Macroeconomic Conditions and Children's Health

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THESIS

Submitted as partial fulfillment of the requirements
for the degree of Doctor of Philosophy in Economics
in the Graduate College of the
University of Illinois at Chicago, 2014

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ACKNOWLEDGEMENTS

I would like to dedicate this dissertation to the memory of Dr. Aijaz A. Khan. He was the first in our family to earn his PhD, and without his encouragement and support I would have never set out on this journey. I would also like to thank my parents, Ashfaq and Tanveer Khan, my husband, Muzammil Qurashi, and my brother, Altaf Khan for their love, faith, dedication, and support during all the difficulties I faced in this long process. I would particularly like to mention my daughter Nuha Qurashi whom I love most in this world, and who never gave up on her mother earning her doctoral degree.

I would also like to sincerely thank my committee members for their encouragement and help. Dr. Frank Chaloupka for being an amazing advisor, Dr. Robert Kaestner for encouraging me to apply to graduate school, Dr. Evelyn Lehrer for introducing me to the field of Economics and sparking that interest in me, Dr. Lisa Powell for giving me the opportunity to learn so much from her by being her research assistant, and Dr. Xin Xu for always reminding me about the light at the end of the tunnel.

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I.BACKGROUND

Introduction

In 1981, a select panel for the Promotion of Child Health quoted "*Children are one third of our population and all of our future"(Select Panel for the Promotion of Health Care, 1981).* Children are the future of our society, and each decision we make for them today has an impact on them tomorrow. More specifically, the decisions we make for our children's health today provides the foundation for their health throughout their life, determines the health of the next generation, and establishes the overall health of the entire nation. Theoretically, health is viewed to be a combination of inherited initial stock of health at birth that depreciates with age and can be increased by investment over time(Grossman, 1972;Halfon, DuPlessis, and Inkelas, 2007). Furthermore, the foundation for physical, cognitive and socio-emotional health is built in the early childhood years such that early investments in health promotion can greatly improve a child's long-term health, behavior, economic and civic outcomes(Heckman, 2006). Therefore, it is important to continue efforts for advancements in children's health in the United States through improvements to a wide range of conditions, health behaviors and quality of life indicators.

A healthy environment is an important determinant of health and well-being, particularly among children. Over the last several years, the United States has faced fluctuating economic conditions (National Bureau of Economic Research, 2010) influencing many aspects of our lifestyle(Cho, 2001;Erikson and Wlezien, 2008), including our health and well-being. This has brought attention to research studying the relationship between health and economic conditions measured by macroeconomic indicators. A majority of these studies have extensively looked at this association among adults while only a few studies have examined this correlation among

children. Surprisingly, the results from these studies indicate economic changes have mixed influences on individual health (Parker-Pope, 2008). Therefore, this inconsistency suggests additional studies that build on the framework and methodology of the analysis, attempt to identify causal mechanisms through which economic activity may affect health, and specifically look at health impact on the child population are needed.

The purpose of this dissertation is to investigate the relationship between economic indicators including unemployment rates and gross domestic product (GDP) on child health outcomes including prevalence of overweight/obese, prevalence of obesity, child BMI percentiles, frequency of illness that required medical attention or treatment among children who reported an illness, and occurrence of a child illnesses that required medical attention or treatment. The theoretical model of demand for child health is presented and potential parental mechanisms are identified. Empirical strategies are constructed that replicate those of cross-sectional work in much of the existing literature and a longitudinal model is developed in attempts to better identify the impact of economic changes on individual children. Finally, the instrumental variables approach is adopted to identify causal mechanisms through which economic activity may affect health outcomes, given that macroeconomic conditions do not affect health, rather it is changes in time and monetary inputs that are associated with changes in indicators that influence health outcomes.

Findings from this research may help to dissect and understand the mixed evidence in existing literature and determine how economic activity is associated with health, and also compare how the results differ between the adult and child samples. It may also help determine policy implications for health investments in many areas including economics and public health policy to reduce any long term health consequences for children associated with the overall

economy. Furthermore, targeting the exact child demographic populations that will most strongly be influenced by the variations in economic conditions may help policy makers determine the areas in which these implications will be most beneficial.

Specific Research Aims

The theoretical framework of this study suggests that a household maximizes its utility over children's health stock and other household characteristics, subject to time and budget constraints. Furthermore, child health is produced by parents using their own time and market goods. Macroeconomic conditions affect children's health through its impact on parental allocation of time and economic resources. Unemployment rates and GDP growth rates are important indicators used to measure the state of the economy(American Association of Individual Investors, 2003). Changes in these state-level indicators are likely to shift the amount of time and monetary resources available for investments in children's health. Based on this theory, the research questions, hypothesis, and contributions for this study include the following:

Research Questions:

Weight Outcomes:

- Are changes in economic indicators measuring labor force participation including state-level unemployment rates associated with child weight outcomes with respect to child prevalence of overweight and obese (BMI percentile $\geq 85^{th}$), prevalence of obesity (BMI percentile $\geq 95^{th}$), and body mass index (BMI) percentiles?
- How does the association of unemployment rates on child weight outcomes differ between economic models including reduced form cross sectional models, individual fixed effect longitudinal models, and an identification strategy model with the use of instrumental variables?

- How does the association between overweight prevalence, obesity prevalence and BMI percentiles related to fluctuations in the state-level unemployment rates differ across the following subpopulations:
    - *Demographic*: Race and age
    - *Mother's characteristics*: Highest level of education completed
    - *Socioeconomic*: Average household income and type of insurance coverage
    - *State-level characteristics*: Unemployment insurance benefits levels
- Are changes in economic indicators measuring productivity and growth including state-level gross domestic product (GDP) growth rate associated with child weight outcomes with respect to prevalence of overweight and obese (BMI percentile $\geq 85^{th}$) , prevalence of obesity (BMI percentile $\geq 95^{th}$), and body mass index (BMI) percentiles?
- How does the association of GDP growth rates on child weight outcomes differ between economic models including reduced form cross sectional models, individual fixed effect longitudinal models, and an identification strategy model with the use of instrumental variables?
- Do these changes in overweight prevalence, obesity prevalence and BMI percentiles associated with fluctuations in the state-level GDP growth rates differ across the following subpopulations:
    - *Demographic*: Race and age
    - *Mother's characteristics*: Highest level of education completed
    - *Socioeconomic*: Average household income and type of insurance coverage
    - *State-level characteristics*: Unemployment insurance benefits levels

Child Illnesses:

- Are changes in economic indicators measuring labor force participation including state-level unemployment associated with the prevalence and number of times children were ill and required medical attention or treatment?
- How does the association of unemployment rates on child prevalence and frequency of illness differ between economic models including reduced form cross sectional models, individual fixed effect longitudinal models, and an identification strategy model with the use of instrumental variables?
- Do these changes in the occurrence and frequency of illnesses associated with fluctuations in the state-level unemployment and/or employment rates differ across the following subpopulations:
    - *Demographic*: Race and age
    - *Mother's characteristics*: Highest level of education completed
    - *Socioeconomic*: Average household income and type of insurance coverage
    - *State-level characteristics*: Unemployment insurance benefits levels
- Are changes in economic indicators measuring productivity and growth including state-level gross domestic product (GDP) growth rate associated with the prevalence and number of times children were ill and required medical attention or treatment?
- How does the association of GDP growth rates on child prevalence and frequency of illness differ between economic models including reduced form cross sectional models, individual fixed effect longitudinal models, and an identification strategy model with the use of instrumental variables?

- Do these changes in the occurrence and frequency of illnesses associated with fluctuations in the state-level GDP growth rates differ across the following subpopulations:
    - *Demographic*: Race and age
    - *Mother's characteristics*: Highest level of education completed
    - *Socioeconomic*: Average household income and type of insurance coverage
    - *State-level characteristics*: Unemployment insurance benefits levels

Hypothesis:

- Improvements in the economy measured by decreasing unemployment rates and increasing GDP growth rates will alter the prevalence of undesired child weight outcomes in terms of overweight and obesity in children due to changes in the composition of parental time and monetary inputs in children's health.
- Improvements in the economy measured by decreasing unemployment rates, increasing employment rates, and increasing GDP growth rates will also alter the prevalence and frequency of illnesses among children due to changes in the composition of parental time and monetary inputs in children's health.

Contributions:

- This is one of the first studies that attempt to evaluate the influence of macroeconomic indicators on child health outcomes using a nationally representative sample in the United States.
- This study replicates the techniques used in many influential papers in the adult literature for the child sample and compares the results for both samples.

- This study attempts to improve the methodology by taking advantage of longitudinal nature of data and implementing individual fixed effect models.
- This study attempts to expand on current studies looking at the relationship between economic conditions and health by attempting to identify the causal mechanisms during economic fluctuations that lead to changes in health outcomes.
- The results from this study will provide preliminary results to help determine implications and directions more advanced work in this area of literature that will be useful for understanding the importance of heath investments in children in relation to economic activity.

II. LITERATURE REVIEW

This chapter reviews the research relevant to the relationship between economic conditions and children's health. It looks over numerous studies conducted on health including health outcomes, mortality, and obesity trends. First, it reviews research primarily among the adult population including both time series and micro-econometric studies which yield mixed results mainly using cross sectional data. This is useful because it provides a strong starting point for the methodology in this study, identifies gaps in the literature in terms of the framework, and attempts to provide a better approach to future research. Next, it looks at a summary of the literature for studies that look at the association between economic activity and health among the youth and children. Finally, a brief overview of the literature review is provided that discusses the contributions of this dissertation to this area of research.

Adult Studies

Background

The relationship between macroeconomic conditions and adult health has been a widely studied area of economics. Numerous studies look at the association between economic activity measured by indicators such as unemployment rates and gross domestic product (GDP) by analyzing how they influence health outcomes measured by mortality, use of medical care, illnesses, and weight outcomes. Although these studies often provide mixed results, the methodological framework and mechanisms through which macroeconomic indicators affect health outcomes may offer useful insight when studying this relationship for children's health outcomes

Economic research has devoted much attention to the impact of macroeconomic fluctuations on a variety of outcomes including employment, earnings, purchasing power,

criminal activity and human capital investment (Arvanites and Defina, 2006;Chen, 2010;Devine, Sheley, and Smith, 1988;McDonald and Worswick, 1999;Raphael and Winter-Ebmer, 2001;Rosenfeld and Fornango, 2007;Sakellaris and Spilimbergo, 2000;Schuetze, 2000;Solimano, 1989;Teles, 2004). There has also been a rising interest in the connection between the macro-economy and health. Conceptually, changes in economic conditions might impact health through different channels.

First, a weakened economy may increase stress as a results of greater uncertainty of present and future income (Catalano, 1991;Catalano and Dooley, 1983). This increase in stress levels may result in poorer overall adult health status. Furthermore, if the uncertainty over income influences the likelihood of other life events such as bankruptcy, foreclosure, or divorce, it will further exacerbate the stress associated with poor economic conditions (Charles and DeCicca, 2008). Therefore, if poor economic conditions induce stress that is harmful to individuals' health in the short run, a positive relationship between macroeconomic conditions and favorable health will occur.

Similarly, with regards to monetary inputs, changes in economic conditions may lead to changes in household income. There is a relatively strong association between income and health (Stronks, van de Mheen, van den Bos, and Mackenbach, 1997). Since unemployment or other factors associated with poor economic conditions leads to restricted financial resources and declines in standards of living, it can lead to poor nutrition and limited access to necessary health care (Creed, 1998;Stern, 1983;Ungvary, Morvai, and Nagy, 1999). These factors may lead to declines in health outcomes suggesting a direct correlation between economic conditions and health outcomes.

On the other hand, they may impact health through changes in the opportunity cost of time. For example, when labor market conditions worsen through a rise in unemployment rates, it leads to a reduction in employment on the intensive and extensive margins. This results in lower opportunity cost of other non-market activities including household production. Since the production of health is a time-intensive component of household production, the lower time costs may encourage affected individuals to devote more time to improvements in health (Charles *et al.*, 2008). These improvements in health can be channeled through more exercise, consumption of healthy home prepared meals versus high calorie energy dense restaurant meals or mass-produced meals, and more use of preventative health care. Therefore, if poor economic conditions allow for more investments in health improving activities due to lower opportunity costs, an inverse relationship between macroeconomic conditions and health will occur.

Although "intuition suggests that health would improve during economic expansions and decline during recessions because of income changes"(Xu, 2013), the net impact of economic changes on health is ambiguous. This may depend on which channel has a stronger effect. If a weakened economy leads to a stronger income effect such that there is a decline in the consumption of health promoting goods, it will result in worsened health outcomes for individuals. On the other hand, if a weakened economy leads to a stronger substitution effect such that there is a decrease in the opportunity cost of time available for investments in health, better health outcomes will emerge. This may be one reason why evidence in this area of literature is mixed, and more research in this area of study is necessary to untangle the mechanisms of economic conditions and their impact on health outcomes. Another reason may be difference in methodology implemented in various studies, and this dissertation attempts to specifically identify these factors.

Time Series Studies: Mortality and Other Health Outcomes

The earliest aggregate level analysis in this field begins with a number of time series studies. This line of research looks at the impact of macroeconomic activity on deaths from various causes, overall mortality, and morbidity. The results from these preliminary aggregate level studies run parallel to individual evidence which suggests that unemployed individuals exhibit higher mortality rates and worse average health compared to the employed population (Ettner, 2000;Gerdtham and Johannesson, 2003;Joan, Derek, and Shaper, 1994) . Even after controlling for demographic and socioeconomic indicators, the overall results conclude that unemployed individuals face increased mortality and morbidity rates compared to their employed counterparts (Martikainen and Valkonen, 1998;Martikainen and Valkonen, 1996). These findings would suggest poor economic conditions measured by high unemployment rates would reduce the health outcomes of the overall population.

Research by Brenner (Brenner, 1971;Brenner, 1973;Brenner, 1975;Brenner, 1979;Brenner, 1984;Brenner, 1987;Harvey Brenner, 1987) which utilizes time series data aggregated over a single geographic location confirms this positive relationship between adult health and economic conditions, suggesting upward trends in the economy lead to better health outcomes and lower mortality. The conclusions from these studies suggest that recessions and other sources of economic instability increase total mortality including but not limited to infant mortality, and deaths associated with heart disease, liver cirrhosis, and homicide. This research claims that better management of the economy in terms of a long term economic prosperity leads to better health care quality and availability (Brenner, 1979). For years, these conclusions were very influential to policy makers and were extensively cited (Colledge, 1982;Spruit, 1982) in the economic literature of that era. However, these studies have been widely criticized for their lack

of adequate controls to their econometric modeling techniques (Cook and Zarkin, 1986;Gravelle, 1984;Gravelle, Hutchinson, and Stern, 1981;Kasl, 1979;Stern, 1983;Wagstaff, 1985). Critics argue that Brenner's poorly specified model omits relevant data and uses a poor dataset. Therefore, it overestimates the social costs of unemployment in terms of its effects on mortality and illnesses. Further work which also utilized time-series models either find that the evidence suggesting a positive relationship between economic activity and health is weak, insignificant or sometimes even invalid (Adams, 1981;Forbes and McGregor, 1984;Joyce, 1990;Joyce and Mocan, 1993;Mcavinchey, 1988). As a result, it is evident that the results from these studies are sensitive to the location, time periods, proxies for health, and methodologies employed.

More recent time series work that corrects for the problems of the earlier work by adjusting the lags (Mcavinchey, 1988), correcting for non-stationarity in the time series data (Joyce, 1990;Joyce *et al.*, 1993;Laporte, 2004), implementing spectral analysis and local regression techniques (Granados, 2005b) and using multiple economic indicators with data on individuals rather than aggregates (Gerdtham and Johannesson, 2005) all result in mixed findings with regards to health outcomes including aggregate illnesses, mortality risk, and total mortality. Consequently, this controversial evidence and debate on the methodology of the research suggests that better econometric modeling techniques are necessary in this area of study.

Although a time series approach is not undertaken in this dissertation, it is useful to know that different analytical strategies tend to result in completely different outcomes. Building on the shortcomings of past work, it is useful to keep this in mind when developing further contributions to this area of research.

Micro-Econometric Studies: Mortality and Other Health Outcomes

Better micro-econometric research has been developed in more recent years to evaluate changes in economic activity at more localized regions and looks at its influence on individual health and mortality. In order to remedy the problems associated with the time series analysis; these studies often employ the use of state fixed effects models to control for possible omitted variable bias. Unlike prior publications, these studies control for time-invariant factors that are spuriously correlated with economic conditions across locations.

Using micro-econometric models jointly with aggregated data over time, the relationship between economic activity and health outcomes using measures of total mortality and health outcomes are re-examined. In the United States, a comprehensive set of literature finds that a weak economy is associated with improved health (Ruhm, 2000;Ruhm, 2003;Ruhm, 2005;Ruhm, 2007;Ruhm and Black, 2002). Authors of these studies have suggested that this occurs because of a rise in adults exhibiting healthy behaviors such as regular exercise and a decline in poor health habits such as smoking, excessive alcohol consumption, and poor eating habits which result in increased mortality rates and worsened health outcomes. Some studies find that total mortality (which include death from ischemic heart disease, acute myocardial infarction, influenza, and pneumonia) rates decline by 0.3 to 0.5 percent as unemployment rates increase by one-percentage point, corresponding to an elasticity of -0.02 to -0.05 (Gerdtham and Ruhm, 2006;Granados, 2005a;Granados, 2005b;Neumayer, 2004;Ruhm, 2000;Ruhm, 2005). Interestingly, the decline in mortality accelerated during recessions and reduced or reversed during economic expansions (Granados, 2005b). They also found that short run declines in per capita GDP were associated with a decrease in the a number of cause specific mortality rates, with the exception of suicides (Gerdtham *et al.*, 2005;Gerdtham *et al.*, 2006;Granados,

2005b;Neumayer, 2004;Ruhm, 2003;Tapia Granados, 2008). Furthermore, in adults aged 30 and over, a one point increase in unemployment reduces the fraction of adults with one or more medical conditions by 1.5 percent (Ruhm, 2003). These results suggest an inverse relationship between the economy and health outcomes. These results for mortality were generally consistent for the United States and other developed countries where lower opportunity costs of health production allows individuals to devote more time to improvements in their overall well-being.

However, other research suggests that mortality does not always decline during periods of economic decline across the globe (Catalano, 1991;Cutler, Knaul, Lozano, Mendez, and Zurita, 2002;Economou, Nikolau, and Theodossiou, 2008;Gerdtham *et al.*, 2005;Martikainen *et al.*, 1996). A European study finds a rise in total mortality rate by 0.3 percent with a one-percentage point increase in unemployment rates (Economou *et al.*, 2008). Similarly, Swedish studies using the same methodology also find improving economic conditions are associated with lower mortality (Gerdtham *et al.*, 2005;Svensson, 2007). More specifically, this inverse relationship is often observed in less developed countries such as Mexico (Cutler *et al.*, 2002), where mortality rates for the very young and elderly were found to rise or decline less rapidly in years of economic crisis. A possible mechanism for this association could be an inverse relationship between local economic conditions (such as local unemployment rate) and personal income. The inability to smooth income during periods of economic distress is more prevalent in less developed countries. Therefore, the rise in mortality can be attributed to a direct income effect or even a result of an income induced stress effect. Additionally, a number of research studies in poor countries have found that economic growth, measured by gross national product (GNP) per capita, improved health outcomes by improving essential living standards such as

food, clean water, shelter and access to basic health services (Bezruchka, 2009). Nevertheless, once a country reaches a GNP per capita of $5,000 to $10,000 there are few health benefits from further economic growth (Pickett and Wilkinson, 2010). In the case of developed countries such as the United States, the distribution of resources across the population is a better indicator of promoting health improvements. Health improvements have declined and greater health disparities have occurred in the U.S. with the rise in income inequality in recent years (Ezzati, Friedman, Kulkarni, and Murray, 2008) Thus, those individuals with lower socioeconomic status (SES) are more likely to see improvements in health with a growing economy, parallel to patterns of the overall population in less developed countries.

Micro-Econometric Studies: Overall Health Behaviors

The effects of local economic activity on adult health behaviors are also examined in the literature. Harmful behaviors that can lead to negative health consequences include excessive alcohol consumption, cigarette smoking, excessive consumption of energy high calorie/energy dense meals, and lack of physical activity. Research suggests that temporary changes in economic conditions influence individual behaviors; however the direction and magnitude of the findings are inconsistent.

The literature suggests that poor macroeconomic conditions that reduce an individual's working hours will result in increased time for non-market activities such as physical activity and preparation of meals at home. Furthermore, the decreased income results in a decline in consumption of normal goods such as alcohol and cigarettes (Ruhm, 2004a). This transition to healthier behaviors supplies one mechanism for better health outcomes. A few studies have found that these health behaviors improve as economic conditions worsen (Ettner, 1997;Ruhm,

2000;Ruhm, 2003;Ruhm, 2005;Ruhm *et al.*, 2002) through reduced alcohol consumption, declines in tobacco use, and increased physical activity. For example, reductions in alcohol related vehicle mortality during weakened economic times occur due to declines in heavy alcohol use (Ruhm *et al.*, 2002).

On the other hand, increased stress during poor economic times may induce poor habits and have the opposite effect on health outcomes resulting from a rise in binge drinking, cigarette smoking, and declines in physical activity. Some research found that economic contractions and involuntary unemployment led to a rise in alcohol consumption and binge drinking (Dee, 2001;Ettner, 1997). Therefore, these studies clearly indicate variations in economic activity impact individual behaviors; however, the concluding results are often mixed.

Micro-Econometric Studies: Weight Outcomes and Obesity Status

Another strong indicator of an individual's well-being used in recent economic literature is obesity status. Individuals who are overweight or obese tend to have poor dietary patterns, low levels of physical activity, and suffer from more health problems overall (Flegal, Carroll, Kuczmarski, and Johnson, 1998). In 2009-2010, obesity rates among adults in the United States were 36.9% (Ogden CL, 2012). Furthermore, the annual healthcare cost burden associated with obesity was recently estimated to be as high as $209.7 billion(Cawley and Meyerhoefer, 2012). Studies that look at the association between economic activity and obesity rates also yield inconsistent findings. A major portion of the literature finds that improvements in the economy led to a stronger association with obesity prevalence among adults (Ruhm, 2000;Ruhm, 2003;Ruhm, 2005). Particularly, reductions in employment rates lead to a decrease in severe obesity, and there is little change in the anticipated prevalence of overweight. The findings

suggest bigger variations in excess body weight for males and minorities in comparison to females and non-Hispanic Whites (Ruhm, 2005). The overall consumption of dietary fat falls and the intake of fruits and vegetables increases, suggesting that obesity may decline because people have more time to exercise and prepare healthy meals during periods of unemployment (Ruhm, 2000). On one hand, a study finds that economic insecurity tends to cause a rise in weight gain (Smith, Stoddard, and Barnes, 2009). It concludes that a one percentage point increase in the probability of becoming unemployed causes a 0.6 pound increase in adult weight. Additionally, improvements in economic conditions measured by the employment rate led to declines in body mass index (BMI) declines and prevalence of obesity for adults in Finland (Bockerman, Johansson, Helakorpi, Prattala, Vartiainen, and Uutela, 2007). Given that the research in this area of literature yields weak and mixed findings, the evidence for impact of economic conditions on weight outcomes and obesity status is not concrete. Overall, the review of the micro-econometric literature suggests improvements in the methodology may help to better capture the effect of changes in economic activity on changes in adult health outcomes. Since most of the existing work utilizes cross-sectional data, taking advantage of longitudinal datasets and methodology may help to identify channels through which changes in economic activity may influence health.

Child Studies

A limited number of studies have looked at the influence of economic conditions children's health, and as in the case of adults the results in the existing literature are also mixed. This particular population is not often directly affected by variations in business cycles from the aspects of personal employment and personal income. However, the impact these conditions have on their parents or society overall may play a crucial role in determining the health effects

on the younger population. In the long run, reducing poor health outcomes as a child may even improve an individual's health attained in adulthood.

A study by (Ferreira and Schady, 2009) provides a useful overview of the literature that analyzes the effects of aggregate economic shocks on child health. They state that the theoretically expected effects are ambiguous because of a tension between income and substitution effects. Their review summarizes that in rich countries with credit markets, such as the United States, health is countercyclical and improves as a result of a negative economic shock due to a decline in the opportunity cost of time intensive health promoting activities for parents and the ability to smooth out income shocks with the availability of credit markets. In these countries, spells of unemployment actually led to a decline in neonatal and post-neonatal mortality, lower birth malformations, and a decline in low birth weight babies because mothers obtain more prenatal care during recessions driven by changes in their opportunity costs of time and behavioral composition (Dehejia and Lleras-Muney, 2004;Ferreira *et al.*, 2009).

However middle and poor income countries that have more credit constraints such as those in Africa or Latin America, the net impact of economic shocks on health outcomes is ambiguous. In some countries, child health actually declines with negative economic shocks. This may be due to the income effect where economic recessions lead to a decline in the consumption of health promoting goods. Infant mortality actually rose and children's nutritional status fell during the economic crisis of Peru from 1988-92 estimating approximately 18,000 "excess" deaths that would not have occurred if there was no economic crisis (Paxson and Schady, 2005). Other studies developing countries including but not limited to in Mexico, Indonesia, and Russia find that economic crisis periods led to increases in infant and child mortality (Baird, Friedman, and Schady, 2011;Catalano, 1991;Cutler *et al.*, 2002;Frankenberg,

Thomas, and Beegle, 1999;Rukumnuaykit, 2003;Simms and Rowson, 2003). A Russian study found that families switched from more expensive sources of calories such as fruits and vegetables to less expensive sources resulting in a slight deterioration of the child's nutritional status(Stillman and Thomas, 2004). Overall, these countries exhibit a larger decline in health promoting expenditures than benefits from more time available for child care and less consumption of unhealthy goods during weakened economic times.

Similar to adult studies, some of the research suggests there is no evidence that economic conditions have an impact on children's health. A group of studies finds no causal relationship between economic conditions as measured by unemployment rates and GDP growth rates and infant mortality (Bhalotra, 2010;Joyce, 1990;Joyce *et al.*, 1993). Studies in Indonesia find no evidence that economic recessions influence height, weight and blood hemoglobin levels in children(Frankenberg *et al.*, 1999;Strauss, 2004).

In general, the effect of aggregate economic shocks on child health outcomes is ambiguous. Based on the existing literature in rich countries such as the United States, negative economic shocks are associated with improvements in child health outcomes. In developing middle income countries the net effect is ambiguous as in some countries the association is negative and in others it is positive. In poor countries, economic recessions are generally associated with unfavorable child health outcomes. Overall, further research with improved methodology is needed in this field to determine the overall influence of changes in macroeconomic conditions on child health outcomes, particularly in more developed countries such as the United States.

III.THEORETICAL MODEL AND EMPIRICAL METHODS

This chapter briefly summarizes the economics theories that are utilized to develop the empirical models used in this study. An analytical framework is presented built on the theoretical model and its predictions. The empirical implementation models are presented in relation to the research design of the current study.

Theoretical Model

The economic model derived in this study uses the human capital model of the demand for health(Grossman, 1972;Grossman, 2000;Leibowitz, 2003), theories of allocation of time(Becker, 1965), and child quality models (Becker and Lewis, 1974;Jacobson, 2000;Leibowitz, 2003) to determine the potential mechanisms through which economic activity may influence children's health outcomes. Children's health depends on many factors including the "stock" of health capital, monetary resources in the form of household income, and time investments of parents. More precisely, parents allocate resources between child health and other factors(Vistnes and Hamilton, 1995). Therefore, parents choose to make investments in their child's health outcomes which are produced using market goods and time such that children do not have a separate choice function.

Demand for Child Health:

The household maximizes lifetime utility:

$$Max\ U = \int_t^T e^{-\theta t}\, u(HP_{it},\ HC_{it},\ Z_{it}) \quad \textbf{(1)}$$
$$t=1,\ 1\ldots n$$

such that

HP_{it}= Stock of parent health in period t

HC_{it}= Stock of child health in period t

Z_{it}=consumption in period t

This is subject to the goods budget constraint shown as the present value of parental expenditures on goods being equivalent to parental earnings income and initial assets:

$$\sum_{t=0}^{n}(PP_t MP_t + PC_t MC_t + Q_t X_t)/(1+r)^t = \sum_{t=0}^{n}(W_t TW_t)/(1+r)^t + Vo \quad \textbf{(2)}$$

MP_t = Vector of inputs purchased in market by parents that contribute to investment in their own health

MC_t = Vector of inputs purchased in market by parents that contribute to investment in child health

X_t = Vector of inputs used in the production of Z

PP= Price of medical care for parent

PC= Price of medical care for child

Q= Price of X

W = Parent's wage rate

TW = Parent's hours of work

V = Parents non-earned income other assets that do not involve any sacrifice of time

r= Market interest rate

Furthermore, it is also subject to the parent's total time budget constraint is written as follows:

$$\Omega = TW_t + THP_t + THC_t + TZ_t + TSP_t + TSC_t \qquad \textbf{(3)}$$

Ω = Total parental time available

TW= Parental time spent working in the labor market for wages

THP= Parental time spent in improving their own health

THC= Parental time spent in improving child health

TZ = Parental time spent producing Z

TSP= Parental time sick

TSC= Parental time spent taking care of sick child

By combining the goods and time budget constraints, the following is obtained:

$$\sum_{t=0}^{n}(PP_t MP_t + PC_t MC_t + Q_t X_t + (W_t(THC_t + THP_t + TZ_t + TSC_t + TSP_t))/(1+r)^t = \sum_{t=0}^{n}(W_t \Omega)/(1+r)^t + Vo \qquad (4)$$

The left hand side of this constraint represents spending while the right hand side represents a family's potential income.

Maximizing the utility function with respect to investments in health and the given budget and time constraints results in the present value of the marginal cost of parental investments being equal to the present value of the marginal benefits. This model implies that the family will invest in health until the rate of marginal utilities of health to the effective price of health for all family members is equal and equal to the marginal utility of wealth, where the family will not try to equalize the amount of health capital between family members (Jacobson, 2000). Further, it suggests that poor families with wealth restrictions value a marginal change in child's health higher than rich families. It also suggests that a child with unhealthy parents may have lower health because of more resources being devoted to improving parental health in comparison to those children with healthy parents. Overall, with regards to child health, the family will invest in child health until the marginal benefit of new child health equals the marginal cost.

