THE EFFECT OF MINIMUM WAGE INCREASE ON EMPLOYMENT IN CANADA

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Bachelor of Science, University for Development Studies, 2019

A thesis submitted

in partial fulfilment of the requirements for the degree of

Master of Arts

in

Economics

Department of Economics
University of Lethbridge
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Date of Defense: August 8, 2024

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DEDICATION

To Mr. Anthony Bright-Addo, whose support and guidance made my study in Canada a reality.

ABSTRACT

This research investigates the effect of minimum wage increases on employment in Canada, focusing on three age groups: 15-19, 20-24, and 15-24. The study utilizes provincial data from 1983 to 2022 and employs Neumark's (2001) pre-specified design to analyze the ratio format of the explanatory variables. Additionally, this study slightly modifies Neumark's design to analyze the explanatory variables in a non-ratio format.

The model results indicate no statistically significant relationship between minimum wage and employment for all age groups for Neumark's (2001) pre-specified model and the modified form. The overall results suggest that firms may respond to minimum wage increases by adjusting other variables such as non-wage benefits, prices, profits, etc.

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ACKNOWLEDGEMENTS

I want to express my gratitude to those who have supported me throughout my academic journey at the University of Lethbridge.

Firstly, I sincerely appreciate my graduate microeconomics professor and thesis supervisor, Professor Kamar Md Ali, whose invaluable support and timely feedback have been helpful throughout my studies.

I am also grateful to my thesis committee members, Professor Richard Mueller and Professor Danny Le Roy, for their shared articles, insightful suggestions and constructive feedback, which significantly improved the quality of this work.

I thank my other coursework professors, Professor Duane Rockerbie, Professor Kien Tran, and Professor Pascal Ghazalian, for their dedication and impactful teaching.

I want to acknowledge the financial support from the Alberta Government for awarding me the Alberta Graduate Excellence Scholarship, which greatly facilitated my studies.

My heartfelt thanks to my program mates for the shared experiences that made this journey memorable. Additionally, I am grateful to the students I had the privilege to serve as a Graduate Assistant; their interactions provided me with valuable learning experiences.

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CHAPTER 1: INTRODUCTION

1.1 Background

Over the past decade, the minimum wage has emerged as a significant macroeconomic variable in North America, largely driven by the influential "Fight for $15" movement and the right to form labour unions (Fortin et al. 2015). This movement began with strikes by workers in various industries, including fast food, childcare, home health care, airports, gas stations, and convenience stores. These strikes have been described as the largest in the history of the fast-food industry.

The movement has achieved remarkable success. What once seemed an ambitious and unattainable demand has now been realized at the state and local levels in the US, in states such as California, Maryland, Massachusetts, and New Jersey. Additionally, major cities like San Francisco, New York City, and Seattle have raised their municipal minimum wage to $15 per hour.

In Canada, the movement began as the "Fight for $15 and Fairness" campaign, which started in Ontario in April 2016. After eight years of campaigning, all provinces, except Saskatchewan, have achieved the $15 minimum wage, with Saskatchewan set to reach this milestone on October 1, 2024.

The minimum wage rate in Canada varies across provinces and at the federal level. For instance, the federal minimum wage in Canada was raised from $16.65 to $17.30 on April 1, 2024, marking a 3.9 percent increase. According to the Government of Canada news release on March 21, 2024, this adjustment is estimated to benefit approximately 30,000 employees in the federally regulated private sector. At the provincial level, Alberta was the first province to achieve the $15 minimum wage milestone on October 1, 2018. However, all provinces except Saskatchewan have since surpassed Alberta's minimum wage, with British Columbia currently having the highest minimum wage at $17.40 and exceeding the federal minimum wage of $17.30.

Policymakers implement minimum wage policies with the intention of raising the income of minimum wage earners. The Government of Canada's (2019) federal minimum wage issue paper by the secretariate to the expert panel on modern federal labour standards highlights several economic advantages of the minimum wage. It states that the Canadian government established a minimum wage standard to reduce low-paying jobs, mitigate poverty, protect non-unionized workers, reduce income inequality, provide an incentive for employment, and stimulate economic growth by increasing demand. Wang et al. (2019) emphasized that the primary purpose of establishing a minimum wage is to safeguard the rights and interests of vulnerable workers while enhancing labour productivity in the U.S. Additionally, Freeman (1996) and Cross (2021) argued that the minimum wage's primary objective is not to decrease employment but to improve the earnings to low-paid workers.

Despite the positive intentions, the minimum wage policy can have unintended negative consequences, particularly for youth employment, which the policy aims to protect. According to Lammam et al. (2018), about 57.8 percent of minimum wage workers in Canada are between the ages of 15 and 24 years as of 2017.

Unemployment data for this study period (1983 - 2022) shows that the youth unemployment rate has consistently been higher compared to the general working population aged 15 and above in any year period. Figure 1.1 shows that the age group 15-19 has the highest unemployment rate in any year period. Followed by the age group 15-24. The age group with the least unemployment is 15 and above.

The graph shows fluctuation trends in unemployment among the age groups, with a noticeable increase during the early 1990 economic recession, the global financial crisis in 2008-2009, and the COVID-19 pandemic.

Figure 1.1: Unemployment Rate by Age Group (1983 – 2022)

Source: Statistic Canada. Table 14 - 10 0327 - 01

Other empirical studies with different time datasets on youth unemployment in Canada have also shown a similar trend. Eisen and Palacious (2024) dataset on recent trends in youth employment from January 2023 to March 2024 indicates that the unemployment rate for the Canadian age group 15 – 19 increased from 12.2 to 17.1 percent. The unemployment rate for the age group 20 – 24 increased from 8.2 to 10.2 percent. For the combined age group 15 – 24, unemployment increased from 9.7 to 12.6 percent.

The youth unemployment rate in Canada over the years can be attributed to several factors, including frictional unemployment and voluntary unemployment, possibly due to affluent parents. However, increases in the minimum wage have the potential to intensify youth unemployment in at least three ways discussed below.

Firstly, when policymakers set the minimum wage higher than the equilibrium level, it can prevent the entry of lowest-skilled job seekers, mostly teens, into the job market. Due to their lack of skill in the labour market, their marginal revenue product of labour (MRP_L)[1] may not warrant the set minimum wage. Consequently, they will likely not be hired and will not get the opportunity to gain the skills and experience needed to become a more productive labour force in the future. Thus, the minimum wage policy may inadvertently harm the very target group it intends to help.

Secondly, increased minimum wages may cause some low-skilled teens who are already employed to lose their jobs. This is because some previously hired teens whose MP_L were at par or barely above the threshold of marginal revenue product $MRP_,$ to be profitably employed at the old minimum wage, will now lie below the new minimum wage and will be laid off.

Thirdly, with respect to the firm, setting the minimum wage above the equilibrium level is likely to reduce firms' profitability by increasing its production costs. Consequently, shareholders may devalue these firms and withdraw or reduce their investments. This devaluation and reduction in investments in the firms will further reduce their ability to expand and hire more in the future, leading to increased unemployment among workers with lower marginal products of labour (MP_L). Lucas and Lucas (2018) show this effect in the USA, where a one-dollar increase in the minimum wage led to a 14 percent increase in the likelihood of exit for restaurants with ratings of 3.5 stars or below.

[1] The marginal revenue product (MRP) of labour is the additional revenue earned by employing an additional labour. It indicates the actual wage that a company is willing and can afford to pay for each new labour they employ. See Ku (2022).

This research is increasingly relevant due to its potential policy implications, particularly the unintended effect of minimum wage increases on youth employment. These effects can impact future employment prospects, earnings, and human capital development.

Baum and Ruhm (2014) suggest that early workforce engagement enhances future employment prospects and increases adult wages in the USA. Similarly, Dagnino and Tam (2012) indicate that limited employment opportunities and work experience for Canadian youth can negatively affect human capital and future development trajectories.

1.2 The Economic Research Problem Statement

The minimum wage is a critical policy tool that influences numerous macroeconomic variables such as employment, income, labour productivity, etc. As a result, policymakers often adjust the minimum wage with the intention of achieving specific economic outcomes. For instance, increasing the minimum wage is generally believed to boost the income of minimum wage earners, potentially leading to a higher standard of living. This is particularly true if the policy is not designed to counterbalance issues like high inflation and the resulting increased cost of living.

However, one significant unintended consequence of raising the minimum wage is its negative impact on youth employment. The age group that minimum wage policies are often intended to benefit can face higher unemployment rates because of these increases.

Therefore, there is a need for this research topic, "The effect of minimum wage increase on employment in Canada."

1.3 Objective of the study

The main objective of this study is to analyze the effect of increases in the minimum wage on employment in Canada using panel data from 1983 to 2022. The study focused on three age groups: teenagers (15 - 19), young adults (20 - 24) and youth (15 - 24). These age groups are considered because they constitute the majority of minimum wage earners in Canada over the years. According to Dionne and Miller (2018), the percentage of total minimum-wage workers in Canada for 1998, 2008 and 2018 are 60.7, 63.6 and 52.3 respectively.

1.4 History of Minimum Wage in Canada

Canada's first minimum wage rate was introduced in the early 20th century, initially applying only to women and children. In 1918, British Columbia and Manitoba implemented minimum wage legislation, followed by Ontario, Quebec, Nova Scotia, and Saskatchewan in 1920. Prince Edward Island was the last province to introduce the minimum wage in 1960, extending coverage to both men and women.

Canada has both federal and provincial minimum wage rates. The federal minimum wage, which applies to federally regulated industries covered by Part III of the Labour Standard Code (such as banking and telecommunications), was $16.65 as of February 2024. According to minimum wage laws, employees must be paid at least the federal minimum wage. If the provincial or territorial minimum wage exceeds the federal rate, employers must pay the higher of the two.

