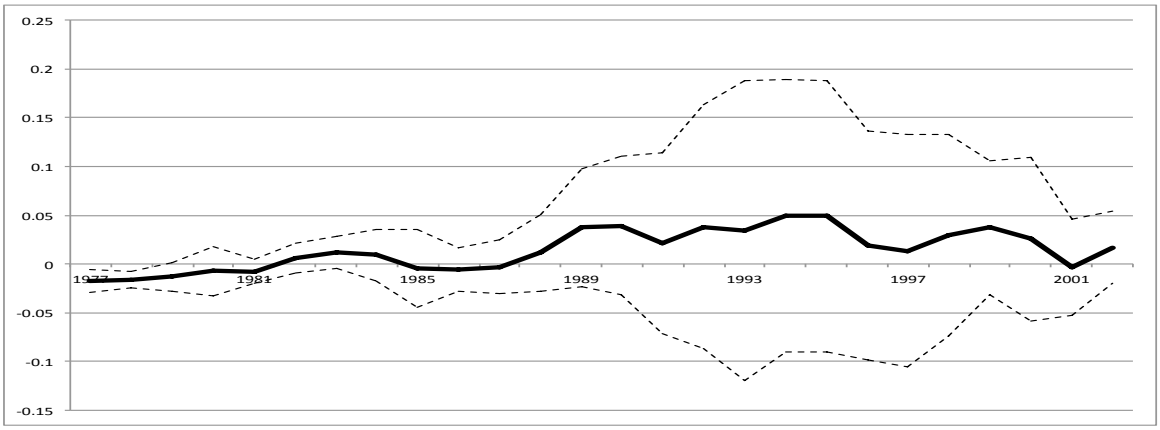
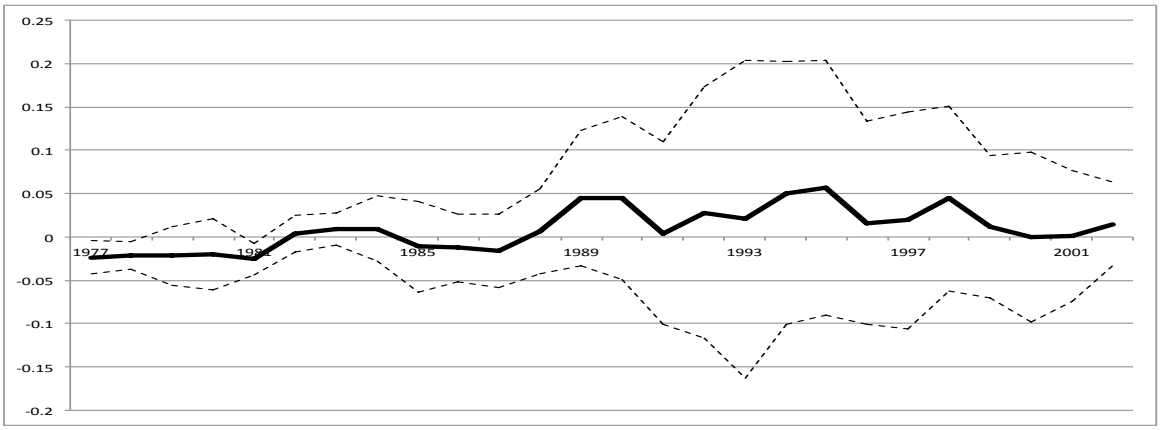