Production Function of Child Health

A child's health at age t depends on her health at birth and all investments in health from birth to age t. Investments in health include parental time, nutrition, physical activity, medical care and other goods (Cunha and Heckman, 2007;Grossman, 1972;Todd and Wolpin, 2007). As in the case of adult health, the allocation and efficiency of non-working parental time and parental income are important components of child health status.

$$HC_{it} = (HC_0, TH_{ik}, THC_{ik}, MC_{ik}) \qquad (5)$$

HC_{it}=Stock of child health

HC_0=Stock of child health at birth

TH_{ik}=Child time spent improving own health

THC_{ik}=Parent time spent improving child health

MC_{ik}=Vector of inputs purchased in market by parents that contribute to investment in child health

Based on this, we obtain the following:

$$HC_{t+1} = (1 - \delta_t)HC_t + I_t \qquad (6)$$

By recursive substitution:

$$HC_{t+1} = f(HC_0, I_1, \dots, I_t) \qquad (6b)$$

The investments in child health and other commodities are measured by:

$$I_t = I_t(MP_t, MC_t, THP_t, THC_t, E) \qquad (7)$$

$$Z_t = Z_t(X_t, TZ_t, E) \qquad (8)$$

MP_t = Vector of inputs purchased in market by parents that contribute to investment in their own health

MC_t = Vector of inputs purchased in market by parents that contribute to investment in child health

THP_t = Parental time spent in improving their own health

THC_t = Parental time spent in improving child health

Z_t= Other commodities

X_t = Vector of inputs used in the production of Z

T_t = Parental time spent producing Z

E= Parent efficiency parameter

If *I* consist of investments in children's health in the derived from time spent improving health of child and inputs purchased in the market, and we assume a linear production function then the production function for child health outcomes can be written as follows:

$$\boldsymbol{HC_{it} = \alpha_i + \sum_{k=0}^{t}(\beta_k TH_{ik} + \delta_k THC_{ik} + \rho MC_{ik}) + \mu_{it}} \qquad \textbf{(9)}$$

Overall, macroeconomic conditions will influence the parental time and monetary resources available for the improvement of their children's health. We can assess the impact of temporary fluctuations in local economic activity through changes in parent's opportunity cost of time in labor market and non-labor market activities, and also through present and future income available for consumption of health related market goods and other goods.

Macroeconomic factors, as measured by state unemployment and gross domestic product growth rates, may affect investments in child health. Economic conditions influence children's health at any age through their effects on the parent's total time (*THC*) and monetary resources available for purchasing market goods (*MC*) that contribute to investments in child health. Some literature suggests that general time is more valuable than current household income in the production of child quality including child health and mortality (Cutler and Miller, 2005;Cutler, Deaton, and Lleras-Muney, 2006;Miller and Urdinola, 2007). The distribution of time is split between time spent in the labor market that generates income from wages, time spent in production of child and parental health, time spent in producing other commodities, and time spent when a member of the family is sick. Adverse economic shocks reduce the price of children's health associated with the opportunity cost of parental time (Grossman, 1972;Ruhm, 2000), allowing them to dedicate more time to investments in their children's health.

Furthermore, economic conditions are likely to influence parent's mental health (such as psychological distress or overall stress levels) and physical health in terms of overall well-being (Dooley and Catalano, 1984;Dooley and Catalano, 1988). These mechanisms will influence the amount of time parents devote to health their own health investments and that of their children. For example, poor economic conditions may increase stress and reduce parental well-being, thus reducing parental time available for children's health investments.

On the other hand, purchasing inputs in the markets that contribute to child health investments is influenced by the ability to purchase these goods. Changes in economic conditions that influence the parent's average household income may have an impact on the ability to purchase these market goods. Child health investments that are made through the consumption of health promoting inputs in the current period can generate higher returns in the future periods. These inputs include and are not limited to nutritious food, clothing, shoes, medicine, hygiene products, and medical care. The ability to purchase these goods depends on both monetary resources available, but also depends on the time intensity of conducting these activities by parents in the form of cooking healthy meals, taking their children to medical care facilities, and providing at home preventative care. Therefore, it may not be as surprising that literature finds time to be a more valuable asset to investments in child health in comparison to household income.

Theoretically, economic growth resulting in more time spent in labor market activities will increase parental income leading to increased household utility and improvements in child health. A household's monetary resources will be greater allowing them to consume more of all commodities. On the other hand, this will also reduce time devoted to investments in children's health production due to the substitution effect. If the time effect is large enough, it has the

ability to offset the increased consumption of health commodities associated with the income effect. Therefore, the change in parent's labor market time has a net ambiguous effect on children's health outcomes. Furthermore, changes in economic conditions are likely to influence parental stress and well-being. The parent's mental and physical health status is an important determinant to the time they have for investments in children's health. Economic downturns result in more time for non-labor market activity such as time available for investments in children's health. However, poor parental well-being health may result in less time actually devoted towards child health.

Overall, utilizing this simple model predicts that both changes in the parent's time inputs and monetary inputs resulting from temporary changes in economic activity result in an ambiguous effect on household utility, therefore studying the impact of changes within a given household is necessary. Children's health will improve if there are increases in the consumption of health improving commodities and/or parental time devoted to child health investments based on the state of the economy. On the other hand, children's health will deteriorate if there is a decline in the ability to purchase health related commodities and/or a decline in time dedicated towards health investments. The aggregate impact of these individual effects will help determine the overall impact on children's health outcomes.

Empirical Model Specification

In order to study the impact of macroeconomic conditions on children's health outcomes, we lay out an empirical methodology based on the theoretical model outlined above. We begin with a simplified reduced form model. Next, we further build a longitudinal individual fixed effect model to measure the effect of changes in inputs on individual health outcomes over time. Finally, we construct a specific instrumental variables model to more precisely identify the mechanisms through which the macro economy impacts children's health. Comparing the results of these various methods will allow us to have a better understanding of the overall consistency of the results, and also enable us to make better informed decisions regarding the impact of the overall economy on child health.

Reduced Form Approach

A simplified model of children's health outcomes of the following reduced form is estimated:

$$\boldsymbol{HealthOutcome_{ist} = \beta EC_{st} + \gamma X_{ist} + \varepsilon_{ist}} \qquad \textbf{(10)}$$

where $HealthOutcome_{it}$ is a health for a child *i* living in state *s* interviewed at time *t* measured by prevalence of one or more annual illnesses that requires medical attention or treatment, the number of these illnesses , child BMI, prevalence of overweight or obesity . EC_{is} the vector of variables of interest which represents the effect of various economic conditions or indictors such as weighted average unemployment rates, and weighted average real GDP growth rates at geographic region *s* and time *t*. X_{ist} is a vector of individual and household characteristics for individual *i* in state *s* at time *t*. The characteristics in the vector X_{ist} include child's gender, age and age-squared in months, birth weight, the mother's race(non-Hispanic white, non-Hispanic

black, Hispanic, Asian, other and unassigned race)[1], mother's marital status (married, separated, divorced, widowed and never married), mother's age, mother's highest level of education completed (less than high school, high school, some college, and college or more), measures of family composition (number of children and presence of grandparent living in household), and degree of urbanicity (urban, suburban and rural). ξ_{it} is the random error term.

Since unobservable determinants of lifestyle behaviors associated with each state and survey year are important, they are added to the model as shown:

$$\boldsymbol{HealthOutcome_{ist} = \beta EC_{st} + \gamma X_{ist} + \delta_s + \alpha_t + \varepsilon_{ist}} \qquad \textbf{(11)}$$

δ is a state fixed-effect that accounts for those that differ across locations but are time invariant. α is a year-specific intercept that holds constant determinants of health that vary uniformly across states over time. Overall, this specification identifies the impact of the macro economy by within-state variations in economic conditions, relative to changes occurring in other states. This method automatically controls for a range of factors (such as lifestyle differences or availability of medical resources) that may influence health and are difficult to observe(Ruhm, 2003).

Furthermore, since seasonal fluctuations may influence child health outcomes, a month dummy variable φ is also added to the specification to control for these variations:

$$\boldsymbol{HealthOutcome_{ismt} = \beta EC_{smt} + \gamma X_{ismt} + \delta_s + \varphi_m + \alpha_t + \varepsilon_{ismt}} \qquad \textbf{(12)}$$

For simplicity, we assume that effects of changing macroeconomic conditions are not restricted to those who are changing employment status. Due to the "economic stress" hypothesis (Catalano, 1991;Catalano *et al.*, 1983), parental stress associated with job loss can have a negative impact on child health.

[1] See Appendix 1 for the computation of mother's race

The results for the model specifications in equations 10, 11 and 12 are presented as [A], [B], and [C] respectfully for the reduced form linear models in all of the regression estimates tables. Linear probability models are utilized for the specifications with binary outcome measures including prevalence of child obesity and occurrence of an illness that requires medical attention or treatment.

Robust standard errors are reported and clustered at the state level. Sampling weights available from the NLSY79 are also included in the analysis to account for unequal probability of inclusion in the sample.

Individual Fixed Effect Approach

Next, we utilize the individual-level fixed effect model to examine the changes in health outcomes for a child over time using the longitudinal aspects of the data. The estimates of the effects of health inputs are specific to age t (Todd and Wolpin, 2003;Todd *et al.*, 2007). This model further developed from previous literature that studies the relationship between economic conditions and health outcomes among adults using only cross-sectional estimation methods. Since these cross-sectional estimates may be biased and standard errors may be underestimated if there unobserved individual-level effects exist. The basic empirical model for this approach shows how state level economic conditions affect child health outcomes:

$$\boldsymbol{HealthOutcome_{ist} = \beta EC_{st} + \gamma X_{ist} + \alpha_t + \nu_i + \omega_{ist}} \qquad \textbf{(13)}$$

In this individual-level fixed effect model, v_i is the constant individual-specific residual and w_{ist} is the standard error residual. To account for unobserved individual-level heterogeneity, the fixed effects panel estimation allows v_i to be arbitrarily correlated with independent variables and time-invariant covariates in the vector X and the constant individual-specific residual v_i are differenced out and within person equation estimates are provided (Wooldridge, 2002). A Hausman test is

run that suggests the fixed effects model is the preferred model. It is important to note that time invariant measures (such as gender, race, etc.) drop out in the individual-level fixed effects. Furthermore, the state fixed effects are not included in this specification.

Identification and Instrumental Variables Approach

Finally, this study also attempts to identify the causal mechanisms through which changes in the economy may influence health and health behaviors; analysis using an Instrumental Variables (IV) approach is conducted. Most prior work in the adult literature utilizes the reduced form approach that relates adult health to economic indicators such as unemployment rates or GDP growth rates. However, the economy is not the direct cause of "changes in health, rather it is changes in use of time, income (wage) and other determinants of health that are associated with changes in economic indicators affect on health and health behaviors"(Xu, 2013). In the case of children, child health will be affected by changes in parental use of time and wages that result from fluctuations in the economy. Therefore, a stronger analysis can be conducted by studying how economic activity affects the proximate causes of child health in the form of parental investments, and therefore identify how these proximate causes affect child health outcomes.

The instrumental variables approach accounts for endogenity due to unobserved factors that affect labor market choices and child health outcomes when including mother's hours of work and wages. Since the parental hours of work is a determinant of child health outcomes, in regards to weight outcomes and illnesses, the IV method is useful for the empirical analysis. Changes in economic activity measured by the indicators are utilized as instruments for mother's working hours and wages in the models for health outcomes. Based on this, the following empirical models are specified:

$$HealthOutcome_{ist} = \theta HoursWorked_{ist} + \varphi Wages_{ist} + \gamma X_{ist} + \delta_s + \alpha_t + \varepsilon_{ist} \quad \textbf{(14)}$$

HealthOutcome of person *i* depends on state effects δ_s, year effects α_t the vector of individual and household characteristics X. The two parameters of interest in this equation are associated with mother's work hours and wages. *HoursWorked* defines the number of hours the child's mother works per week or per year. *Wages* measure the average hourly wage the mother earns in the labor market(Heckman, 2000;Heckman, 2006)[2]. In this IV analysis, the sample is restricted to children who live with their mothers only. This is because information on the father's work hours is unavailable in the dataset. "Since mother's wages and hours of work are likely to be endogenous due to unobserved factors that affect labor market choices", we use the IV approach to instrument for wages and hours using state-specific macroeconomic indicators and industry mix as used in the adult literature (Xu, 2013). More specifically, the following first stage regressions are estimated to obtain the instrumented variables:

$$HoursWorked_{ist} = \beta EC_{st} + \varphi IND_{st} + \psi(EC_{st} * IND_{st} * MomAge_{ist}) + \gamma X_{ist} + \delta_s + \alpha_t + \mu_{ist} \quad \textbf{(15a)}$$

$$Wages_{ist} = \beta EC_{st} + \varphi IND_{st} + \psi(EC_{st} * IND_{st} * MomAge_{ist}) + \gamma X_{ist} + \delta_s + \alpha_t + \mu_{ist} \quad \textbf{(15b)}$$

In this model, the instruments for wages and working hours are *EC* which represent macroeconomic indicators such as unemployment rate and GDP growth rates, *IND* which represents industry mix, and the interaction between unemployment/GDP, industry mix, and mother's age categories *MomAge*[3]. The interaction terms "are meant to capture different responses in labor demand in various industries when they confront similar changes in local economic conditions"(Xu, 2013). A study by Xu (2013) summarizes literature that shows local industry mix influences cyclical sensitivity of unemployment rates possibly due to industries in diverse economies experiencing fluctuations at different severity and timing(Browne,

[2] Reservation wages are computed using the Heckman Selection Model and used in place of standard wages.
[3] Mother's age categories are defined as 21-29 years, 30-39 years, 40-49 years and 50-53 years.

1978a;Browne, 1978b;Forrest and Naisbitt, 1988;Hyclak and Lynch, 1980;Malizia and Ke, 1993). The age interaction is specified based on the literature that suggests work hours are a U-shaped function of age(Becker, 1975;Clark and Summers, 1980;Gomme, Rogerson, Rupert, and Wright, 2005;Hansen and Imrohoroglu, 2009;Jaimovich and Siu, 2008). Changes in the hours of work and wages in response to changes in economic activity as measured by the indicators will show the effects of parent's time and monetary inputs on child health outcomes. This will help to identify the causal mechanisms that link economic activity to children's health and determine if the economy in fact does impact child health outcomes. An identical instrumental model is set up using individual fixed effects to account for unobserved individual-level heterogeneity in addition to the standard IV model.

IV.DATA

This study combines mother-child data available from the National Longitudinal Study of Youth 1979 (NLSY79) and Children and Young Adult of NLSY79 (NLSYCYA). The data is linked to external datasets measuring various macroeconomic variables over time using State Federal Information Processing Standard (FIPS) codes. All state-level employment data is obtained from the Bureau of Labor Statistics and state-level productivity data is obtained from the Bureau of Economic Analysis. The definitions for all of the variables used in this analysis are described in Table 1. Data analysis for this project was conducted using STATA 12.0 (StataCorp, 2009). This study was approved by the Institutional Review Board at the University of Illinois at Chicago. This chapter provides an overview of the data and its relevance to the study.

National Longitudinal Study of Youth 1979

This study utilized individual-level data from the National Longitudinal Study of Youth 1979 (NLSY79). The NLSY79 is a nationally representative sample of 12,686 individuals between the ages of 14-21 years at the initial start of the project on December 31, 1978. The sample was first interviewed in 1979, and followed annually through 1994 and biannually ever since. Beginning in 1986, children born to the women of NLSY79 were first surveyed as a supplement to the NLSY79 and followed every other year to run parallel with the main adult surveys.

By merging the child-mother files from the NLSY, a solid dataset was constructed to conduct analysis on children's health outcomes. For children under the age of 10, the information on detailed health and physical characteristics was collected from the child's mother.

The child measures are combined with detailed information from the main survey including mother and household characteristics.

This particular study utilized 13 rounds of the matched mother-child survey data between the periods of 1986-2010. Since this is a panel dataset, each individual can have up to 13 repeated observations in multiple survey rounds varying by the frequency of survey participation. For consistency, we limit our study specifically to individuals under the age of 15 because young adults 15 years and older were given a different instrument and confidential supplemental surveys in place of the child assessment beginning in 1994 (NLSY79, 2005). The merged data provide information on children's health status outcome variables including height and weight measures which enable the computation of body mass index (BMI), their respective BMI percentiles and prevalence of child overweight and prevalence of childhood obesity status. Furthermore, indices for prevalence of any illnesses and frequency of illnesses are also analyzed.

Child Weight Outcomes:

Children's overall weight status is measured by a continuous measure of body mass index (BMI) which is calculated using height and weight outcomes. In each round of the NLSYCYA sample, height and weight for each child are measured or reported. If efforts to objectively measure a child's weight and height are rejected, the mother-reported height and weight are used as an alternative. BMI is calculated as (weight (lb.)/height (in) ^{2} * 703. BMI is adjusted for age and gender specifications using the revised version of the Centers for Disease Control and Prevention (CDC) Growth Charts for the United States released in 2000 (Department of Health and Human Services, 2002). These charts are recommended to assess the size and growth in infants, children and adolescents. More specifically, the 2000 CDC growth charts include specific percentiles cutoff points to identify underweight and overweight children to categorize

the weight status of children. Children are defined to be "underweight" with a BMI-for-age below 5th percentile, "healthy weight" within the 5th to less than 85th percentile range, "overweight" between 85th and 95th percentile, and "obese" if above 95th percentile. In order to generate consistent indices of weight measures for children in our sample, we utilized the CDC's updated version of the SAS program to compute the calculated BMI value and percentile for BMI-for-age (Centers for Disease Control and Prevention, 2011). Since some of the child height and weight observations are self-reported, it is important to note that they are subject to measurement error. The SAS program generates a variable indicating if the child's height or weight or BMI is biologically impossible for age and gender, usually a result of reporting error or poor measurement. Only the observations with measurements in the normal range are included by dropping any observations that have an improbable BMI that is too low or too high from the acceptable range.

Child Illnesses:

An outcome variable of interest in this study includes child illnesses. In each round of the NLSYCYA occurrence and frequency are measured by the mother's self-reported responses. Occurrence of an illness is measured as a dichotomous response to the question "During the past 12 months has <child name> had any illnesses that required medical attention or treatment". This variable is reported as a 1 for those children who had any positive number of illnesses and 0 if the child was not sick at all in the past year. It is important to note that the severity of the illness is not accounted for in this variable; therefore there is no way of distinguishing between a serious or minor illness. Furthermore, when an illness is reported, the frequency is measured by the number of illnesses a child had that required medical attention or treatment in the past 12 months. A limitation of the data is that this outcome variable is self-reported by the child's

mother. There may be systematic biases in reporting if more educated mothers were more likely to assess various child illnesses as "requiring medical attention". As in the case of occurrence of illnesses, the severity of the child's condition is not measured, therefore, there also may be some downward bias since minor health conditions are not reported. Frequency of all illnesses is only reported and tracked for those individuals who reported occurrence of an illness in the past 12 months.

Individual, Household and Local Area Characteristics:

An important set of individual, household and local area characteristics obtained from the NLSY79 child sample are included in this study both for the purposes of control variables and to also allow us to further examine the results by various subgroups. Children's individual demographic characteristics are included as vital components of understanding the nature of the data sample. Gender is measured to distinguish between boys and girls. Since the child's race reported in the survey is limited to a set of three categories including black, Hispanic, and those children that are not defined as black or Hispanic, we utilize mother's race which is computed using variables from the NLSY79 adult survey (a detailed description of this computation is shown in Appendix 1). Mother's race/ethnicity is categorized as non-Hispanic white, non-Hispanic black, Hispanic, Asian, other, or an unassigned race which are mutually exclusive and exhaustive. Characteristics of a child's birth are measured by a continuous variable of the child's birth weight is reported in pounds (lbs.). Family characteristics are measured by including the number of children in the household and binary a binary indicator of the presence of a grandparent. The type of health insurance coverage a child has is also measured by a dummy

variable distinguishing between private, public, or no insurance[4]. Children's age at the time of interview is reported in NLSYCYA in months, and age in months squared is also computed. Age can also be converted into years by dividing by a factor of 12. Only children between the ages of 2 and 14 years are kept in the sample. Finally, the specific year and month in which the child's measurements were obtained are also included. However, since this dataset only allows measurement of when items were reported rather than when they occurred, the seasonality controls are not strongly emphasized in the results.

Household characteristics are obtained from the NLSY79 adult sample. Traits of the child's mother are included. Mother's current age is measured as a continuous variable in years at the time of interview. Marital status is comprised of the mother being currently married, never married, currently separated from her spouse, currently a widow or is currently divorced. Mother's highest educational attainment is measured as either completed less than high school, completed high school, completed some college, and completed college or more[5]. Additional variables obtained from the NLSY79 data include mother's information on mother's labor force participation and wages. These measures are used as instruments in the identification strategy. Work status is measured by the average number of hours the mother worked in the labor force in the past calendar year. Based on this information, the mother's average work hours per week are also calculated by dividing the annual work hours by a factor of 52. Household income is reported as a continuous measure of annual average household income per thousand dollars and it is adjusted using consumer price index (CPI) 1982-84 deflated price indices(Bureau of Labor

[4] No insurance is computed if both public and private coverage for the child do not exist. In the case that some children have both forms of coverage, they are coded as having private insurance.
[5]These are computed using the "highest grade completed" variable from the NLSY79 adult survey, such that individuals who completed less than grade 12 are defined "less than high school", those that completed grade 12 are defined as "high school", those that completed 1-3 years of college are defined as "some college" and those that completed 4 or more years of college are defined as "college or more"

Statistics, 2013) and is comprised of all forms of income including but not limited to those earned in the form of wages or salary, business, welfare benefits, unemployment insurance benefits, disability benefits, and spouses income (NLSY79, 2005). The income variable is used for subgroup analysis. Furthermore, average weekly hourly wages (CPI inflated) are computed by dividing total annual wages by total number of hours worked per year[6].

The local area measures also include measures of urbanicity of neighborhood is obtained from the 2000 census (United States Census Bureau, 2011). They are merged to the child data using the child's home zip code. Urbanicity measures are constructed based on population density where urban areas are defined as 50,000 or more people with a population density of 1,000 persons per square mile, suburban clusters consist of at least 2,500 but less than 50,000 people, and rural non-farm and rural farm areas include less than 2,500 people.

Unemployment Data

The unemployment rate is often used as an indicator of economic activity(American Association of Individual Investors, 2003). It is computed as a percentage by dividing the number or people unemployed and actively seeking work by all individuals currently in the labor force. In this study, data on annual unemployment statistics for the state-level are obtained from the Bureau of Labor Statistics (BLS) for the years 1986-2008 and linked to the NLSY79 data based on state Federal Information Processing Standards (FIPS) codes, where a "state" was defined to include the 50 states, the District of Columbia, and Puerto Rico. The Local Area Unemployment Statistics (LAUS) program that tracks annual average estimates for unemployment rates defines unemployed to include "all persons who had no employment during

[6] Analysis conducted using hourly wages is restricted to children who live with their mother only because information on the work hours of the father is not available.

the reference week, were available for work, except for temporary illness, and had made specific efforts to find employment some time during the 4 week-period ending with the reference week. Persons who were waiting to be recalled to a job from which they had been laid off need not have been looking for work to be classified as unemployed." Therefore, the unemployment rate used in this study is the ratio of the unemployed to the civilian labor force (includes all persons in the civilian non-institutional population classified as either employed or unemployed) expressed as a percent(Bureau of Labor Statistics, 2011). Given that most literature on health and the macro-economy uses state-level measures(Ruhm, 2000;Ruhm, 2003;Ruhm, 2005) and few have incorporated county level unemployment rates in health economics research(Dehejia *et al.*, 2004) we began this study at the state-level. Since unemployment rates are measured in calendar year averages, a weighted average unemployment rate is computed to obtain a more precise measure given that the respondents are surveyed throughout the year. The weighted average of the current year and previous year's unemployment rate is computed based on the households' month of interview *M* for an individual *I* interviewed in calendar year *t* as follows:

$$\boldsymbol{Weighted\ Avg\ UErate_i = [M_i * UErate_{it}] + (12 - M_i)UErate_{it-1}]/12} \quad \textbf{(16)}$$

This method allows for the majority of the weight to be placed on the unemployment rate in the calendar year that includes the majority of the 12 months prior to the household's interview. Table I shows the trends in unemployment rates representative to this dataset.

Table I: Trends in Weighted Average Unemployment Rates

Year	Weighted Average Unemployment Rate[7]
1986	7.296 (1.613)
1988	6.008 (1.611)
1990	5.586 (1.006)
1992	7.179 (1.228)
1994	6.576 (1.341)

[7] See Appendix 2 for Labor force statistics from the Current Population Survey (Bureau of Labor Statistics)

1996	5.525 (1.139)
1998	4.798 (0.970)
2000	4.119 (0.814)
2002	5.139 (0.746)
2004	5.894 (0.794)
2006	5.043 (0.853)
2008	5.095 (0.919)
2010	9.567 (1.671)

Furthermore, we included annual unemployment insurance data at the state-level to distinguish between residents of state with different types of unemployment benefits(United States Department of Labor, 2012). This is measured by the average weekly benefits paid for total unemployment (payments for partial unemployment are excluded) during the year divided by the number of weeks for which total unemployment was compensated. In this study we used the ratio of average weekly benefit amount to average weekly total wage (in taxable and reimbursable employment) to better account for the employment and benefit characteristics of each state.

Gross Domestic Product Data

Gross Domestic Product (GDP) allows us to evaluate the overall economic output, measured by the market value of all final goods and services within the given year. Data on GDP is obtained from the Bureau of Economic Analysis (BEA) for the years 1987-2011. Specifically, we will use real GDP (chained dollars) percent change from the preceding period for each individual state to obtain a better overview of changes in short run productivity within each state's borders. The GDP measures utilize the total productivity of all industries. The Standard Industrial Classification (SIC) industry detail for the years 1987-1997 is based on 1987 SIC definitions. The North American Industry Classification System (NAICS) industry detail for the years 1998-2011 is based on the 2002 NAICS definitions. The weighted average of the

current year and previous year's GDP growth rate is computed based on the households' month of interview *M* for an individual *I* interviewed in calendar year *t* as follows:

$$\boldsymbol{Weighted\ Avg\ GDPGrowthrate_i} =$$

$$[\boldsymbol{M_i} * \boldsymbol{GDPgrowthrate_{it}}] + (\mathbf{12} - \boldsymbol{M_i})\boldsymbol{GDPgrowthrate_{it-1}}]/\mathbf{12} \quad \textbf{(17)}$$

This method allows for the majority of the weight to be placed on the GDP growth rate in the calendar year that includes the majority of the 12 months prior to the household's interview. The GDP data is linked to the NLSY dataset based on state-level FIPS codes. It is important to note that for all the analysis that includes GDP as a measurement of economic conditions, we only use the survey years 1988-2008 since there is no GDP data available in 1986. Also, due to small sample sizes in Delaware and Wyoming, these states are omitted from the analysis as well. Trends in GDP growth rate for this data set are shown in Table II.

Table II: Trends in Weighted Average Real GDP Growth Rate

Year	Weighted Average Real GDP Growth Rate[8]
1990	1.893 (1.337)
1992	1.682 (2.182)
1994	3.462 (2.124)
1996	3.815 (1.378)
1998	4.937 (1.455)
2000	4.356 (1.943)
2002	1.300 (1.294)
2004	2.501 (1.299)
2006	2.578 (1.768)
2008	0.886 (1.517)
2010	-2.091 (2.557)

[8] See Appendix 3 for Real GDP percent change from preceding period data (Bureau of Economic Analysis)

Industry Mix Data

In order to investigate the causal mechanisms through which economic activity may impact health, the state level industry mix data is used to instrument for adult wages and labor market hours. Data on wages and salaries for various industries are obtained from the Bureau of Economic Analysis (BEA) for 1986-2010. Based on the North American Industry Classification System (NAICS)[9], nine state industry mix divisions are created to match the industrial categories in prior literature (Xu, 2013). State industry mix is constructed as the percentages of wages and salary disbursements paid by each industry including agriculture, mining, construction, manufacturing, transportation (transportation and warehouses, utilities), trade (wholesale, retail), financial (information, financial and insurance, real estate, rental, leasing), services, and public administration. Industry mix data is utilized in conjunction with macroeconomic indicator variables including unemployment rate and GDP growth rates in this dissertation.

[9] The estimates for 2007-2010 are based on the 2007 NAICS.

V.DATA VALIDATION

This section briefly summarizes economic literature on socioeconomic characteristics that impact child health outcomes in an attempt to analyze the integrity of the variables used in this dissertation from the NLSY79 dataset. A brief overview of the child health literature is provided and the results corresponding to the literature as produced by the dataset used in this dissertation are discussed. Children's health outcomes have often been studied by economists, and may be influenced various socioeconomic factors. Evidence on the impact of maternal work hours, household income, and mother's education on child health has been well established. Economic studies model health outcomes as a form of human capital that is influenced by parental choices and behaviors. These choices and behaviors are defined by the family's socioeconomic status. In this dissertation, the child human capital outcomes are measured by child health variables including body mass index (BMI) percentiles, prevalence of overweight and obesity, prevalence of obesity, frequency of illness, and prevalence of illness

Child Health and Mother's Employment

Economic literature finds child quality can be influenced by their mother's maternal work status. In general terms, the impact of mother's work hours in the labor force also depends on the overall socioeconomic status of the child's family as well. Among children of less privileged homes, as a mother's average work hour's increase, child quality tends to rise, often attributed to the higher availability of resources generated through higher income and a substitution in the quality of child care (Leibowitz, 2003). This also translates into maternal employment being associated with better health outcomes for children from disadvantaged backgrounds (Ruhm, 2008). On the other hand, there is some confirmation of a negative relationship between maternal employment on child quality that is concentrated in children from higher

socioeconomic status households (Blau and Grossberg, 1990;Desai, Chase-Lansdale, and Michael, 1989).

Specific to child weight outcomes, the literature finds a consistently positive and statistically significant relationship between maternal work hours in the labor force and child BMI and probabilities of obesity. Using the NLSY79 child sample of children aged 3 to 11, a study found that an increase in mothers' weekly work hours was associated with significantly higher prevalence of obesity (Anderson, Butcher, and Levine, 2003). Another study estimated that when the average mother doubles her weekly work hours, this is associated with their children having a high probability of being overweight and at risk for overweight with BMI in the 85^{th} percentile or higher (Ruhm, 2004a;Ruhm, 2004b). Similar results were found in a study that used the Child Development Supplement (CDS) of Panel Study of Income Dynamics (PSID) dataset from 1997-2000 (Fertig, Glomm, and Tchernis, 2009). Additionally, mothers who work full time were found to have children with higher obesity probability compared to mothers who only worked part time or did not work at all (Classen and Hokayem, 2005). Across various demographic subgroups, the rise in obesity prevalence with more maternal work hours is mainly prevalent in the highest income quartile, those who have mothers with at least a college degree, and non-Hispanic white children (Anderson *et al.*, 2003), suggesting that household socioeconomic and demographic variables are also an important factor when determining the impact of mothers' employment status on child weight outcomes.