Government of Canada data on minimum wage reveals that the federal minimum wage has only undergone six adjustments since 1981. This change in minimum wage is smaller than the ten provinces that have experienced an average of 30.6 changes during the same period, with Alberta having the fewest (18 changes).

While the minimum wage is the foundational employee rate, it does not universally apply. The Government of Canada database highlights special categories of employees excluded from general minimum wage provisions in some jurisdictions. For example, in Alberta, students under 18 working up to 28 hours a week or during school holidays have distinct provisions. British Columbia offers wage packages for farm workers, liquor servers, live-in-home support workers, resident caretakers, and live-in camp leaders. New Brunswick has wage packages for crown construction workers, counsellors, and program staff at residential summer camps. From minimum wage legislation, Nova Scotia excludes early childhood educators, logging, and forestry operators. In Ontario, hunting, fishing, wilderness guides, students under 18, liquor servers, and home workers receive varying wages. Additionally, employees receiving gratuities, such as restaurant workers in Quebec, receive a rate lower than the Quebec minimum wage.

1.5 Organization of The Study

The rest of the thesis is organized as follows: Chapter 2 contains the literature review on the effect of an increase in the minimum wage on employment in Canada and other jurisdictions. Chapter 3 reviews the theoretical relationship between minimum wage and employment. Chapter 4 discusses the empirical and econometric models used in minimum wage and employment analysis. Chapter 5 presents the empirical results and compares them to findings from earlier empirical studies. Finally, Chapter 6 discusses the policy recommendations and limitations of the study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The minimum wage law policy, first implemented in New Zealand in the late 19th century, has since been adopted by many countries, including Canada. The primary goal of this policy is to protect vulnerable workers. Researchers have widely studied the impact of an increase in minimum wage on employment, yielding diverse findings. Some empirical studies support the traditional view that an increase in the minimum wage reduces employment. In contrast, other studies indicate that minimum wage increases have positive or neutral employment effects.

2.2 Minimum Wage-Employment: Negative Relationship

Fossati and Marchand (2023) utilized a synthetic control approach to analyze labour survey data in Canada when Alberta became the first province, state, or territory in North America to reach a $15 minimum wage in 2018. Their findings indicate that a significant number of workers moved up the wage distribution. However, there was a disemployment effect among young workers. Additionally, employment losses were observed in four of the five non-urban economic regions but not in Alberta's two main cities.

Rybczynski and Sen (2018) did a similar study using panel data across Canadian provinces from 1981 to 2011. The ordinary least squares and instrumental variable (IV) estimates show a 10% increase in the minimum wage is associated with a 1% - 4% reduction in the employment rate for both male and female teenagers and prime-aged immigrants in Canada. Green (2015) predicted that the increase in the minimum wage from $10.25 to $15 in British Columbia would result in a job loss of less than 1 percent.

Wessels (1980) utilized data from the Census of Retail Trade and found that an increase in the federal minimum wage significantly reduced the teenage employment rate in the highly affected states of the USA. Galan and Puente (2002) also supported this result, using a data set for Spain from 2004 to 2010.

Dickens et al. (2011) analyzed the effect of a legislated increase in the UK national minimum wage at age 22 on the employment rate for low-skilled workers. Their findings suggested that overall unemployment declined among men during the 22 years of introducing the minimum wage policy.

Leigh's (2003) study used a monthly labour force survey of approximately 61,500 Australians aged 15 and over. The study employed a natural experiment arising from six increases in the Western Australian minimum wage from 1994 to 2001 compared to the rest of Australia. The result suggested a fall in employment - to - population ratio in Western Australia compared to the rest of Australia. The disemployment effect was substantial among young employees aged 15-24, with an elasticity of -0.39.

Neumark and Wascher (2004) used a pooled cross-section time-series data set comprising 17 Organization for Economic Co-operation and Development (OCED) countries for the 1975–2000 period; their estimate provides evidence of youth unemployment due to an increase in the minimum wage. However, there was also evidence of considerable variation across countries. For instance, the effect of the policy on disemployment turns out to be smaller in countries with subminimum wage provisions for youth. The subminimum wage provisions encourage hiring younger, less experienced workers by reducing the cost of employing them.

According to Freeman (1996), raising the minimum wage increases the potential for redistributive benefits and increases the risk of job loss. Bell (1997) used panel data from Colombia and Mexico to analyze the impact of minimum wage on employment. Her result suggested that an increase in the minimum wage has a negative effect in Colombia, where the impact was estimated to be around 2%–12% over the 1981–87 period. However, no disemployment effect was found on Mexico's economy.

Furthermore, Harrison and Scorse (2010) used a data set from Indonesia during the human rights and anti-sweatshop activists' campaign in the 1990s, and their result suggests evidence that an increase in the minimum wage reduces the employment of unskilled workers. This negative relationship between an increased minimum wage on employment could result from teenagers having less experience in the labour force, resulting in lower productivity below the minimum wage and hence not being hired or fired.

Currie and Fallick (1993) used panel data on individuals from the National Longitudinal Survey of Youth in the US; they found that employed individuals who were affected by the increase in the federal minimum wage in 1979 and 1980 were about 3 percent less likely to be employed a year later, even after accounting for the fact that workers employed at the minimum wage may differ from their peers in unobserved ways using at risk methodology.

Substantial literature has recorded the negative effect of minimum wage employment in various jurisdictions. However, other literature results suggest otherwise.

2.3 Minimum Wage-Employment: Positive Relationship

Fang and Gunderson (2009) used an "at-risk" methodology to utilize longitudinal data from a master file survey of labour and income dynamics in Canada from 1993 to 1999. They compared the employment transition probabilities of workers affected by minimum wage increases with those of a comparison group unaffected by the minimum wage policy. They estimated the employment impacts for the older workers of the large number (24) of minimum wage increases that have occurred across the different provincial jurisdictions over the past six years, and their result suggested that minimum wage increases have a positive impact on the employment of the older workers in Canada.

Card and Krueger (2000) used the difference-in-difference methodology on US data, and their empirical results differed from the conventional minimum wage result. They found that the minimum wage increase led to higher pay and, ultimately, higher income for the workers, with no evidence of teenagers losing their jobs.

Machin and Manning (1992) used 1975–1990 data from the United Kingdom. They used a simple model of a generic labour market with frictions that permit wages to affect employment positively or negatively. They concluded that the relationship between an increase in the minimum wage and employment is positive.

Wang et al.(2019) used a structural vector autoregression model (SVAR) with five macroeconomic variables, mainly the inflation rate, unemployment rate, minimum wage relative to industry earnings in the manufacturing industry, percentage change in labour productivity in the manufacturing industry, and economic growth from the Taiwan economy. They hypothesized that an upward adjustment of the minimum wage in Taiwan would not intensify the unemployment rate but would help promote labour productivity and ultimately positively impact Taiwan's economic growth rate. Their result supported the hypothesis, they also suggested the minimum wage policy should not be opposed due to its negative preconceptions.

Flinn (2006) used a continuous-time model to analyze the effect of a change in the minimum wage on labour market outcomes and welfare in the US; his result was indecisive on the employment effect. However, the policy can improve the lives of labour market participants on both the supply and demand sides of the labour market. On the supply side, higher income will lead to an increase in earnings and improve living standards. On the demand side, an increase in earnings for minimum-wage workers may lead to an increase in demand for goods and services and has the potential to increase the price of these goods and services which may improve the profit margins for the producers.

Karageorgiou (2004) analyzed how the minimum wage influences teenage and youth employment in Greece, and her result suggested statistical evidence supporting more teenage employment in most of the specifications.

Lemos (2007) used a Brazilian household panel data survey from 1982 to 2000 and found no evidence of adverse employment in either sector at the aggregate level or for vulnerable groups such as teenagers, women, and low-educated employees.

Furthermore, Kagel and Owens (2010) study suggested evidence that an increase in the minimum wage was associated with a modest increase in employment levels, generating a Pareto improvement in social welfare.

2.4 Minimum Wage – Employment: Neutral or No Relationship

Other empirical studies have demonstrated that increasing the minimum wage has a neutral effect on employment. Neumark (2001) used his prespecified design to analyze the effect of the minimum wage on employment when the federal government in the US increased the minimum wage in October 1996 and September 1997. His results were statistically insignificant, whether current, lagged, or summed on the employment rate for teenagers and young adults.

Reich et al. (2017) used the synthetic control method to analyze Seattle's increase in the minimum wage to $13 per hour from $9.47. Their results suggested that the wage increase raised wages for low-paid workers in the food service sector and limited–service restaurants without causing disemployment. They also found that each ten percent increase in the minimum wage in Seattle raised pay by nearly one percent in the food service sector and by 2.3 percent in limited-service restaurants.

Baker et al. (1999) examined the effect of minimum wage legislation in Canada over the period of 1975–1993. For teenagers, their results suggested that a 10% increase in the minimum wage was associated with approximately a 2.5% decrease in employment. However, their result was statistically insignificant.

Brennan and Stanford (2014) used Canadian data from 1983 to 2012 to analyze the impact of the minimum wage on employment. They found no evidence of any connection between a higher minimum wage and employment levels across provinces in Canada.

Lyon (2021) used Neumark's prespecified design model to analyze the effect of a minimum wage increase on employment in Canada. Using a dataset from 1996 to 2010, his results suggested that an increase in the minimum wage caused a moderate but statistically insignificant adverse effect on youth employment, with an elasticity estimate of -0.12.