Figure 3.7: Estimates of economic effects, 10-year sample windows

(a) Infant mortality



(b) Neonatal mortality



(c) Postneonatal mortality

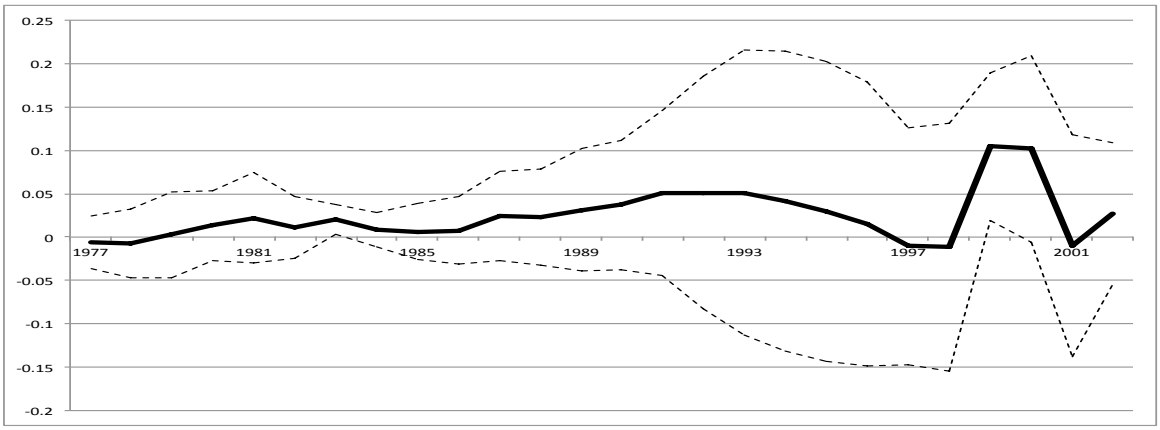
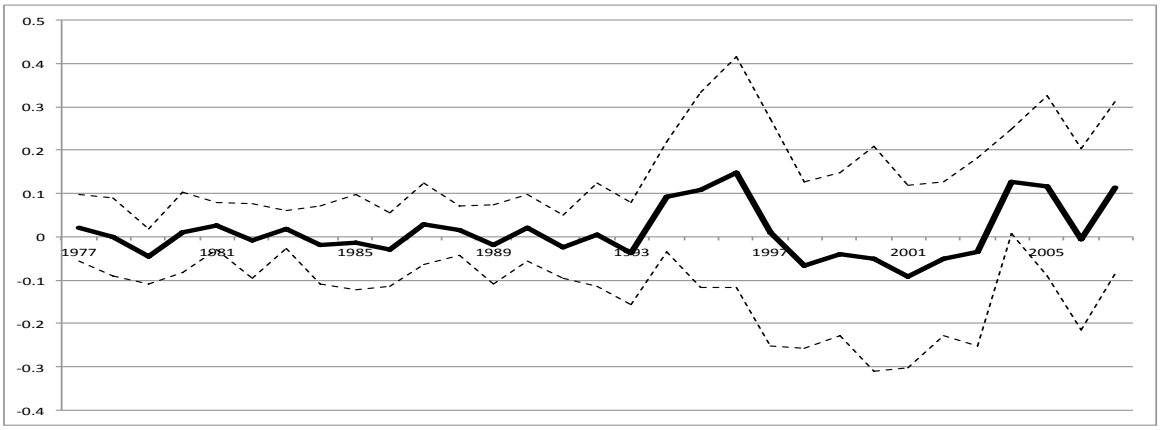
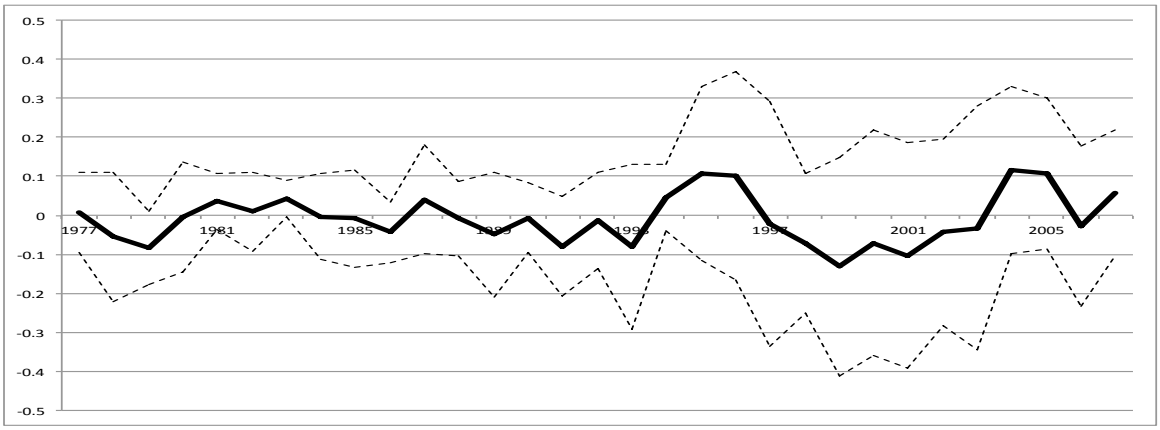


Figure 3.8: Estimates of economic effects, 5-year windows

(a) Infant mortality



(b) Neonatal mortality



(c) Postneonatal mortality

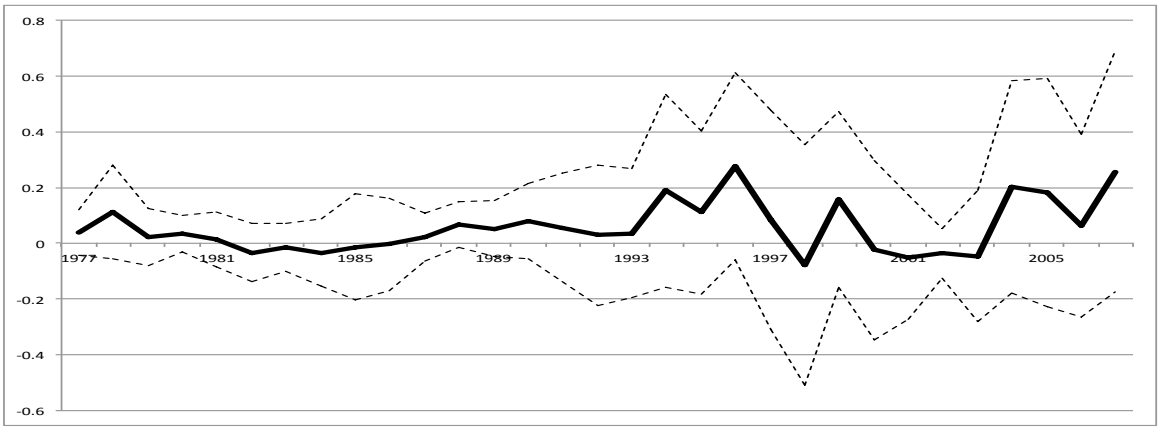
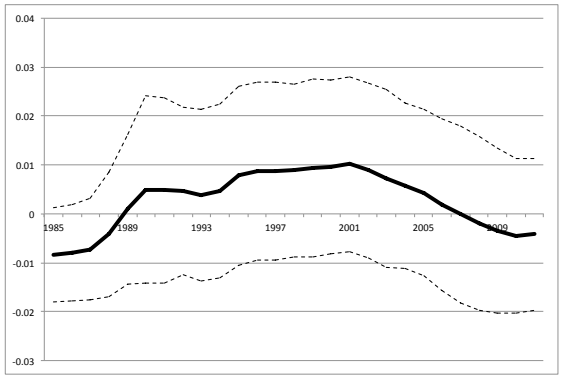
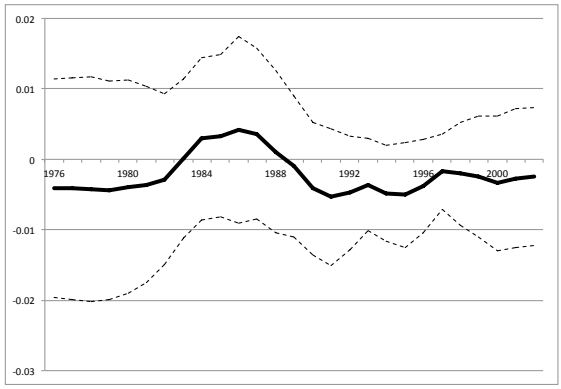