Using the NLSY79 dataset and outcome variables used in this dissertation, a preliminary analysis is conducted to verify the integrity of the data and outcome variables. A basic reduced form model is specified as follows:

$$HealthOutcome_{ist} = Hours\ Worked_{ist}\beta + X_{ist}\gamma + \varepsilon_{ist} \qquad (18)$$

Using maternal weekly work hours (*HoursWorked)* as the dependent variable of interest, we find that the overall expectations derived from the literature hold true. Overall, Table III shows an increase in mothers' average weekly work hours is associated with higher body mass index percentiles with a coefficient of 0.042. More specifically, the rise in BMI percentiles and obesity prevalence is strongest among the highest income tertiles, consistent with what is discussed in the prior obesity literature. For this sample, a rise in average weekly maternal work hours is associated with significantly fewer overall illnesses and a lower overall prevalence of illness. There are few differences identified between the different income tertiles, however this may suggest that the poor variable definition[10] and measurement error may attribute to mothers with various education levels interpreting and responding to the survey differently, leading to an inconsistency in the data.

Table III: Estimations of Child Health Outcomes on Maternal Employment

		By Household Income Level		
	Maternal Work Hours	**Low**	**Middle**	**High**
Child Weight Outcomes				
BMI Percentile	0.042**	0.039	0.064	0.078**
	(0.020)	(0.051)	(0.043)	(0.031)
Prevalence of Obesity	0.0001	0.0001	0.001	0.001**
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Child Illness Variables				
Frequency of All Illnesses	-0.003*	-0.003	-0.003	-0.003
	(0.001)	(0.002)	(0.002)	(0.002)
Frequency of Illness only if Illness Reported	-0.005	-0.005	-0.005	-0.005
	(0.002)	(0.006)	(0.004)	(0.003)
Prevalence of Illness	-0.001*	-0.001	-0.001*	-0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)

Note: All models include the full set of individual, household and local area characteristics.
Standard errors (SE) are reported in parentheses and are robust.
* significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation. N=35,850 for child weight outcomes; N=39,750 for sample analyzed with prevalence of illness and frequency of all illness; N=13,297 for sample analyzed using frequency of illness if illness reported

[10] Prevalence of illness variable is asked as "Has child had illness in last 12 months requiring medical attention or treatment? Frequency of illness variable is asked as "Number of illnesses that required medical attention or treatment child had in last 12 months" only if the respondent responded YES to the occurrence question.

Child Health and Family Income

Economic literature finds children from low income households often have poorer health in comparison to children from higher income households (Case, Fertig, and Paxson, 2003;Case, Lee, and Paxson, 2008;Case, Lubotsky, and Paxson, 2001). The effects of family income on child body weight outcomes however tend to be more mixed. Particularly for the NLSY79 sample, higher income families tend to have children with lower BMI outcomes and lower obesity prevalence (Anderson *et al.*, 2003). Further, poor and high income children have a lower probability of obesity when compared to their counterparts (Classen *et al.*, 2005;Hofferth and Curtin, 2005;Kumanyika and Grier, 2006;Strauss and Knight, 1999). Overall, the trends in the literature for the NLSY79 sample and a few other data sources suggest that higher income households tend to have children with lower BMI outcomes and obesity prevalence.

In our sample, the following model is estimated:

$$\boldsymbol{HealthOutcome_{ist} = \beta Income_{ist} + \gamma X_{ist} + \varepsilon_{ist}} \qquad \textbf{(19)}$$

Where *Income* is the average family household income reported as a continuous measure of annual average household income per thousand dollars and it is adjusted using consumer price index (CPI) 1982-84 deflated price indices(Bureau of Labor Statistics, 2013) and is comprised of all forms of income including but not limited to those earned in the form of wages or salary, business, welfare benefits, unemployment insurance benefits, disability benefits, and spouses income (NLSY79, 2005). Table IV shows that higher average household income is significantly associated with lower child BMI percentiles and obesity prevalence, further confirming the integrity of the child weight variables in the NLSY79 data set. With respect to child illnesses,

overall frequency tends to decline as families earn more income, however the prevalence of illness is unaffected.

Table IV: Estimations of Child Health Outcomes on Household Income

	Household Income
Child Weight Outcomes	
BMI Percentile	-0.209***
	(0.055)
Prevalence of Obesity	-0.003***
	(0.000)
Child Illness Variables	
Frequency of All Illnesses	-0.003
	(0.003)
Frequency of Illness only if Illness Reported	-0.009**
	(0.004)
Prevalence of Illness	0.000
	(0.001)

Note: All models include the full set of individual, household and local area characteristics. Standard errors (SE) are reported in parentheses and are robust.
* significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation. N=35,850 for child weight outcomes; N=39,750 for sample analyzed with prevalence of illness and frequency of illness; N=13,297 for sample analyzed using frequency of illness if illness reported

For the most part, the results tend to hold consistent with the overall expectations based on prior literature studying the impact of income on child weight in the NLSY79.

Child Health and Mother's Education Level

It is well established that mother's education has a favorable impact on child health outcomes. Better-educated mothers are more efficient at producing their own health (Grossman, 1972) and this may translate into better health for their children as well. Maternal education is associated with improved child health since it is strongly linked to the family socioeconomic situation, which as shown in the previous section is a determinant of child health. Furthermore, maternal education is hypothesized to bring changes in the mother's behavior with regards to child care and use of modern health services which translates into better child health (Caldwell, Caldwell, Li, Morikawa, Nakagawa, Yoshita, Tabata, Nishijo, Senma, and Kawano,

1992;Cleland, 1989;Desai and Alva, 1998). A study finds that maternal education is strongly associated with positive outcomes for different markers of child health (Cleland and Van Ginneken, 1988;Desai *et al.*, 1998;Victoria, Huttly, Barros, Lombardi, and Vaughan, 1992). As in the case of maternal work hours, maternal education exhibits diminishing returns to child health as household wealth increases (Boyle, Racine, Georgiades, Snelling, Hong, Omariba, Hurley, and Rao-Melacini, 2006) suggesting that socioeconomic household status plays a role in the returns to maternal education on child health as well.

Using this data, the following model is estimated:

$$\boldsymbol{HealthOutcome_{ist} = \beta MomEducation_{ist} + \gamma X_{ist} + \varepsilon_{ist}} \quad \textbf{(20)}$$

The dependent variable of interest *MomEducation* references the highest grade of education the mother completed. The relationship between child weight outcomes and maternal education aligns perfectly to the literature where children of more educated mothers tend to have higher child quality in the form of significantly lower BMI values and a significantly lower probability of obesity as seen in Table V. However, given the limitations discussed regarding the self-reported measurements of the illness variables, a mother's education seems to influence the interpretation and responses for the frequency of illness and prevalence of illness variables. Thu, the results show that, contrary to expectations, the better educated mothers have children with more illnesses and see higher prevalence of illness. These findings likely reflect a systematic over-reporting of illnesses "requiring" medical attention by more educate women.

Table V: Estimations of Child Health Outcomes on Mother's Highest Education Level Completed

	Mother's Highest Education Level Completed
Child Weight Outcomes	
BMI	-0.060**
	(0.025)
Prevalence of Obesity	-0.007***
	(0.002)
Child Illness Variables	
Frequency of All Illnesses	0.024**
	(0.010)
Frequency of Illness only if Illness Reported	-0.007
	(0.017)
Prevalence of Illness	0.011***
	(0.003)

Note: All models include the full set of individual, household and local area characteristics.
Standard errors (SE) are reported in parentheses and are robust.
* significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation. N=35,850 for child weight outcomes; N=39,750 for sample analyzed with prevalence of illness and frequency of illness; N=13,297 for sample analyzed using frequency of illness if illness reported

Overall, the data validation shows that results of the impact of socioeconomic characteristics studied in economic literature are consistent within this data set with regards to the influence on child health outcome variables related to child weight. This relationship is highly parallel to the results in the child obesity literature particularly for studies using the NLSY79. However, the fact that results for child illnesses are mixed and not always aligning consistently with past research is a strong indication that these variables are weaker and concrete conclusions regarding the impact of macroeconomic conditions on child illnesses should not be established solely from this dataset. Rather, further investigation with higher quality data on illnesses should be conducted in future research. A more ideal variable would be more precisely quantifiable such that it would document how many days the child had a fever of a specific temperature or higher, bacterial or viral infections. These days can be segregated by type of illness. For example, NHANES data documents days of respiratory illnesses using the survey question "In the past 7 days, have you had a cough, cold, phlegm, runny nose or other respiratory illness? Do not count allergies or hay fever" which could be transposed to fit a questionnaire for children and different types of illnesses in the NLSY survey(Centers for Disease Control and

Prevention Center for Health Statistics, 2011). Additionally, specific frequency of visits to a health care facility specified as a clinic, doctors' office, or other place could be specified. Furthermore, daily frequency of need for medication either prescription or over the counter could also be asked in the NLSY in terms of different categories including pain relievers, antibiotics, cough or cold medications, etc.

Macroeconomic Conditions and NLSY79 Adult Health Outcomes

Extensive work has been done on the impact of macroeconomic conditions on adult health outcomes. Intuition suggests health is likely to improve when economic conditions improve and deteriorate as economic conditions deteriorate. However, the findings from data on economic influences on adult health are mixed (Parker-Pope, 2008). It is this lack of concrete evidence that suggest additional studies are needed to examine the effects of economic activity on health using a solid framework that distinguishes between changes in health among individuals and identifies causal mechanisms through which changes in economic activity affects health.

Most of the existing literature uses a reduced form approach that relates adult health outcomes to measures of economic activity. In order to further validate the integrity of this dataset, the analysis conducted in prior literature is replicated using the NLSY79 adult cohort. Since weight outcomes for children are the focus of this dissertation, a comparison of adult weight outcomes using the methodology from existing studies is conducted. The most prominent studies in this area find that rising unemployment rates are associated with lower prevalence of severe obesity(BMI is greater than or equal to 35) among adults when utilizing a reduced form model with state and year fixed effects (Ruhm, 2005). The NLSY79 adult sample confirms this

finding. Table VI shows that by replicating the models used by Ruhm and controlling for year and state unobservables, rising unemployment rates lead to a decline in prevalence of severe obesity among adults, with a coefficient estimate of -0.007.

Table VI: Regression Estimations of Adult Body Weight on Weighted Average State Unemployment Rate (Full Sample)

	A	B	C	D
Body Weight				
Overweight (BMI≥25)	0.004	-0.004	-0.004	-0.003
	(0.003)	(0.005)	(0.005)	(0.002)
Obese (BMI≥30)	0.003	-0.005	-0.005	0.000
	(0.004)	(0.005)	(0.005)	(0.001)
Severely Obese (BMI≥35)	-0.000	-0.007*	-0.007*	0.001
	(0.002)	(0.004)	(0.003)	(0.001)
Year controls	NO	YES	YES	YES
State controls	NO	YES	YES	NO
Seasonality controls	NO	NO	YES	NO
Individual fixed effects	NO	NO	NO	YES

Note: All models include the full set of individual, household and local area characteristics.
Standard errors (SE) are reported in parentheses and are robust.
* significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation in panels A, B and C. N=42,046

The results of the reduced form models shown in panels A, B and C correspond to equations 10, 11 and 12 from Chapter III. However, when taking advantage of the longitudinal nature of the dataset and controlling for individual level fixed effects using equation 13; the relationship between unemployment rates and prevalence of severe obesity among adults no longer exists as shown in panel D. This suggests that there are several unobservable individual level characteristics within each household that contribute to changes in adult health rather than just the state level effects. Furthermore, the adult literature finds these results are more prominent among men and minorities. Given that we are only utilizing data from the women of the NLSY79 sample we are unable to look at the full effect on males. This dataset does find the same results for Hispanics as shown in Table VII who see less severe obesity when unemployment rates are high.

Since this dissertation studies the association between GDP growth rates and health, a similar analysis is conducted using this economic indicator on adult weight outcomes. This is an area of the adult literature where a large gap exists as a limited number of studies use GDP growth rates as a proxy for economic activity (Bockerman *et al.*, 2007;Gerdtham *et al.*, 2005;Tapia Granados, 2008). The only study that analyzes adult weight outcomes finds economic improvements benefit health in terms of decreasing BMI among adults (Bockerman *et al.*, 2007). Overall, the results shown in Table VIII find that in the reduced form models, improvements in the economy measured by higher GDP growth is associated with a decline in adult prevalence of overweight (BMI≥ 25). Again, implementing the individual fixed effect methodology suggests that the GDP activity has no association with adult body weight outcomes. Although the overall direction of the reduced form model suggest higher GDP growth rates is associated with lower prevalence of overweight, obese and severely obese, the results hold no statistical significance.

Table VII: Estimations of Adult Body Weight on Weighted Average Unemployment Rates, by Subpopulations (Linear Model with Individual and State Fixed Effects) [Mother's Race, Mother's Highest Education Level Completed, Average Household Income]

		By Mother's Race			By Mother's Highest Education Level Completed				By Average Household Income		
	Full Sample	NH White	NH Black	Hispanic	Less than HS	High School	More than HS	College	Low	Middle	High
Full Sample											
Body Weight											
Overweight (BMI≥25)	-0.004	-0.004	-0.006	0.002	-0.004	-0.000	-0.006	0.098	0.004	-0.004	-0.010
	(0.005)	(0.007)	(0.006)	(0.008)	(0.005)	(0.009)	(0.011)	(0.043)	(0.009)	(0.008)	(0.007)
Obese (BMI≥30)	-0.005	-0.009	-0.007	0.000	-0.006	0.000	-0.015	-0.028	-0.009	0.002	-0.007
	(0.005)	(0.007)	(0.010)	(0.009)	(0.007)	(0.007)	(0.010)	(0.025)	(0.008)	(0.008)	(0.007)
Severely Obese (BMI≥35)	-0.007*	-0.007	-0.003	-0.011**	-0.010***	-0.004	-0.004	-0.039***	-0.012*	0.002	-0.010*
	(0.004)	(0.005)	(0.006)	(0.005)	(0.002)	(0.007)	(0.006)	(0.012)	(0.006)	(0.008)	(0.005)

Note: All models include the full set of individual, household and local area characteristics. All models also include year fixed effects. Standard errors (SE) are reported in parentheses and are robust. * significance at 10%; ** significance at 5%; *** significance at 1%.

Table VIII: Estimations of Adult Body Weight on Weighted Average State Gross Domestic Product Growth Rate (Full Sample)

	A	B	C	D
Body Weight				
Overweight (BMI≥25)	-0.004*	-0.004*	-0.004*	-0.001
	(0.002)	(0.002)	(0.002)	(0.001)
Obese (BMI≥30)	-0.002	-0.002	-0.002	-0.001
	(0.002)	(0.002)	(0.002)	(0.001)
Severely Obese (BMI≥35)	-0.001	-0.0002	-0.0002	-0.0001
	(0.001)	(0.001)	(0.001)	(0.000)
Year controls	NO	YES	YES	YES
State controls	NO	YES	YES	NO
Seasonality controls	NO	NO	YES	NO
Individual fixed effects	NO	NO	NO	YES

Note: All models include the full set of individual, household and local area characteristics.
Standard errors (SE) are reported in parentheses and are robust.
* significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation in panels A, B and C.

In addition to taking advantage of the longitudinal nature of the NLSY79 dataset by utilizing individual fixed effects models, an instrumental variables (IV) approach is used to identify the causal mechanisms that impact adult health. Since the economy does not directly impact changes in health, but instead these changes are channeled through changes in use of time, income (wage) and other determinants of health associated with economic indicators, the IV model will help identify these channels. The model shown in equation 21 is analyzed using the adult weight outcomes data. Since wages and hours worked "are likely to be endogenous due to unobserved factors that influence labor market decisions and health behaviors"(Xu, 2013), the instruments for wages and hours work are state specific macroeconomic indicators (unemployment), industry mix, and the interaction between economic conditions, industry mix, and age categories as shown in equations 22a and 22b.

$$\boldsymbol{HealthOutcome_{ist} = \theta HoursWorked_{ist} + \varphi Wages_{ist} + \gamma X_{ist} + \delta_s + \alpha_t + \varepsilon_{ist}} \quad \textbf{(21)}$$

HealthOutcome of person *i* depends on state effects δ_s, year effects α_t the vector of individual and household characteristics X. The two parameters of interest in this equation are associated with mothers' work hours and wages. *HoursWorked* defines the number of hours worked in the labor market per week or per year. *Wages* measure the average hourly wages(Heckman, 2000;Heckman, 2006)[11]. Since "wages and hours of work are likely to be endogenous due to unobserved factors that affect labor market choices"(Xu, 2013), we use the IV approach to instrument for wages and hours using state-specific macroeconomic indicators and industry mix[12]. More specifically, the following first stage regressions are estimated to obtain the instrumented variables:

$$\boldsymbol{HoursWorked_{ist} = \beta EC_{st} + \varphi IND_{st} + \psi(EC_{st} * IND_{st} * MomAge_{ist}) + \gamma X_{ist} + \delta_s + \alpha_t + \mu_{ist}} \quad \textbf{(22a)}$$

$$\boldsymbol{Wages_{ist} = \beta EC_{st} + \varphi IND_{st} + \psi(EC_{st} * IND_{st} * MomAge_{ist}) + \gamma X_{ist} + \delta_s + \alpha_t + \mu_{ist}} \quad \textbf{(22b)}$$

[11] Reservation wages are computed using the Heckman Selection Model and used in place of standard wages.
[12] Detailed description in Chapter III

The results presented in Table IX suggest that among women in this dataset, wages do not influence the prevalence of severe obesity (BMI≥35). Those adult women who work more hours in the labor market see higher severe obesity prevalence in the reduced form linear models, however this results no longer holds statistical significance in the individual fixed effect models, instrumental variables models, and the IV models with individual level fixed effects.

Table IX: Instrumental Variables Results of Prevalence of Severe Obesity on Women's Working Hours and Reservation Wages (BMI ≥35) (Full Sample)

	Hours Worked per Week	**Reservation Wages**	***Joint F Statistic***
Ordinary Least Squares Model	0.001***(0.000)	-0.0002* (0.000)	
Individual Fixed Effect Model	0.0001 (0.000)	-0.0001* (0.000)	
Instrumental Variable Model			
State unemployment rate	0.0001 (0.000)	-0.001 (0.001)	*5.963*
Instrumental Variable Model with Individual Fixed Effects			
State unemployment rate	0.002 (0.002)	-0.0001 (0.002)	*5.085*

Note: All models include the full set of individual, household and local area characteristics. Standard errors (SE) are reported in parentheses and are robust.
* significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation.

These results suggest that for the full sample of adult women in this dataset, severe obesity is minimally influenced wages and work hours given the small magnitude of the results. Since these results are restricted to female, the results for the overall adult population may differ. Economic theory suggests business cycles have the greatest impact on the wages and working hours of those who are less educated (Bartik, 1994;Becker, 1965;Bils, 1985;Charles *et al.*, 2008;Hoynes, 1999) therefore in a more nationally representative dataset of both men and women, analysis on the less educated may find a stronger association between the economy and prevalence of severe obesity.

The data validation suggest some key factors that apply to developing the methodology, conducting the analysis, and interpreting the results of this dissertation studying the relationship between macroeconomic conditions and children's health outcomes. First, child health outcome variables measuring child weight hold some data integrity. For all variables measuring child

weight outcomes including prevalence of overweight or obese, body mass index, and BMI percentiles, the data validation suggests they are reliable measures of child health outcomes. Next, given the self-reported nature of the child illness variables and poor definition structure in the survey, systematic variations in interpretation of these survey questions seem to exist. Since the data validation suggests they do no align with the relationships in well-established existing literature, their validity is week. Therefore, although an analysis is conducted on illness variables for the purposes of this dissertation, it must be strongly emphasized that no concrete conclusions should be drawn from these results. Finally, the data validation suggests the reduced form methodology used in existing adult literature on cross sectional data has areas for improvement. Implementation of the fixed effect model to account for differences among individuals using longitudinal data finds no correlation exists between economic conditions and adult health measured by weight outcomes. The use of the fixed effect instrumental variables model as opposed to the standard IV model again finds no relationship among adults. Therefore, the implementation of this longitudinal analysis is crucial when studying the impact of economic changes on child health outcomes, and will eventually lead to more accurate and reliable results.

VI.RESULTS: CHILD WEIGHT OUTCOMES

Children's weight outcomes measured by body mass index (BMI), age-gender adjusted BMI percentiles, and obesity statuses are strong indicators of a child's health status. The incidence of obesity increased rapidly among children and adolescents in the US over the past few decades. In 2007-08 prevalence of obesity (with BMI greater than or equal to the 95th percentile of the Centers for Disease Control and Prevention growth chart) was 19.6% for children aged 6-11 and 18.1% for adolescents aged 12-19 (Ogden CL, 2012). In this study we used the NLSY79 merged mother-child data biannually for rounds 1986 to 2010 in conjunction with economic data measuring unemployment and gross domestic product growth rates. The estimation sample is restricted to include only children up to the age of 14 years old because those above the age of 15 are classified as a young adult and given a separate computer assisted survey (NLSY79, 2005). Additionally, only observations with a valid state identifier were included. The final sample for the analysis includes 35,241 observations[13].

Analysis on Child Overweight & Obesity Prevalence and Obesity Prevalence

Child prevalence of overweight is defined as a child BMI greater than or equal to the 85th percentile and child prevalence of obesity is defined as child BMI greater than or equal to the 95th percentile(Department of Health and Human Services, 2002). The overall trends in prevalence overweight/obese and prevalence of obesity among children in the NLSY79 child sample between 1986 and 2010 are displayed in Table X.

[13] The sample sizes reported are for the sample used when using unemployment. Since the analysis conducted using GDP growth rates are unavailable in 1986 and the states of Delaware and Wyoming are omitted, the overall sample size for that group is 31,234 when studying weight outcomes.

Table X: Trends in Child Overweight and Obesity Prevalence

Year	Overweight and Obese	Obese
1986	0.190 (0.392)	0.080 (0.272)
1988	0.231 (0.421)	0.106 (0.308)
1990	0.278 (0.448)	0.138 (0.345)
1992	0.312 (0.463)	0.163 (0.369)
1994	0.264 (0.441)	0.134 (0.341)
1996	0.285 (0.452)	0.157 (0.363)
1998	0.311 (0.463)	0.158 (0.365)
2000	0.372 (0.483)	0.185 (0.388)
2002	0.404 (0.491)	0.227 (0.419)
2004	0.371 (0.483)	0.206 (0.404)
2006	0.356 (0.479)	0.191 (0.393)
2008	0.66 (0.482)	0.181 (0.385)
2010	0.389 (0.488)	0.199 (0.399)

Figure 1 provides a graphical presentation of the trends in child prevalence of obesity in comparison to unemployment rates and gross domestic product (GDP) growth rates, while figure 2 displays the deviations from the mean. Overall, the obesity rates in children have been on the rise over the past several years, therefore this analysis will allow us to see if these changes correlate to any overall economic changes during this time.

Figure 1: Trends in Prevalence of Obesity, Unemployment Rate and GDP Growth Rates

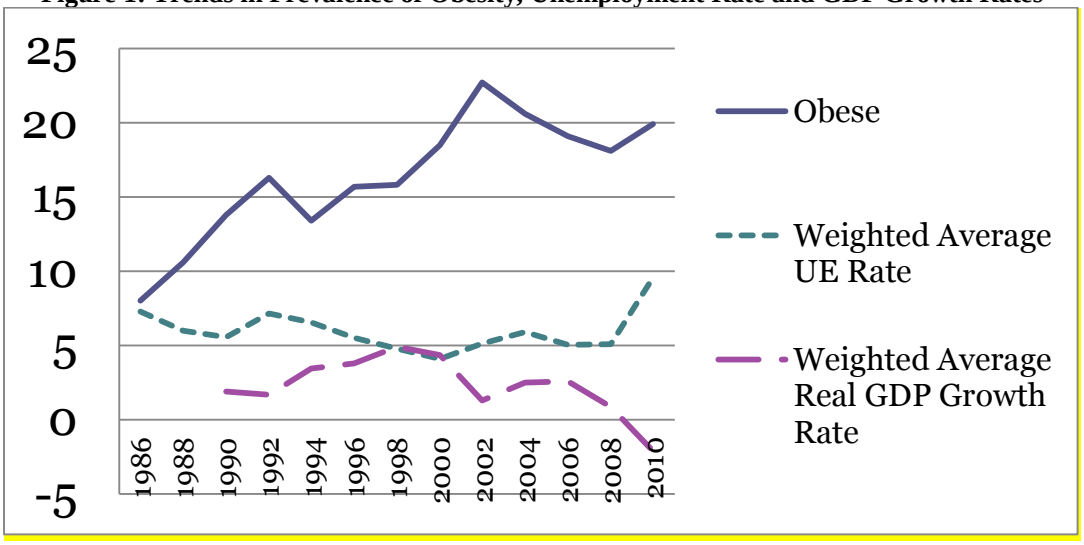
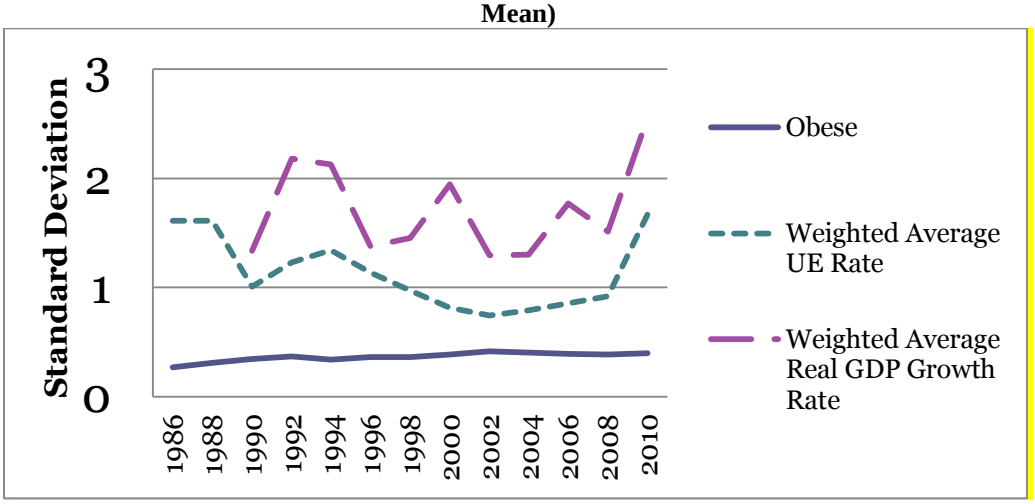


Figure 2: Trends in Prevalence of Obesity, Unemployment Rate and GDP Growth Rates (Deviations from Mean)



Descriptive Statistics

The basic summary statistics for the analysis on child weight outcomes are shown in Table XI. Among this sample 27.8% of the sample is overweight or obese and 13.6% of the children face obesity prevalence. Among the household characteristics, less than half (49.5%) of the sample was female. Additionally, about 14.4% of the mothers were non-Hispanic Black, 6.7% were Hispanic, and 57.8% were defined as non-Hispanic White. On average, less than a quarter of the children (18.2%) had mothers who completed less than high school; about 37.7% of children had mothers whose highest level of education was high school. 21.6% of the population had mothers who completed college. Nearly 74.2% of the households were from urban residential areas, while 8.9% were from suburban areas and 16.9% were from rural areas. 5.5% of households had the presence of the child's grandparent living with them. On average, a family is comprised of 2.4 children. For the unemployment measures, the average unemployment rate for the current year was 5.696, while the average weighted-average unemployment rate was 5.754. . Among the GDP measures, the average GDP growth rate for the current year was 3.551, while the weighted average GDP growth rate was 3.009.

Table XI: Summary Statistics for Analysis using Child Weight Outcomes

Variable Name	Mean (SD)
Body Mass Index	18.194 (6.374)
Body Mass Index Percentile	56.915 (34.132)
Prevalence of Obesity (BMI percentile ≥95)	0.136 (0.343)
Prevalence of Overweight or Obesity (BMI percentile ≥85)	0.278 (0.443)
Economic Conditions Measures	
Current unemployment rate	5.696 (1.564)
Weighted average unemployment rate	5.754 (1.540)
Current GDP growth rate	3.551 (2.363)
Weighted average GDP growth rate	3.009 (2.141)
Individual, Household and Local Area Characteristics	
Female	0.495 (0.500)
Male	0.505 (0.500)
Mother NH black	0.144 (0.351)
Mother Hispanic	0.067 (0.251)
Mother NH white	0.578 (0.494)
Mother Asian	0.007 (0.084)
Mother other	0.072 (0.259)
Mother unassigned	0.132 (0.338)
Age in months	96.526 (45.441)
Age in months^2	11382.1 (8808)
Childs birth weight (lbs)	7.440 (1.328)
Mother's age in years	41.837 (8.895)
Mother married	0.697 (0.459)
Mother never married	0.068 (0.251)
Mother separated	0.051 (0.220)
Mother widowed	0.018 (0.132)
Mother divorced	0.166 (0.373)
Mother completed less than high school	0.182 (0.386)
Mother completed high school	0.377 (0.485)
Mother completed some college	0.225 (0.418)
Mother completed college	0.216 (0.412)
Urban	0.742 (0.438)
Suburban	0.089 (0.255)
Rural	0.169 (0.375)
Grandparents live in HH	0.055 (0.229)
Number of children in HH	2.432 (1.108)

N==35,241 (SD)=Standard Deviation
Sample weights are used to have national representation

Regression Analysis: Reduced form and Individual Fixed Effect

Linear probability models in their reduced forms are used for the binary indicator outcomes of overweight and obese, and obesity prevalence and the regression results are shown in Tables XII and XIII respectively. The simplest reduced form results without state and year fixed effects are presented with controls listed in Table XI corresponding to equation 10, in panel A. Panel B introduces state and year fixed effects to control for unobservable determinants of

lifestyle behaviors associated with each state and survey year that corresponds to equation 11. In order to test for the influence of seasonal fluctuations on child health outcomes, a model with seasonality controls is reported in panel C corresponding to equation 12. Although the results in panels A, B and C are all similar, theoretically the inclusion of state and year fixed effects is vital for the micro-econometric specification (Ruhm, 2000;Ruhm, 2003;Ruhm, 2005). By comparison, controlling for seasonality using the month dummy variables does not influence the results much and prior literature among adults also does not emphasize it is a crucial component in this field of research. The longitudinal individual fixed effect model results are reported in panel D of this table corresponding to equation 13. This model attempts to account for unobserved individual level heterogeneity taking advantage of the longitudinal nature of the dataset. Given the longitudinal advantage in this study in comparison to other studies that use cross-sectional data, panel D with the individual fixed effect model will be our preferred specification. However, it will still be compared to the reduced form models used in existing literature represented in panel B. It is important to remember that since the child's height and weight are self-reported by the mothers, and BMI is computed based on these values, all improbable BMI values are dropped from the regression sample.