Myatt and MacDonald (2010) also used Neumark's prespecified design in their analysis of minimum wage increases on employment in eight provinces in Canada using a dataset from 1976 to 2004. Their results suggested that six out of the eight analyzed provinces had negative coefficients that were statistically insignificant.

Goldberg and Green (1999) used a dataset from 1968–1997 to analyze the effect of an increase in the minimum wage on employment. Their results suggested that the immediate impact of a change in the minimum wage on employment was statistically insignificant for all gender and age groups and only statistically significantly different from zero for young male adults

2.5 Why an Increase in The Minimum Wage Might Not Affect Employment?

Traditional economic theory predicts that an increase in the minimum wage will positively affect unemployment, especially for the youth. However, researchers such as Card and Krueger (2000), Reich et al. (2017), Fang and Gunderson (2009), Machin and Manning (1992), and others have shown otherwise in various jurisdictions. The possible economic channels through which an increase in the minimum wage might yield results contrary to the traditional economic analysis of minimum wage theory and unemployment effects are as follows:

2.5.1 Higher Price

Increasing the minimum wage tends to raise production costs through labour expenses. If a firm does not produce goods with perfectly elastic demand, economic theory predicts that it will pass on some of these costs to consumers through higher prices. Aaronson (2001) discovered that a 10 percent increase in the minimum wage is associated with a 0.7 percent increase in prices of food away from home (FAFH) in the USA. MacDonald and Nilsson (2016) found a small effect of a 0.036 percent increase in prices of FAFH for every 10 percent increase in the minimum wage. The rise in prices for goods and services due to a minimum wage increase may be sufficient to offset the higher labour costs, resulting in no adverse effect on employment. Comparing this result to other industries where the price elasticity demand is higher, producers in higher price elasticity industries are presumably able to pass along more of the cost of the minimum wage increase to consumers.

2.5.2 Profit Reduction

In dealing with the higher wage costs resulting from an increase in the minimum wage, firms may reduce their profit margin without necessarily reducing their workforce, especially in a situation where labour is protected through a union, according to McNicholas et al. (2021). The firm's absorption of minimum wage costs may result in no employment effect in the labour market. Draca et al. (2011) found evidence of a significant reduction in firm profitability in the UK after an increase in the minimum wage but no effect on employment or productivity.

2.5.3 Increase in Demand

Increasing the minimum wage will lead to a rise in income for minimum wage earners. Aaronson et al. (2012) found that a one-dollar increase in the minimum wage increased household income by $250 per quarter in the US. The low–wage earners will spend more as the minimum wage increases, as supported by Jung et al. (2021), using Canadian data. The surge in demand can stimulate business growth through higher consumption, potentially leading to more job opportunities. This effect may offset any negative impact on employment resulting from the minimum wage increase.

2.5.4 Labour Efficiency

An increase in the minimum wage may be associated with improved labour efficiency. According to the efficiency wage theory, employees' higher minimum wage may motivate them to work harder independently of employers' actions to increase productivity. A higher wage increases the cost of employees losing their jobs. Ku (2022) found that a 6% increase in Florida’s minimum wage improved the labour productivity of the piece rate workers.

2.5.5 The Nature of the Labour Demand Curve

The elasticity of the labour-demand curve can affect the employment impact of an increase in the minimum wage on unemployment. A firm with a relatively elastic demand curve will have a more significant employment effect than a firm with a relatively inelastic demand curve.

2.5.6 Reduction in Non–Wage Benefit

Employers may decide to absorb the costs associated with the minimum wage increase by reducing non-wage benefits to employees, such as health care and retirement contributions. Reducing fringe benefits may offset the minimum wage increase cost, leading to no employment effect. This is supported by Clemens et al.'s (2018) empirical work in the US, where an increase in the minimum wage led to a decline in employer-sponsored healthcare insurance.

CHAPTER 3: THEORETICAL OVERVIEW

3.1 Theory of Minimum Wage

A competitive firm that uses two inputs (capital and labour) to produce its output maximizes its profit by setting the marginal revenue product of inputs (capital and labour) equal to the input prices (capital rental rate and wage rate, respectively). This can be seen from the firm's profit maximization problem and is defined as,

$$\pi = Pf(K, L) - (rK + wL)$$

where π is the profit for the firm, P is the market price of outputs, at which the firm takes for its product, K and L are capital and labour inputs and $r\ and\ w$ are the unit cost of capital and labour respectively.

The first-order necessary condition for the variable of interest, which is labour L, is expressed as $P\frac{\partial f(K,L)}{\partial L} - w = 0$. By letting $\partial f(K, L)/\partial L = f_L$, the first-order condition can be written as $Pf_L = w$. From this equation, Pf_L is defined as the marginal revenue product for labour (MRP), and w is the wage rate. A competitive firm determines its labour demand from this equation. It tells that a firm should employ labour when its marginal revenue product (MRP) equals the wage rate w. Also, since the marginal revenue product of labour (MRP) is the product of the marginal productivity of labour (f_L) and the market output price of the product indicates that the equilibrium wage rate (w) can be increased due to a rise in the workers' marginal productivity of labour or increase in the market price of the product or both.

In the market, the marginal revenue product (MRP) for labour equals the demand curve for labour. The outcome of a firm's profit maximization problem is that the first-order conditions give the firm demand functions of labour and capital. If all firms pursue profit-maximizing objectives, their demand functions for labour can be aggregated to derive the market demand function of labour. This is also known as the marginal revenue product curve, as shown in Figure 3.1

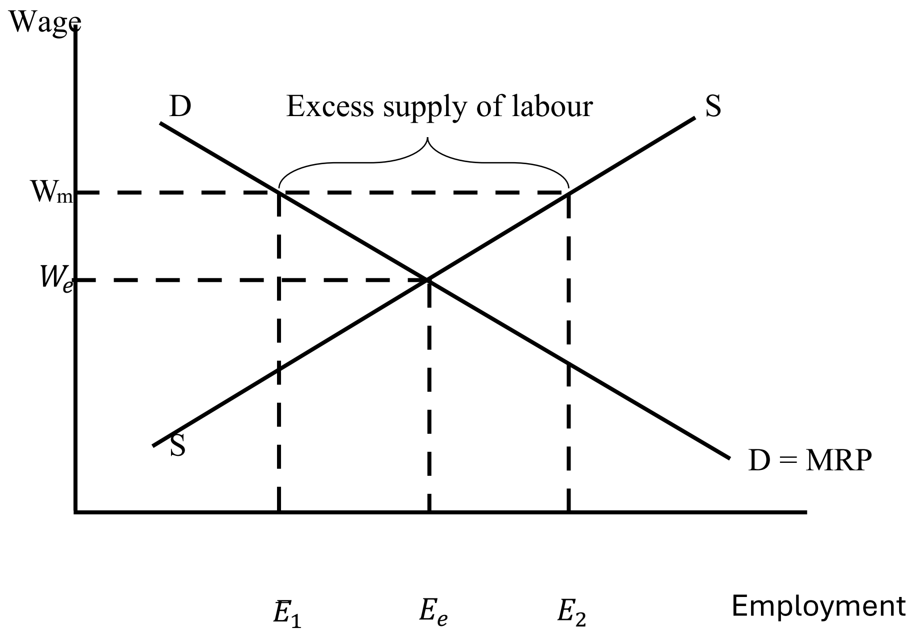

Figure 2.1: Competitive Market Model Diagram

When a minimum wage is implemented, it affects primarily the teen categories of workers because they mostly lack experience on the job. Firms anticipate that their employees must generate a higher marginal product to justify the increased wage expenses. As a result, employees whose marginal productivity times the product price falls below the newly increased minimum wage may risk losing their jobs. To adapt to the increased minimum wage, firms may adjust, such as cutting back on less productive workers, automating tasks, or streamlining operations to ensure they remain economically viable. In this process, workers with lower marginal productivity, who cannot contribute enough to justify their higher wages, may find themselves without employment opportunities.

3.1.1 Minimum Wage and The Competitive Market

Neoclassical economic theory predicts that the introduction of a minimum wage in a competitive labour market has a negative employment effect if the minimum wage exceeds the equilibrium wage. The introduced minimum wage results in unemployment because the higher wage makes labour costs more expensive, leading to an increased cost of production. Firms may respond by reducing their demand for labour and substituting it with relatively cheaper capital inputs. Additionally, individuals in the labour force who were previously voluntarily unemployed may re-enter the labour market in search of jobs due to the higher minimum wage. These factors combine to create an oversupply of labour in the competitive labour market, exceeding the demand from firms and ultimately causing unemployment.

The competitive model diagram is presented in Figure 3.1 above.

From the diagram, the market determining wage at the equilibrium is at $W_{e,}$ with its associated equilibrium employment at E_e when the government introduces a minimum wage higher than the equilibrium market wage at W_e it causes an excess labour supply (unemployment) by increasing labour supply from E_e to E_2. The firm reduces its labour demand from E_e to E_1 causing an unemployment level of the difference between labour supply and labour demand. That is the difference between the labour demand and labour supply curve.

CHAPTER 4: EMPIRICAL/ECONOMETRIC MODELS

4.1 Introduction

This section presents various econometric models/methods for examining the effect of the minimum wage increase on employment levels in Canada. It intends to critically assess their methodology and identify the most appropriate econometric methods for this study. For ease of presentation, the models are presented in four broad streams or categories: difference-in-difference method, at-risk method, synthetic control method, and Neumark's (2001) pre-specified design model.

4.2 Difference-in-Difference Method

One noteworthy and traditional approach, as demonstrated by Card and Krueger (2000), involves using a difference-in-difference methodology in their famous and influential studies on minimum wage and unemployment in the USA.