Figure 3.9: Time varying relationship: Crude birth rate

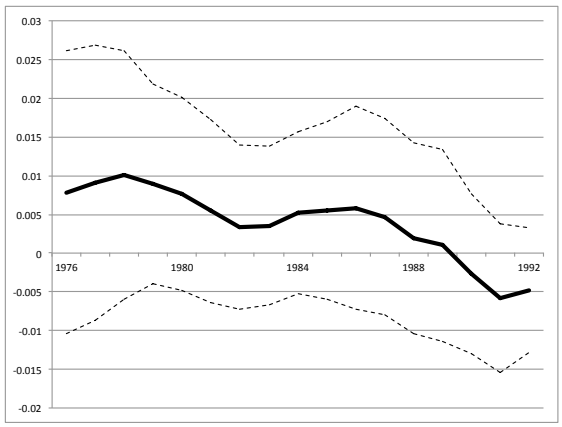
(a) Fix 1976 start year, vary end year from 1985 to 2011



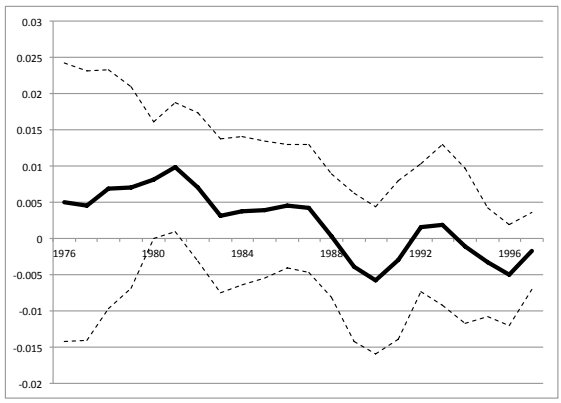
(b) Fix end year 2011, vary start year from 1976 to 2002



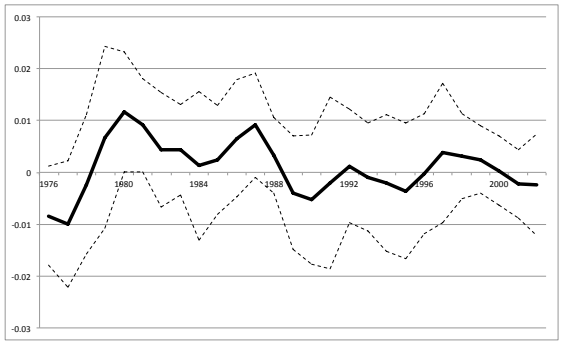
(c) 20-year window



(d) 15-year window



(e) 10-year window



(f) 5-year window

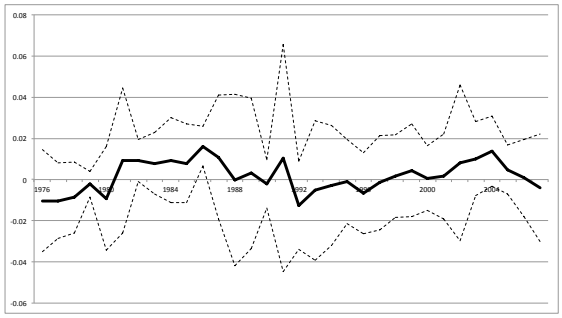
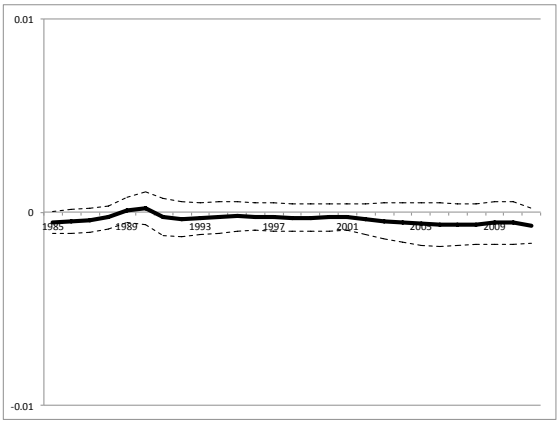
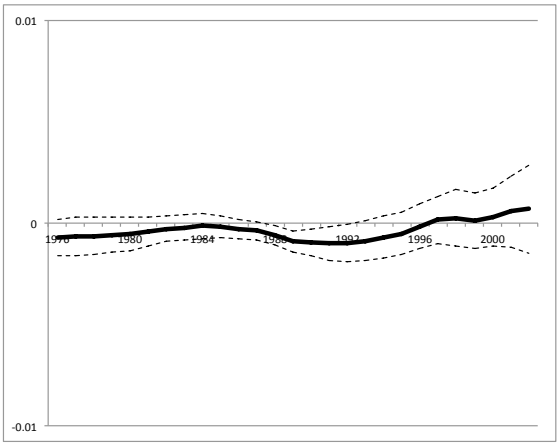


Figure 3.10: Time varying relationship: Birth weight

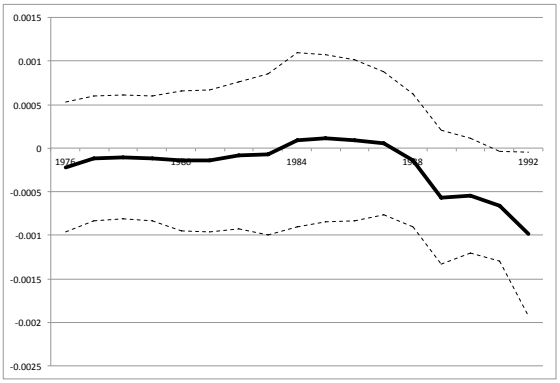
(a) Fix start year 1976, vary end year from 1985 to 2011