For child overweight and obese prevalence (BMI percentile $\geq 85^{th}$) the reduced form models replicating methodology from the adult cross sectional studies suggest improvements in the economy in the form of higher GDP growth rate are associated with a reduction in undesirable weight outcomes for children as seen in Table XII. The magnitude and strength of this value declines but still holds true when accounting for time and state controls with a coefficient estimate of -0.003. However, when including the individual fixed effect to control from individual level unobservables suggest that GDP is no longer associated with child

overweight and obesity prevalence and the overall estimate further declines. Inclusion of the individual fixed effect suggests for children, changes in the economy may not be associated with overweight or obesity prevalence because of numerous other individual specific components such as other sources of child care and the impact of relatives and other individual specific factors that may influence a child's weight outcomes.

Table XII: Estimations of Child Overweight and Obesity Prevalence on Weighted Average Macroeconomic Indicators (Full sample)

	A	B	C	D
Macroeconomic Indicators				
State unemployment rate	-0.005	0.001	0.001	0.002
	(0.003)	(0.004)	(0.004)	(0.004)
State GDP growth rate	-0.006***	-0.003*	-0.003*	-0.001
	(0.002)	(0.002)	(0.002)	(0.001)
Year controls	NO	YES	YES	YES
State controls	NO	YES	YES	NO
Seasonality controls	NO	NO	YES	NO
Individual fixed effects	NO	NO	NO	YES

Note: All models include the full set of individual, household and local area characteristics listed in Table XI. Standard errors (SE) are reported in parentheses and are robust.
* significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation in panels A, B and C.
N=35,241 for sample analyzed with unemployment rates; N=31,234 for sample analyzed using GDP growth rates

Overall, no significant results were found from changes in macroeconomic indicators on prevalence of childhood obesity (BMI percentile $\geq 95^{th}$) in the reduced form linear probability specifications among the full sample as seen in Table XIII. The point estimates suggest that a weakening economy shown by higher unemployment rates increases the likelihood of obesity while a strengthening economy demonstrated in the form of higher gross domestic product growth rates has the opposite effect. A similar pattern is observed with the individual fixed effects model such that improvements in the economy results in obesity prevalence reductions. However, these results are not significant and the conclusion is that there is no association between the economy and overweight/obesity prevalence.

Table XIII: Estimations of Child Obesity Prevalence on Weighted Average Macroeconomic Indicators (Full sample)

	A	B	C	D
Macroeconomic Indicators				
State unemployment rate	-0.004*	0.005	0.005	0.002
	(0.003)	(0.004)	(0.004)	(0.003)
State GDP growth rate	-0.003	-0.002	-0.001	-0.0001
	(0.001)	(0.001)	(0.001)	(0.001)
Year controls	NO	YES	YES	YES
State controls	NO	YES	YES	NO
Seasonality controls	NO	NO	YES	NO
Individual fixed effects	NO	NO	NO	YES

Note: All models include the full set of individual, household and local area characteristics listed in Table XI. Standard errors (SE) are reported in parentheses and are robust.
* significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation in panels A, B, and C.
N=35,241 for sample analyzed with unemployment rates; N=31,234 for sample analyzed using GDP growth rates

It is important to note that although the overall results do not hold any statistical significance, the sample of children that lives with their mother only presented in Table XIV and Table XV faces an opposite association with the economy on overweight and obesity prevalence and obesity prevalence. The sample of children that live with their mother only are shown because they will be useful for comparison purposes with the instrumental variables model results which study the impact of mothers' hours worked in the labor market and mothers' wages on child health since detailed information on the fathers work hours is not available in the dataset.

Table XIV: Estimations of Child Overweight and Obesity Prevalence on Weighted Average Macroeconomic Indicators (Children who reside with mother only)

	A	B	C	D
Macroeconomic Indicators				
State unemployment rate	-0.010**	-0.008	-0.008	0.003
	(0.004)	(0.009)	(0.009)	(0.006)
State GDP growth rate	-0.005*	0.001	0.001	0.000
	(0.003)	(0.002)	(0.003)	(0.003)
Year controls	NO	YES	YES	YES
State controls	NO	YES	YES	NO
Seasonality controls	NO	NO	YES	NO
Individual fixed effects	NO	NO	NO	YES

Note: All models include the full set of individual, household and local area characteristics listed in Table XI Standard errors (SE) are reported in parentheses and are robust. * significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation in panels A, B, and C. N=13,757 for sample analyzed with unemployment rates; N=11,514 for sample analyzed using GDP growth rates

Table XV: Estimations of Child Obesity Prevalence on Weighted Average Macroeconomic Indicators (Children who reside with mother only)

	A	B	C	D
Macroeconomic Indicators				
State unemployment rate	-0.007	-0.001	-0.001	-0.001
	(0.003)	(0.007)	(0.007)	(0.006)
State GDP growth rate	-0.002	0.001	0.001	0.002
	(0.002)	(0.002)	(0.002)	(0.002)
Year controls	NO	YES	YES	YES
State controls	NO	YES	YES	NO
Seasonality controls	NO	NO	YES	NO
Probit	NO	NO	NO	NO
Individual fixed effects	NO	NO	NO	YES

Note: All models include the full set of individual, household and local area characteristics listed in Table XI. Standard errors (SE) are reported in parentheses and are robust.
* significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation in panels A, B, and C.
N=13,757 for sample analyzed with unemployment rates; N=11,514 for sample analyzed using GDP growth rates

Although the analysis on children who live with both parents indicates no statistical significance, the magnitude and direction of the point estimates shown in Table XVI and Table XVII matches that of the full sample. Again, the longitudinal analysis using the individual fixed effects is preferred; the results find no association between the economy and weight for children living with both parents.

Table XVI: Estimations of Child Overweight and Obesity Prevalence on Weighted Average Macroeconomic Indicators (Children who reside with both parents)

	A	B	C	D
Macroeconomic Indicators				
State unemployment rate	-0.001	0.004	0.004	0.002
	(0.004)	(0.005)	(0.005)	(0.004)
State GDP growth rate	-0.005	-0.003	-0.002	-0.001
	(0.002)	(0.003)	(0.003)	(0.002)
Year controls	NO	YES	YES	YES
State controls	NO	YES	YES	NO
Seasonality controls	NO	NO	YES	NO
Individual fixed effects	NO	NO	NO	YES

Note: All models include the full set of individual, household and local area characteristics listed in Table XI. Standard errors (SE) are reported in parentheses and are robust.
* significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation in panels A, B, and C.
N=20,150 for sample analyzed with unemployment rates; N=18,499 for sample analyzed using GDP growth rates

Table XVII: Estimations of Child Obesity Prevalence on Weighted Average Macroeconomic Indicators on (Children who reside with both parents)

	A	B	C	D
Macroeconomic Indicators				
State unemployment rate	-0.003	0.008	0.008	0.004
	(0.003)	(0.004)	(0.004)	(0.003)
State GDP growth rate	-0.004**	-0.003	-0.002	-0.001
	(0.002)	(0.002)	(0.002)	(0.001)
Year controls	NO	YES	YES	YES
State controls	NO	YES	YES	NO
Seasonality controls	NO	NO	YES	NO
Individual fixed effects	NO	NO	NO	YES

Note: All models include the full set of individual, household and local area characteristics listed in Table XI. Standard errors (SE) are reported in parentheses and are robust.
* significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation in panels A, B, and C.
N=20,150 for sample analyzed with unemployment rates; N=18,499 for sample analyzed using GDP growth rates

Although the dataset has been dissected to study the differences in the association between economic activity on child overweight and obesity prevalence by the child's residential status, the results of the full sample are the most representative of the child population. Similar to adult studies, the reduced form methodology findings suggest that changes the economy are associated with prevalence of being overweight/obese (BMI $\geq 85^{th}$ percentile. The direction of the relationship is more in line with intuition among the child sample suggesting improvements in the economy measured by GDP growth is associated with declines in undesirable weight outcomes. However, implementation of the individual fixed effects longitudinal model suggests that unemployment rates and GDP growth rates have no direct association with weight outcomes for individual children. Therefore the parental mechanisms of monetary and time inputs are most likely to influence each individual child uniquely suggesting that weight outcomes are not likely to be associated with the macro-level economy.

Individual Fixed Effect Subgroup Analysis

It is likely that individuals with varying characteristics may have different health responses to temporary fluctuations in the economy. Prior literature often shows different associations related to economic changes and health outcomes by demographic factors such as race (Dehejia *et al.*, 2004). The mother's characteristics including highest education level completed have also been shown to have different levels of association on their children's health outcomes in comparison to their counterparts (Dehejia *et al.*, 2004;Pongou, Salomon, and Ezzati, 2006). The existing literature also shows that family's income status plays a role in child health outcomes (Catalano, 1991;Dehejia *et al.*, 2004;Ferreira *et al.*, 2009;Paxson *et al.*, 2005;Pongou *et al.*, 2006). There were also differences found amongst different age groups of children whose health was most vulnerable to changes in the economy (Cutler *et al.*, 2002;Maluccio, Hoddinott, Behrman, Martorell, Quisumbing, and Stein, 2009). Finally, types or gaps in insurance coverage have been shown to alter the frequency of health care among children(Fairbrother, Carle, Cassedy, and Newacheck, 2010). Thus, we expanded our analysis to estimate models by various subpopulations.

In order to determine which subgroups were most influenced by the changes in economic indicators, we conducted a subpopulation analysis by, mother's race (non-Hispanic white, non-Hispanic black or Hispanic), mother's highest educations level completed (less than high school, high school, more than high school or college), average household income categories (low, middle and high), child's age in years (2 to 5, 6 to 9 or 10 to 14), type of insurance coverage (public, private or none) and level of state unemployment benefits categories (low, middle and high).

Table XVIII presents the subgroup analysis of the impact of economic indicators on prevalence of overweight and obese (BMI≥85th percentile) among children, corresponding to the individual fixed effects results in panel D from tables XII, XIX and XVI for the full sample, children that reside with their mother only and children that reside with both parents respectively. Since the individual fixed effects model is the most suitable model for this analysis because it accounts for individual unobservables and takes advantage of the longitudinal nature of the data, allowing for measurement of changes in individual children's at risk of obese and obesity prevalence over time with corresponding changes in the economy and yields individual level results. Overall, there is very little significant difference in the subgroup analysis which shows the impact of indicators between each subpopulation category. The only group that sees a positive association with obesity prevalence as unemployment rises is children between the ages of 2 to 5 years. Improvements in the economy are associated with to higher prevalence of overweight and obese for these children with an unemployment coefficient of -0.023 for the full sample and -0.027 for the sample of children that lives with both parents. For children who live with both parents, higher GDP growth rates lead to an increase in prevalence of overweight and obese by a coefficient estimate of 0.013. The only other subgroup that saw declines in weight outcomes of this category were those children who lived with both parents in mid-level unemployment insurance benefits states. There were no other overall significant differences between the subgroups.

Table XVIV presents the subgroup analysis of the association between economic indicators and prevalence of obesity (BMI ≥ 95th percentile) among children, corresponding to the individual fixed effects results in panel D from tables XIII, XV and XVII. When analyzing the subgroups with respect to prevalence of obesity we find a similar pattern where children

between the ages of 2 to 5 years of age see a negative relationship with obesity prevalence as unemployment rates rise with a point estimate of -0.021. Interestingly, with regards to obesity, the results also indicate that or children who live with both parents those between the ages of 10 to 14 years see an inverse relationship between a good economy and obesity prevalence where higher unemployment rates are associated with a higher obesity prevalence by a point estimate of 0.016 and higher GDP growth rates are associated with lower obesity prevalence with a coefficient of -0.007. This further emphasizes that children in different age brackets may face differing consequences on their health based on the economic environment. The comprehensive results from the subgroup analysis suggest there is no overall consistency of that the effects of macroeconomic conditions on obesity prevalence for children in different subgroups aside for those groups that differ by age.

Table XVIII: Estimations of Child Overweight and Obesity Prevalence on Weighted Average Macroeconomic Indicators, by Subpopulations (Individual Fixed Effect)
[Mother's Race, Mother's Highest Education Level Completed, Child's Age in Years]

		By Mother's Race			By Mother's Highest Education Level Completed				By Child's Age in Years		
	Full Sample	**NH White**	**NH Black**	**Hispanic**	**Less than HS**	**High School**	**More than HS**	**College**	**2 to 5**	**6 to 9**	**10 to 14**
Full Sample											
Macroeconomic Indicators											
State unemployment rate	0.002	0.006	0.009	-0.009	0.002	0.004	0.004	0.005	-0.023**	0.004	0.001
	(0.004)	(0.004)	(0.006)	(0.007)	(0.005)	(0.008)	(0.006)	(0.007)	(0.009)	(0.006)	(0.006)
State GDP growth rate	-0.001	-0.001	-0.003	-0.004	0.000	-0.009	-0.022	-0.021	0.010	-0.003	-0.005
	(0.001)	(0.003)	(0.003)	(0.003)	(0.002)	(0.004)	(0.035)	(0.025)	(0.006)	(0.003)	(0.003
Children who reside with MOTHER ONLY											
Macroeconomic Indicators											
State unemployment rate	0.003	0.011	0.004	-0.006	0.004	-0.001	0.089	n/a	-0.008	0.002	-0.000
	(0.006)	(0.007)	(0.010)	(0.010)	(0.007)	(0.014)	(0.062)		(0.017)	(0.011)	(0.009)
State GDP growth rate	0.000	0.001	-0.001	-0.003	0.003	-0.007	-0.015	n/a	0.005	-0.004	-0.003
	(0.003)	(0.005)	(0.003)	(0.006)	(0.003)	(0.005)	(0.004)		(0.014)	(0.005)	(0.003)
Children who reside with BOTH PARENTS											
Macroeconomic Indicators											
State unemployment rate	0.002	-0.000	0.022	-0.009	0.001	0.007	0.002	0.011	-0.027**	-0.006	0.005
	(0.004)	(0.006)	(0.018)	(0.006)	(0.006)	(0.009)	(0.052)	(0.051)	(0.012)	(0.008)	(0.009)
State GDP growth rate	-0.001	0.001	-0.003	-0.006	0.000	-0.008	0.009	-0.013	0.013**	-0.002	-0.005
	(0.002)	(0.003)	(0.007)	(0.004)	(0.003)	(0.003)	(0.035)	(0.027)	(0.004)	(0.004)	(0.004)

Table XVIII (continued): Estimations of Child Overweight and Obesity Prevalence on Weighted Average Macroeconomic Indicators, by Subpopulations (Individual Fixed Effect)
[Child's Insurance Coverage ,State UE Insurance Benefits, Average Household Income]

		By Child's Insurance Coverage			By State UE Insurance Benefits			By Average Household Income		
	Full Sample	**Private**	**Public**	**None**	**Low**	**Mid**	**High**	**Low**	**Middle**	**High**
Full Sample										
Macroeconomic Indicators										
State unemployment rate	0.002	0.003	0.004	-0.004	0.006	0.002	0.007	0.000	-0.005	0.001
	(0.004)	(0.004)	(0.006)	(0.008)	(0.006)	(0.004)	(0.009)	(0.005)	(0.006)	(0.006)
State GDP growth rate	-0.001	-0.001	-0.000	0.003	-0.001	-0.005	-0.003	0.000	-0.002	-0.003
	(0.001)	(0.002)	(0.004)	(0.007)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)
Children who reside with MOTHER ONLY										
Macroeconomic Indicators										
State unemployment rate	0.003	-0.002	0.015	-0.003	0.004	0.006	0.015	0.001	-0.002	0.007
	(0.006)	(0.007)	(0.011)	(0.018)	(0.007)	(0.008)	(0.009)	(0.008)	(0.009)	(0.014)
State GDP growth rate	0.000	0.003	-0.001	-0.001	-0.001	0.004	0.002	0.003	-0.002	0.005
	(0.003)	(0.004)	(0.005)	(0.008)	(0.004)	(0.007)	(0.007)	(0.003)	(0.004)	(0.007)
Children who reside with BOTH PARENTS										
Macroeconomic Indicators										
State unemployment rate	0.002	0.000	-0.001	-0.005	0.005	0.012	0.006	0.004	-0.002	-0.004
	(0.004)	(0.005)	(0.011)	(0.015)	(0.007)	(0.008)	(0.012)	(0.006)	(0.008)	(0.006)
State GDP growth rate	-0.001	-0.001	0.005	-0.001	0.000	-0.009**	-0.005	0.001	-0.002	-0.005
	(0.002)	(0.002)	(0.009)	(0.009)	(0.001)	(0.004)	(0.005)	(0.003)	(0.003)	(0.003)

Note: All models include the full set of individual, household and local area characteristics listed in Table XI. All models also include year fixed effects. Standard errors (SE) are reported in parentheses and are robust. * significance at 10%; ** significance at 5%; *** significance at 1%.

Table XIX: Estimations of Child Obesity Prevalence on Weighted Average Macroeconomic Indicators, by Subpopulations (Individual Fixed Effect)
[Mother's Race, Mother's Highest Education Level Completed, Child's Age in Years]

		By Mother's Race			By Mother's Highest Education Level Completed				By Child's Age in Years		
	Full Sample	**NH White**	**NH Black**	**Hispanic**	**Less than HS**	**High School**	**More than HS**	**College**	**2 to 5**	**6 to 9**	**10 to 14**
Full Sample											
Macroeconomic Indicators											
State unemployment rate	0.002	0.007	0.004	-0.005	0.006	-0.002	-0.008	0.009	-0.021**	-0.001	0.005
	(0.003)	(0.006)	(0.005)	(0.005)	(0.004)	(0.005)	(0.009)	(0.017)	(0.008)	(0.004)	(0.004)
State GDP growth rate	-0.000	0.000	-0.001	-0.002	0.0001	-0.004	-0.005	-0.009	0.003	0.004	-0.001
	(0.001)	(0.002)	(0.002)	(0.003)	(0.001)	(0.003)	(0.004)	(0.016)	(0.006)	(0.003)	(0.002)
Children who reside with MOTHER ONLY											
Macroeconomic Indicators											
State unemployment rate	-0.001	0.012	0.003	-0.015	0.001	-0.007	-0.000	n/a	-0.015	-0.005	0.002
	(0.006)	(0.009)	(0.008)	(0.009)	(0.005)	(0.010)	(0.020)		(0.021)	(0.010)	(0.005)
State GDP growth rate	0.002	0.002	-0.000	0.004	0.003	-0.004	-0.004	n/a	0.008	0.001	0.003
	(0.002)	(0.003)	(0.001)	(0.005)	(0.002)	(0.005)	(0.007)		(0.010)	(0.005)	(0.004)
Children who reside with BOTH PARENTS											
Macroeconomic Indicators											
State unemployment rate	0.004	0.006	0.008	-0.006	0.008	-0.001	-0.007	0.001	-0.022**	-0.001	0.016***
	(0.003)	(0.005)	(0.009)	(0.007)	(0.007)	(0.005)	(0.009)	(0.005)	(0.008)	(0.005)	(0.006)
State GDP growth rate	-0.001	0.000	-0.001	-0.003	0.000	-0.004	-0.006	0.006	0.005	0.003	-0.007***
	(0.001)	(0.002)	(0.006)	(0.004)	(0.002)	(0.003)	(0.004)	(0.004)	(0.006)	(0.003)	(0.002)

Table XIX (continued): Estimations of Child Obesity Prevalence on Weighted Average Macroeconomic Indicators, by Subpopulations (Individual Fixed Effect)
[Child's Insurance Coverage ,State UE Insurance Benefits, Average Household Income]

		By Child's Insurance Coverage			By State UE Insurance Benefits			By Average Household Income		
	Full Sample	**Private**	**Public**	**None**	**Low**	**Mid**	**High**	**Low**	**Middle**	**High**
Full Sample										
Macroeconomic Indicators										
State unemployment rate	0.002	0.005	-0.002	-0.003	0.007	-0.001	0.013	0.002	-0.003	0.008
	(0.003)	(0.005)	(0.005)	(0.009)	(0.005)	(0.005)	(0.007)	(0.004)	(0.004)	(0.007)
State GDP growth rate	-0.000	-0.001	0.000	-0.003	-0.001	-0.002	-0.003	0.002	0.000	-0.005
	(0.001)	(0.001)	(0.002)	(0.006)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)
Children who reside with MOTHER ONLY										
Macroeconomic Indicators										
State unemployment rate	-0.001	-0.002	-0.004	0.008	0.002	-0.002	0.020	-0.001	-0.006	0.008
	(0.006)	(0.009)	(0.007)	(0.015)	(0.007)	(0.006)	(0.019)	(0.007)	(0.008)	(0.015)
State GDP growth rate	0.002	0.000	0.002	-0.013	-0.002	0.009	-0.002	0.002	0.004	0.003
	(0.002)	(0.004)	(0.002)	(0.008)	(0.003)	(0.006)	(0.004)	(0.002)	(0.004)	(0.005)
Children who reside with BOTH PARENTS										
Macroeconomic Indicators										
State unemployment rate	0.004	0.005	-0.007	-0.011	0.012	0.009	0.007	0.008	-0.003	0.005
	(0.003)	(0.005)	(0.014)	(0.011)	(0.014)	(0.006)	(0.008)	(0.006)	(0.006)	(0.006)
State GDP growth rate	-0.001	-0.002	0.004	0.003	0.000	-0.006	-0.003	0.005	-0.001	-0.007
	(0.001)	(0.002)	(0.005)	(0.008)	(0.003)	(0.003)	(0.004)	(0.003)	(0.002)	(0.006)

Note: All models include the full set of individual, household and local area characteristics listed in Table XI. All models also include year fixed effects. Standard errors (SE) are reported in parentheses and are robust. * significance at 10%; ** significance at 5%; *** significance at 1%.

Instrumental Variables Approach:

As described in the empirical section, an identification strategy is developed to determine how parental inputs impact child health outcomes. These are measured through mothers' hours worked in the labor market and mothers' wages[14] for the sample of children that reside with only their mother. Data on father's work hours is unavailable in the NLSY79 data therefore an accurate estimation cannot be measured for children who live with both parents. Although the results in Table XIV and Table XV suggest that economic activity has a different relationship with weight outcomes for children of single mothers in comparison children who live with both parents and even to the full sample, the limitations of the dataset does not allow for a more representative analysis. The purpose of this analysis is to lay out a solid foundation for better methodology and study using better datasets with more comprehensive data on parental inputs for both parents and child health in the future.

The instrumental variables approach is conducted to account for possible endogeneity due to unobserved factors and to also help identify the causal mechanisms thru which economic activity affects children's health. The empirical model for this research design is derived from equations 14 and 15 where unemployment or GDP growth rates, industry mix composition, and mother's age are used as instruments for wages and hours worked per week in the labor market.

The results in Table XX and Table XXI suggests that in the basic relationship mothers' wages and work hours are not associated with child overweight and obesity prevalence outcomes when controlling for individual and household level characteristics using both the ordinary least squares (OLS) method however wages are associated with weight outcomes when using the individual fixed effect model for the full sample. It is important to note that the results are

[14] Reservation wages for all mothers are computed using the Heckman selection model

consistent with those presented in the data validation sample. For the subsample of children who live with only their mothers, mother's wages and hours worked per week have no association with children being at risk for obese and obese when using the specified instruments.

Furthermore, the IV model with fixed effects also finds no evidence of economic fluctuations influencing child overweight and obesity prevalence. Among specific subgroups, the individual fixed effect IV model finds a relationship among children between the ages of 2 and 5 years. Based on the analysis from the reduced form models, these results further confirm that younger children may be the subgroup that is most susceptible to changes in weight outcomes as economic conditions change. Future work should pay particular attention to the child's age categories and how parental mechanisms influence children from different age brackets differently.

Table XX: Instrumental Variables Results of Child Overweight and Obesity Prevalence on Mother's Working Hours and Reservation Wages (Full sample)

	Hours Worked per Week	Reservation Wages
Ordinary Least Squares Model	0.0002 (0.0003)	-0.002 (0.005)
Individual Fixed Effects Model	0.0001 (0.0001)	-0.018*** (0.006)

(Children who reside with mother only)

	Hours Worked per Week	Reservation Wages	*Joint F Statistic*
Ordinary Least Squares Model	-0.0002 (0.0002)	-0.004 (0.008)	
Individual Fixed Effects Model	-0.0001 (0.0002)	-0.001 (0.011)	
Instrumental Variable Model			
State unemployment rate	-0.001 (0.002)	-0.006 (0.005)	3.630
State GDP growth rate	-0.002 (0.003)	-0.009 (0.006)	3.194
Instrumental Variable Model with Individual Fixed Effects			
State unemployment rate	-0.006 (0.005)	-0.044 (0.034)	3.049
State GDP growth rate	-0.027 (0.033)	0.004 (0.006)	2.386
Instrumental Variable Model with Individual Fixed Effects (By Subpopulations)			
By Mother's Race			
NH White			
State unemployment rate	0.007 (0.006)	-0.030 (0.063)	1.151
State GDP growth rate	-0.002 (0.006)	-0.002 (0.069)	0.940
NH Black			
State unemployment rate	-0.001 (0.005)	0.036 (0.029)	3.130
State GDP growth rate	-0.012 (0.007)	0.060 (0.039)	1.693
Hispanic			
State unemployment rate	0.005 (0.005)	-0.009 (0.057)	1.098
State GDP growth rate	0.005 (0.009)	0.039 (0.078)	1.098
By Mother's Highest Education Level Completed			
Less than High School			
State unemployment rate	0.000 (0.004)	-0.025 (0.035)	3.209
State GDP growth rate	-0.001 (0.006)	0.045 (0.035)	2.107
High School			
State unemployment rate	0.001 (0.005)	0.007 (0.071)	1.639
State GDP growth rate	-0.003 (0.005)	0.010 (0.100)	1.894
More than High School			
State unemployment rate	0.010 (0.006)	0.040 (0.089)	1.841
State GDP growth rate			
College			
State unemployment rate	n/a	n/a	n/a
State GDP growth rate	n/a	n/a	n/a
By Child's Age in Years			
2 to 5 years			
State unemployment rate	-0.008 (0.014)	0.120 (0.127)	1.680
State GDP growth rate	-0.007 (0.009)	0.322*** (0.106)	1.841
6 to 9 years			
State unemployment rate	0.009 (0.007)	0.073 (0.097)	0.985
State GDP growth rate	0.001 (0.010)	0.074 (0.097)	1.072
10 to 14 years			
State unemployment rate	-0.007 (0.006)	0.049 (0.057)	1.078
State GDP growth rate	0.005 (0.005)	0.018 (0.064)	1.883

	Hours Worked per Week	Reservation Wages	*Joint F Statistic*
By Child's Insurance Coverage			
Private			
State unemployment rate	-0.008 (0.005)	-0.092 (0.045)	1.474
State GDP growth rate	-0.003 (0.008)	0.004 (0.052)	2.150
Public			
State unemployment rate	-0.003 (0.007)	0.027 (0.037)	5.201
State GDP growth rate	0.001 (0.007)	-0.003 (0.038)	1.403
None			
State unemployment rate	0.000 (0.006)	0.039 (0.078)	1.451
State GDP growth rate	0.008 (0.010)	-0.201 (0.129)	0.565
By State UE Insurance Benefits			
Low			
State unemployment rate	0.006 (0.006)	-0.012 (0.046)	1.999
State GDP growth rate	0.011 (0.008)	0.024 (0.051)	1.492
Mid			
State unemployment rate	-0.005 (0.006)	0.046 (0.034)	1.768
State GDP growth rate	-0.005 (0.007)	-0.041 (0.037)	1.894
High			
State unemployment rate	0.005 (0.005)	-0.019 (0.075)	1.911
State GDP growth rate	-0.002 (0.005)	0.025 (0.091)	1.961
By Average Household Income			
Low			
State unemployment rate	-0.000 (0.006)	0.019 (0.049)	7.719
State GDP growth rate	0.010 (0.008)	0.053 (0.052)	3.088
Mid			
State unemployment rate	0.002 (0.007)	-0.025 (0.062)	2.222
State GDP growth rate	0.002 (0.008)	-0.017 (0.069)	1.739
High			
State unemployment rate	0.011 (0.008)	0.055 (0.048)	1.004
State GDP growth rate	0.002 (0.006)	0.015 (0.061)	1.628

Note: All models include the full set of individual, household and local area characteristics.
Standard errors (SE) are reported in parentheses and are robust. * significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national

Table XXI: Instrumental Variables Results of Child Obesity Prevalence on Mother's Working Hours and Reservation Wages (Full sample)

	Hours Worked per Week	Reservation Wages
Ordinary Least Squares Model	0.0002 (0.0002)	0.001 (0.004)
Individual Fixed Effects Model	0.0001 (0.0001)	-0.015** (0.007)

(Children who reside with mother only)

	Hours Worked per Week	Reservation Wages	*Joint F Statistic*
Ordinary Least Squares Model	-0.0001 (0.0001)	0.004 (0.005)	
Individual Fixed Effects Model	0.0001 (0.0001)	0.005 (0.010)	
Instrumental Variable Model[15]			
State unemployment rate	-0.002 (0.002)	-0.004 (0.004)	4.175
State GDP growth rate	-0.004 (0.002)	-0.001 (0.004)	3.194
Instrumental Variable Model with Individual Fixed Effects[16]			
State unemployment rate	0.0002 (0.003)	-0.044 (0.028)	3.444
State GDP growth rate	0.0003 (0.004)	-0.022 (0.027)	2.386
Instrumental Variable Model with Individual Fixed Effects (By Subpopulations)			
By Mother's Race			
NH White			
State unemployment rate	-0.0002 (0.004)	-0.059 (0.048)	1.151
State GDP growth rate	-0.001 (0.004)	-0.021 (0.058)	0.938
NH Black			
State unemployment rate	-0.0001 (0.004)	0.025 (0.024)	3.130
State GDP growth rate	-0.011 (0.016)	0.038 (0.031)	1.708
Hispanic			
State unemployment rate	-0.001 (0.004)	0.031 (0.044)	2.032
State GDP growth rate	-0.001 (0.006)	0.029 (0.074)	1.103
By Mother's Highest Education Level Completed			
Less than High School			
State unemployment rate	-0.001 (0.003)	-0.045 (0.029)	3.209
State GDP growth rate	-0.001 (0.004)	-0.045 (0.030)	2.127
High School			
State unemployment rate	-0.000 (0.005)	-0.006 (0.060)	1.639
State GDP growth rate	-0.003 (0.004)	-0.014 (0.094)	1.895
More than High School			
State unemployment rate	0.013 (0.005)	-0.014 (0.064)	1.290
State GDP growth rate	0.004 (0.003)	-0.066 (0.072)	1.851
College			
State unemployment rate	n/a	n/a	n/a
State GDP growth rate	n/a	n/a	n/a
By Child's Age in Years			
2 to 5 years			
State unemployment rate	-0.026 (0.012)	0.182*** (0.083)	1.824
State GDP growth rate	-0.011 (0.008)	0.296*** (0.074)	2.231
6 to 9 years			

[15] First stage estimates corresponding to this model are shown in Table XLII in Appendix 5
[16] First stage estimates corresponding to this model are shown in Table XLIII in Appendix 5

	Hours Worked per Week	Reservation Wages	*Joint F Statistic*
State unemployment rate	0.009 (0.006)	0.079 (0.082)	0.985
State GDP growth rate	0.003 (0.006)	0.105 (0.078)	1.073
10 to 14 years			
State unemployment rate	0.003 (0.006)	-0.036 (0.048)	1.078
State GDP growth rate	0.004 (0.005)	-0.050 (0.066)	1.885
By Child's Insurance Coverage			
Private			
State unemployment rate	0.006 (0.006)	-0.010 (0.030)	1.013
State GDP growth rate	0.001 (0.005)	-0.026 (0.045)	1.403
Public			
State unemployment rate	-0.003 (0.004)	-0.027 (0.027)	5.832
State GDP growth rate	-0.008 (0.006)	-0.036 (0.039)	2.704
None			
State unemployment rate	0.004 (0.005)	-0.081 (0.060)	1.451
State GDP growth rate	0.018 (0.007)	-0.024 (0.137)	0.563
By State UE Insurance Benefits			
Low			
State unemployment rate	0.007 (0.006)	-0.047 (0.042)	1.999
State GDP growth rate	0.004 (0.006)	-0.016 (0.047)	1.513
Mid			
State unemployment rate	-0.003 (0.004)	0.047 (0.026)	1.768
State GDP growth rate	-0.005 (0.004)	0.036 (0.033)	1.893
High			
State unemployment rate	-0.001 (0.055)	-0.001 (0.004)	1.911
State GDP growth rate	-0.002 (0.004)	-0.092 (0.080)	1.987
By Average Household Income			
Low			
State unemployment rate	0.002 (0.004)	-0.024 (0.043)	7.719
State GDP growth rate	0.006 (0.008)	-0.033 (0.044)	3.123
Mid			
State unemployment rate	0.006 (0.004)	-0.056 (0.046)	2.222
State GDP growth rate	0.003 (0.004)	-0.019 (0.057)	1.742
High			
State unemployment rate	-0.000 (0.005)	0.069 (0.042)	1.004
State GDP growth rate	-0.003 (0.004)	0.107 (0.048)	1.624

Note: All models include the full set of individual, household and local area characteristics.
Standard errors (SE) are reported in parentheses and are robust. * significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national

Analysis on Child Age-Gender Adjusted Body Mass Index Percentiles

Child age-gender adjusted body mass index percentiles are used to track the growth of children in the United States since 1977 (Centers for Disease Control and Prevention, 2011;Department of Health and Human Services, 2002) and will be used as a proxy for child health in this dissertation similar to how they are used in other literature. The overall trends in child BMI and age-gender adjusted BMI percentiles are presented in Table XXII. Figure 3 provide a graphical presentation of the trends in BMI in comparison to unemployment rates and gross domestic product (GDP) growth rates, while figure 4 displays the deviations from the mean. Overall, the trends in BMI have shifted dramatically over the past two decades, and it will be interesting to see how these changes correlate to economic fluctuations over this time span.