Difference-in-difference analysis is particularly effective when studying the effects of a government policy change. This method compares two groups: a control group unaffected by the policy change, that is, the minimum wage increase, and an experimental group subject to change. In Card and Krueger's (2000) research, Pennsylvania was chosen as the control group, while New Jersey served as the experimental group. Their study comprises two sets of data: one recorded before the 1992 minimum wage increase in New Jersey from \$4.25 to \$5.05, and another after the policy change through interviewing 410 fast–food restaurants in New Jersey and eastern Pennsylvania.

The model representation in economic literature for the difference-in-difference analysis is outlined as:

$$Y = B_0 + \delta_0 d_2 + B_1 d_T + \delta_1 d_2 d_T + \varepsilon_t \quad (4.0)$$

In model (4.0) above, Y is the outcome of interest in the case, the employment rate. d_2 is the group indicator variables and d_T is the time indicator variables. B_0 is the intercept before the minimum wage policy change for the control group and after the policy change is $(B_0 + \delta_0)$. Therefore, the difference is (After – Before) is δ_0. For the treatment group, which is New Jersey, the intercept before and after the minimum wage policy change are $(B_0 + B_1)$ and $(B_0 + \delta_0)$ + $(B_1 + \delta_1)$ respectively. Therefore, the difference for New Jersey is $(\delta_0 + \delta_1)$. ε_t is the error term associated with the model. Regarding the difference between the New Jersey and Pennsylvania groups, the intercept before and after the minimum wage is $B_1,$ and $(B_1 + \delta_1)$ respectively. The difference is δ_1. Therefore, the coefficient δ_1 measures the effect of the minimum wage increase. After interviewing 410 fast–food restaurants in New Jersey and eastern Pennsylvania, they found that the minimum wage increase led to higher pay and ultimately higher income for the workers, with no evidence of teenagers losing their jobs. The difference-in-difference methodology is a best-fit model for policy research, such as an increase in the minimum wage effect on employment in Canada. However, a significant challenge in applying this method to the Canadian context is finding an appropriate control group. This difficulty arises because the study encompasses all provinces in Canada, making it impossible to find other provinces that could serve as a control group.

4.3 At-risk Method

The at-risk methodology is another commonly used methodology impacting employment in the minimum wage field. Campolieti et al. (2006) and Currie and Fallick (1993) employed this approach to compare how the likelihood of individuals being affected by changes in the minimum wage differed from comparison groups that were not affected by this policy, all within the context of Canada. The underlying principle of this model assumes that if the minimum wage and unemployment rates are positively correlated, as suggested by the classic economic model, an increase in the minimum wage would heighten the chances of an individual transitioning from employment to non-employment. Their empirical method estimates the probability of an individual being employed at a period t given that they were unemployed at a previous time–lag period, that is, $t-1$. The specification of the model is provided by,

$$\Pr(E_{it}^{j} = 1 \mid E_{it-1}^{j} = 1) = f\left(\alpha MINWAGE_{it}^{j} + X_{it-1}\beta + \mathrm{T}_t\delta + R_i\,\varphi + \varepsilon_{it}\right) \tag{4.1}$$

Where $E_{it}^{j} = 1$ is when an individual i from province j is employed at period t.

X_{it-1} is a vector of control variables for individual i at time $t-1$.

T_t is a set of time dummies, R_i is a set of region dummies and ε_{it} is the error term associated with the model. The α parameter in the MINWAGE variable is explained as follows: if α is negative, it suggests that an increase in the minimum wage is associated with a decrease in the conditional probability of employment for individuals transitioning from employment to non-employment. This is often referred to as the disemployment effect. Campolieti et al. (2006) suggest that raising the minimum wage led to a slight increase in employed low-wage youths transitioning from employment to non-employment. This increase amounts to roughly 6 percentage points, spanning from 4 to 8 percentage points. Consequently, these adverse employment consequences imply that the employment elasticity concerning the minimum wage stands at approximately 0.4, ranging between 0.3 and 0.5.

However, the at-risk methodology has some limitations, as Campolieti et al. (2006) pointed out. It primarily assesses the impact of minimum wage increases on the transition from employment to non-employment. Still, it does not capture the effect on the transition from non-employment to employment. Currie and Fallik (1996) argue that one needs to consider both transitions to understand the minimum wage's impact on overall employment. Unfortunately, the at-risk methodology cannot address this aspect due to the lack of wage information for individuals not employed and who cannot be classified as part of the "at-risk" group.

4.4 Synthetic Control Method

The Synthetic Control Method (SCM) shares similarities with difference-in-difference techniques used in research methodology. SCM becomes appropriate for finding a perfect control group, which is challenging when government interventions like minimum wage increases are introduced. Researchers like Neumark and Wascher (2004), Reich et al. (2017), and Powell (2022) have applied this method in the context of the United States on this topic.

In the Canadian context, Fossati and Marchand (2023) have also employed SCM in their ongoing research. In their work, they selected the province of Saskatchewan as the control group since it is the only province yet to reach the $15 minimum wage. They also argue that Saskatchewan exhibits characteristics similar to Alberta's regarding general labour market trends. These similarities include the labour demand of both provinces, which was influenced by energy prices and dependence on agriculture. Additionally, Alberta and Saskatchewan share other resemblances, such as being the two youngest provinces in Canada and having similar median ages of 38.1 for

Alberta and 37.9 for Saskatchewan compared to the Canadian median age of 41.1 for all populations.

According to Abadie et al. (2010), SCM slightly outperforms similar methodologies when analyzing the effect of introducing government policy.

This study examines the impact of minimum wage on employment in all Canadian provinces.

This method is unsuitable for this study since all provinces are considered. It is difficult to get a country to serve as the control variable for the Canadian economy and labour market structure. However, it may be appropriate to explore the use of SCM for provincial comparisons within Canada. By identifying provinces with similar economic and labour market characteristics, the synthetic control method could effectively apply within the Canadian context.

4.5 Pre-Specified Research Method

The data limitations and unique features of Canada's minimum wage policies challenge the abovementioned traditional methods. Annual increases in minimum wages across most provinces make it hard to find a proper control group when using the difference-in-difference approach. The at-risk method also has issues as it cannot capture the impact on people moving from not working to working due to a lack of wage information for those not employed as stipulated by Campolieti et al. (2006). This may not fully capture the overall effects of minimum wage changes on different aspects of the job market.

Synthetic control methods face challenges in finding a suitable country to compare with Canada. Canada's unique economic, social, and political setting makes it difficult to identify a good match country to serve as a control variable.

Neumark (2001) developed a pre-specified research design for analyzing minimum wage and employment effects on U.S. data. Researchers like Campolieti et al. (2006), Myatt and McDonald (2010), and Fortin (2010) have subsequently applied this model to analyze the effect of minimum wage on unemployment in Canada. Neumark's (2001) pre-specified research design involves committing to a detailed set of statistical analyses before examining the data. This approach helps to avoid biased specifications. Neumark's (2001) pre-specified design model is as follows:

$$E_{it} = B_0 + B_1 MW_{it} + B_2 MW_{it-1} + B_3 X_{it} + B_4 Province_i + B_5 Year_t + \varepsilon_{it} \quad (4.2)$$

Here, E_{it} represents the dependent variable, defined as the employment-population ratio of a specific age group, such as teens in province i at year t. The primary independent variables consist of the minimum wage (MW_{it}) and its one–year lag (MW_{it-1}). The minimum wage variable is defined as the ratio of the real minimum wage to the real average wage of a worker in the industrial aggregate, excluding unclassified businesses. The model includes the lagged minimum wage variable because some studies (Baker et al. (1999), Neumark and Wascher (1992), and Myatt and McDonald (2010)) found that it takes a year to capture the full effect of a minimum wage increase on employment. X_{it} is a vector comprised of three control variables that independently affect the dependent variable, aside from the primary variable of interest (i.e. the minimum wage). These control variables are the prime-age male unemployment rate, real per capita income and ratio of population share for each age group. Neumark's (2001) pre-specified model included two control variables: population share and prime-age male unemployment rate. Subsequent researchers, such as Campolieti et al. (2006), Myatt and McDonald (2010), and Fortin (2010), expanded on this by including GDP value. This research follows Campolieti et al. (2006) specification of using three control variables but replacing the nominal GDP with real per capita income.

The prime-age (25 - 54) male unemployment rate and per capita income both control for the province's aggregate economic activity. Additionally, the inclusion of the share of the specific age group under study relative to the working age population (15 - 65) is used to control supply variations from the age group under study. $Province_i$ represents the unobserved heterogeneity arising from the labour supply group under study across the ten provinces of Canada, and it is set to provincial dummy. $Year_t$ is a set of year dummy variables for all ten provinces.

Model 4.3 is the non-ratio version of the independent variables of model 4.2, but it uses the same notation as model 4.2.

Model 4.3 aims to determine whether these transformations of the independent variables better fit the data, offering new insights into the relationships between the dependent and explanatory variables. The new model specification is given by:

$$E_{it} = A_0 + A_1 MW_{it} + A_2 MW_{it-1} + A_3 X_{it} + A_4 Province_i + A_5 Year_t + \varepsilon_{it} \quad (4.3)$$

This study adopts Neumark's (2001) pre-specified design model because it overcomes the limitations that would have been encountered when using the other methods discussed above. Also, Campolieti et al. (2006) argue that this model minimizes cognitive biases and avoids data-driven model specification associated with the Canadian labour market.