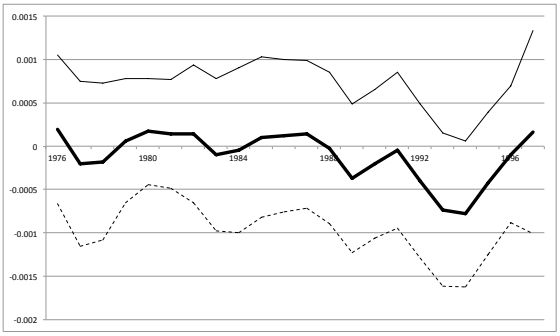
(b) Fix end year 2011, vary start year from 1976 to 1992



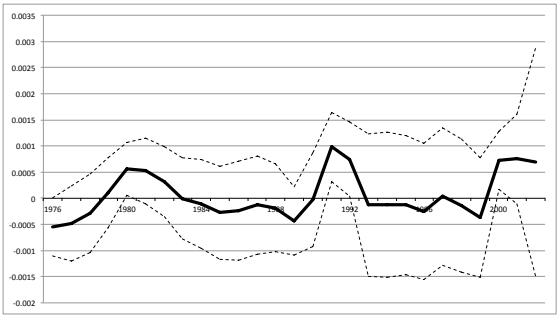
(c) 20-year window



(d) 15-year window



(e) 10-year window



(f) 5-year window

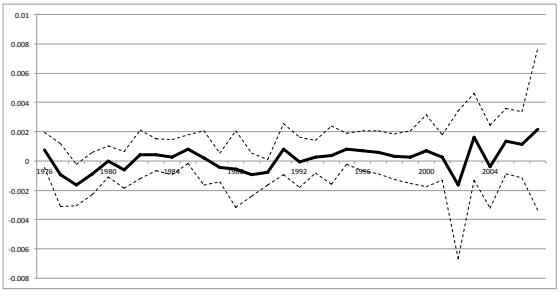
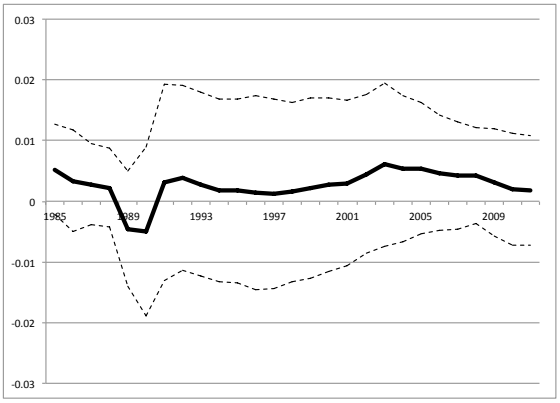
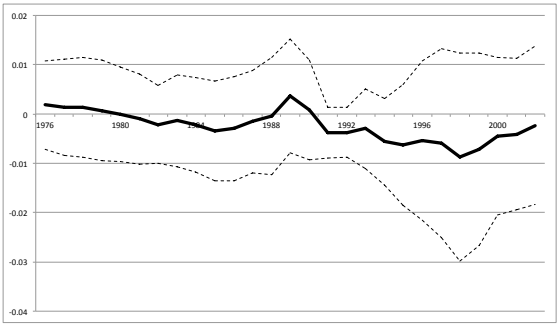


Figure 3.11: Time varying relationship: Low birth weight

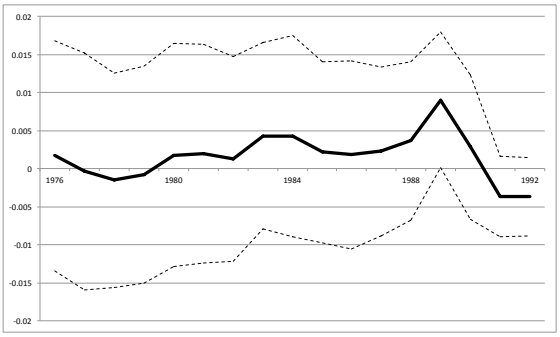
(a) Fix start year 1976, vary end year from 1985 to 2011



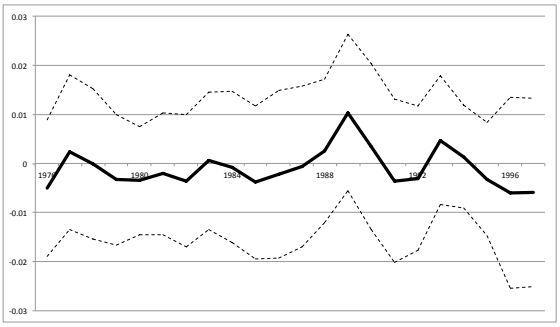
(b) Fix end year 2011, vary start year from 1976 to 2002



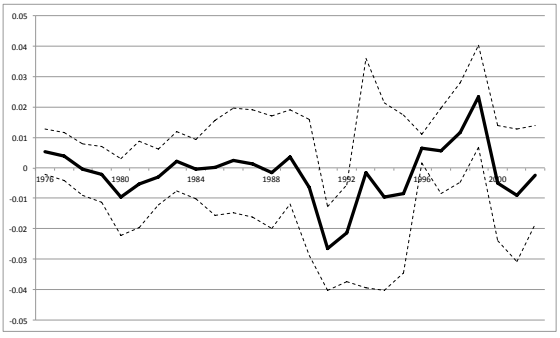
(c) 20-year window



(d) 15-year window



(e) 10-year window



(f) 5-year window

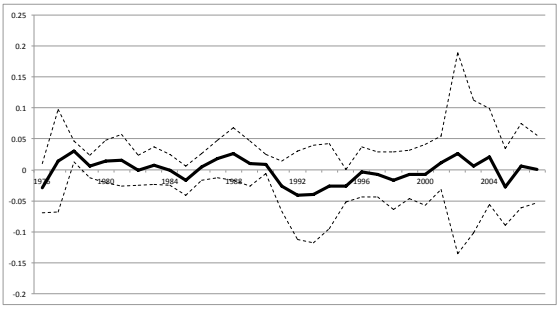
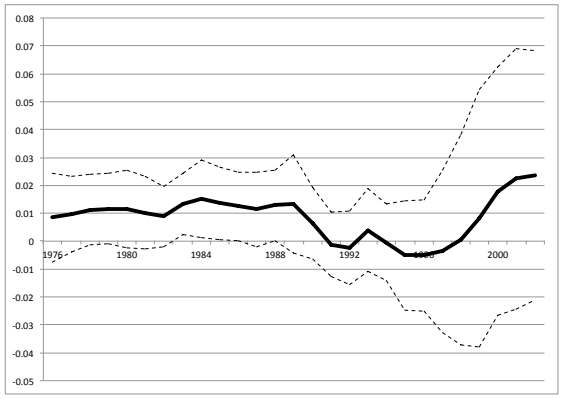