Table XXII: Trends in Child BMI and BMI Percentile

Year	BMI	BMI Percentile
1986	16.521 (4.201)	49.146 (32.517)
1988	17.106 (5.679)	53.595 (32.417)
1990	17.708 (6.372)	55.375 (33.781)
1992	18.144 (5.500)	59.938 (32.292)
1994	18.063 (6.744)	52.020 (35.050)
1996	18.404 (4.168)	56.050 (33.876)
1998	18.828 (8.457)	58.443 (33.129)
2000	19.309 (5.438)	64.230 (31.636)
2002	19.976 (5.808)	66.995 (30.536)
2004	20.022 (4.783)	65.557 (30.780)
2006	20.056 (5.015)	63.492 (31.471)
2008	20.231 (4.856)	64.678 (30.924)
2010	20.748 (5.029)	65.621 (30.356)

Figure 3: Trends in Child BMI, Unemployment Rate and GDP Growth Rates

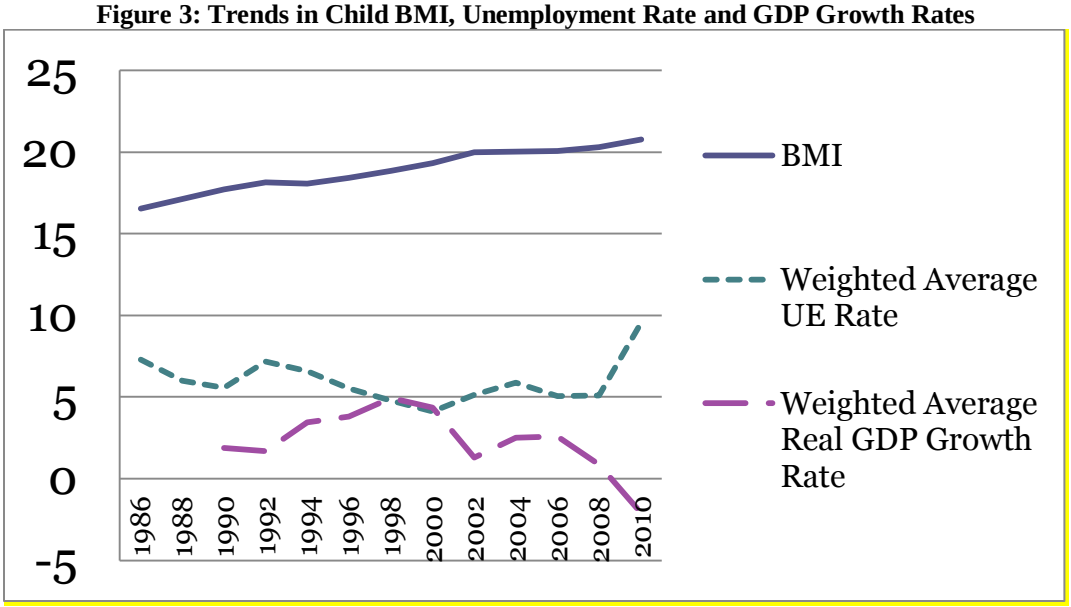
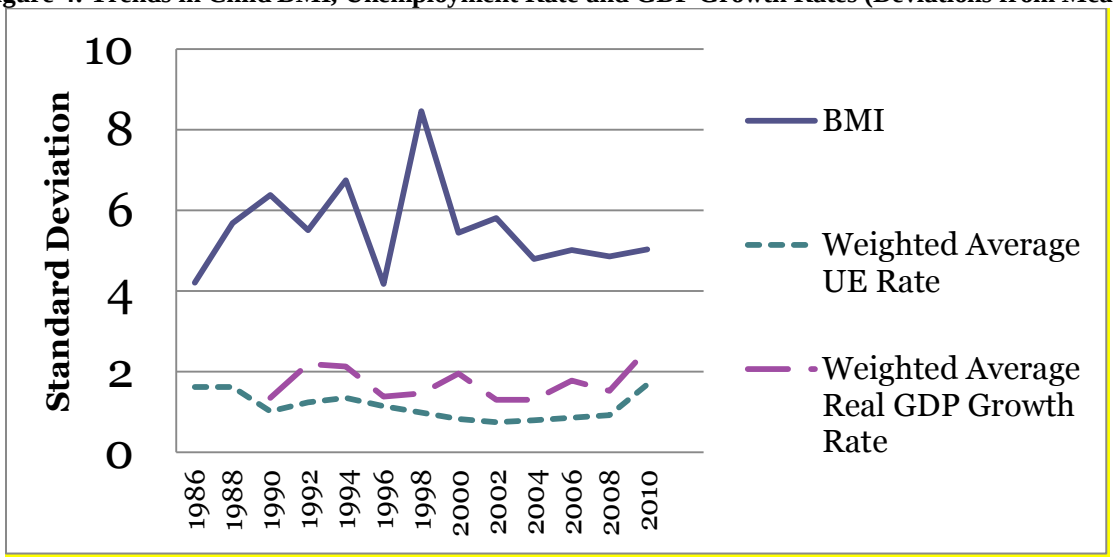


Figure 4: Trends in Child BMI, Unemployment Rate and GDP Growth Rates (Deviations from Mean)



Descriptive Statistics

The basic summary statistics for the analysis on child body mass percentiles are the same as those shown in the previous section Table XI for child overweight and obesity prevalence. The average BMI for children was 18.194 and the average BMI percentile for these children is 56.915. To avoid repetition, the descriptive statistics are not re-discussed.

Regression Analysis: Reduced form and Individual Fixed Effect

The reduced form model methodology applied in much of the existing microeconomic literature studying the impact of economic indicators on health outcomes is used for the continuous outcomes of BMI percentiles and the regression results are shown in Table XXIII for the full sample. The simplest reduced form results are presented without any controls corresponding to equation 10 in panel A, state and year fixed effects in panel B, and seasonal fluctuations in panel C. The longitudinal individual fixed effect model results that attempts to account for unobserved individual level heterogeneity are shown in panel D of this table. As discussed in the previous section, panel D with the individual fixed effect model will be our preferred specification and it will still be compared to the reduced form models used in existing literature represented in panel B. Again, since the child's height and weight are self-reported by the mothers, and BMI is computed based on these values, all improbable BMI values are dropped from the regression sample.

For the full sample, the overall analysis suggests that the economic indicators of unemployment rates and gross domestic product growth rates have no conclusive association with child BMI percentiles. The reduced form models often used in adult literature for cross sectional data suggest improvements in the economy reduce BMI percentiles, particularly using GDP growth rates as a proxy for economic activity. A one-percent increase in GDP growth rates is related to a decrease in the BMI percentile coefficient by -0.549 without any location, time or seasonality controls. Inclusion of year and state controls reduces the magnitude in BMI percentile to -0.281 which has a slight loss of power which would roughly translate into a ball park of two pounds depending on the child's age, height and weight. However, the individual fixed effect model suggests there are several other individual level characteristics for children

that influence weight outcomes, therefore the state of the economy has no overall impact on influencing child BMI. Although the point estimate is not significant, it further declines to -0.062 which in terms of actual child weight can be less than a pound. Similarly the coefficient estimate suggests higher unemployment rates are associated with higher BMI percentiles, but again the results hold no statistical power. Therefore, taking advantage of the longitudinal aspect of this data, and controlling for individual level heterogeneity further suggests that economic activity does not influence child BMI outcomes.

Table XXIII: Estimations of Child Body Mass Index Percentiles on Weighted Average Macroeconomic Indicators (Full sample)

	A	B	C	D
Macroeconomic Indicators				
State unemployment rate	-0.338	0.114	0.075	0.095
	(0.240)	(0.360)	(0.357)	(0.251)
State GDP growth rate	-0.549***	-0.281**	-0.217	-0.062
	(0.158)	(0.138)	(0.140)	(0.130)
Year controls	NO	YES	YES	YES
State controls	NO	YES	YES	NO
Seasonality controls	NO	NO	YES	NO
Individual fixed effects	NO	NO	NO	YES

Note: All models include the full set of individual, household and local area characteristics listed in Table XI
Standard errors (SE) are reported in parentheses and are robust. * significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation in panels A, B and C.
N=35,241 for sample analyzed with unemployment rates; N=31,234 for sample analyzed using GDP growth rates

Among those children that live in their mother's household without the presence of their father, the economy has no relationship with child BMI percentiles both in the reduced form models and the individual fixed effect model as seen in Table XXIV. Since the individual fixed effect model seems to be the most accurate form of analysis accounting for unobservable individual level heterogeneity, the results in panel D are preferred. Although they are not significant, the point estimates suggest that children living in single mother households, economic improvements are associated with a rise in BMI percentile outcomes for children. Given the demographics of the population, these women are more likely to come from lower

socioeconomic status background and maybe recipients of welfare, child support or child care credits. Changes in economic activity are likely to have a different relationship with this population given they have several other external factors in their households including inputs from various child supplemental sources. Overall, no strong conclusions can be made since these results hold no statistical power.

Table XXIV: Estimations of Child Body Mass Index Percentiles on Weighted Average Macroeconomic Indicators (Children who reside with mother only)

	A	B	C	D
Macroeconomic Indicators				
State unemployment rate	-0.528	-0.885	-0.825	-0.149
	(0.324)	(0.713)	(0.703)	(0.500)
State GDP growth rate	-0.507***	-0.207	-0.184	0.087
	(0.163)	(0.245)	(0.246)	(0.202)
Year controls	NO	YES	YES	YES
State controls	NO	YES	YES	NO
Seasonality controls	NO	NO	YES	NO
Individual fixed effects	NO	NO	NO	YES

Note: All models include the full set of individual, household and local area characteristics listed in Table Standard errors (SE) are reported in parentheses and are robust. * significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation in panels A, B and C.
N=13,757 for sample analyzed with unemployment rates; N=11,514 for sample analyzed using GDP growth rates

For children living with both parents shown in Table XXV, the overall results the individual level fixed effect models resemble those of the full sample. Again, since the coefficients hold no statistical power, it is clear that in all sample sets the economy has no association with child BMI percentiles when controlling for individual level unobservables among children.

Table XXV: Estimations of Child Body Mass Index Percentiles on Weighted Average Macroeconomic Indicators (Children who reside with both parents)

	A	B	C	D
Macroeconomic Indicators				
State unemployment rate	-0.222	0.707	0.632	0.284
	(0.254)	(0.339)	(0.344)	(0.254)
State GDP growth rate	-0.582**	-0.303	-0.201	-0.031
	(0.199)	(0.198)	(0.183)	(0.137)
Year controls	NO	YES	YES	YES
State controls	NO	YES	YES	NO
Seasonality controls	NO	NO	YES	NO
Individual fixed effects	NO	NO	NO	YES

Note: All models include the full set of individual, household and local area characteristics listed in Table XI
Standard errors (SE) are reported in parentheses and are robust.
* significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation in panels A, B and C.
N=20,150 for sample analyzed with unemployment rates; N=18,499 for sample analyzed using GDP growth rates

The overall results in Tables XXIII, XXIV and XXV suggest that with replication the reduced form methodology from the adult literature, improvements in the economy measured by rising GDP growth rates are associated with a decline in BMI percentiles when controlling for time and location, although in terms of actual weight this only comprises a few pounds that would not substantially change the child's total weight. However, incorporating the longitudinal fixed effect methodology suggests unemployment rates and GDP growth rates have no direct association with weight outcomes for individual children.

Individual Fixed Effect Subgroup Analysis

A subpopulation analysis on the link between economic indicators on child age-gender adjusted body mass index percentiles is also conducted for differences across race, mother's education level, child's age, type of health insurance coverage, state unemployment benefits levels, and family income and these findings are presented in Table XVI. The coefficient estimates shown in this table correspond to the individual level fixed effects models shown in panel D of the full sample shown in Table XXIII, the sample of children that resides with only their mothers in Table XXIV, and the sample of children that resides with both parents in Table XXV. The results of the subgroup analysis show the impact of the changes in these indicators,

and in particular how they are significantly different from their counterparts for certain categories. Overall, there are very few statistically significant results by the individual level fixed effect subgroup analysis suggesting that the overall state of the economy has little impact on changes in individual level child BMI percentiles. For the full sample, children who are between the ages of 2 and 5 years see a negative relationship with BMI as the economy worsens in the form of higher unemployment rates. It is a possibility that pre-school children in this age bracket are more susceptible to health problems due to poor nutrition in the earliest stages of their life, with a coefficient estimate of -1.394. On the other hand, as the economy improves in the form of higher GDP growth rates, children who live in states with mid-level unemployment insurance benefits see improving weight outcomes both in the full sample and the subsample of children that live with both parents. Economic indicators have no association among various subsamples of children that reside with only their mother.

The comprehensive results from the subgroup analysis suggests that unemployment rates have different relationships with BMI percentiles for children from the lowest age bracket and better GDP growth rate is only seen to reduce BMI percentiles for children who live in states with mid-level unemployment insurance benefits. Future analysis on these categories using the identification strategy will help to confirm the validity of these results.

Table XXVI: Estimations of Child Body Mass Index Percentiles on Weighted Average Macroeconomic Indicators, by Subpopulations (Individual Fixed Effect)
[Mother's Race, Mother's Highest Education Level Completed, Child's Age in Years]

		By Mother's Race			By Mother's Highest Education Level Completed				By Child's Age in Years		
	Full Sample	NH White	NH Black	Hispanic	Less than HS	High School	More than HS	College	2 to 5	6 to 9	10 to 14
Full Sample											
Macroeconomic Indicators											
State unemployment rate	0.095	0.207	0.034	-0.257	0.107	0.124	-0.397	0.148	-1.394**	0.712	-0.064
	(0.251)	(0.296)	(0.431)	(0.605)	(0.296)	(0.531)	(0.715)	(2.944)	(0.658)	(0.420)	(0.393)
State GDP growth rate	-0.062	0.063	-0.043	-0.400	-0.105	-0.200	-0.011	-1.370	0.467	-0.169	-0.046
	(0.130)	(0.244)	(0.180)	(0.242)	(0.163)	(0.239)	(0.257)	(1.306)	(0.318)	(0.282)	(0.139)
Children who reside with MOTHER ONLY											
Macroeconomic Indicators											
State unemployment rate	-0.149	0.469	-0.442	-0.304	-0.141	-0.386	0.982	n/a	-1.840	1.144	-0.268
	(0.500)	(0.591)	(0.710)	(0.848)	(0.413)	(1.005)	(1.337)		(1.228)	(0.853)	(0.534)
State GDP growth rate	0.087	0.206	0.219	-0.531	0.074	0.107	-0.492	n/a	0.956	-0.272	0.033
	(0.202)	(0.368)	(0.233)	(0.320)	(0.207)	(0.407)	(0.598)		(0.803)	(0.475)	(0.184)
Children who reside with BOTH PARENTS											
Macroeconomic Indicators											
State unemployment rate	0.284	-0.004	1.098	-0.267	0.311	0.645	-0.588	-1.221	-1.094	-0.216	0.674
	(0.254)	(0.354)	(0.590)	(0.550)	(0.341)	(0.626)	(0.663)	(3.958)	(0.895)	(0.545)	(0.501)
State GDP growth rate	-0.031	0.119	0.063	-0.380	-0.055	-0.276	0.173	-2.168	0.401	0.001	-0.038
	(0.137)	(0.270)	(0.373)	(0.317)	(0.197)	(0.313)	(0.330)	(1.293)	(0.380)	(0.277)	(0.232)

Table XXVI (continued): Estimations of Child Body Mass Index Percentiles on Weighted Average Macroeconomic Indicators, by Subpopulations (Individual Fixed Effect)
[Child's Insurance Coverage ,State UE Insurance Benefits, Average Household Income]

		By Child's Insurance Coverage			By State UE Insurance Benefits			By Average Household Income		
	Full Sample	**Private**	**Public**	**None**	**Low**	**Mid**	**High**	**Low**	**Middle**	**High**
Full Sample										
Macroeconomic Indicators										
State unemployment rate	0.095	0.148	0.010	-1.048	0.232	0.098	0.329	0.322	-0.782	-0.166
	(0.251)	(0.255)	(0.482)	(0.724)	(0.438)	(0.438)	(0.512)	(0.438)	(0.465)	(0.440)
State GDP growth rate	-0.062	-0.062	-0.253	-0.088	-0.037	-0.697***	-0.077	-0.222	0.097	-0.075
	(0.130)	(0.172)	(0.426)	(0.539)	(0.176)	(0.202)	(0.284)	(0.190)	(0.194)	(0.210)
Children who reside with MOTHER ONLY										
Macroeconomic Indicators										
State unemployment rate	-0.149	-0.367	0.095	-0.595	0.035	0.537	-0.012	-0.207	-0.570	-0.719
	(0.500)	(0.568)	(0.739)	(0.775)	(0.852)	(0.583)	(0.580)	(0.654)	(0.519)	(1.006)
State GDP growth rate	0.087	0.386	-0.045	-0.361	0.251	-0.508	0.309	-0.033	0.415	0.430
	(0.202)	(0.291)	(0.363)	(1.015)	(0.237)	(0.438)	(0.562)	(0.242)	(0.333)	(0.444)
Children who reside with BOTH PARENTS										
Macroeconomic Indicators										
State unemployment rate	0.284	0.198	0.870	-1.162	0.696	0.392	0.702	1.152	-0.923	-0.361
	(0.254)	(0.324)	(0.902)	(1.093)	(0.410)	(0.689)	(0.749)	(0.700)	(0.712)	(0.438)
State GDP growth rate	-0.031	-0.010	-0.489	0.036	-0.051	-0.689***	-0.002	-0.266	0.028	-0.082
	(0.137)	(0.185)	(0.920)	(0.723)	(0.268)	(0.240)	(0.344)	(0.247)	(0.292)	(0.202)

Note: All models include the full set of individual, household and local area characteristics listed in Table XI. All models also include year fixed effects. Standard errors (SE) are reported in parentheses and are robust. * significance at 10%; ** significance at 5%; *** significance at 1%.

Instrumental Variables Approach:

Just as with overweight and obesity prevalence, identification is developed to determine how parental inputs in the form of time and monetary inputs impact child body mass index percentiles. These are measured through mothers' hours worked in the labor market and mothers' wages[17] for the sample of children that reside with only their mother. Again, since the results in Table XXIV suggest that economic activity has a different association with children of single mothers in comparison children who live with both parents and even to the full sample, the limitation of the dataset does not allow for a more representative analysis.

The basic relationship suggests that mothers' work hours are related to child BMI percentiles in the basic linear model and mothers' wages are associated with child BMI percentile outcomes when controlling for individual and household level characteristics with the individual fixed effect model for the full sample as seen in Table XXVII. Unfortunately, this relationship does not hold strongly for the subsample of children that live with only their mothers. Again, it is important to remember that this is specifically for the subsample of children who live with only their mothers, and a more representative instrumental variables model with information on the father's work hours and wages will yield more accurate results.

The results of the instrumental variables model and instrumental variables model with individual level fixed effects also find no evidence of economic expansions being associated with child BMI percentile. Even among the subgroups that found a significant relationship in the individual fixed effects model, the identification strategy suggests that no such strong association exists. Overall, the implications of this finding suggest that there are numerous individual level characteristics among children that influence child weight outcomes, particularly for the sample

[17] Reservation wages for all mothers are computed using the Heckman selection model

that live with mothers only. These individual unobservables can be in the form of other child care arrangements, welfare payments, or child supplemental programs. Therefore, taking advantage of longitudinal data that accounts for these individual differences suggests that changes in economic activity are less likely to have a direct relationship with child weight outcomes.

Table XXVII: Instrumental Variables Results of Child Body Mass Index Percentiles on Mother's Working Hours and Reservation Wages

(Full sample)

	Hours Worked per Week	Reservation Wages
Ordinary Least Squares Model	0.040* (0.020)	-0.031 (0.336)
Individual Fixed Effects Model	-0.003 (0.017)	-1.871*** (0.393)

(Children who reside with Mother only)

	Hours Worked per Week	Reservation Wages	*Joint F Statistic*
Ordinary Least Squares Model	0.012 (0.025)	-0.250 (0.457)	
Individual Fixed Effect Model	-0.012 (0.027)	-0.599 (0.677)	
Instrumental Variable Model			
State unemployment rate[18]	-0.236 (0.155)	-0.252 (0.350)	*3.630*
State GDP growth rate	-0.317 (0.178)	-0.275 (0.401)	*3.194*
Instrumental Variable Model with Individual Fixed Effects			
State unemployment rate[19]	-0.058 (0.268)	-2.105 (1.993)	*3.049*
State GDP growth rate	0.206 (0.332)	-1.606 (1.996)	*2.386*
Instrumental Variable Model with Individual Fixed Effects (By Subpopulations)			
By Mother's Race			
NH White			
State unemployment rate	-0.081 (0.300)	-1.494 (3.344)	*1.151*
State GDP growth rate	-0.179 (0.349)	-0.567 (3.415)	*0.892*
NH Black			
State unemployment rate	-0.264 (0.302)	0.302 (2.119)	*3.130*
State GDP growth rate	-0.655 (0.427)	1.608 (2.232)	*2.447*
Hispanic			
State unemployment rate	0.804 (0.456)	-0.185 (3.664)	*2.032*
State GDP growth rate	1.239 (0.767)	-0.028 (4.208)	*0.704*
By Mother's Highest Education Level Completed			
Less than High School			
State unemployment rate	-0.234 (0.277)	-0.867 (2.164)	*3.209*
State GDP growth rate	-0.173 (0.346)	-0.531 (2.099)	*2.254*
High School			
State unemployment rate	-0.280 (0.293)	-2.491 (3.777)	*1.639*
State GDP growth rate	-0.361 (0.289)	-1.692 (4.359)	*2.281*
More than High School			
State unemployment rate	0.277 (0.364)	-5.091 (5.794)	*1.290*
State GDP growth rate	0.556 (0.410)	-6.538 (5.847)	*1.745*
College			
State unemployment rate	n/a	n/a	n/a
State GDP growth rate			
By Child's Age in Years			
2 to 5 years			
State unemployment rate	-0.249 (0.706)	8.346 (6.710)	1.824
State GDP growth rate	-0.072 (0.588)	7.044 (5.146)	1.502
6 to 9 years			

[18] First stage estimates corresponding to this model are shown in Table XIV in Appendix 5
[19] First stage estimates corresponding to this model are shown in Table XLV in Appendix 5

	Hours Worked per Week	Reservation Wages	*Joint F Statistic*
State unemployment rate	-0.186 (0.463)	-0.581 (5.546)	0.985
State GDP growth rate	-0.843 (0.598)	-0.345 (5.269)	1.283
10 to 14 years			
State unemployment rate	-0.593 (0.331)	-0.889 (3.310)	1.078
State GDP growth rate	-0.217 (0.296)	-1.619 (3.390)	1.334
By Child's Insurance Coverage			
Private			
State unemployment rate	-0.029 (0.415)	-0.639 (0.230)	1.474
State GDP growth rate	-0.351 (0.440)	-0.079 (2.328)	1.270
Public			
State unemployment rate	0.084 (0.255)	-3.822 (3.172)	5.832
State GDP growth rate	0.235 (0.297)	-3.649 (3.001)	5.025
None			
State unemployment rate	0.282 (0.306)	-1.955 (4.376)	1.451
State GDP growth rate	0.859 (0.491)	-3.842 (8.285)	0.835
By State UE Insurance Benefits			
Low			
State unemployment rate	0.033 (0.380)	-0.815 (2.694)	1.999
State GDP growth rate	0.246 (0.409)	-0.264 (2.694)	2.085
Mid			
State unemployment rate	0.187 (0.355)	3.469 (2.218)	1.768
State GDP growth rate	0.739 (0.479)	5.329 (2.270)	1.645
High			
State unemployment rate	0.175 (0.275)	-5.668 (4.198)	1.911
State GDP growth rate	0.116 (0.308)	-5.379 (4.699)	1.828
By Average Household Income			
Low			
State unemployment rate	0.378 (0.293)	-2.843 (2.737)	7.719
State GDP growth rate	0.020 (0.419)	-0.717 (3.111)	4.454
Mid			
State unemployment rate	0.359 (0.423)	-2.348 (3.477)	2.222
State GDP growth rate	0.066 (0.372)	-1.596 (3.294)	2.589
High			
State unemployment rate	-0.418 (0.507)	0.142 (2.982)	1.004
State GDP growth rate	-0.124 (0.459)	4.411 (2.804)	1.065

Note: All models include the full set of individual, household and local area characteristics.
Standard errors (SE) are reported in parentheses and are robust. * significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national

VII.RESULTS: CHILD ILLNESSES

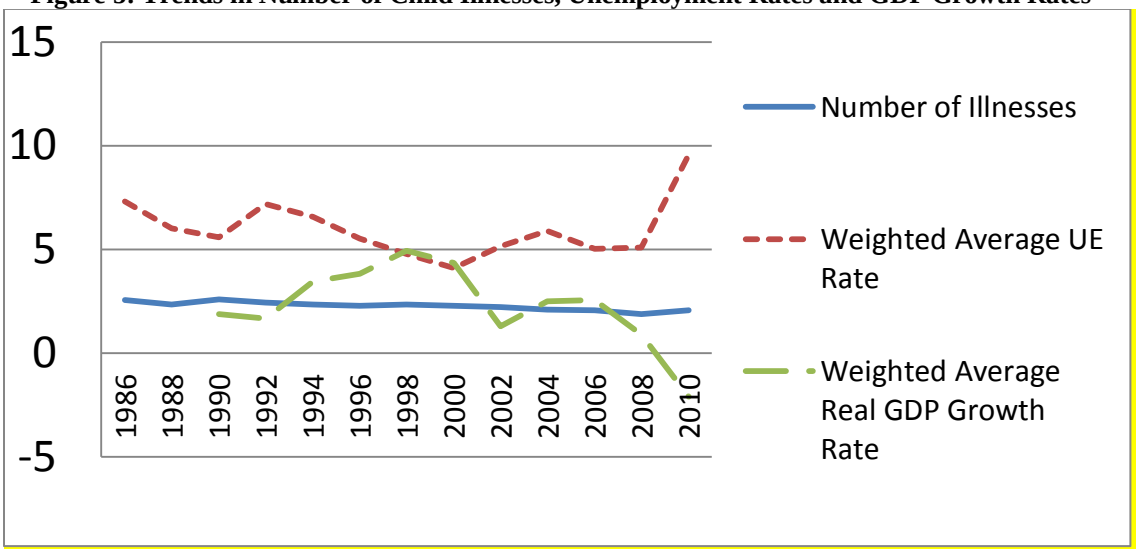
Analysis on Number of Child Illnesses if an Illness is Reported

The trends in child illnesses including the number of illnesses when a parent reports child illnesses are shown in Table XXVIII. Figure 5 provides a graphic display of these trends while figure 6 displays the trend deviations from the mean.