4.6 Data

The research examining the effect of minimum wage increases on employment in Canada utilizes data from Statistics Canada's Labour Force Survey (LFS), available through the public use microdata files (PUMF). The LFS provides employment statistics and various labour market indicators, including labour participation rate, industrial occupation, hours worked, wage rate, union status, job permanency, and establishment size. Information on Canada's general hourly wage rate from 1983 to 2022 is gathered. Across all provinces in Canada, there have been a total of 306 minimum wage changes during the specified period. Prince Edward Island and Quebec have experienced the highest number of changes, with 33 changes each. In contrast, Alberta has seen the fewest changes, with only 18 adjustments to the minimum wage. On average, there are 30.6 changes for each province during this period.

It is important to note that in some years, provinces experienced more than one change in the minimum wage, and in such cases, the minimum wage at the year-end is used for the estimation. The minimum wage data is adjusted to real terms by deflating each provincial minimum wage using the annual Consumer Price Index (CPI) specific to each province. The CPI data is obtained from Statistics Canada's consumer price index, annual average, not seasonally adjusted datafile with Table 18-10-0005-01 (formerly CANSIM 326-0021). The CPI data has an initial base year of 2002, and it is converted to 1983.

The minimum wage ratio is defined as the minimum wage divided by the average hourly minimum wage of industrial aggregate workers. [2] Annual average hourly minimum wage data for the aggregate sector from 1983 to 2000 were sourced from Statistics Canada's annual average hours earnings and average weekly hours paid by the hour (SEPH) with Table 14-10-0189-01 (formerly CANSIM 281-0004). The remaining annual data from 2001 to 2022 is obtained from the annual average hourly earnings for employees paid by industry with Table 14-10-0206-01 (formerly CANSIM 281-0030). Overtime earnings are included in all values.

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[2] According to Statistics Canada Table 14-10-0189-01, average hourly earnings data from the Survey of Employment Payroll and Hours (SEPH) were collected using the Standard Industrial Classification (SIC) 1980 prior to 2001. However, in January 2001, the SEPH program switched from the SIC 1980 to the North American Industry Classification System (NAICS) 1997, and data were historically revised back to 1991. Due to this revision, data prior to 1991 is only available using the old SIC 1980 classification system.

For the control variable, data on labour force characteristics, such as prime-age male unemployment and overall employment rates for specified age groups and their respective total population, are obtained from Statistics Canada's annual labour force characteristics by sex and detailed age group with Table 14-10-0327-01. Population values are reported in thousands.

This study data ranges from 1983 to 2022 because data such as the GDP and average hourly wage from Statistics Canada for all provinces have 1983 as their start date.

Table 4.1 Summarizes the variables used in the study, including their descriptions and data sources.

Table 4.1: Data Source and Description

Variable	Description	Source	Table number	File name
Minimum wage	The minimum wage value are adjusted to the real minimum wage using 1983 dollar as the base year.	Government of Canada	Not applicable	General hourly minimum wage rate in Canada since 1965.
CPI	The provincial CPI values for all items are used, original based year of 2002 dollar value used by Statistics Canada are transformed to base year of 1983 dollar value	Statistics Canada	18 – 10 – 0005 - 01	Consumer price index, annual average, not seasonally adjusted.
GDP	Provincial GDP at expenditure based is used for this study. The values are reported in millions of chained 2017 dollars. These values are transformed to per – capita income using 1983 dollars as the based year.	Statistics Canada	36 – 10 - 0222 - 01	Annual gross domestic product, expenditure – based, provincial and territorial.
Employment	Provincial annual employment values for both males and females are used for three age -groups (15 – 19, 20 – 24, and 15 – 24). The values are reported in thousands	Statistics Canada	14 – 10 – 0327 -01	Annual labour force characteristics (LFC) by sex and detailed age groups.
Population	Provincial population values for both male and females are used for the specified age – groups. The values are reported in thousands	Statistics Canada	14 – 10 – 0327 -01	Annual labour force characteristics (LFC) by sex and detailed age groups

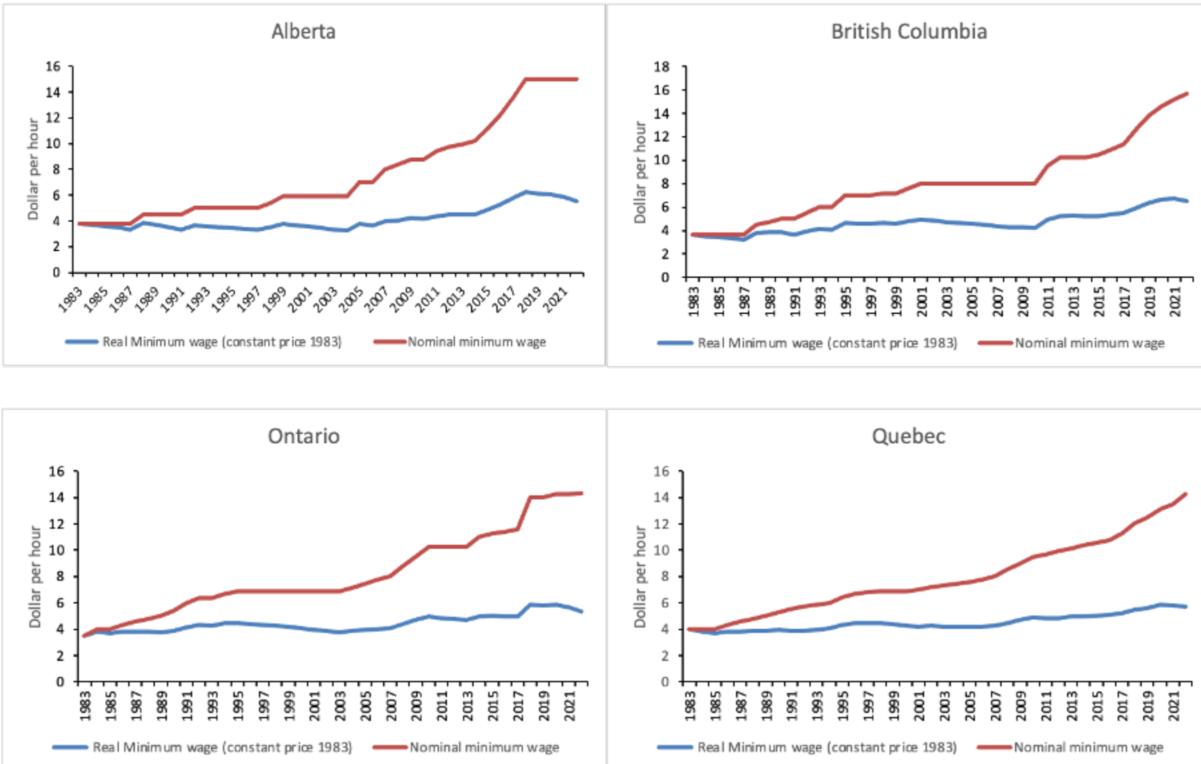

Figure 3.1: Gaps Between Nominal and Real Minimum Wages

Note: Data on the minimum wage are sourced from the Government of Canada website from 1983 to 2022. The nominal minimum wage data are converted into real terms in constant 1983 dollars using the CPI for each province.

For illustration purposes, Figure 4.1 shows the gaps between the nominal and real minimum wages for the four largest provinces in Canada. The trend lines for nominal and real minimum wages reveal that the increase in real minimum wages did not keep pace with the increase in nominal wages for all four provinces. Moreover, in recent years, the gaps between the two wages have widened compared to earlier years. Ontario has the widest divergence between nominal and real wages, with Quebec having the least among the four provinces. This suggests that minimum wage earners in Ontario are relatively worse off in purchasing power than those in other provinces.

Table 4.2: Percentage change in the real and nominal minimum wage (1983 -2022)

Province	Real minimum wage	Nominal minimum wage	Difference
Alberta	44.74	294.74	250
British Columbia	78.08	328.77	250.69
Ontario	51.71	310	258.29
Quebec	43.25	256.25	213

The calculated percentage change values in Table 4.2 indicate that the nominal minimum wage change for all the selected provinces is larger than its real value. The difference shows that Ontario has the highest difference between the nominal and real minimum wage percentage change, confirming that minimum wage earners in Ontario are relatively worse off within this dataset period than other provinces.

4.7 Explanatory Variables and Their Expected Signs

This study utilized Neumark's (2001) pre-specified design model, which has been used by other researchers, such as Campolieti et al. (2006), Fortin (2010), and Myatt and McDonald (2010) to analyze the effect of minimum wage on employment in Canada. The economic explanation and the expected estimation signs for the dependent and independent variables are as follows.

Employment

The number of employees for a specific age group, such as teens (15-19), has been the dependent variable in Canada's employment and minimum wage studies. Prior researchers, such as Campolieti et al. (2006), modified the dependent variable to the employment-population ratio. This study follows this approach for estimating age groups, namely (15-19, 20-24, and 15-24).

The rationale for selecting these age groups stems from conventional economic theory, suggesting that an increase in the minimum wage hurts the employment rate, primarily affecting teenagers (15-19) and those with little experience in the job market, such as the age groups for 20-24 and 15-24. According to the 2017 Labour Force Survey in Canada, 58% of individuals under the age of 25 earn minimum wage, while the corresponding figures are 30% for those aged between 25 and 54 and 25% for individuals aged 55 and above. Dionne and Miller (2019) indicate that the 15 - 24 age group has always constituted the highest percentage of minimum wage workers in Canada, with a total of 60.7%, 63.6% and 52.3% for the years 1998, 2008 and 2018, respectively.

Minimum wage

The minimum wage is the legal minimum amount employers must pay to their employees in sectors covered by minimum wage laws. The real minimum wage ratio is this study's primary variable of interest. The minimum wage ratio used in this study aligns with previous research such as Neumark (2001), Campolieti et al. (2006), and Fortin (2010).