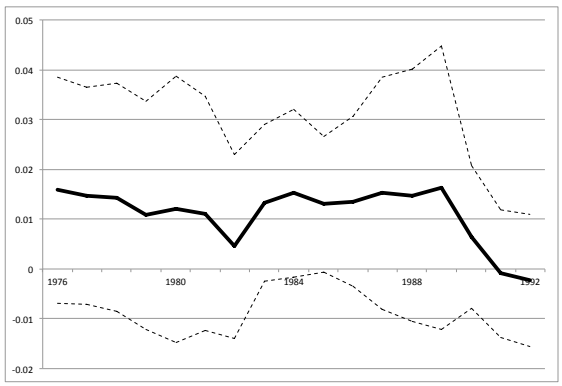
Figure 3.12: Time varying relationship: Very low birth weight

(a) Fix start year 1976, vary end year from 1985 to 2011

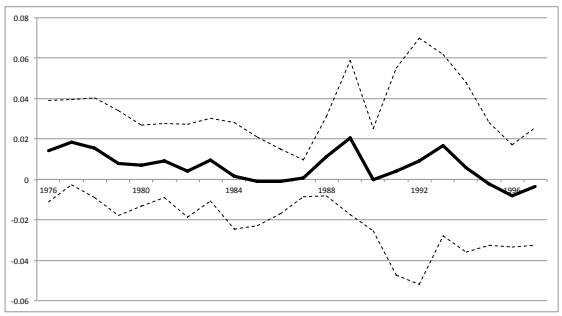
(b) Fix end year 2011, vary start year from 1976 to 2002



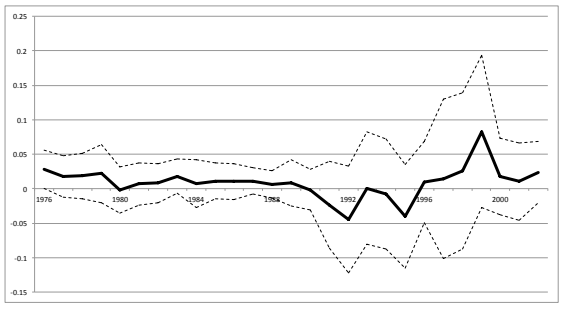
(c) 20-year window



(d) 15-year window



(e) 10-year window



(f) 5-year window

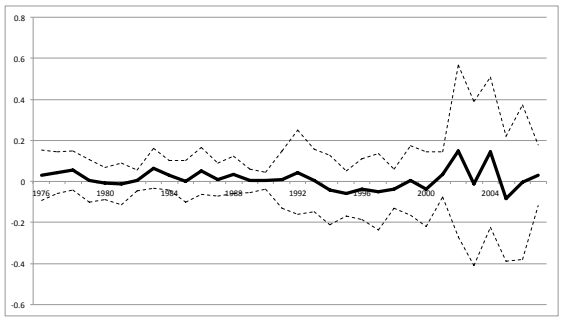
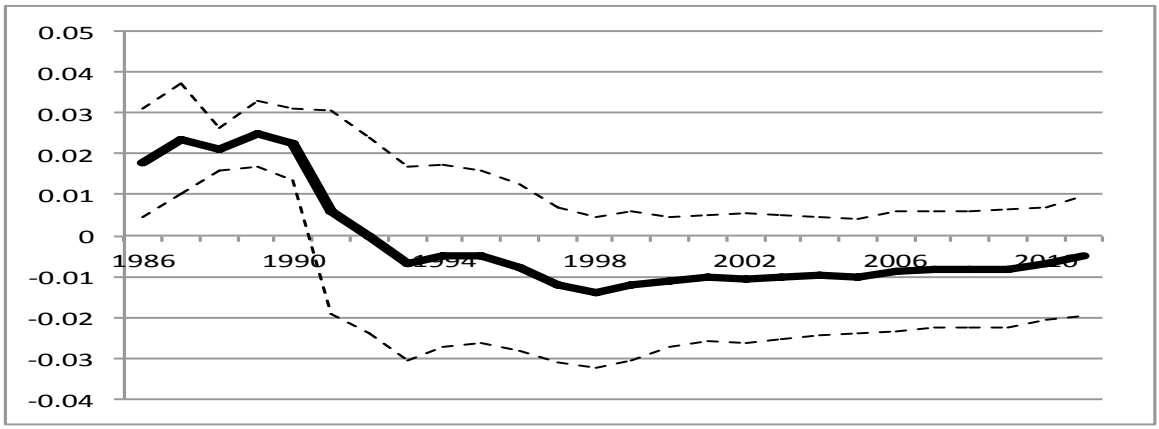
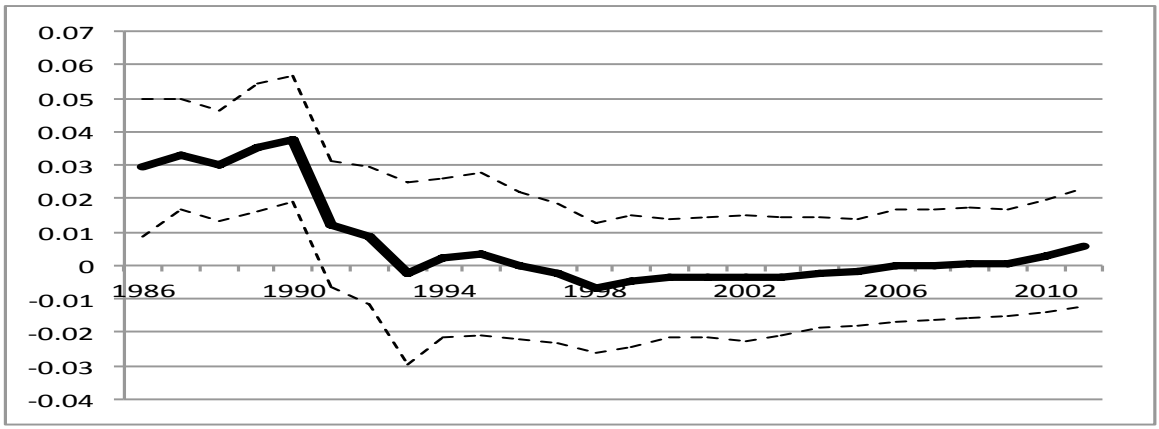