Table XXVIII: Trends in Child Number of Illnesses if Reported

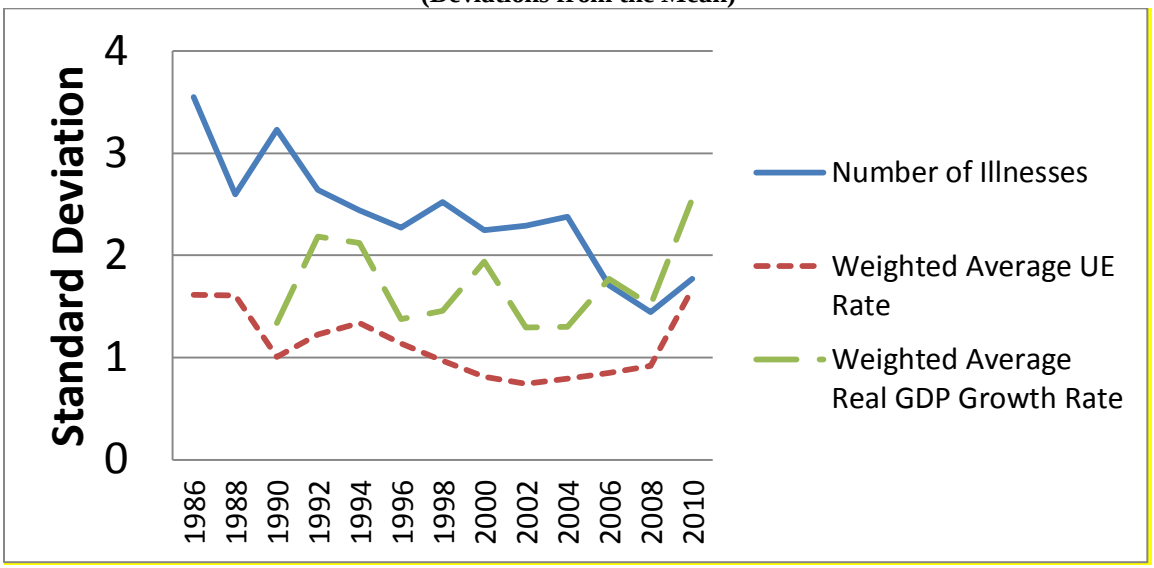
Year	Number of Illnesses
1986	2.577 (3.551)
1988	2.359 (2.597)
1990	2.599 (3.230)
1992	2.451 (2.643)
1994	2.340 (2.442)
1996	2.298 (2.274)
1998	2.343 (2.524)
2000	2.288 (2.250)
2002	2.232 (2.290)
2004	2.111 (2.377)
2006	2.080 (1.707)
2008	1.883 (1.446)
2010	2.057 (1.770)

Figure 5: Trends in Number of Child Illnesses, Unemployment Rates and GDP Growth Rates[20]



[20] The weighted average employment rates are not shown since they are the inverse of the unemployment rates

Figure 6: Trends in Number of Child Illnesses, Unemployment Rates and GDP Growth Rates (Deviations from the Mean)



Overall, it is clear that there is significant fluctuation in the economy over the course of the 24 years covered in this study, therefore making this a suitable sample for analysis.

Descriptive Statistics

The basic summary statistics for the analysis on number of child illnesses are shown in Table XXIX. The size of the overall sample used in this analysis is 13,435. The average number of illnesses reported in a year for a child between the ages of 2 to 14 was roughly 2.379 in the past year. Among the household characteristics, about half (50.2%) of the sample was female. Additionally, about 63.0% of the population was non-Hispanic white, 8.7% were non-Hispanic Black, 5.4% were Hispanic, 0.7% was Asian, 7.7% were of another race and 14.5% were of an unassigned race based on their mother's race definition. On average, only 7.5% had mothers who completed less than high school; about 43.6% of children had mothers whose highest level of education completed was high school, 27.1% had mothers who completed some college and 21.8% of the mothers completed a four year college education or more. With regards to the mother's marital status, 73.3% of the mothers were married. On the other hand, 5.2%, 4.5%, 1.4% and 15.7% were never married, separated, widowed, and divorced respectively. On

average, the mothers were near the age of 41 years. Nearly 74.3% of the households were from urban residential areas, while 8.8% were from suburban areas and 16.9% were from rural areas. Each family had an average number of 2.258 children and only 5.3% of household had the presence of the child's grandparent. Among the economic indicators, the average unemployment rate for the current year was 5.770, while the average weighted-average unemployment rate was 5.818. Current GDP growth rates were 3.508 while the weighted average GDP growth rates were slightly lower at 2.895.

Table XXIX: Summary Statistics for Analysis using Number of Illnesses

Variable Name	Mean (SD)
Outcome Variables	
Number of Illnesses	2.379 (2.594)
Economic Conditions Measures	
Current unemployment rate	5.770 (1.586)
Weighted average unemployment rate	5.818 (1.558)
Current GDP growth rate	3.508 (2.345)
Weighted average GDP growth rate	2.895 (2.127)
Individual, Household and Local Area Characteristics	
Female	0.502 (0.500)
Male	0.498 (0.500)
Mother NH black	0.087 (0.282)
Mother Hispanic	0.054 (0.226)
Mother NH white	0.630 (0.483)
Mother Asian	0.007 (0.083)
Mother other race	0.077 (0.267)
Mother unassigned race	0.145 (0.352)
Birth weight in pounds (lb.)	7,455 (1.336)
Age in months	84.758 (45.649)
Age in months^2	9267.613 (8367.63)
Mother's age in years	4,318 (9.134)
Mother married	0.733 (0.442)
Mother never married	0.052 (0.221)
Mother separated	0.044 (0.206)
Mother widowed	0.014 (0.116)
Mother divorced	0.157(0.364)
Mother completed less than high school	0.075 (0.469)
Mother completed high school	0.436 (0.449)
Mother completed some college	0.271 (0.352)
Mother completed college	0.218 (0.102)
Urban	0.743 (0.437)
Suburban	0.088 (0.283)
Rural	0.169 (0.375)
Number of children	2.258 (1.012)
Grandparents live in HH	0.053 (0.224)

N=13,435 (SD) =Standard Deviation

Sample weights are used to have national representation

Regression Analysis: Reduced form and Individual Fixed Effect

Table XXX presents the regression estimates of weighted average macroeconomic indicators on the number of child illnesses that required medical attention or treatment when an illness is reported. The simplest reduced form results are presented without any controls corresponding to equation 10 in panel A. Panel B introduces state and year fixed effects to control for unobservable determinants of lifestyle behaviors associated with each state and survey year that corresponds to equation 11. In order to test for the influence of seasonal fluctuations on child health outcomes, a model with seasonality controls is reported in panel C corresponding to equation 12. Although the overall results in the linear models shown in panels A, B and C indicate an inverse relationship between favorable economic conditions and children's health outcomes as measured by number of child illnesses, such worsening economic conditions measured by rising unemployment rates leads to a negative relationship with the overall number of illnesses and are statistically significant only when using GDP growth rates as the measure of economic activity. Economic conditions measured by rising GDP growth rates results in a positive association with the overall number of illnesses among children. Specifically, the inclusion of the state and year fixed effects results in a coefficient estimate of 0.030 which slightly declines in magnitude and losses power at an estimate of 0.026 when controlling for seasonality.

Table XXX: Estimations of Child Frequency of Illness Reported if an Illness is Reported on Weighted Average Macroeconomic Indicators (Full sample)

	A	B	C	D
Macroeconomic Indicators				
State unemployment rate	-0.011	-0.005	-0.003	0.029
	(0.027)	(0.040)	(0.040)	(0.043)
State GDP growth rate	0.018	0.030**	0.026*	0.028
	(0.018)	(0.014)	(0.014)	(0.021)
Year controls	NO	YES	YES	YES
State controls	NO	YES	YES	NO
Seasonality controls	NO	NO	YES	NO
Individual fixed effects	NO	NO	NO	YES

Note: All models include the full set of individual, household and local area characteristics listed in Table XXIX. Standard errors (SE) are reported in parentheses and are robust.
* significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation in panels A, B and C.
N=13,435 for sample analyzed with unemployment rates; N=10,337 for sample analyzed using GDP growth rates

Finally, panel D presents the longitudinal individual fixed effects estimates corresponding to the model in equation 13. In this model, the changes in health outcomes are measured for each individual respective to the changes in economic conditions that occurred over this time span. Overall, the results no longer seem consistent with the other models in this table such that both economic downturns from higher unemployment and economic prosperity from higher GDP growth both related to a higher number of illnesses reported among children. However, the estimates are statistically insignificant, suggesting that there is little evidence of an association between the economic indicators and frequency of child illnesses. This suggests that the reduced form approach estimates may be overstating the association between economic conditions on number of illnesses, particularly for those results obtained using GDP growth rates, thus making the individual fixed effects model more suitable for this analysis. This also leads us to suggest that further analysis in the form of a more defined identification strategy is necessary. Furthermore, given the poor nature of the illness variables, strong associations between economic activity and frequency of illnesses cannot be derived from this analysis.

For the sample of children who reside with only their mothers, no statistically significant relationship exists between economic activity and frequency of child illnesses. In general, the results of the reduced form estimations show illnesses are higher with both higher unemployment rates and GDP growth rates. However, these results hold no statistical power, and both the poor nature of the dataset and limitations in the reduced for methodology suggest there is no strong correlation. The longitudinal results with the improved methodology may be more suitable and yield more accurate results on future studies that utilize stronger child health outcome variables.

Table XXXI: Estimations of Child Frequency of Illness Reported if an Illness is Reported on Weighted Average Macroeconomic Indicators (Children who reside with mother only)

	A	B	C	D
Macroeconomic Indicators				
State unemployment rate	0.015	0.013	0.013	0.075
	(0.053)	(0.091)	(0.092)	(0.097)
State GDP growth rate	0.030	0.042	0.048	-0.019
	(0.029)	(0.031)	(0.032)	(0.046)
Year controls	NO	YES	YES	YES
State controls	NO	YES	YES	NO
Seasonality controls	NO	NO	YES	NO
Individual fixed effects	NO	NO	NO	YES

Note: All models include the full set of individual, household and local area characteristics listed in Table XXIX. Standard errors (SE) are reported in parentheses and are robust.
* significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation in panels A, B and C.
N=4,245 for sample analyzed with unemployment rates; N=3,104 for sample analyzed using GDP growth rates

Finally, for the sample of children that live with both parents there is no statistically significant relationship between frequency of illnesses and economic activity. The direction and magnitude of the results resemble those for children in the full sample, and more particularly some of the results in adult literature using the reduced form methodology that suggests health outcomes improve during economic downturns as seen by the coefficients on unemployment rates, and decline during economic prosperity as seen by the coefficients on GDP growth rates. However, the results for all cohorts of children suggests there is no strong evidence that supports

this counter intuitive result, therefore further emphasizing the need for stronger methodology and richer data.

Table XXXII: Estimations of Child Frequency of Illness Reported if an Illness is Reported on Weighted Average Macroeconomic Indicators (Children who reside with both parents)

	A	B	C	D
Macroeconomic Indicators				
State unemployment rate	-0.009	-0.011	-0.009	-0.010
	(0.024)	(0.037)	(0.037)	(0.052)
State GDP growth rate	0.011	0.022	0.016	0.033
	(0.020)	(0.019)	(0.019)	(0.027)
Year controls	NO	YES	YES	YES
State controls	NO	YES	YES	NO
Seasonality controls	NO	NO	YES	NO
Individual fixed effects	NO	NO	NO	YES

Note: All models include the full set of individual, household and local area characteristics listed in Table XXIX and age*gender interaction terms.
Standard errors (SE) are reported in parentheses and are robust.
* significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation in panels A, B and C.
N=8,777 for sample analyzed with unemployment rates; N=6,951 for sample analyzed using GDP growth rates

Individual Fixed Effect Subgroup Analysis

It is likely that individuals with varying characteristics may have different health responses to temporary fluctuations in the economy. Prior literature often shows different impacts of economic changes on health outcomes demographic factors such as race (Dehejia *et al.*, 2004). The mother's characteristics including highest education level completed have also been shown to have different effects on their children's health outcomes in comparison to their counterparts (Dehejia *et al.*, 2004;Pongou *et al.*, 2006). The existing literature also shows that family's income status plays a role in child health outcomes (Catalano, 1991;Dehejia *et al.*, 2004;Ferreira *et al.*, 2009;Paxson *et al.*, 2005;Pongou *et al.*, 2006). There were also differences found amongst different age groups of children whose health was most vulnerable to changes in the economy (Cutler *et al.*, 2002;Maluccio *et al.*, 2009). Finally, types or gaps in insurance

coverage have been shown to alter the frequency of health care among children(Fairbrother *et al.*, 2010). Thus, we expanded our analysis to estimate models by various subpopulations.

In order to determine which subgroups were most related to economic indicators, we conducted a subpopulation analysis mother's race (non-Hispanic white, non-Hispanic black or Hispanic), mother's highest educations level completed (less than high school, high school, more than high school or college), average household income categories (low, middle and high), child's age in years (2 to 5, 6 to 9 or 10 to 14), type of insurance coverage (public, private or none) and level of state unemployment benefits categories (low, middle and high). The individual fixed effect coefficient estimates shown in table XXXIII correspond to the overall models for the full sample, sample of children that live with only their mothers, and the sample of children that live with both parents shown in panel D Table XXX, Table XXXI and Table XXXII. The results of the subgroup analysis the relationship with economic indicators, and in particular how they are significantly different from their counterparts for certain categories. Overall, frequency of illnesses reported among children have significantly different variations based on the child's age. For example, among the full sample, poor economic conditions in the form of rising unemployment rates lead to a decline in illnesses reported for children between the ages of 6 and 9 years with a coefficient estimate of -0.167. Similarly for children who live with their single mothers, a rise in GDP growth leads to more illnesses being reported among children in this age group with a coefficient of 0.207. On the other hand, younger children between the ages of 2 to 5 years report more illnesses as the economy weakens in terms of rising unemployment rates with a point estimate of -0.857 which is the largest effect seen in this subgroup analysis. Based on the findings from the previous chapter on child weight outcomes,

these results further confirm economic conditions have significantly different effects of children of different age groups.

With regards to frequency of illnesses, the subpopulation analysis also finds that higher unemployment rates is associated with more illnesses among Hispanic children who live with their mothers only, and children who come from higher income households and live with both parents. Middle income children who live with both parents see the opposite effect where weaker economies measured by higher unemployment yield a coefficient estimate of -0.726. Likewise, stronger economies measured by better GDP growth rates face increased illnesses by a coefficient of 0.097 for the full sample of children.

Overall, the results from the subgroup analysis suggest that the effects of macroeconomic conditions have significantly different impacts among children in different age brackets. The direction and magnitude of these effects vary; however given the poor nature of these illness variables, strong conclusions cannot be drawn. This analysis only help to further confirm and emphasize those economic indicators can have significant influences on health outcomes for children based on their age.

Table XXXIII: Estimations of Frequency of Child Illnesses if an Illness is Reported on Weighted Average Macroeconomic Indicators, by Subpopulations (Individual Fixed Effect)
[Mother's Race, Mother's Highest Education Level Completed, Child's Age in Years]

		By Mother's Race			By Mother's Highest Education Level Completed				By Child's Age in Years		
	Full Sample	**NH White**	**NH Black**	**Hispanic**	**Less than HS**	**High School**	**More than HS**	**College**	**2 to 5**	**6 to 9**	**10 to 14**
Full Sample											
Macroeconomic Indicators											
State unemployment rate	0.029	-0.009	-0.001	0.086	0.024	0.017	0.085	-0.115	0.051	-0.167**	0.222
	(0.043)	(0.068)	(0.004)	(0.060)	(0.046)	(0.073)	(0.120)	(0.339)	(0.162)	(0.066)	(0.163)
State GDP growth rate	0.028	0.047	0.011	0.014	0.026	0.026	0.042	-0.324	-0.172	0.210	-0.098
	(0.021)	(0.029)	(0.009)	(0.033)	(0.031)	(0.037)	(0.043)	(0.237)	(0.123)	(0.216)	(0.111)
Children who reside with MOTHER ONLY											
Macroeconomic Indicators											
State unemployment rate	0.075	-0.110	0.035	0.353***	0.067	-0.106	0.660	n/a	0.857***	-0.108	0.219
	(0.097)	(0.248)	(0.031)	(0.107)	(0.118)	(0.079)	(0.479)		(0.285)	(0.164)	(0.253)
State GDP growth rate	-0.019	-0.056	0.010	-0.032	-0.010	0.038	-0.097	n/a	-0.123	0.207**	-0.161
	(0.046)	(0.116)	(0.015)	(0.040)	(0.059)	(0.079)	(0.120)		(0.218)	(0.083)	(0.122)
Children who reside with BOTH PARENTS											
Macroeconomic Indicators											
State unemployment rate	-0.010	-0.035	-0.046	-0.030	-0.025	0.117	-0.092	-0.079	0.067	-0.157	0.263
	(0.052)	(0.071)	(0.031)	(0.095)	(0.071)	(0.010)	(0.067)	(0.318)	(0.134)	(0.126)	(0.233)
State GDP growth rate	0.033	0.067	0.007	0.027	0.030	0.025	0.068	-0.286	0.042	-0.030	0.022
	(0.027)	(0.038)	(0.026)	(0.044)	(0.046)	(0.046)	(0.043)	(0.216)	(0.057)	(0.056)	(0.053)

Table XXXIII (continued): Estimations of Frequency of Child Illnesses if an Illness is Reported on Weighted Average Macroeconomic Indicators, by Subpopulations (Individual Fixed Effect)
[Child's Insurance Coverage ,State UE Insurance Benefits, Average Household Income]

		By Child's Insurance Coverage			By State UE Insurance Benefits			By Average Household Income		
	Full Sample	**Private**	**Public**	**None**	**Low**	**Mid**	**High**	**Low**	**Middle**	**High**
Full Sample										
Macroeconomic Indicators										
State unemployment rate	0.029	0.030	-0.025	0.052	0.043	0.028	-0.042	0.055	-0.022	0.082
	(0.043)	(0.056)	(0.089)	(0.374)	(0.061)	(0.044)	(0.112)	(0.055)	(0.071)	(0.069)
State GDP growth rate	0.028	-0.029	0.018	-0.045	0.021	-0.009	0.031	-0.004	0.097***	0.022
	(0.021)	(0.046)	(0.078)	(0.298)	(0.035)	(0.014)	(0.192)	(0.045)	(0.029)	(0.035)
Children who reside with MOTHER ONLY										
Macroeconomic Indicators										
State unemployment rate	0.075	-0.042	-0.033	-0.228	0.248	0.173	-0.102	0.103	-0.028	0.200
	(0.097)	(0.116)	(0.103)	(0.838)	(0.151)	(0.143)	(0.217)	(0.113)	(0.148)	(0.199)
State GDP growth rate	-0.019	-0.029	-0.083	0.415	-0.000	-0.087	-0.147	-0.084	0.159	-0.000
	(0.046)	(0.070)	(0.086)	(0.356)	(0.068)	(0.137)	(0.096)	(0.083)	(0.109)	(0.005)
Children who reside with BOTH PARENTS										
Macroeconomic Indicators										
State unemployment rate	-0.010	-0.023	-0.064	0.069	-0.031	0.041	0.043	-0.003	-0.726**	0.399**
	(0.052)	(0.063)	(0.099)	(0.082)	(0.062)	(0.077)	(0.124)	(0.066)	(0.331)	(0.189)
State GDP growth rate	0.033	0.036	-0.038	-0.204	0.014	0.030	-0.039	-0.020	0.056	0.028
	(0.027)	(0.028)	(0.309)	(0.121)	(0.025)	(0.056)	(0.061)	(0.047)	(0.043)	(0.043)

Note: All models include the full set of individual, household and local area characteristics listed in Table XXIX. All models also year fixed effects. Standard errors (SE) are reported in parentheses and are robust. * significance at 10%; ** significance at 5%; *** significance at 1%.

Instrumental Variables Approach

The Instrumental Variables approach is utilized on child illness frequency to account for endogenity due to unobserved factors that affect labor market choices and child health outcomes when including mothers' hours of work and wages in the labor market. As described in the previous chapter, changes in economic indicators are utilized as the instruments for mothers' working hours and wages in the models for health outcomes and will show the effects of parent's time and monetary inputs on child health outcomes. This will help to identify the causal mechanisms that link economic activity to children's health. The results for the instrumental variables are shown in Table XXXIV, corresponding to equations 14 and 15 in the empirical strategy chapter. The initial analysis looks at the impact of temporary changes in mothers' hours worked per week[21] and reservation wages[22] associated with local economic activity on the number of illnesses requiring medical attention or treatment among children. The joint F statistics for the various specifications are almost always never greater than 4.0, which is well below the 10.0 threshold recommendations (Staiger, Stock, and Watson, 1997), suggesting the need for better instruments for this methodology to be developed in the future.

The basic relationship suggests that mothers' work hours affect child illnesses reported in the basic linear model and mothers' wages impact child illnesses when controlling for individual and household level characteristics with the individual fixed effect model for the full sample as seen in Table XXIV. Unfortunately, this relationship does not hold strongly for the subsample of children that live with only their mothers. Again, it is important to remember that this is specifically for the subsample of children who live with only their mothers, and a more

[21] Computed by taking the hours worked per year divided by 52 weeks
[22] Heckman selection model

representative instrumental variables model with information on the father's work hours and wages will yield more accurate results.

The results of the instrumental variables model and instrumental variables model with individual level fixed effects also find no evidence of economic expansions on influencing child frequency of illness. Even among the subgroups that found a significant relationship in the individual fixed effects model, the identification strategy suggests that this association only holds true in the sample of children between the ages of 2 and 5 years. Overall, the implications of this finding suggest that there are numerous individual level characteristics among children aside from parental monetary and time inputs that influence child weight outcomes, particularly for the sample that live with mothers only. These individual unobservables can be in the form of other child care arrangements, welfare payments, or child supplemental programs. Therefore, taking advantage of longitudinal data that accounts for these individual differences suggests that changes in economic activity are less likely to have a direct impact on child weight outcomes. However, given the poor measurement of this illness variable in the NLYS dataset, no concrete conclusions can be drawn, and this analysis should simply be used as a framework and guidelines for future work that may be conducted using better child health outcome variables.

Table XXXIV: Instrumental Variables Results of Frequency of Child Illnesses if an Illness is Reported on Mother's Working Hours and Reservation Wages on (FULL SAMPLE)

	Hours Worked per Week	Reservation Wages
Ordinary Least Squares Model	0.040* (0.020)	-0.031 (0.336)
Individual Fixed Effects Model	-0.003 (0.017)	-1.871*** (0.393)

(Children who reside with Mother ONLY)

	Hours Worked per Week	Reservation Wages	*Joint F Statistic*
Ordinary Least Squares Model	-0.004 (0.003)	0.114** (0.056)	
Individual Fixed Effect Model	-0.004 (0.004)	0.207 (0.140)	
Instrumental Variable Model			
State unemployment rate	0.013 (0.021)	0.103** (0.045)	*2.053*
State GDP growth rate	0.236 (0.155)	0.252 (0.350)	*1.987*
Instrumental Variable Model with Individual Fixed Effects			
State unemployment rate	-0.007 (0.028)	0.034 (0.332)	*1.695*
State GDP growth rate	-0.058 (0.267)	0.210 (0.393)	*1.752*
Instrumental Variable Model with Individual Fixed Effects (By Subpopulations)			
By Mother's Race			
NH White			
State unemployment rate	-0.022 (0.036)	-0.299 (0.515)	*0.916*
State GDP growth rate	0.065 (0.038)	-0.654 (0.712)	*1.225*
NH Black			
State unemployment rate	-0.004 (0.028)	0.135 (0.279)	*1.765*
State GDP growth rate	0.033 (0.024)	0.431 (0.294)	*1.432*
Hispanic			
State unemployment rate	0.010 (0.032)	0.422 (0.418)	*1.279*
State GDP growth rate	-0.002 (0.041)	0.057 (0.513)	*0.704*
By Mother's Highest Education Level Completed			
Less than High School			
State unemployment rate	0.009 (0.024)	-0.079 (0.328)	*2.158*
State GDP growth rate	0.035 (0.023)	-0.137 (0.343)	2.265
High School			
State unemployment rate	0.025 (0.027)	-0.047 (0.601)	*1.925*
State GDP growth rate	-0.007 (0.025)	0.786 (0.799)	*3.321*
More than High School			
State unemployment rate	0.005 (0.045)	0.739 (0.887)	*1.255*
State GDP growth rate	-0.011 (0.045)	1.482 (1.083)	*2.027*
College			
State unemployment rate	n/a	n/a	n/a
State GDP growth rate	n/a	n/a	n/a
By Child's Age in Years			
2 to 5 years			
State unemployment rate	0.039 (0.035)	1.002 (0.861)	1.917
State GDP growth rate	0.144*** (0.047)	1.182 (1.045)	0.904
6 to 9 years			
State unemployment rate	-0.023 (0.024)	0.829 (1.043)	1.170
State GDP growth rate	0.058 (0.036)	0.459 (0.748)	0.982
10 to 14 years			
State unemployment rate	0.058 (0.038)	0.419 (.0854)	1.296

	Hours Worked per Week	Reservation Wages	*Joint F Statistic*
State GDP growth rate	0.027 (0.025)	-0.338 (1.016)	1.575
By Child's Insurance Coverage			
Private			
State unemployment rate	-0.031 (0.033)	-0.371 (0.419)	1.207
State GDP growth rate	0.008 (0.026)	-0.099 (0.403)	1.576
Public			
State unemployment rate	0.064 (0.028)	0.339 (0.657)	3.297
State GDP growth rate	0.006 (0.023)	0.837 (0.769)	2.592
None			
State unemployment rate	-0.015 (0.031)	0.439 (0.607)	2.389
State GDP growth rate	-0.018 (0.022)	0.679 (0.506)	2.189
By State UE Insurance Benefits			
Low			
State unemployment rate	-0.013 (0.025)	0.891 (0.685)	2.143
State GDP growth rate	0.044 (0.049)	-0.230 (0.373)	1.881
Mid			
State unemployment rate	0.034 (0.047)	-0.633 (0.449)	1.493
State GDP growth rate	0.001 (0.021)	0.305 (0.692)	1.706
High			
State unemployment rate	0.091 (0.054)	-0.755 (0.749)	1.581
State GDP growth rate	0.078 (0.054)	0.055 (0.872)	2.152
By Average Household Income			
Low			
State unemployment rate	0.019 (0.061)	-0.263 (0.757)	3.539
State GDP growth rate	0.058 (0.054)	0.025 (0.671)	2.150
Mid			
State unemployment rate	0.033 (0.028)	-0.081 (0.530)	2.100
State GDP growth rate	0.050 (0.046)	-0.426 (0.635)	2.104
High			
State unemployment rate	0.010 (0.028)	0.355 (0.338)	1.490
State GDP growth rate	-0.019 (0.026)	0.165 (0.324)	1.439

Note: All models include the full set of individual, household and local area characteristics listed in Table XXIX. All models also include year fixed effects. Standard errors (SE) are reported in parentheses and are robust. * significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation.

Analysis on Occurrence of Child Illnesses

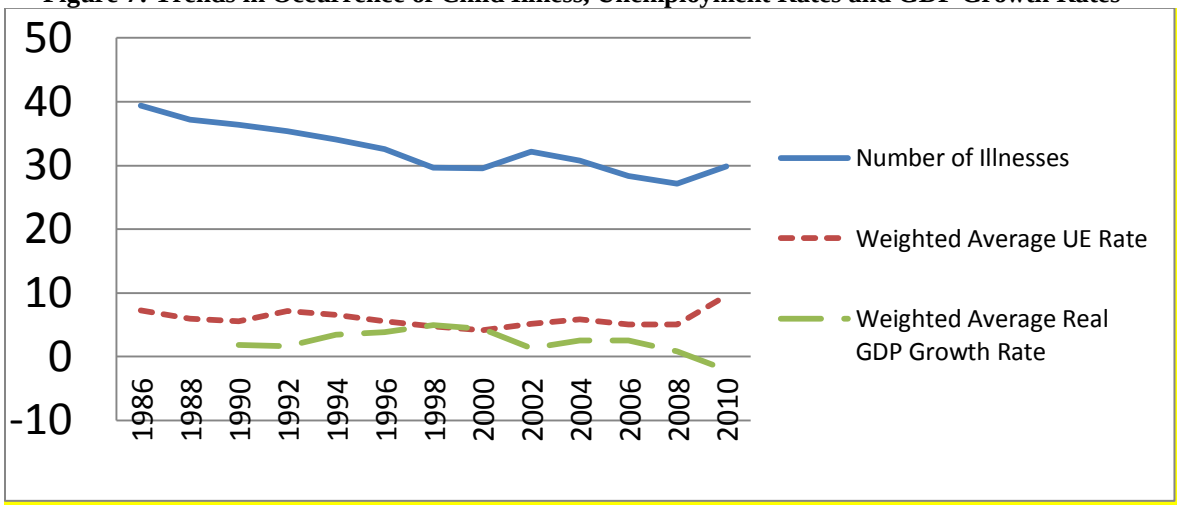
The trends in child illnesses including the occurrence of an illness that required medical attention or treatment are shown in Table XXXV.

Table XXXV: Trends in Occurrence of Child Illness

Year	Occurrence of Child Illness
1986	0.394 (0.489)
1988	0.372 (0.483)
1990	0.364 (0.481)
1992	0.354 (0.479)
1994	0.341 (0.474)
1996	0.326 (0.469)
1998	0.297 (0.457)
2000	0.296 (0.457)
2002	0.322 (0.467)
2004	0.308 (0.462)
2006	0.284 (0.451)
2008	0.272 (0.445)
2010	0.299 (0.458)

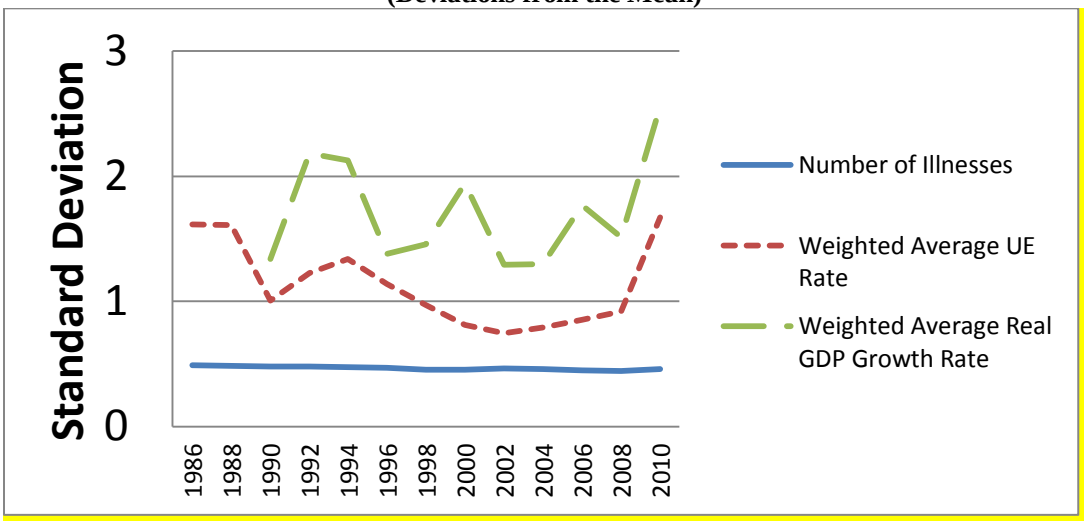
Figure 7 provides a graphic display of these trends while figure 8 displays the trend deviations from the mean.