The ratio of the real minimum wage to the average hourly wage in the industrial aggregate sector shows how substantial the minimum wage is compared to the typical earnings in the industrial sector. A higher ratio implies that the sector's wage is influenced by minimum-wage workers, indicating that a more significant proportion of employees in the industrial sector earn the minimum wage. A smaller ratio suggests that a smaller portion of employees in the industrial sector earn the minimum wage.

Control Variables

Control variables are critical economic factors that affect the dependent variable, that is, the employment rate, apart from the main variable of interest. This study uses three main control variables: population share, prime-age male unemployment rate and GDP. These control variables have been used by earlier researchers such as Campolieti et al. (2006), Myatt and McDonald (2010), and Fortin (2010). However, this study modifies the GDP value into real per capita income. Prime age male unemployment rate and per capita income account for the province's aggregate economic activity. Economic theory suggests that provinces facing high unemployment rates among male prime-age individuals (25 -54) are expected to demonstrate lower employment rates for other age groups being considered for this study. Population shares for each age group are considered to account for the provincial labour supply.

4.8 Conversion of Nominal Values to Their Real Values

This study converts all nominal variables to their real values, such as minimum wage and GDP. Statistics Canada reports the Consumer Price Index (CPI) values in the 2002 base year. For easy reference points of comparison, this study converts the base year from 2002 to 1983 because 1983 is the starting year for all datasets.

Table 4.3 shows the conversion of nominal minimum wage values to their real values with a 1983 base year for selected years and the conversion of CPI values from the base year 2002 to 1983.

Table 4.3: Example of Conversion Value

Province	Year	Minimum wage	Real minimum wage (1983 base year)	CPI (2002 base year)	CPI (1983 base year)
Alberta	1983	3.8	3.8	58.3	100
Alberta	1992	5	3.62	80.6	46.98
Alberta	2002	5.9	3.44	100	58.3
Alberta	2012	9.75	4.47	127.1	74.1
Alberta	2022	15	5.5	158.9	92.64

The mathematical conversion process for values in Table 4.3 is detailed below:

4.8.1 Converting the 1992 nominal minimum wage value to its real value

$$Real\ minimum\ wage = \frac{norminal\ minimum\ wage}{CPI_{current\ year}} \times CPI_{base\ year}$$

$$Real\ minimum\ wage_{1992} = \frac{5}{80.6} \times 58.3$$

$$Real\ minimum\ wage_{1992} = 3.62$$

4.8.2 Converting CPI values from 2002 to 1983 base year

$$CPI = \frac{CPI_{current\ year}}{CPI_{2002}} \times CPI_{base\ year}$$

$$CPI_{1992} = \frac{80.6}{100} \times 58.3$$

$$CPI_{1992} = 46.98$$

4.9 Estimation strategy

Panel data across the ten provinces in Canada containing provincial unobserved heterogeneity can be modelled as

$$Y_{it} = \mathrm{A}_i + Bx_{it} + c_i + \Phi Year_t + \Upsilon Province_i + u_{it}, \quad t = 1, 2, \dots T; \quad i = 1, 2, \dots N \qquad (4.4)$$

Where x_{it} consists of explanatory variables used in this study, such as minimum wage, prime-age male unemployment rate, real per capita income, and the ratio of population age group. c_i is province-specific unobserved characteristics that affect each province's employment rate and explanatory variables. Province–specific unobserved characteristics include provincial cultures, such as language, policies of the provincial governor, provincial climate conditions and many others, which can affect either dependent or any of the explanatory variables. y_{it} is the dependent variable, the employment-population ratio for a specific age group. u_{it} is the idiosyncratic error because these errors change across time and in each province.

4.9.1 Fixed Effect and Random Effect Model

This study utilizes a panel dataset from 10 Canadian provinces. Provinces in Canada have distinct characteristics, policies and cultural practices. For instance, Alberta's economy heavily relies on energy sectors like oil and gas. In contrast, Ontario's economy depends more on service-producing industries. According to the Government of Canada, real estate, rental, and leasing are the largest contributing sectors to British Columbia’s economy. Also, provinces like Quebec have unique cultural practices, with French being the official language that differs from the remaining provinces. These province-specific characteristics, such as cultural practices, economic structure, and policy differences, tend to be fixed over time for each province and may influence how changes in the minimum wage impact employment levels and the explanatory variables used for this study. Analyzing the effect of an increase in the minimum wage changes on employment levels using a panel dataset, it's necessary to control for these fixed effects to obtain unbiased estimates, as they influence both the outcome variable (employment level) and the independent variables such as per capita income, minimum wage and prime-age unemployment rate.

Estimating model 4.4 using fixed effects assumes a correlation between the unique province-observed characteristics and explanatory variables, that is, $E(x_{it}, c_i) \neq 0$. The fixed effects model captures all unobserved characteristics in the intercept terms specific to each province in model 4.4, resulting in unbiased estimated coefficients.

In contrast, the random effects model estimates model (4.4) by incorporating the unobserved characteristics c_i into the model error term u_{it} and assumes no correlation between the province-specific characteristics and the explanatory variables, implying $E(x_{it}, c_i) = 0$. Using random effects to analyze provincial panel data in Canada will likely result in biased estimates. Province-specific unobserved characteristics will likely be correlated with both the outcome and explanatory variables. To determine the appropriate estimation between the fixed effect and random effect model, the Hausman test is used.

4.9.2 Hausman Test

Hausman (1978) introduced a test that hinges on comparing the estimates derived from fixed effect (FE) and random effect (RE) models when analyzing panel data. The primary distinction between RE and FE lies in whether province–specific unobserved characteristics are correlated with the explanatory variable. RE estimation remains appropriate when there is no correlation between explanatory variables and the province-specific unobserved factors. In contrast, FE estimation becomes applicable when a correlation exists between the province-specific unobserved characteristics and explanatory variables. The Hausman test follows a chi-square distribution. The hypotheses for the Hausman test are:

$H_0: Random\ effect\ model\ is\ appropriate$

$H_1: Fixed\ effect\ model\ is\ appropriate$

CHAPTER 5: EMPIRICAL RESULTS AND INTERPRETATION

5.1 Descriptive Statistics

This study analyzes the effect of increases in the minimum wage on employment for age groups: 15-19, 20-24, and 15-24 in Canada.

A panel dataset covering ten provinces from 1983 to 2022 is utilized, resulting in 400 observations. Table 5.1 presents descriptive statistics of the dependent (shown in bold) and independent variables used in the regression models.

Among the three age groups analyzed, teenagers have the lowest employment numbers, with a mean employment value of 88,700 across ten provinces. Correspondingly, they also have the lowest average population of 204,000, resulting in the lowest employment-to-population ratio of 0.43. In contrast, the young adult age group (20 – 24) has the highest employment-to-population ratio, with a value of 0.69, indicating that a higher proportion of this age group is employed than their teenage counterparts. When the two age - groups are combined to form the youth (15 – 24), the overall employment-to-population ratio is 0.57, between the individual ratios of the separate age groups.

On average, the minimum wage across the provinces is observed to be lower than the average wage, with mean values of $4.26 and $9.64, respectively, at the 1983-dollar constant price. A minimum wage ratio of 0.44 indicates that the minimum wage constitutes 44% of the average wage across provinces.

The average value of the prime age (25 – 54) unemployment rate across provinces is 8.46%. This suggests that males in their prime working age experienced higher unemployment rates than the general workforce for this dataset.

The average per capita income across provinces is $27,888, at 1983-dollar constant price. However, there is a significant disparity between the population's highest and lowest per capita incomes. The dataset's maximum and minimum per capita income are $52,019 and $17,707 respectively, indicating considerable income inequality across the provinces within this dataset.

Table 5.1: Descriptive Statistics of Non-Logarithmic Variables

Variable	Mean	Median	S.D.	Min	Max
Minimum wage (1983 $ / hr)	4.26	4.12	0.71	3.32	6.75
Average wage (1983 $ / hr)	9.64	9.57	1.19	5.52	12.60
Minimum wage ratio	0.44	0.43	0.06	0.29	0.62
Per capita income (1983 $ / yr)	27888.00	26197.00	6281.00	17707.00	52019.00
Prime-age (25 - 54) male unemployment rate (%)	8.46	8.00	3.52	2.50	18.90
Teens, Aged (15 - 19)					
Employment	88.70	36.20	103.00	3.70	413.00
Population in '000	204.00	74.80	238.00	8.80	884.00
Employment popuation ratio	0.43	0.45	0.08	0.16	0.59
Population share	0.10	0.10	0.02	0.08	0.17
Youth Adults, Aged (20 - 24)					
Employment	153.00	55.10	180.00	5.70	684.00
Population in '000	221.00	75.60	261.00	8.90	1030.00
Employment population ratio	0.69	0.69	0.07	0.44	0.80
Population share	0.11	0.10	0.02	0.08	0.17
Youth, Aged (15 - 24)					
Employment	241.00	91.90	282.00	9.90	1060.00
Population in '000	424.00	150.00	499.00	17.70	1870.00
Employment population ratio	0.57	0.57	0.07	0.31	0.69
Population share	0.21	0.20	0.03	0.16	0.31

Note: The data for all variables are sourced from Statistics Canada, except the minimum wage data, which are sourced from the Government of Canada website. Dependent variables are shown in bold.

Table 5.2 presents the minimum wage-employment elasticities from 12 regression models and the model diagnostic statistics.

The dependent variables in these models are the employment-population ratios of specific age groups. To save space, the table shows only the elasticities of the main predictor variable, the minimum wage (the full regression outputs are shown in the Appendix).