Figure 3.13: Employment rate - fix 1977 start year, vary end year from 1986 to 2011

(a) Infant mortality



(b) Neonatal mortality



(c) Postneonatal mortality

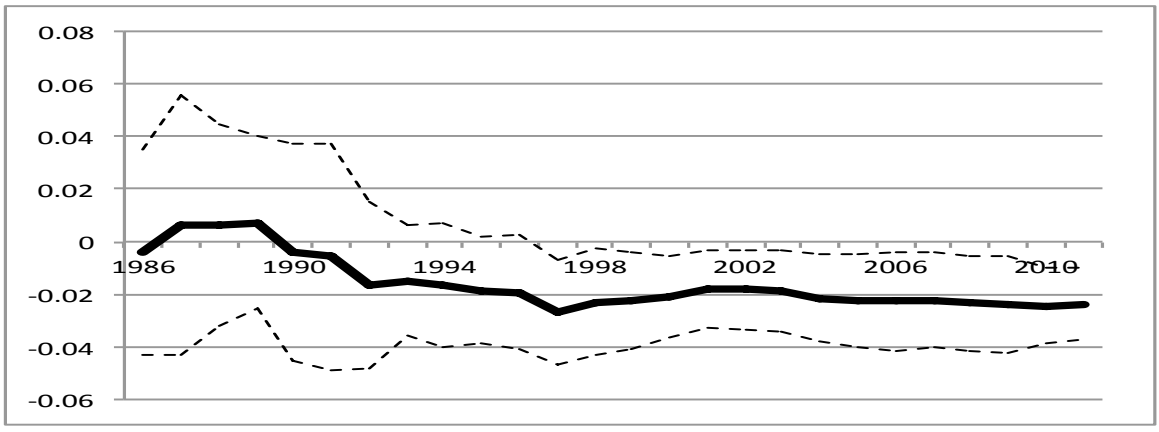
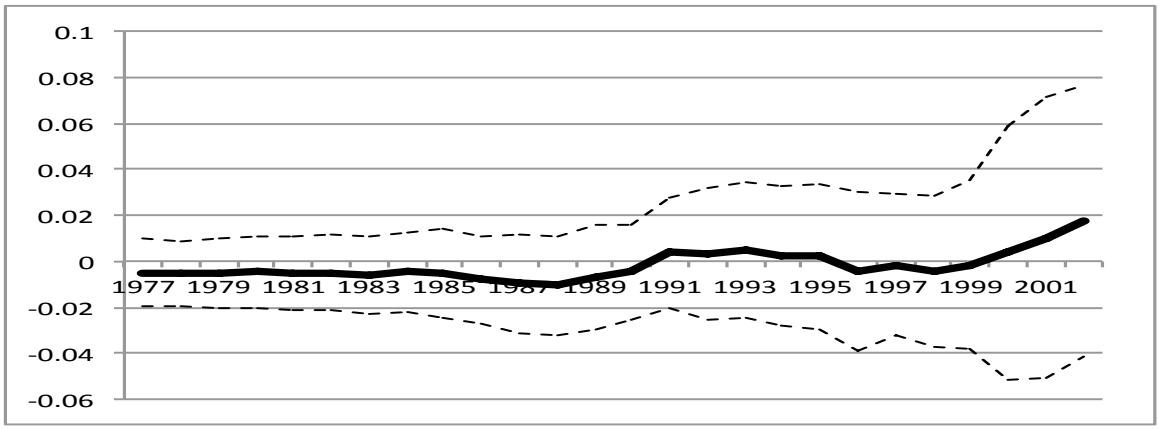
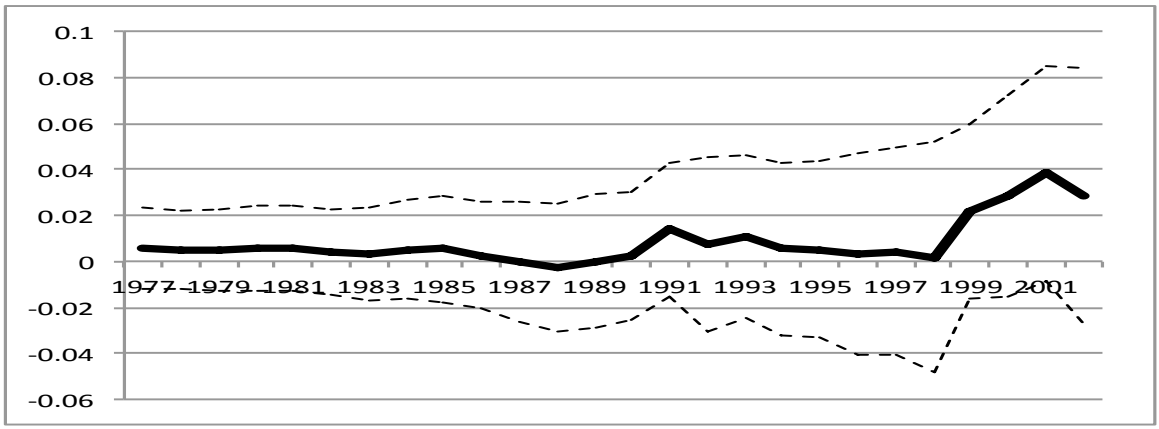