Figure 7: Trends in Occurrence of Child Illness, Unemployment Rates and GDP Growth Rates[23]



[23] The weighted average employment rates are not shown since they are the inverse of the unemployment rates

Figure 8: Trends in Occurrence of Child Illness, Unemployment Rates and GDP Growth Rates (Deviations from the Mean)



Descriptive Statistics

The basic summary statistics for the analysis on the occurrence of an illness among the child are shown in Table XXXVI. The size of the overall sample used in this analysis is much higher at 33,888 than that when using number of illnesses as the dependent variable because it measures whether or not an illness was reported for the full survey sample. The descriptive statistics are slightly different from those described in the previous section for the number of child illnesses, and they are also discussed in this section for the purpose of completeness. The average probability that an illness was reported in a year for a child between the ages of 2 to 14 was roughly 38.4%. Among the household characteristics, about half (49.5%) of this sample was female. Additionally, about 58.0% of the population was non-Hispanic white, 14.3% were non-Hispanic Black, 6.7% were Hispanic, 0.7% was Asian, 7.2% were of another race and 13.1% were of an unassigned race based on their mother's race definition. On average, 18.0% had mothers who completed less than high school; about 36.2% of children had mothers whose highest level of education completed was high school, 23.5% had mothers who completed some college and 22.3% of the mothers completed a four year college education or more. With regards to the mother's marital status, 69.7% of the mothers were married. On the other hand, 6.8%, 5.0%, 1.8% and 16.7% were never married, separated, widowed, and divorced respectively. On average, the mothers were near the age of 42 years. Nearly 74.3% of the households were from urban residential areas, while 8.8% were from suburban areas and 16.9% were from rural areas. Each family had an average number of 2.4 children and only 5.6% of household had the presence of the child's grandparent. Among the economic indicators, the average unemployment rate for the current year was 5.701, while the average weighted-average

unemployment rate was 5.751. Current GDP growth rates were 3.510 while the weighted average GDP growth rates were slightly higher at 2.969.

Table XXXVI: Summary Statistics for Analysis using Occurrence of Child Illness

Variable Name	Mean (SD)
Outcome Variables	
Occurrence of Illnesses	0.384 (0.486)
Economic Conditions Measures	
Current unemployment rate	5.701 (1.554)
Weighted average unemployment rate	5.751 (1.530)
Current GDP growth rate	3.510 (2.357)
Weighted average GDP growth rate	2.969 (2.126)
Individual, Household and Local Area Characteristics	
Female	0.495 (0.500)
Male	0.505 (0.500)
Mother NH black	0.143 (0.350)
Mother Hispanic	0.067 (0.251)
Mother NH white	0.520 (0.494)
Mother Asian	0.007 (0.084)
Mother other	0.072 (0.258)
Mother unassigned	0.131 (0.337)
Birth weight in pounds (lb)	7.438 (1.329)
Age in months	96.299 (45.424)
Age in months^2	11336.79 (8791.416)
Mother's age in years	41.911 (8.832)
Mother married	0.697 (0.4950)
Mother never married	0.068 (0.251)
Mother separated	0.050 (0.219)
Mother widowed	0.018 (0.133)
Mother divorced	0.167 (0.373)
Mother completed less than high school	0.180 (0.490)
Mother completed high school	0.362 (0.449)
Mother completed some college	0.235 (0.441)
Mother completed college	0.223 (0.092)
Urban	0.742 (0.437)
Suburban	0.088 (0.283)
Rural	0.169 (0.375)
Number of children	2.431 (1.110)
Grandparents live in HH	0.056 (0.230)

N=39,888 (SD)=Standard Deviation
Sample weights are used to have national representation

Regression Analysis: Reduced form and Individual Fixed Effects

Table XXXVII presents the regression estimates of weighted average macroeconomic indicators on the occurrence of child illnesses that required medical attention or treatment for the full sample. The overall results of the reduced form linear models with state and year controls

show in panel B and those of the longitudinal individual fixed effects model shown in panel D suggest that downturns in the economy measured by rising unemployment rates suggest overall higher rates of occurrence of illnesses that required medical attention or treatment among children. The results are weakly significant for the reduced form methodology with a coefficient estimate of 0.009 and hold stronger significance yet slight declines in magnitude when applying the individual fixed effect model with a coefficient estimate of 0.006. Given the poor nature of the illness variables in this dataset, no strong conclusions should be drawn from these results, however given the individual fixed effect model seems to be the best form of analysis for this overall dissertation, the results do suggest that economic prosperity is associated with a decline in prevalence of illness while economic downturns lead to a rise in prevalence of illnesses among children. Further investigation is necessary to accurately validate this finding.

Table XXXVII: Estimations of on Occurrence of Child Illness on Weighted Average Macroeconomic Indicators (Full sample)

	A	B	C	D
Macroeconomic Indicators				
State unemployment rate	-0.0001	0.009*	0.008*	0.006**
	(0.003)	(0.004)	(0.004)	(0.003)
State GDP growth rate	-0.003	-0.003	-0.003	-0.002
	(0.003)	(0.003)	(0.003)	(0.002)
Year controls	NO	YES	YES	YES
State controls	NO	YES	YES	NO
Seasonality controls	NO	NO	YES	NO
Individual fixed effects	NO	NO	NO	YES

Note: All models include the full set of individual, household and local area characteristics listed in Table XXXVI. Standard errors (SE) are reported in parentheses and are robust.
* significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation in panels A, B and C.
N=13,435 for sample analyzed with unemployment rates; N=10,337 for sample analyzed using GDP growth rates

In the sample of children that reside only with their mother, a similar pattern is observed where improving economies measured by lower unemployment rates and declining GDP growth rates are associated with a decline in the prevalence of child illnesses as seen in Table XXXVIII. However, the results hold no statistical power. For the sample of children that live with both

parents presented in Table XXXIX, the relationship runs parallel to that of the full sample such that an increase in unemployment rates is linked to an increase in prevalence of child illnesses with a coefficient estimate of 0.010. Overall the results of this analysis further confirm the importance of utilizing an individual fixed effect model when conducting analysis on longitudinal data in order to capture the unobservable individual level characteristics that contribute to changes in child health rather than just state level effects.

Table XXXVIII: Estimations of Occurrence of Child Illness on Weighted Average Macroeconomic Indicators (Children who reside with mother only)

	A	B	C	D
Macroeconomic Indicators				
State unemployment rate	-0.002	0.009	0.009	0.006
	(0.003)	(0.006)	(0.006)	(0.005)
State GDP growth rate	-0.004	-0.001	-0.001	-0.000
	(0.004)	(0.005)	(0.005)	(0.004)
Year controls	NO	YES	YES	YES
State controls	NO	YES	YES	NO
Seasonality controls	NO	NO	YES	NO
Individual fixed effects	NO	NO	NO	YES

Note: All models include the full set of individual, household and local area characteristics listed in Table XXXVI. Standard errors (SE) are reported in parentheses and are robust.
* significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation in panels A, B and C.
N=13,435 for sample analyzed with unemployment rates; N=10,337 for sample analyzed using GDP growth rates

Table XXXIX: Estimations of Occurrence of Child Illness on Weighted Average Macroeconomic Indicators on (Children who reside with both parents)

	A	B	C	D
Macroeconomic Indicators				
State unemployment rate	0.002	0.011*	0.010*	0.010**
	(0.003)	(0.006)	(0.006)	(0.004)
State GDP growth rate	-0.003	-0.004	-0.004	-0.004
	(0.003)	(0.004)	(0.004)	(0.003)
Year controls	NO	YES	YES	YES
State controls	NO	YES	YES	NO
Seasonality controls	NO	NO	YES	NO
Individual fixed effects	NO	NO	NO	YES

Note: All models include the full set of individual, household and local area characteristics listed in Table XXXVI. Standard errors (SE) are reported in parentheses and are robust.
* significance at 10%; ** significance at 5%; *** significance at 1%. Sample weights are used to have national representation in panels A, B and C.
N=13,435 for sample analyzed with unemployment rates; N=10,337 for sample analyzed using GDP growth rates

Individual Fixed Effect Subgroup Analysis

The results of the subgroup analysis are shown in Table XL and correspond to the individual fixed effects models in Panel D for the full sample in Table XXXVII, the sample of children that live with only their mothers in Table XXXVIII, and the sample of children that live with both parents in Table XXXIX.

For simplicity we will discuss the results with respect to changes in unemployment rates and GDP growth rates with respect to different subgroups of children. Overall, the occurrence of illnesses reported among children are influenced by unemployment rates for the full sample and the sample of children that live with both parents such that higher unemployment rates lead to higher prevalence of illnesses. However, given the poor nature of these variables as discussed in the data validation chapter, the overall results and results of the subgroup analysis hold no conclusive findings and should be used more as guidelines for future work with better data.

The subgroup analysis for the full sample suggests a weaker economy in the form of higher unemployment rates is associated with a higher prevalence of illness among children whose mothers have completed some college beyond high school but not college as their highest education level, children between the ages of 6 and 9 years, children who have private insurance coverage, children residing in states with low levels of state unemployment benefits, and children from high income households. A stronger economy in the form of higher GDP growth rates is linked to a decline in prevalence of illnesses among children living in states with mid-level unemployment benefits and children from middle income families. For children who live with their mothers only and have no insurance coverage, an improving economy shows lower prevalence of illness; however this result may not be the strongest form of evidence given the combination of a small sample size and weak variables. By income, for children living with

single mothers in middle income homes, GDP growth shows lower prevalence of illness and in higher income homes higher unemployment is associated with higher prevalence of illness. Finally, the results of the sample of children that live with both parents run parallel to those of the full sample where unemployment and GDP growth rates are related to prevalence among children whose mothers have some college exposure, are aged 6 to 9 years, live in mid-level unemployment insurance benefit states, and come from high average household income homes. In the previous sections of this dissertation, it was determined that different child age groups were most susceptible to changes in health outcomes from fluctuations in economic activity. This holds true in the case of child illness prevalence as well, but extreme caution should be undertaken when drawing conclusions regarding the results by mother's education child insurance status, state benefits levels, and household income given the weak integrity of the prevalence of illness variable, suggesting further analysis with stronger data is warranted.

Table XL: Estimations of Occurrence of Child Illness on Weighted Average Macroeconomic Indicators, by Subpopulations (Individual Fixed Effect)
[Mother's Race, Mother's Highest Education Level Completed, Child's Age in Years]

		By Mother's Race			By Mother's Highest Education Level Completed				By Child's Age in Years		
	Full Sample	**NH White**	**NH Black**	**Hispanic**	**Less than HS**	**High School**	**More than HS**	**College**	**2 to 5**	**6 to 9**	**10 to 14**
Full Sample											
Macroeconomic Indicators											
State unemployment rate	0.006**	0.004	-0.001	0.012	0.003	0.006	0.024**	0.033	0.001	0.023**	0.002
	(0.003)	(0.005)	(0.004)	(0.008)	(0.003)	(0.006)	(0.010)	(0.041)	(0.008)	(0.009)	(0.008)
State GDP growth rate	-0.002	-0.005	0.001	-0.001	-0.003	0.003	-0.004	-0.028	-0.000	-0.008	-0.001
	(0.002)	(0.003)	(0.003)	(0.004)	(0.002)	(0.004)	(0.005)	(0.017)	(0.009)	(0.007)	(0.006)
Children who reside with MOTHER ONLY											
Macroeconomic Indicators											
State unemployment rate	0.006	0.004	-0.001	0.013	0.007	-0.011	0.016	n/a	-0.004	0.016	0.008
	(0.005)	(0.010)	(0.006)	(0.013)	(0.006)	(0.012)	(0.020)		(0.015)	(0.014)	(0.012)
State GDP growth rate	-0.000	0.000	0.003	-0.002	0.002	-0.002	-0.012	n/a	0.001	0.001	-0.000
	(0.004)	(0.008)	(0.004)	(0.005)	(0.004)	(0.006)	(0.011)		(0.009)	(0.005)	(0.005)
Children who reside with BOTH PARENTS											
Macroeconomic Indicators											
State unemployment rate	0.010**	0.010	-0.002	0.013	0.004	0.015	0.024**	0.056	0.000	0.024**	0.005
	(0.004)	(0.005)	(0.006)	(0.009)	(0.005)	(0.017)	(0.012	(0.052)	(0.013)	(0.011)	(0.009)
State GDP growth rate	-0.004	-0.007	-0.003	0.000	-0.007	0.006	-0.003	-0.042	0.001	-0.008	0.001
	(0.003)	(0.006)	(0.006)	(0.005)	(0.004)	(0.005)	(0.006)	(0.032)	(0.006)	(0.006)	(0.006)

Table XL (continued): Estimations of Occurrence of Child Illness on Weighted Average Macroeconomic Indicators, by Subpopulations (Individual Fixed Effect)
[Child's Insurance Coverage, State UE Insurance Benefits, Average Household Income]

		By Child's Insurance Coverage			By State UE Insurance Benefits			By Average Household Income		
	Full Sample	**Private**	**Public**	**None**	**Low**	**Mid**	**High**	**Low**	**Middle**	**High**
Full Sample										
Macroeconomic Indicators										
State unemployment rate	0.006**	0.009**	-0.002	-0.019	0.009**	0.007	0.004	-0.001	0.009	0.018***
	(0.003)	(0.003)	(0.008)	(0.011)	(0.003)	(0.005)	(0.006)	(0.005)	(0.006)	(0.006)
State GDP growth rate	-0.002	-0.003	0.016	0.014	-0.000	-0.009**	-0.000	0.002	-0.009**	-0.004
	(0.002)	(0.003)	(0.020)	(0.009)	(0.003)	(0.004)	(0.002)	(0.003)	(0.003)	(0.004)
Children who reside with MOTHER ONLY										
Macroeconomic Indicators										
State unemployment rate	0.006	0.014	-0.005	-0.050***	0.012	0.013	0.003	-0.010	0.020	0.035**
	(0.005)	(0.008)	(0.013)	(0.014)	(0.008)	(0.011)	(0.013)	(0.009)	(0.011)	(0.015)
State GDP growth rate	-0.000	-0.002	0.002	0.017**	-0.004	-0.004	0.008	0.004	-0.013***	-0.003
	(0.004)	(0.005)	(0.006)	(0.008)	(0.005)	(0.005)	(0.009)	(0.004)	(0.005)	(0.008)
Children who reside with BOTH PARENTS										
Macroeconomic Indicators										
State unemployment rate	0.010**	0.011	-0.016	0.008	0.011	0.008	0.015	0.011	0.005	0.018**
	(0.004)	(0.004)	(0.019)	(0.014)	(0.007)	(0.008)	(0.009)	(0.007)	(0.009)	(0.008)
State GDP growth rate	-0.004	-0.003	-0.007	-0.001	0.002	-0.012**	-0.006	0.004	-0.009	-0.006
	(0.003)	(0.003)	(0.012)	(0.007)	(0.005)	(0.005)	(0.004)	(0.003)	(0.004)	(0.005)

Note: All models include the full set of individual, household and local area characteristics listed in Table XXXVI. All models also year fixed effects. Standard errors (SE) are reported in parentheses and are robust. * significance at 10%; ** significance at 5%; *** significance at 1%.

Instrumental Variables Approach

The overall results from the individual fixed effect instrumental variables model using the binary occurrence of an illness variable among children who live with only their mother are similar to that of the analysis using the number of illnesses in that no strong conclusions can be drawn. Although the joint F statistics are still weak in this analysis ranging from 0.738 to 5.602, they are still well below the threshold of 10.0. Furthermore, there is no statistical significance for the sample and very little significant differences across the subgroups. It is only among children living in states with mid-level unemployment insurance benefits that we find improvements in mothers' wages are associated with a decline in the prevalence of child illnesses. This further confirms that the individual level fixed effect model finds almost no correlation between economic activity and health outcomes in longitudinal data analysis, somewhat refuting the findings from cross sectional work. Again, better identification strategy development can allow for a model that will yield greater statistical power and lead to more sound conclusions.

Table XLI: Instrumental Variables Results of Occurrence of Child Illness on Mother's Working Hours and Reservation Wages (Full sample)

	Hours Worked per Week	Reservation Wages
Ordinary Least Squares Model	-0.004* (0.002)	0.063 (0.026)
Individual Fixed Effects Model	-0.005** (0.002)	0.081 (0.096)

(Children who reside with mother only)

	Hours Worked per Week	Reservation Wages	*Joint F Statistic*
Ordinary Least Squares Model	-0.001** (0.00)	-0.005 (0.004)	
Individual Fixed Effect Model	-0.000 (0.000)	-0.020** (0.008)	
Instrumental Variable Model			
State unemployment rate	-0.006** (0.002)	-0.008 (0.005)	*3.771*
State GDP growth rate	-0.003 (0.003)	-0.013* (0.007)	*2.465*
Instrumental Variable Model with Individual Fixed Effects			
State unemployment rate	-0.007 (0.005)	-0.011 (0.037)	*2.975*
State GDP growth rate	-0.004 (0.007)	-0.011 (0.044)	*2.135*
Instrumental Variable Model with Individual Fixed Effects (By Subpopulations)			
By Mother's Race			
NH White			
State unemployment rate	-0.006 (0.006)	0.020 (0.062)	*1.183*
State GDP growth rate	-0.001 (0.006)	0.055 (0.080)	*1.075*
NH Black			
State unemployment rate	-0.003 (0.004)	-0.014 (0.024)	*2.881*
State GDP growth rate	0.002 (0.006)	-0.047 (0.029)	
Hispanic			
State unemployment rate	-0.006 (0.007)	-0.007 (0.057)	*1.630*
State GDP growth rate	0.007 (0.010)	-0.020 (0.081)	*0.913*
By Mother's Highest Education Level Completed			
Less than High School			
State unemployment rate	-0.003 (0.004)	-0.009 (0.025)	*3.128*
State GDP growth rate	0.006 (0.006)	-0.063 (0.079)	*1.814*
High School			
State unemployment rate	-0.0002 (0.005)	-0.081 (0.053)	*1.858*
State GDP growth rate	0.0003 (0.006)	-0.094 (0.077)	*1.719*
More than High School			
State unemployment rate	0.005 (0.007)	-0.134 (0.090)	*1.104*
State GDP growth rate	0.0001 (0.007)	-0.119 (0.102)	*1.127*
College			
State unemployment rate	n/a	n/a	n/a
State GDP growth rate	n/a	n/a	n/a
By Child's Age in Years			
2 to 5 years			
State unemployment rate	0.014 (0.10)	0.109 (0.093)	0.993
State GDP growth rate	0.014 (0.008)	0.088 (0.095)	1.765
6 to 9 years			
State unemployment rate	-0.004 (0.009)	-0.084 (0.071)	1.034
State GDP growth rate	0.003 (0.009)	0.001 (0.076)	0.738
10 to 14 years			
State unemployment rate	0.0002 (0.008)	-0.036 (0.049)	0.783
State GDP growth rate	0.002 (0.005)	-0.103 (0.057)	1.427

	Hours Worked per Week	Reservation Wages	*Joint F Statistic*
By Child's Insurance Coverage			
Private			
State unemployment rate	0.0001 (0.004)	-0.023 (0.030)	4.345
State GDP growth rate	0.004 (0.006)	-0.036 (0.032)	2.591
Public			
State unemployment rate	0.007 (0.007)	-0.0444 (0.032)	1.097
State GDP growth rate	-0.006 (0.007)	-0.020 (0.043)	1.052
None			
State unemployment rate	-0.010 (0.005)	-0.008 (0.054)	1.279
State GDP growth rate	-0.015 (0.017)	0.001 (0.123)	0.820
By State UE Insurance Benefits			
Low			
State unemployment rate	0.001 (0.007)	-0.017 (0.037)	1.641
State GDP growth rate	0.001 (0.008)	-0.012 (0.049)	1.157
Mid			
State unemployment rate	-0.002 (0.005)	-0.029 (0.022)	2.076
State GDP growth rate	0.001 (0.007)	-0.058** (0.026)	1.127
High			
State unemployment rate	-0.004 (0.005)	-0.024 (0.067)	1.842
State GDP growth rate	-0.002 (0.006)	-0.044 (0.088)	1.521
By Average Household Income			
Low			
State unemployment rate	0.004 (0.005)	-0.018 (0.029)	5.602
State GDP growth rate	0.005 (0.008)	-0.045 (0.035)	4.179
Mid			
State unemployment rate	-0.006 (0.006)	-0.067 (0.050)	2.050
State GDP growth rate	0.011 (0.009)	-0.075 (0.059)	1.156
High			
State unemployment rate	-0.013 (0.009)	-0.049 (0.037)	0.924
State GDP growth rate	-0.004 (0.007)	-0.061 (0.042)	1.191

Note: All models include the full set of individual, household and local area characteristics listed in Table XXXVI. All models also include year fixed effects. Standard errors (SE) are reported in parentheses and are robust. * significance at 10%; ** significance at 5%; *** significance at 1%.

VII.CONCLUSIONS

As quoted by the Panel for Promotion of Child Health "Children are one third of our population and all of our future" (Select Panel for the Promotion of Health Care, 1981). The decisions we make for our children in the present day will determine their well-being as adults. Given the United States continues to face economic fluctuations often measured by changes in unemployment rate and GDP growth rate indicators, this dissertation set out to determine if there is a relationship between macroeconomic conditions and children's health outcomes. Expanding on the mixed evidence from existing literature that utilized reduced form econometric methodology on cross-sectional adult data, this study first attempted to replicate the results for the adult sample, developed a stronger longitudinal methodology given the nature of the data, and applied the overall analysis to the child population to determine the impact of economic activity on child health outcomes. Furthermore, a structural approach is also implemented to determine the casual mechanisms through which economic conditions may impact child health.

The purpose of this dissertation was to describe the relationship between macroeconomic conditions and child health outcomes using a nationally representative data set. The macroeconomic indicators used were state-level unemployment rates and gross domestic product (GDP) growth rates. Weight related health outcomes were measured using child prevalence of being overweight or obese, prevalence of obesity, and child body mass index percentiles. Illness related health outcomes were measured by the number of child illnesses that required medical attention or treatment and occurrence of an illness that required medical attention or treatment. Drawing on the human capital models and health production functions, a theoretical model on the demand for child health is developed. Child health is assumed to be a determinant of parental inputs including monetary inputs and time investments. Changes in economic conditions are

likely to cause a shift in the parental resources available for investments in child health. Furthermore, this research attempts to identify the mechanisms through which changes in mothers' work hours and wage rates influence health outcomes by using variations in these factors caused by changes in state economic activity while controlling for other possible causal factors.

Empirically, this dissertation studies the effect of economic conditions on child health outcomes using a cross sectional reduced form model with state and year fixed effects, a longitudinal individual fixed effects model and a fixed effect instrumental variables model. For empirical analysis, the primary data was obtained from the NLSY79 adult and child cohorts ranging from 1986-2010. Other data resources were used to obtain information on unemployment rates, GDP growth rates, and industry mix.

Overall, this study concludes there is no strong association between economic conditions and child health outcomes. The findings of this study suggests that improvements in the economy measured by higher GDP growth rated are associated with a decline in prevalence of child overweight and obese with a linear coefficient of -0.003 for the full sample of children when using the reduced form cross sectional methodology. Similarly, GDP growth is associated with reductions in child BMI percentiles with a coefficient of -0.281. However, when implementing the individual fixed effect model, the magnitude of these estimates falls to -0.001 and -0.062 and the results no longer hold statistical significance. Given the weak nature of the child illness variables, the results with respect to frequency of child illness and prevalence of illness hold no credibility. Interestingly, the preliminary results from the identification strategy approach also suggest that the economy has no effect on child health outcomes when utilizing the fixed effect IV. The theoretical framework described in this paper suggests children's health outcomes are

influenced by parental investments using market goods and time. Changes in these state-level economic indicators imply that the dynamics of the overall availability for these market goods and time has shifted. The best way to understand the impact of the economy on parental investments in child health is to investigate a stronger identification strategy given the strategies explored in this dissertation were not the strongest and further studies in this area are still needed.

There are several limitations to this particular study. First, the child health measures in the NLSY79 dataset are poor measures of the overall health status of the child. However, this dataset was most appropriate as a starting point for this dissertation given it covers a time span of almost two decades worth of economic fluctuations. Also, given the confidential nature of individual health data being linked to geographic identifiers, a user agreement was required to access the restricted information from NLSY. A second limitation in this study is that a majority of the child health data is self-reported by the child's mother, leading to a reasonable amount of bias as to how each mother determines an illness and reports the frequency, the poor integrity of the data after the data validation confirms this limitation. Furthermore, the severity of the child's condition is not measured, leading to the possibility of even more reporting bias between children. Possible alternatives for better questions are discussed in the data validation chapter, however currently none are available in this dataset. A third limitation is a measurement error that may occur in weight outcomes that occurs due to the self-reported child height and weight values. A fourth limitation includes restrictions in the instrumental variables model that only captures mother's characteristics, such that analysis is only done on the sample of children that live with their mothers. This can become an issue when analyzing the impact of economic conditions on children's health because of there are substantial marital break ups in a longitudinal model a pattern could be introduced where the issue of causality must be re-evaluated. Better

investigation of causes of single parent households with regards to systematic changes in the economy must be captured in the models of child health outcomes. The final limitation in this study is that it was only able to assess the impact of economic indicators at the state level due to data limitations in the availability of economic growth data at more narrowly defined geographic regions.

On the whole, this is the first study that attempts to decipher the relationship between economic conditions and children's health outcomes. It utilizes across sectional reduced form model with state and year fixed effects similar to those used in previous adult literature in this field of study (Ruhm, 2000;Ruhm, 2003;Ruhm, 2005), develops a longitudinal fixed effect model, and attempts to set up a longitudinal instrumental variables model to identify the mechanisms through which economic activity influences child health. The overall results indicate that the cross sectional methodology that does not consider past or future levels and only analyzes health outcomes at a particular point in time may be a poor form of analysis when studying the impact of economic conditions on children's health because it does not account for a cause and effect relationship. Therefore, the implementation of the longitudinal individual fixed effect model that discards all variation between individuals and only uses variation over time within individuals is a more suitable form of analysis for this research question. Overall, the longitudinal results for the analysis on child health outcomes indicate that the economy has no overall impact in influencing child health. There is no significant relationship between the state of the economy on child weight outcomes including prevalence of overweight and obese, prevalence of obese, and overall BMI outcomes when using the individual fixed effect model. Similar results are found on frequency of child illnesses which are not influenced by fluctuations in the economy, whereas higher unemployment rates tend to lead to higher prevalence of illness among children using the

fixed effect methodology. However, the validity of the child illness analysis is weak given the data shows poor integrity and these variables may consist of a lot of measurement error. Furthermore, the results of the fixed effect instrumental variables models which attempt to identify the causal mechanisms through which the economy impacts child health do not find any strong relationship. On the whole, there is very limited consistency in the findings reported for child subpopulations, suggesting that the economy may only influence child health for children who are between the ages of 2 to 5 years. Therefore, although parental inputs influence children's health outcomes, the fluctuations in the economy do not play a strong role in altering health for the overall population of children. The overall impact of economic activity on child health outcomes is weak, suggesting that when accounting for the specific characteristics of each individual child including their upbringing, family culture, innate abilities, and other characteristics, economic conditions do not cause changes within individual child health outcomes.

This dissertation leads to a few important contributions. First, it was the first study to look at the impact of economic conditions on a national sample of children between the ages of 2 to 14 years. Second, it paved the way for the conclusion that implementation of a longitudinal individual fixed effect methodology in this area of research will help to measure the cause and effect relationship between economic conditions and health by measuring variations over time within an individual as opposed to between individuals at a particular point in time. Both the adult and child samples were studied individually, and results from existing cross sectional work were replicated using the adult sample. Finally, it established that causal mechanisms in the form of parental investments may help identify the identification strategy of how economic activity influences child health; however stronger instruments are required in future research. In the long

run, concrete evidence from this study is still necessary, but the overall results from this dissertation are a good starting point for further studies in this particular area of research. Overall, further research is needed to determine the net impact on health as a child and its lasting impact on adults. This future work may be vastly helpful in determining policy efforts geared towards assistance programs for children to help improve health outcomes that may possibly translate into healthier outcomes later in adulthood.

VIII.FUTURE DIRECTIONS

Future extensions after the completion of this dissertation include the following:

- Conduct the analysis on prevalence of overweight and obese, body mass index percentiles, frequency and occurrence of illnesses using more narrowly defined macroeconomic indicators by using county level unemployment and employment.
- Utilize alternate datasets which may consist of Early Childhood Longitudinal Study-Kindergarten Cohort (ECLS-K), Youth Risk Behavior Surveillance System (YRBSS), National Longitudinal Study of Youth 1997 cohort (NLSY97), and/or National Health Interview Survey (NHIS). The outcome health variables would include but are not limited to health status, measured weight outcomes (instead of self-reported), physical activity variables, and asthma variables. Further investigation of the datasets mentioned is still required. Furthermore, permission to link these datasets to the macroeconomic indicators using state and county level fips codes will need to authorization by submitting the necessary applications.
- Utilize additional macroeconomic variables including but not limited to:

➢ Poverty Rates and Median Income Estimates: Data on Poverty rates and median income will be collected from the US Census Bureau for the years 1989, 1993, and 1995-2006.

➢ Personal Income: Annual and Quarterly data on personal income and employment will be attained through the Bureau of Economic Analysis (BEA) for personal income, compensation, detailed earnings, wage and salary disbursements, employment and state economic profiles by industry.

➢ Health Insurance Coverage and Type of Status: Data on health insurance coverage and type of status will be obtained from the US census Bureau for all persons by each state

for 1987-2009. We can also use more detailed data that looks at children under the age of 18 by each state from 1987-2009.

- Food Assistance Programs: Data on the Supplemental Nutrition Assistance Program (SNAP) will be acquired from the Economic Research Service (ERS) to help us further understand the utilization of food assistance programs at the state and county levels. Specifically, the data looks at participation counts, participation benefits, population counts, poverty counts, and ratios.
- New Housing Permits data: We will obtain data on "New Privately-Owned Housing Units Authorized by Building Permits in Permit-Issuing Places" from the United States Census Bureau. This data is available for the years 1980-2009.

- Study the impact of macroeconomic conditions on child educational outcomes including but not limited to test scores and school absences.

IX.APPENDICES

Appendix 1: Constructing Detailed Race/Ethnicity Categories

NLSY79 identified respondents' race by variable R0214700, which categorized respondents into either Hispanic (=1), black (=2) or Non-Hispanic, Non-Black (=3). In order to identify respondents into finer racial/ethnic groups, we used following criteria:

(1) Based on variable R0214700, if the mother was coded as Hispanic she was recoded to have a dichotomous indicator, RACHISP, equal to 1. If a respondent was coded as black she was recoded to have a dichotomous indicator, RACBLACK, equal to 1.

(2) For those respondents coded Non-Hispanic, Non-Black by variable R0214700 we used variables R0010200 (Racial/Ethnic Origin Which R Identifies Most Closely) and R0009600 (1st or Only Ethnic Origin) to determine their detailed race/ethnicity. We created variable ORIGIN that equals R0010200 unless it was missing. If R0010200 was missing for a respondent, her/his ORIGIN variable would equal variable R0009600. This step was summarized as in the following table.