Using the regressor coefficients of the top six models, elasticities are calculated at the mean values of the variables. For example, under model 4.3 (non-ratio format), the age-group (15 – 19) elasticity estimate at a mean value in Table 5 is calculated as follows:

$$elasticity = B_1 \times \frac{mean\ value\ of\ the\ independent\ variable}{mean\ value\ of\ the\ dependent\ variable}$$

From model 1 in the Appendix, $B_1 = 0.00509451$,

From Table 5.1, the mean value of the dependent variable (employment-population ratio) = 0.43, and the mean value of the independent variable (minimum wage) = 4.26

$$elasticity = 0.00509451 \times \frac{4.26}{0.43}$$

Therefore, the elasticity estimates for the age – group (15 – 19) under model 4.3 is 0.05

The bottom six models are estimated in log-log format to compare the calculated elasticities in the top six models with directly obtained elasticity coefficients in the bottom six models.

Columns 2 to 4 of Table 5.2 show the model in non-ratio form, while columns 5 to 7 show the model's result in ratio form.

Table 4.2: Minimum Wage - Employment Elasticities from Fixed Effect Models

	Model 4.3			Model 4.2		
	Teens (15 - 19)	Young Adults (20 - 24)	Youth (15 - 24)	Teens (15 - 19)	Young Adult (20 - 24)	Youth (15 - 24)
Minimum wage	0.05	0.03	0.04	–	–	–
Lag minimum wage	- 0.08	- 0.01	- 0.04	–	–	–
Sum of current and lag Min. Wage	-0.03	0.02	0.00	–	–	–
Minimum wage ratio	–	–	–	- 0.01	-0.01	-0.02
Lag minimum wage ratio	–	–	–	- 0.11	- 0.05	- 0.06
Sum of current and lag Min. Wage ratio	–	–	–	-0.12	-0.06	-0.08
Model diagnostics						
H_0: provinces have a common intercept						
F - statistics	17.67***	27.83***	22.7***	25.49***	25.11***	25.48***
H_0: No time effects						
Chi - square	218.67***	126.21***	168.10***	193.47***	141.04***	218.53***
Hausman test:						
H_0: GLS estimated are contsistent						
Chi - square	978.23***	513.75***	863.69***	47.19***	22.72***	34.46***
Within R - square	0.74	72	76	0.71	0.72	0.77
Logarithmic specification:						
ln(minimum wage)	0.12	0.04	0.05	–	–	–
ln(lag minimum wage)	- 0.02	0.03	0.03	–	–	–
Sum of (ln current and ln lag Min.Wage)	0.1	0.07	0.08	–	–	–
ln(minimum wage ratio)	–	–	–	0.04	0.01	- 0.01
ln(lag minimum wage ratio)	–	–	–	- 0.14	0.0009	- 0.05
Sum of ln current and ln lag Min.Wage ratios	–	–	–	- 0.10	0.011	- 0.06
Model diagnostics						
H_0: provinces have a common intercepts						
F - statistics	17.22***	24.97***	26.67***	26.80***	19.41***	18.80***
H_0: No time effects						
Chi - square	290.00***	107.29***	165.93***	208.56***	117.71***	254.24***
Hausman test:						
H_0: GLS estimates are consistent						
Chi - square	210.18***	119.14***	213.29***	91.61***	25.21***	49.07***
Within R - square	0.83	0.76	0.85	0.77	0.74	0.8
Number of observation	390	390	390	390	390	390

Note: Mode 4.2 (columns 5-7) is Neumark's (2001) pre-specified design, where all explanatory variables are in ratio format. Model 4.3 (columns 2-4) is a slightly modified version with all explanatory variables in linear levels. The dependent variable for all models is expressed as employment to population ratio for specific age groups. Each model includes the province and year dummies, average hourly wage, per capita income, prime-age (25-54), male unemployment rate, and the population age group as control variables. *, **, *** denote statistical significance at 10%, 5%, and 1% level respectively. All elasticities are calculated at the mean values of the variables.

5.2 Model Diagnostic Results

This study examines three diagnostic tests across 12 regression models: the test for differing province intercepts, the Wald joint test on time dummies, and the Hausman test. Each test addresses different aspects of model specification in analyzing the effect of an increase in the minimum wage on the employment rate using panel data across ten provinces in Canada.

5.2.1 Test for Differing Group Intercepts

Test for differing province intercepts assesses the null hypothesis that provinces share a common intercept against the alternative hypothesis that intercepts vary by province. The test follows F–statistics. The hypothesis for the test statistic is given as:

$H_0: The\ provinces\ have\ a\ common\ intercept$

$H_1: The\ provinces\ do\ not\ have\ a\ common\ intercept$

Reported test results for the 12 models reject the null hypothesis at the 1% significance level. This rejection indicates that an increase in the minimum wage is not uniform across provinces, suggesting that the impact varies by province.

5.2.2 Wald Joint Test on Time Dummies

Wald's joint test on time dummies examines whether the coefficients of the time dummies are jointly equal to zero, suggesting that there is an insignificant time effect on the employment-population ratio for a given age group. Wald joint test on time dummies follows a chi-square distribution. The hypothesis for the test statistics is presented as follows.

$H_0: there\ is\ no\ time\ effect$

$H_1: there\ is\ time\ effect$

The chi-square test results and reported p-values reject the null hypothesis at the 1% significance level for all 12 models. This indicates that time-varying factors, such as provincial government policies and economic conditions, influence employment rates across provinces.

5.2.3 Hausman Test

The Hausman test determines whether the province-specific unobserved heterogeneity is correlated with other regressors in the model. The test statistics of the Hausman test follow a chi-square distribution. This test helps choose between a fixed and random effects model.

$H_0: Random\ effect\ model\ is\ appropriate$

$H_1: Fixed\ effect\ model\ is\ appropriate$

Reported test–results for the 12 models reject the null hypotheses mostly at a 1% significant level. This rejection implies that the fixed effects model is more appropriate, as it controls for province-specific heterogeneity by allowing the intercept to vary across provinces.

5.3 Results for Neumark's (2001) Pre-Specified Design Model

The upper right - section of Table 5.2 (columns 5-7) presents the estimated results for Neumark's (2001) pre-specified design. Elasticities for the minimum wage ratio, its lagged form, and the sum of the two ratios are reported. All estimates are in elasticities, calculated at the mean values of the variables. All estimated results show a negative relationship with the dependent variable (employment-population ratio). For teens and young adults, the elasticity estimate for the minimum wage ratio is -0.01, indicating that a ten percent increase in the minimum wage ratio leads to a 0.1% reduction in the employment-population ratio for these age groups. Youth exhibit the highest sensitivity to changes in the minimum wage ratio compared to other age groups with an elasticity estimate of -0.02. However, teens exhibit the highest sensitivity to change in the minimum wage in the lag form compared to the other age groups. Lag estimates are more negative than the corresponding minimum wage ratio estimates, which are -0.12 for teens, -0.06 for young adults and -0.08 for youth. However, the elasticity estimates for all the age – groups are statistically insignificant. The estimates result for teenagers and young adults align with Neumark's (2001) empirical studies, which found that an increase in the minimum wage has no statistically significant effect on the minimum wage or its lagged values for the two age - groups. Also, estimates for the three age groups are similar to those of other researchers, like Baker et al. (1999) and Lyons (2021), who found insignificant results across all age groups.

5.4 Results for modified Neumark's pre-specified design model

The upper left section of Table 5.2 (columns 2-4) presents the estimated results for modified Neumark's (2001) pre-specified design, which utilizes linear formats for all explanatory variables. The elasticity of the lag minimum wage estimate is -0.08 for the teenage group. This indicates a 10% increase in the minimum wage leads to a 0.8% decrease in the employment rate for the teenage population. However, the result is statistically insignificant. The lagged minimum wage estimates for three age groups exhibit a negative relationship with their dependent variable. Among age groups for the lag estimates, teenagers show the highest sensitivity to changes in the minimum wage. While the sign values for minimum wage estimates are positive. The minimum ratio and lag estimate for the youth are the same with an estimated value of 0.04 and -0.04 respectively.

5.5 Logarithmic Results for Neumark's (2001) Pre-Specified Design Model

The lower right section of Table 5.2 (columns 5-7) presents the logarithmic estimated results for Neumark's (2001) pre-specified design. Estimates for all age groups for the current and lag of the minimum wage ratio show a mixed relationship with the dependent variable, but these results are statistically insignificant. Teens exhibit the highest sensitivity to change in the minimum wage in the lag form with an estimated value of -0.10. This result is consistent with past empirical studies such as Baker et al. (1999), Myatt and McDonald (2010), and Lyons (2021), where an increase in the minimum wage does not affect logarithmic estimates for the Neumark's pre-specified model. Also, Campolieti et al. (2006) find no statistically significant effect of the minimum wage increase on employment growth using a dataset of 1983 – 2000. Myatt and Danald (2010) conclude that the linear format of the model is preferable to the logarithmic format.

5.6 Logarithmic Results for Modified Neumark's Pre-Specified Design Model

The lower left section of Table 5.2 (columns 2-4) presents the logarithmic estimated results for the modified Neumark (2001) pre-specified design. Estimates for all age groups for the current and lag of the minimum wage ratio show a positive relationship with the dependent variable except the lag estimate for the teens which shows a negative relationship with an estimated value of -0.02. However, these results are statistically insignificant. Comparing the minimum wage estimates for logarithmic and non-logarithmic formats shows that the former shows lower estimates across all age groups.

5.7 Possible Economic Explanation of the Model Results

First, not everyone within the study's age group of 15–24 is minimum wage earner. The percentage of minimum wage earners has significantly decreased over the years. According to Dionne and Miller (2018), this percentage declined from 63.6% in 2008 to 52.3% in 2018. Since nearly half of the 15–24 age group earns more than the minimum wage, this suggests that they have a higher marginal revenue product of labour. Consequently, they are less likely to lose their jobs when the minimum wage increases, leading to no employment effect.