Figure 3.14: Employment rate - fix end year 2011, vary start year 1977 to 2002

(a) Infant mortality



(b) Neonatal mortality



(c) Postneonatal mortality

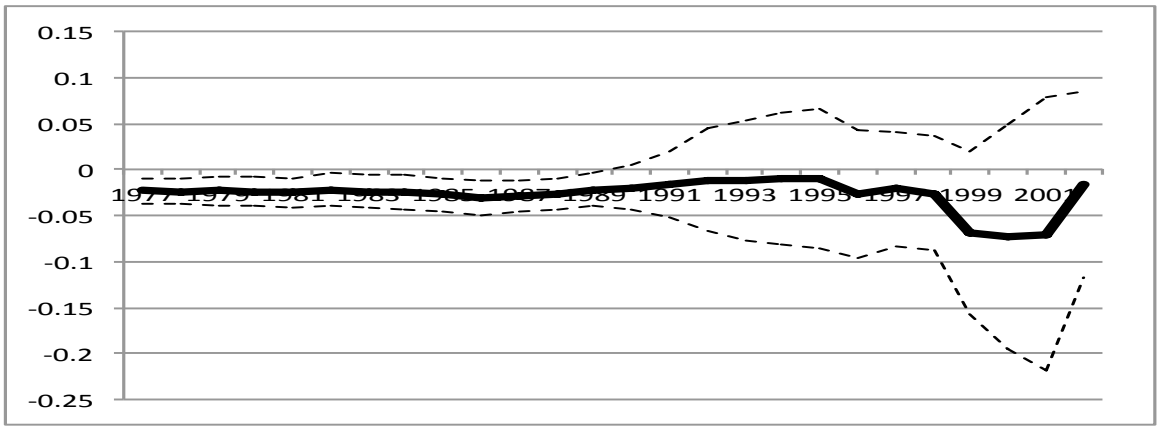
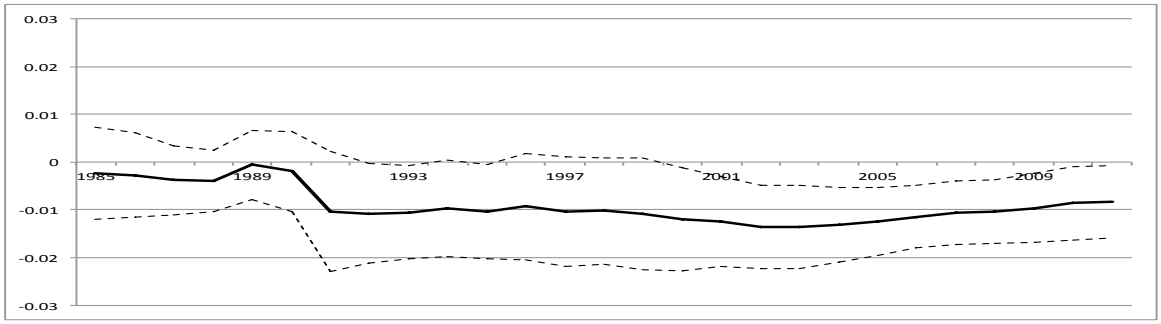


Figure 3.15: Employment rate - fix 1976 start year, vary end year from 1985 to 2011

(a) Low birth weight



(b) very low birth weight

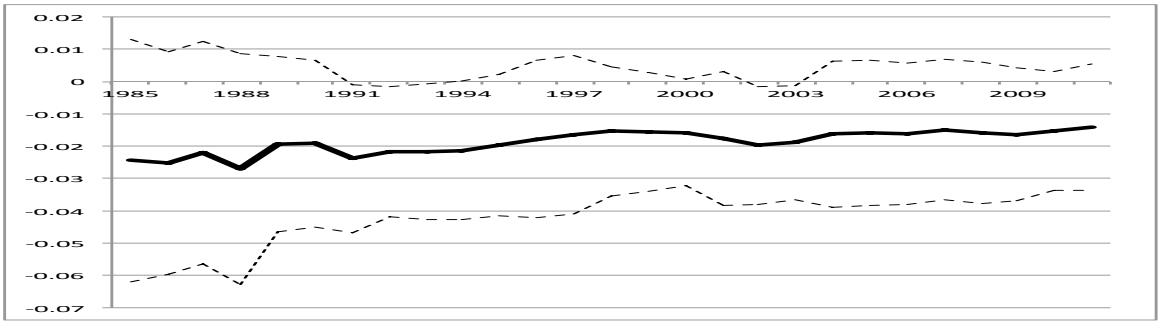
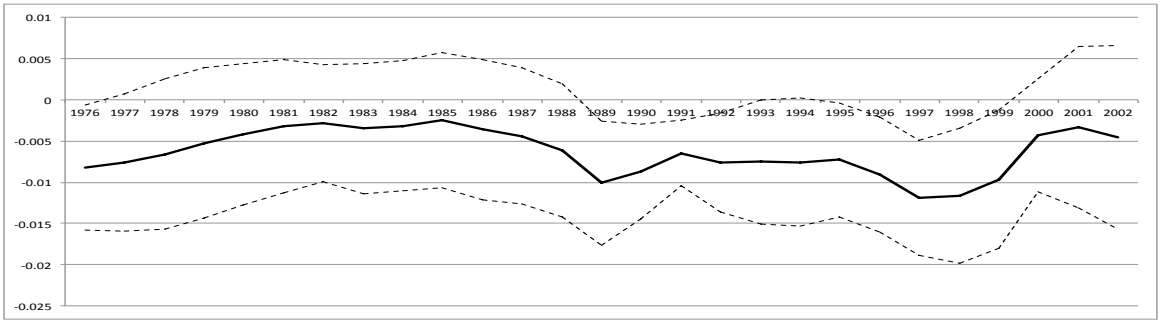
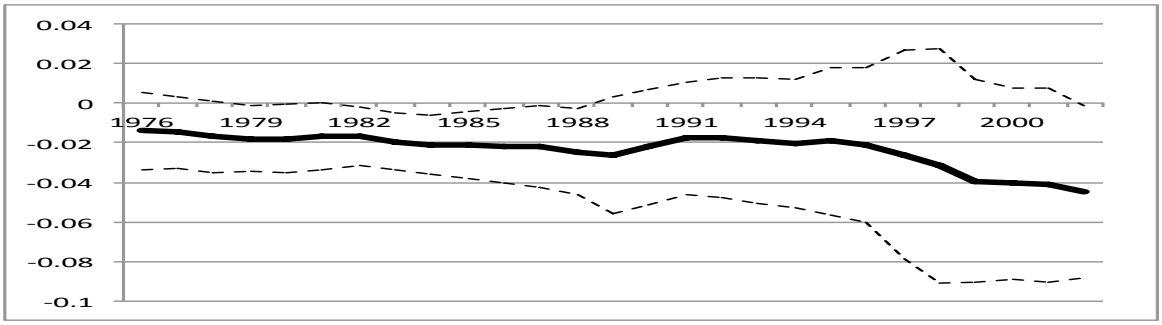