(2.1) Based on created variable ORIGIN, we performed following assignment of racial/ethnic groups:

- Categories indicated 15-21: Cuban, Chicano, Mexican, Mexican American, Puerto Rican, other Hispanic and other Spanish, were assigned to be Hispanic (RACHISP=1);
- Categories indicated 3, 5-7, 11-12, 22-25 and 27: English, French, German, Greek, Irish, Italian, Polish, Portuguese, Russian, Scottish, and Welsh, were assigned to be non-Hispanic White (RACWHIT=1);
- Category indicated 1: black, was assigned to be non-Hispanic Black (RACBLAC=1);
- Categories indicated 2, 4, 10, 13, 14 and 26: Chinese, Filipino, Asian Indian, Japanese, Korean and Vietnamese, were assigned to be Asian (RACASIA=1);
- Categories indicated 8 and 9: Hawaiian or Pacific Islander, and, Indian American or Native American, were assigned to be other race (RACOTHR=1);
- Remaining categories indicated 0, 28 and 29: none, other, and American, go to next step of assignment.

(2.2) Finally, for ORIGIN categorized in none, other or American, and those were missing values from step (2), we based our racial/ethnic group assignment on an additional variable R0172700 (Interviewer's Remarks on Respondents' Race to Be White, Black or Other). These 1650 respondents was assigned into either white (RACWHIT=1), black (RACBLAC=1) or unsigned (RACUNAS=1).

Appendix 2: Labor Force Statistics from the Current Population Survey

Unemployment Rates for Adults 16 and over (1986-2010)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1986	6.7	7.2	7.2	7.1	7.2	7.2	7.0	6.9	7.0	7.0	6.9	6.6	**7.0**
1987	6.6	6.6	6.6	6.3	6.3	6.2	6.1	6.0	5.9	6.0	5.8	5.7	**6.2**
1988	5.7	5.7	5.7	5.4	5.6	5.4	5.4	5.6	5.4	5.4	5.3	5.3	**5.5**
1989	5.4	5.2	5.0	5.2	5.2	5.3	5.2	5.2	5.3	5.3	5.4	5.4	**5.3**
1990	5.4	5.3	5.2	5.4	5.4	5.2	5.5	5.7	5.9	5.9	6.2	6.3	**5.6**
1991	6.4	6.6	6.8	6.7	6.9	6.9	6.8	6.9	6.9	7.0	7.0	7.3	**6.9**
1992	7.3	7.4	7.4	7.4	7.6	7.8	7.7	7.6	7.6	7.3	7.4	7.4	**7.5**
1993	7.3	7.1	7.0	7.1	7.1	7.0	6.9	6.8	6.7	6.8	6.6	6.5	**6.9**
1994	6.6	6.6	6.5	6.4	6.1	6.1	6.1	6.0	5.9	5.8	5.6	5.5	**6.1**
1995	5.6	5.4	5.4	5.8	5.6	5.6	5.7	5.7	5.6	5.5	5.6	5.6	**5.6**
1996	5.6	5.5	5.5	5.6	5.6	5.3	5.5	5.1	5.2	5.2	5.4	5.4	**5.4**
1997	5.3	5.2	5.2	5.1	4.9	5.0	4.9	4.8	4.9	4.7	4.6	4.7	**4.9**
1998	4.6	4.6	4.7	4.3	4.4	4.5	4.5	4.5	4.6	4.5	4.4	4.4	**4.5**
1999	4.3	4.4	4.2	4.3	4.2	4.3	4.3	4.2	4.2	4.1	4.1	4.0	**4.2**
2000	4.0	4.1	4.0	3.8	4.0	4.0	4.0	4.1	3.9	3.9	3.9	3.9	**4.0**
2001	4.2	4.2	4.3	4.4	4.3	4.5	4.6	4.9	5.0	5.3	5.5	5.7	**4.7**
2002	5.7	5.7	5.7	5.9	5.8	5.8	5.8	5.7	5.7	5.7	5.9	6.0	**5.8**
2003	5.8	5.9	5.9	6.0	6.1	6.3	6.2	6.1	6.1	6.0	5.8	5.7	**6.0**
2004	5.7	5.6	5.8	5.6	5.6	5.6	5.5	5.4	5.4	5.5	5.4	5.4	**5.5**
2005	5.3	5.4	5.2	5.2	5.1	5.0	5.0	4.9	5.0	5.0	5.0	4.9	**5.1**
2006	4.7	4.8	4.7	4.7	4.6	4.6	4.7	4.7	4.5	4.4	4.5	4.4	**4.6**
2007	4.6	4.5	4.4	4.5	4.4	4.6	4.7	4.6	4.7	4.7	4.7	5.0	**4.6**
2008	5.0	4.9	5.1	5.0	5.4	5.6	5.8	6.1	6.1	6.5	6.8	7.3	**5.8**
2009	7.8	8.3	8.7	9.0	9.4	9.5	9.5	9.6	9.8	10.0	9.9	9.9	**9.3**
2010	9.7	9.8	9.9	9.9	9.6	9.4	9.5	9.5	9.5	9.5	9.8	9.4	**9.6**

Appendix 3: Real GDP Percent Change from Previous Period (1988-2010)

Year	United States Real GDP % Change
1987-1988	5.3
1988-1989	2.21
1989-1990	1.5
1990-1991	-0.16
1991-1992	3.03
1992-1993	2.04
1993-1994	4.6
1994-1995	3.44
1995-1996	4.41
1996-1997	5.24
1997-1998	4.31
1998-1999	4.77
1999-2000	4.22
2000-2001	1.24
2001-2002	1.71
2002-2003	2.16
2003-2004	3.31
2004-2005	2.78
2005-2006	2.69
2006-2007	1.77
2007-2008	-0.66
2008-2009	-3.76
2009-2010	3.13

Appendix 4: Variable Names and Definitions

Variable Name	Variable Definitions
Outcome Variables	
Any Illnesses	=1 if child had any illness that required medical attention or treatment in the past 12 months
Number of Illnesses	Number of illnesses child had that required medical attention or treatment in the past 12 months
BMI	Body Mass Index calculated for Children
Overweight	=1 if BMI is above or at the 85th percentile, but less than 95th percentile; =0 otherwise
Obese	=1 if BMI is above or at the 95th percentile; =0 otherwise
Economic Conditions Measures	
State employment rate	State unemployment rate expressed as a percentage of the number of people unemployed and actively seeking work divided by all individuals currently in the labor force
Lagged unemployment rate	One-year lag of the state unemployment rate
Weighted average unemployment rate	State unemployment rate calculated from weighted averages of current and lagged unemployment rates based on month of interview
Real Gross Domestic Product (GDP)	Real GDP (chained dollars) percent change from the preceding period for each individual state.
Lagged real GDP	One-year lag of the state real GDP percent change
Weighted average real GDP growth rate	Real GDP percent change calculated from weighted averages of current and lagged real GDP percent changes based on month of interview
Individual, Household and Local Area Characteristics	
Girl	=1 if child is female; =0 if male
Black	=1 if child is black; =0 otherwise
Hispanic	=1 if child is Hispanic; =0 otherwise
Other	=1 if child is not defined as black or Hispanic; =0 otherwise (default)
Birth weight	Continuous variable of the child's birth weight in pounds (lbs.)
Month of birth	=1 if January; =2 if February; =3 if March; =4 if April; =5 if May; =6 if June; =7 if July; =8 if August; =9 if September; =10 if October; =11 if November; =12 if December
Year of birth	Year in which the child was born
Birth order	Birth order of child
Age	Continuous variable of the child's age in months
Age^2	Continuous variable of the child's age in months squared
Mother NH black	=1 if mother is black; =0 otherwise
Mother Hispanic	=1 if mother is Hispanic; =0 otherwise
Mother NH white	=1 if mother is white; =0 otherwise
Mother Asian	=1 if mother is Asian; =0 otherwise
Mother other	=1 if mother is of other race; =0 otherwise
Mother unassigned	=1 if mother's race is unassigned; =0 otherwise
Mother's age	Continuous variable of the mother's age in years at time of interview
Mother's age at child's birth	Continuous variable of the mother's age in years at the time of child's birth
Mother married	=1 if child's mother is currently married; =0 otherwise (default)
Mother never married	=1 if child's mother has never been married; =0 otherwise
Mother separated	=1 if child's mother is currently separated from her spouse; =0 otherwise
Mother widowed	=1 if child's mother is currently a widow; =0 otherwise
Mother divorced	=1 if child's mother is currently divorced; =0 otherwise
Mother completed less than high school	=1 if child's mother's highest level of education completed is less than high school or equivalent

Mother completed high school	=1 if child's mother's highest level of education completed is high school or equivalent
Mother completed some college	=1 if child's mother's highest level of education completed is some college
Mother completed college	=1 if mother's highest level of education completed is a four year college degree or more
Mother's weeks worked	Average mother's weeks worked in the labor force in the past calendar year
Household income	Continuous measure of annual average household income in 10,000 dollars adjusted using CPI 1982-84 deflated price indices
Year 1986	=1 if child measurement is taken in year 1986; =0 otherwise (default)
Year 1988	=1 if child measurement is taken in year 1988; =0 otherwise
Year 1990	=1 if child measurement is taken in year 1990; =0 otherwise
Year 1992	=1 if child measurement is taken in year 1992; =0 otherwise
Year 1994	=1 if child measurement is taken in year 1994; =0 otherwise
Year 1996	=1 if child measurement is taken in year 1996; =0 otherwise
Year 1998	=1 if child measurement is taken in year 1998; =0 otherwise
Year 2000	=1 if child measurement is taken in year 2000; =0 otherwise
Year 2002	=1 if child measurement is taken in year 2002; =0 otherwise
Year 2004	=1 if child measurement is taken in year 2004; =0 otherwise
Year 2006	=1 if child measurement is taken in year 2006; =0 otherwise
Year 2008	=1 if child measurement is taken in year 2008; =0 otherwise
Urban	=1 if child's household residence is defined as urban; =0 otherwise
Suburban	=1 if child's household residence is defined as suburban; =0 otherwise
Rural	=1 if child's household residence is defined as rural; =0 otherwise
Number of family members	Number of family members in household of mother
Number of children	Number of children in household of mother
Grandparents live in household	=1 if mother/step/grandmother AND/OR father/step/grandfather of child's mother present in household of mother; =0 otherwise
Private insurance	=1 if child health care covered by employer or private insurance; =0 otherwise
Public insurance	=1 if child health care covered by Medicaid; =0 otherwise
No insurance	=1 only if both private insurance and public insurance=0
Weekly benefit ratio	State level ratio of average weekly benefits paid to the average weekly total wage

Appendix 5: First Stage Estimates from IV Models

Table XLII: First Stage Results of Mother's Working Hours and Reservation Wages on Child Obesity Prevalence (Children who reside with Mother ONLY)

	Hours Worked per Week	Reservation Wages
Agriculture	412.132 (337.673)	-13.332 (12.314)
Mining	388.623** (185.511)	21.921*** (6.513)
Construction	-83.131 (120.940)	19.936*** (4.486)
Manufacturing	-31.727 (54.087)	13.667*** (2.190)
Transportation	-343.730* (197.563)	11.301* (6.735)
Trade	195.756* (101.916)	0.959 (3.795)
Financial	-47.984 (58.402)	16.108*** (2.260)
Services	-53.801 (63.096)	15.084*** (2.355)
Unem*Agri*MomAge1	-42.836 (47.386)	4.094** (1.701)
Unem*Min*MomAge1	-34.827** (16.324)	0.284 (0.549)
Unem*Con*MomAge1	11.736 (23.073)	-3.072*** (0.828)
Unem*Man*MomAge1	-0.170 (3.101)	-0.194** (0.098)
Unem*Tran*MomAge1	45.671* (27.631)	-0.161 (0.990)
Unem*Trade*MomAge1	-20.126 (14.789)	0.671 (0.477)
Unem*Fin*MomAge1	2.405 (6.243)	-0.757*** (0.225)
Unem*Sev*MomAge1	3.217 (4.288)	-0.598*** (0.151)
Unem*Pub*MomAge1	-5.257 (4.980)	0.199 (0.221)
Unem*Agri*MomAge2	-15.024 (43.540)	5.041*** (1.523)
Unem*Min*MomAge2	-47.205*** (16.278)	0.085 (0.524)
Unem*Con*MomAge2	20.615 (21.096)	-3.020*** (0.719)
Unem*Man*MomAge2	0.086 (3.068)	-0.119 (0.096)
Unem*Tran*MomAge2	51.597* (28.640)	-0.108 (0.960)
Unem*Trade*MomAge2	-22.735 (14.807)	0.466 (0.463)
Unem*Fin*MomAge2	1.265 (5.032)	-0.311* (0.172)
Unem*Sev*MomAge2	2.767 (3.848)	-0.555*** (0.127)
Unem*Pub*MomAge2	-7.337 (4.512)	0.322* (0.196)
Unem*Agri*MomAge3	-23.099 (44.830)	1.621 (1.544)
Unem*Min*MomAge3	-34.043** (16.690)	-1.464*** (0.522)
Unem*Con*MomAge3	-1.206 (21.146)	-0.050 (0.716)
Unem*Man*MomAge3	-0.783 (3.110)	0.173* (0.096)
Unem*Tran*MomAge3	34.574 (28.528)	0.530 (0.939)
Unem*Trade*MomAge3	-4.563 (14.808)	0.804* (0.460)
Unem*Fin*MomAge3	0.918 (4.939)	-0.155 (0.161)
Unem*Sev*MomAge3	-0.185 (3.561)	-0.688*** (0.120)
Unem*Pub*MomAge3	-5.483 (4.661)	0.758*** (0.208)
Unem*Agri*MomAge4	4.510 (44.154)	0.022 (1.616)
Unem*Min*MomAge4	-57.989*** (17.746)	-2.444*** (0.531)
Unem*Con*MomAge4	-20.970 (22.832)	2.848*** (0.751)
Unem*Man*MomAge4	-0.169 (3.144)	0.196* (0.101)
Unem*Tran*MomAge4	92.177*** (28.728)	1.627 (1.003)
Unem*Trade*MomAge4	-31.372 (15.035)	-0.065 (0.472)
Unem*Fin*MomAge4	4.686 (5.128)	0.090 (0.179)
Unem*Sev*MomAge4	4.360 (3.676)	-0.722*** (0.128)
Unem*Pub*MomAge4	-8.422* (4.629)	0.912*** (0.221)
F statistics	*3.15*	*699.62*

Note: All models include the full set of individual, household and local area characteristics listed in Table XI and a full set of year and state dummy variables. MomAge1 if mother between 21-29 years of age; MomAge2 if mother between 30 to 39 years of age; MomAge3 if mother between 40 to 49 years of age; MomAge4 if mother between 50 to 53 years of age.Standard errors (SE) are reported in parentheses and are robust. n/a: not available

* significance at 10%; ** significance at 5%; *** significance at 1%.

Table XLIII: First Stage Results of Individual Fixed Effects Model for Mother's Working Hours and Reservation Wages on Child Obesity Prevalence (Children who reside with Mother ONLY)

	Hours Worked per Week	Reservation Wages
Agriculture	256.490 (190.739)	-4.190 (7.390)
Mining	109.002 (72.427)	2.811 (3.001)
Construction	-2.5771 (82.561)	1.677 (3.223)
Manufacturing	-1.904 (24.351)	-0.017 (1.296)
Transportation	-148.994 (122.147)	-7.624** (3.790)
Trade	38.158 (52.271)	-7.543*** (2.354)
Financial	-20.517 (26.643)	7.708*** (1.501)
Services	15.569 (31.778)	2.164* (1.303)
Unem*Agri*MomAge1	-16.957 (40.981)	-0.680 (1.152)
Unem*Min*MomAge1	-18.572* (11.253)	0.372 (0.297)
Unem*Con*MomAge1	11.231 (17.991)	-2.692*** (0.539)
Unem*Man*MomAge1	-6.747** (3.153)	-0.327 (0.064)
Unem*Tran*MomAge1	46.090** (22.877)	1.228** (0.592)
Unem*Trade*MomAge1	-16.985 (11.442)	-0.741** (0.300)
Unem*Fin*MomAge1	8.920 (6.047)	-0.494*** (0.128)
Unem*Sev*MomAge1	-1.746 (3.600)	0.346*** (0.089)
Unem*Pub*MomAge1	-1.387 (3.187)	0.139 (0.225)
Unem*Agri*MomAge2	11.889 (33.212)	1.146 (0.225)
Unem*Min*MomAge2	-21.878* (11.568)	1.146 (1.093)
Unem*Con*MomAge2	25.910 (15.792)	-0.430 (0.312)
Unem*Man*MomAge2	-6.463* (3.533)	-0.151 (0.483)
Unem*Tran*MomAge2	46.314** (22.546)	-0.257*** (0.065)
Unem*Trade*MomAge2	-17.937 (11.818)	1.239** (0.604)
Unem*Fin*MomAge2	7.129 (4.544)	-0.999*** (0.319)
Unem*Sev*MomAge2	-0.443 (3.496)	-0.288** (0.118)
Unem*Pub*MomAge2	-5.264* (2.987)	0.250*** (0.093)
Unem*Agri*MomAge3	-4.737 (22.474)	-0.265 (0.229)
Unem*Min*MomAge3	-13.493 (8.587)	0.353 (1.063)
Unem*Con*MomAge3	2.115 (11.838)	-0.461 (0.322)
Unem*Man*MomAge3	-0.214 (1.771)	1.005** (0.436)
Unem*Tran*MomAge3	16.406 (17.500)	0.116* (0.061)
Unem*Trade*MomAge3	-0.504 (8.580)	0.864 (0.583)
Unem*Fin*MomAge3	1.387 (2.695)	-0.126 (0.297)
Unem*Sev*MomAge3	-0.866 (2.130)	0.060*** (0.115)
Unem*Pub*MomAge3	-2.668 (2.509)	-0.417 (0.082)
Unem*Agri*MomAge4	-20.109 (23.075)	0.077 (0.187)
Unem*Min*MomAge4	-13.943* (7.991)	-0.272 (0.321)
Unem*Con*MomAge4	9.330 (11.640)	0.106 (0.515)
Unem*Man*MomAge4	0.268 (1.493)	0.092 (0.074)
Unem*Tran*MomAge4	18.738 (17.171)	-0.542 (0.612)
Unem*Trade*MomAge4	-3.481 (7.883)	0.182 (0.310)
Unem*Fin*MomAge4	3.237 (2.282)	-0.482*** (0.143)
Unem*Sev*MomAge4	-2.045 (2.157)	-0.396*** (0.108)
Unem*Pub*MomAge4	-1.362 (2.308)	0.481 (0.272)
F statistics	*2.09*	*69.57*

Note: All models include the full set of individual, household and local area characteristics listed in Table XI and a full set of year and state dummy variables. MomAge1 if mother between 21-29 years of age; MomAge2 if mother between 30 to 39 years of age; MomAge3 if mother between 40 to 49 years of age; MomAge4 if mother between 50 to 53 years of age.Standard errors (SE) are reported in parentheses and are robust. n/a: not available
* significance at 10%; ** significance at 5%; *** significance at 1%.

Table XIV: First Stage Results of Mother's Working Hours and Reservation Wages on Child Body Mass Index Percentiles (Children who reside with Mother ONLY)

	Hours Worked per Week	Reservation Wages
Agriculture	408.374 (337.529)	-13.247 (12.307)
Mining	388.873** (185.638)	21.916 *** (6.512)
Construction	-82.872 (120.915)	19.930*** (4.485)
Manufacturing	-32.608 (54.113)	13.688*** (2.190)
Transportation	-346.014* (194.461)	11.373* (6.732)
Trade	194.096* (101.986)	0.997 (3.795)
Financial	-48.847 (58.405)	16.128*** (2.259)
Services	-55.172 (63.108)	15.114*** (2.356)
Unem*Agri*MomAge1	-43.060 (47.400)	4.099** (1.719)
Unem*Min*MomAge1	-34.858** (16.331)	0.284 (0.549)
Unem*Con*MomAge1	11.630 (23.065)	-3.700*** (0.828)
Unem*Man*MomAge1	-0.191 (3.103)	-0.194** (0.098)
Unem*Tran*MomAge1	45.847*- (27.626)	-0.165 (0.989)
Unem*Trade*MomAge1	-20.047 (14.798)	0.669 (0.477)
Unem*Fin*MomAge1	-2.310 (6.251)	-0.759*** (0.225)
Unem*Sev*MomAge1	3.226 (4.290)	-0.598*** (0.151)
Unem*Pub*MomAge1	-5.383 (4.983)	0.202 (0.221)
Unem*Agri*MomAge2	-15.030 (43.537)	5.040*** (1.522)
Unem*Min*MomAge2	-47.063*** (16.282)	0.081 (0.524)
Unem*Con*MomAge2	20.369 (21.094)	-3.014*** (0.718)
Unem*Man*MomAge2	0.075 (3.068)	-0.118 (0.096)
Unem*Tran*MomAge2	51.488* (28.638)	-0.105 (0.960)
Unem*Trade*MomAge2	-22.519 (14.815)	0.461 (0.463)
Unem*Fin*MomAge2	1.211 (5.043)	-0.310* (0.172)
Unem*Sev*MomAge2	2.790 (3.851)	-0.556*** (0.127)
Unem*Pub*MomAge2	-7.422 (4.511)	0.324* (0.196)
Unem*Agri*MomAge3	-22.983 (44.834)	1.618 (1.543)
Unem*Min*MomAge3	-34.123** (16.702)	-1.462*** (0.523)
Unem*Con*MomAge3	-1.340 (21.146)	-0.047 (0.715)
Unem*Man*MomAge3	-0.8665 (3.114)	0.175* (0.096)
Unem*Tran*MomAge3	34.709 (28.537)	0.527 (0.939)
Unem*Trade*MomAge3	-4.345 (14.827)	0.799* (0.460)
Unem*Fin*MomAge3	0.834 (4.955)	0.154 (0.161)
Unem*Sev*MomAge3	0.177 (3.566)	-0.688*** (0.120)
Unem*Pub*MomAge3	-5.545 (4.660)	0.759*** (0.208)
Unem*Agri*MomAge4	4.935 (44.155)	0.012 (1.616)
Unem*Min*MomAge4	-57.937*** (17.756)	-2.445*** (0.531)
Unem*Con*MomAge4	-21.166 (22.830)	2.853*** (0.751)
Unem*Man*MomAge4	-0.159 (3.144)	0.196** (0.101)
Unem*Tran*MomAge4	92.223*** (28.724)	1.626 (1.022)
Unem*Trade*MomAge4	-31.289** (15.039)	-0.067 (0.472)
Unem*Fin*MomAge4	4.721 (5.133)	0.089 (0.179)
Unem*Sev*MomAge4	4.296 (3.678)	-0.721*** (0.128)
Unem*Pub*MomAge4	-8.409* (4.628)	0.912*** (0.221)
F statistics	*3.16*	*700.20*

Note: All models include the full set of individual, household and local area characteristics listed in Table XI and a full set of year and state dummy variables. MomAge1 if mother between 21-29 years of age; MomAge2 if mother between 30 to 39 years of age; MomAge3 if mother between 40 to 49 years of age; MomAge4 if mother between 50 to 53 years of age. Standard errors (SE) are reported in parentheses and are robust. n/a: not available
* significance at 10%; ** significance at 5%; *** significance at 1%. N=13,216 . Sample weights are used to have national representation.

Table XLV: First Stage Results of Individual Fixed Effects Model for Mother's Working Hours and Reservation Wages on Child Body Mass Index Percentiles (Children who reside with Mother ONLY)

	Hours Worked per Week	Reservation Wages
Agriculture	256.490 (190.739)	-4.190 (7.391)
Mining	109.002 (72.427)	2.811 (3.000)
Construction	-2.571 (82.561)	1.677 (3.223)
Manufacturing	-1.904 (24.351)	-0.017 (1.296)
Transportation	-148.994 (122.147)	-7.624** (3.790)
Trade	38.158 (52.271)	-7.543*** (2.354)
Financial	-20.517 (26.643)	7.708*** (1.501)
Services	15.569 (31.778)	2.163* (1.303)
Unem*Agri*MomAge1	-16.957 (40.981)	-0.680 (1.152)
Unem*Min*MomAge1	-18.572 (11.253)	-0.372 (0.297)
Unem*Con*MomAge1	11.231 (17.991)	-2.692*** (0.539)
Unem*Man*MomAge1	-6.747** (3.153)	-0.327*** (0.064)
Unem*Tran*MomAge1	46.090** (22.877)	1.228** (0.592)
Unem*Trade*MomAge1	-16.985 (11.442)	-0.741** (0.300)
Unem*Fin*MomAge1	8.920 (6.047)	-0.494*** (0.128)
Unem*Sev*MomAge1	-1.746 (3.600)	0.346*** (0.089)
Unem*Pub*MomAge1	-1.387 (3.187)	0.139 (0.225)
Unem*Agri*MomAge2	11.889 (33.212)	1.146 (1.093)
Unem*Min*MomAge2	-21.878* (11.568)	-0.430 (0.312)
Unem*Con*MomAge2	25.910* (15.792)	-0.151 (0.483)
Unem*Man*MomAge2	-6.463* (3.533)	-0.257*** (0.065)
Unem*Tran*MomAge2	46.314** (22.546)	1.239 (0.604)
Unem*Trade*MomAge2	-17.937 (11.818)	-0.999*** (0.319)
Unem*Fin*MomAge2	7.129 (4.544)	-0.288** (0.118)
Unem*Sev*MomAge2	-0.443 (3.497)	0.250*** (0.093)
Unem*Pub*MomAge2	-5.264* (2.987)	-0.265 (0.229)
Unem*Agri*MomAge3	-4.737 (22.474)	0.353 (1.063)
Unem*Min*MomAge3	-13.492 (8.587)	-0.461 (0.323)
Unem*Con*MomAge3	2.115 (11.838)	1.004** (0.436)
Unem*Man*MomAge3	-0.214 (1.771)	0.116 (0.061)
Unem*Tran*MomAge3	16.406 (17.500)	0.863 (0.583)
Unem*Trade*MomAge3	-0.504 (8.580)	-0.126 (0.297)
Unem*Fin*MomAge3	1.387 (2.695)	0.060 (0.115)
Unem*Sev*MomAge3	-0.866 (2.130)	-0.417 (0.082)
Unem*Pub*MomAge3	-2.668 (2.509)	0.077 (0.187)
Unem*Agri*MomAge4	-20.109 (23.075)	0.971 (1.202)
Unem*Min*MomAge4	-13.943 (7.991)	-0.273 (0.321)
Unem*Con*MomAge4	9.330 (11.640)	0.106 (0.515)
Unem*Man*MomAge4	0.268 (1.493)	0.092 (0.074)
Unem*Tran*MomAge4	18.738 (17.171)	-0.542 (0.612)
Unem*Trade*MomAge4	-3.481 (7.83)	0.182 (0.310)
Unem*Fin*MomAge4	3.237 (2.282)	-0.482*** (0.143)
Unem*Sev*MomAge4	-2.045 (2.157)	-0.396*** (0.108)
Unem*Pub*MomAge4	-1.362 (2.308)	0.481 (0.272)
F statistics	*2.09*	*69.57*

Note: All models include the full set of individual, household and local area characteristics listed in Table XI and a full set of year and state dummy variables. MomAge1 if mother between 21-29 years of age; MomAge2 if mother between 30 to 39 years of age; MomAge3 if mother between 40 to 49 years of age; MomAge4 if mother between 50 to 53 years of age.Standard errors (SE) are reported in parentheses and are robust. n/a: not available
* significance at 10%; ** significance at 5%; *** significance at 1%.

X. VITA

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EDUCATION

University of Illinois at Chicago (UIC):

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MA Degree in Economics, 2007

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PUBLICATIONS

PUBLISHED WORK

Rose, Shyanika, Dianne C. Barker, Heather D'Angelo, **Tamkeen Khan**, Jidong Huang, Frank J. Chaloupka and Kurt M. Ribisl (2014). The Availability of Electronic Cigarettes in US Retail Outlets, 2012: Results of Two National Studies.*Tobacco Control.* DOI: 10.1136/tobaccocontrol-2013-051461

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Powell, Lisa M., Jamie F. Chriqui, **Tamkeen Khan**, Roy Wada, and Frank J. Chaloupka (2012) Assessing the potential effectiveness of food and beverage taxes and subsidies for improving public health: a systematic review of prices, demand and body weight outcomes. *Obesity Reviews*. DOI: 10.1111/obr.12002

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Powell, Lisa M., Euna Han, Shannon N. Zenk, **Tamkeen Khan**, Christopher M. Quinn, Kevin P. Gibbs, Oksana Pugach, Dianne C. Barker, Elissa A. Resnick, Jaana Myllyluoma, Frank J. Chaloupka (2011) Field Validation of Secondary Commercial Data Sources on the Retail Food Outlet Environment in the U.S. *Health & Place*, 17(5):1122-1131.

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Khan, Tamkeen, Dianne C. Barker, Jidong Huang. Availability of Cigarillos and Little Cigars Differs by U.S. Neighborhoods.

Khan, Tamkeen. Economic Conditions and Children's Health: Macroeconomic Conditions and Children's Illnesses.

Khan, Tamkeen. Economic Conditions and Children's Health: Macroeconomic Conditions and Children's Weight Outcomes. *(Job Market Paper)*

Roberts, Helen and **Tamkeen Khan**. Effects on High School Students of Participation in Career and Technical Education: Chicago Public Schools.

CONFERENCE PRESENTATIONS

Availability of Reduced Harm Tobacco Products Relative to E-Cigarettes in Retail Stores in the United States. UIC School of Public Health's 9th Annual Research and Practice Day, Chicago, IL April 2014.

Economic Conditions and Children's Health: Macroeconomic Conditions and Children's Illnesses. Presented at the Illinois Economics Association Annual Meeting, Chicago, IL, October, 2013.

Economic Conditions and Children's Health: Unemployment Rates and Children's Illnesses. Presented at the UIC Economics Research Lunch Seminar (EARL), Chicago, IL, April, 2013.

Economic Conditions and Children's Health: Unemployment Rates and Children's Illnesses. Presented at the Midwest Economics Association Annual Meeting, Columbus, OH, March, 2013.

Economic Conditions and Children's Health: Unemployment Rates and Children's Illnesses. Presented at the Illinois Economics Association Annual Meeting, Chicago, IL, October, 2012.

Fast Food Consumption and Food Prices: Evidence from Panel Data on 5th and 8th Grade Children. Presented at the Illinois Economics Association Annual Meeting, Chicago, IL, October, 2011

Effects of High School Students of Participation in Career and Technical Education: Chicago Public Schools. Presented at the Midwest Economics Association Annual Meeting, Cleveland, OH, March, 2009.

Effects of High School Students of Participation in Career and Technical Education: Chicago Public Schools. Presented at the Illinois Economics Association Annual Meeting, Chicago, IL, October, 2008.

AWARDS

Elizabeth Bass Award in Economics, 2013
Chancellor's Graduate Research Fellowship, 2012-13, 2011-12
Graduate College Student Presenters Award, 2013
College of Liberal Arts and Sciences PhD Student Travel Award, 2013
Undergraduate Geldard Award in Economics, 2005
Marilyn Fors Scholarship in the College of Business Administration, 2004

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