Figure 3.16: Employment rate - fix 2011 end year, vary start year from 1976 to 2002

(a) Low birth weight



(b) very low birth weight



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Conclusion

This thesis has investigated a range of questions related to the economics of health. Birth related health is important because it can have lasting effects into childhood and adulthood. Moreover, health behaviours are modifiable which might suggest an avenue for policy to address the impact of economic fluctuations. The first chapter focused on individual health behaviours, and whether individuals change their behaviours as a result of economic fluctuations. The second chapter focused on examining the impact of labour market conditions on infant health, while the third chapter continued to examine this group but undertook a detailed sensitivity analysis of the modeling, choice of time frame and proxy definition. Each thesis chapter is a self-contained piece of research and each makes contributions to the current literature in these areas of health economics.

The first thesis chapter used the working age population as the sample for study and analyzed how local labour market fluctuations impact the health and health behaviours of individuals in Canada. It used repeated cross sectional Canadian data combined with a fixed effects methodology to look at how changes in Census Metropolitan Area unemployment rates are related to health and health behaviours. Moreover, we defined the working age population as those between 25 and 59 in order to restrict the sample to those for whom labour market conditions are most relevant. We estimated full sample models, and also models that are stratified by sex and by education level.

From the results, of particular note is the association of the unemployment rate with the

consumption of fruits and vegetables. As the unemployment rate increases, the consumption of fruit and vegetables decreases. This result is particularly important to note because diets that consist of sufficient fruit and vegetable consumption may have a significant input into the long term health of individuals by avoiding risks of chronic diseases, cardiovascular disease, and cancer and even improve mental well-being. Our results suggest that since changes in economic conditions impact the consumption of fruits and vegetables of Canadians, policy response to economic contractions should consider this accordingly. Overall, many other estimates are not robust to changes in economic conditions, which might suggest that Canadians are more resilient than their U.S. counterparts to the impact of worse economic conditions on health and health behaviours.

Both the second and third chapters provide results that shed light on the understanding of how infant health outcomes measured by crude birth rate, birth weight, the percentage of babies born with low birth weight (below 2500 grams) and very low birth weight (below 1500 grams) are impacted by worse economic conditions. This evidence may provide important insight for the design of health policy that aims to improve infant health. The second chapter contributes to the child health literature since a paucity of studies in the child health literature have looked at the relationship between infant health outcomes and economic fluctuations, specifically for Canada. The results from the models indicate that when the unemployment rate increases infant health deteriorates.

The third chapter examined the sensitivity of the relationship between economic conditions and infant health outcomes and explored how the choice of alternate economic proxies, model specification and time frame affect estimates of the relationship(s) of interest. We used a comprehensive set of definitions of economic proxies and find that some estimates show difference in magnitude but most follow similar patterns to that of the unemployment rate. We found that the estimates are sensitive to the choice of start and end date and to the time frame under analysis. Finally, the employment rate as a proxy yields many more

estimates that are statistically significant regarding the relationship between economic conditions and the percentage of infants born weighing less than 2500 grams and the percentage of infants born weighing less than 1500 grams.

The last two chapters provide important messages about the impact of economic conditions on infant health. First, it is important to recognize that infant health in Canada suffers in worse economic times and that policies aimed at attenuating these effects may be important. Second, while results are robust for most time frames under analysis, we found that results can be sensitive to the choice of start and end date and that this consideration needs to be appropriately considered in devising relevant policy.

This thesis reveals some important areas for future research and extensions. Considering infant health, one direction for future studies is the attempt to better identify the causal effect of labour market conditions on infant health. Identifying the causal effect of labour market conditions on infant health faces some common empirical challenges as outlined in the thesis. Furthermore, the level of aggregation might be considered when modeling economic conditions. Looking at more disaggregated levels of variation like economic regions may provide improved estimates, but migration would become an issue. If researchers possessed information on residential location and location of employment, in that case, future studies could use similar methods but implement narrower definitions of area to explicitly examine variation at those levels. Another direction is to study the connection between birth outcomes and child outcomes by using a longitudinal dataset such as the National Longitudinal Survey of Children and Youth. This thesis found that Canadian infants are negatively impacted by worse economic times, and thus using the National Longitudinal Survey of Children and Youth to look at child health outcomes born during worse economic conditions would be a natural extension. Similarly, the first chapter used the Census Metropolitan Area level to look at how local labour market fluctuations impact the health and health behaviours of individuals. This chapter can be extended to study more hetero-

geneous impacts such as rural and urban regions and then perhaps dissecting the sample to examine how different races are impacted. Overall, it seems there is substantial work left to do, especially in the Canadian context.