Second, changes in the nominal minimum wage data across each province were relatively small in the early years of the study. Most of the increases were less than a dollar. If an increase in the minimum wage is small or just slightly above the equilibrium wage, as depicted in Figure 3.1, then the disemployment effect associated with the minimum wage increment would be minimal or negligible, resulting in no significant impact. Ontario was the first province to record a minimum wage increase of over two dollars, from $11.60 in 2017 to $14.00 in 2018. However, other provinces like Newfoundland and New Brunswick have only recently recorded similar $2.00 minimum wage increases from 2021 to 2022.

Third, employers might respond to minimum wage changes by adjusting other variables within their control. These adjustments could include reducing non-wage benefits to employees, increasing the prices of the goods and services they produce, reducing their profit margins, or cutting down on employee hours. Such adjustments could lead to no effect on employment when the minimum wage increased.

CHAPTER 6: CONCLUSION, POLICY RECOMMENDATIONS AND LIMITATIONS OF THE STUDY

6.1 Conclusion

This study investigates the effect of increases in the minimum wage on employment in Canada. It considers three age groups: teens (15 – 19), young adults (20 – 24), and youth (15 -24). The study uses a data set with 400 observations from 1983 to 2022. Neumark's (2001) pre-specified model is utilized for this study. Also, this study slightly modifies Neumark’s (2001) model into a linear format for comparison of results. Logarithmic and non-logarithmic specifications are considered for both models. Estimated coefficients are in elasticities calculated at the mean value of the variables. The estimated coefficients for both Neumark’s (2001) pre-specification and the modified specification are statistically insignificant.

6.2 Policy Recommendations

The main finding of this study for policymakers is that increasing the minimum wage has no statistically significant effect on employment within the age group studied. This suggests that policymakers should be cautious about making important changes to the minimum wage based solely on this analysis results. The lack of significant results suggests that further research is needed to understand how an increase in the minimum wage affects variables other than employment. Factors such as prices, fringe benefits, firm profitability, and others should be studied using present data to gain a holistic view of the impact of minimum wage increases on the Canadian economy.

Also, the lack of significant results suggests that Neumark's (2001) pre-specified and modified model may not fully capture the complexities of Canada's labour market. As a result, future research on this topic may consider different models or the addition of relevant variables to the Neumark (2001) model to fully capture the effect of the minimum wage increase on employment in Canada.

6.3 Limitations of the Study

One possible limitation of this study is the presence of heterogeneity across the Canadian provinces when using panel data. This can lead to heteroscedastic errors leading to unreliable standard errors of the regression coefficients. To address the issue of heterogeneity, I use robust standard errors in my estimation. Also, many estimated values are statistically insignificant, suggesting that employers in Canada might respond to an increase in the minimum wage by adjusting other factors like prices, fringe benefits and others. However, investigating the effect of an increase in the minimum wage on these variables is beyond the scope of this empirical study.

The average hourly wage from the manufacturing sector was used in earlier research (Campolieti et al. (2006), Myatt and McDonald (2010), and Fortin (2010)). However, some data for this sector were unavailable for my study period because Statistics Canada either suppressed the data to meet confidentiality requirements or deemed the data too unreliable for publication. As a result, my study utilized average hourly wage data from the industrial aggregate sector, excluding unclassified businesses. This change may impact my estimated results.

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APPENDIX

Model 1: Fixed-effects, using 390 observations
Included 10 cross-sectional units
Time-series length = 39
Dependent variable: EmpPop1519
Standard errors clustered by unit

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.321638	0.113562	2.832	0.0196	**
RealMinimumWage	0.00509451	0.00939786	0.5421	0.6009	
RealMinimumWage_1	−0.00813452	0.00995219	−0.8174	0.4348	
RealAverageHourlyWage	0.0190350	0.0103704	1.836	0.0996	*
Maleunemploymentrate2554	−0.0101354	0.00313879	−3.229	0.0103	**
RealPerCapitaIncome	6.25823e-06	1.33315e-06	4.694	0.0011	***
Populationfor1519in1000	−0.000605336	0.000187046	−3.236	0.0102	**
dt_2	−0.0604730	0.0413466	−1.463	0.1776	
dt_3	−0.0606264	0.0422663	−1.434	0.1853	
dt_4	−0.0437426	0.0449932	−0.9722	0.3564	
dt_5	−0.0330232	0.0414492	−0.7967	0.4461	
dt_6	−0.0247588	0.0409030	−0.6053	0.5599	
dt_7	−0.00296252	0.0389044	−0.07615	0.9410	
dt_8	0.00390108	0.0390689	0.09985	0.9227	
dt_9	0.0141732	0.0426834	0.3321	0.7475	
dt_10	−0.00286200	0.0443403	−0.06455	0.9499	
dt_11	−0.0114741	0.0447801	−0.2562	0.8035	
dt_12	−0.0166597	0.0443372	−0.3758	0.7158	
dt_13	−0.0253601	0.0431981	−0.5871	0.5716	
dt_14	−0.0363734	0.0428921	−0.8480	0.4184	
dt_15	−0.0576159	0.0426017	−1.352	0.2092	
dt_16	−0.0584535	0.0370702	−1.577	0.1493	
dt_17	−0.0463545	0.0375202	−1.235	0.2479	
dt_18	−0.0386441	0.0348980	−1.107	0.2969	
dt_19	−0.0335457	0.0313926	−1.069	0.3131	
dt_20	−0.00529006	0.0334120	−0.1583	0.8777	
dt_21	−0.00237400	0.0310890	−0.07636	0.9408	
dt_22	−0.0188078	0.0278218	−0.6760	0.5160	
dt_23	−0.0192166	0.0279587	−0.6873	0.5092	
dt_24	−0.00144087	0.0276737	−0.05207	0.9596	
dt_25	0.0153264	0.0250632	0.6115	0.5560	
dt_26	0.0245157	0.0222703	1.101	0.2995	
dt_27	0.00512105	0.0203439	0.2517	0.8069	
dt_28	−0.0117695	0.0175915	−0.6690	0.5203	
dt_29	−0.0213756	0.0141887	−1.507	0.1662	

```
     dt_30           -0.0306935  0.0140872    -2.179      0.0573   *
     dt_31           -0.0377048  0.0161694    -2.332      0.0446   **
     dt_32           -0.0443474  0.0107198    -4.137      0.0025   ***
     dt_33           -0.0317824  0.0115126    -2.761      0.0221   **
     dt_34           -0.0297324  0.0119742    -2.483      0.0348   **
     dt_35           -0.0296617  0.00834343   -3.555      0.0062   ***
     dt_36           -0.0316102  0.00792977   -3.986      0.0032   ***
     dt_37           -0.0325433  0.00886232   -3.672      0.0051   ***
     dt_38           -0.0665850  0.0114275    -5.827      0.0003   ***
     dt_39           -0.0206677  0.00813381   -2.541      0.0317   **

     Mean dependent var     0.434192   S.D. dependent var     0.076419
     Sum squared resid      0.259040   S.E. of regression     0.027766
     LSDV R-squared         0.885970   Within R-squared       0.738817
     Log-likelihood         873.4132   Akaike criterion      -1638.826
     Schwarz criterion     -1424.654   Hannan-Quinn          -1553.927
     rho                    0.751114   Durbin-Watson          0.508017

Joint test on named regressors -
 Test statistic: F(6, 9) = 305.568
 with p-value = P(F(6, 9) > 305.568) = 7.05709e-10

Test for differing group intercepts -
 Null hypothesis: The groups have a common intercept
 Test statistic: Welch F(9, 152.8) = 17.6704
 with p-value = P(F(9, 152.8) > 17.6704) = 7.85427e-20

Hausman test -
  Null hypothesis: GLS estimates are consistent
  Asymptotic test statistic: Chi-square (6) = 978.232
  with p-value = 4.56183e-208

Wald joint test on time dummies -
  Null hypothesis: No time effects
  Asymptotic test statistic: Chi-square (38) = 218.672
  with p-value = 3.05151e-27
```

Model 2: Fixed-effects, using 390 observations
Included 10 cross-sectional units
Time-series length = 39
Dependent variable: EmpPop2024
Standard errors clustered by unit

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.476930	0.0833445	5.722	0.0003	***
RealMinimumWage	0.00548297	0.00949371	0.5775	0.5777	
RealMinimumWage_1	−0.00277365	0.00789972	−0.3511	0.7336	
RealAverageHourlyWage	0.0192110	0.00674562	2.848	0.0192	**
Maleunemploymentrate2554	−0.00989801	0.00270751	−3.656	0.0053	***
RealPerCapitaIncome	4.55993e-06	1.15880e-06	3.935	0.0034	***
Populationfor2024in1000	−0.000165564	6.29155e-05	−2.632	0.0273	**
dt_2	−0.0309644	0.0256151	−1.209	0.2575	
dt_3	−0.0166079	0.0274351	−0.6054	0.5599	
dt_4	−0.00511718	0.0279297	−0.1832	0.8587	
dt_5	−0.00343488	0.0268366	−0.1280	0.9010	
dt_6	0.00253372	0.0235138	0.1078	0.9166	
dt_7	0.0177517	0.0242874	0.7309	0.4834	
dt_8	0.0168025	0.0264609	0.6350	0.5412	
dt_9	0.0110345	0.0298711	0.3694	0.7204	
dt_10	0.00540967	0.0274914	0.1968	0.8484	
dt_11	0.00318302	0.0272106	0.1170	0.9094	
dt_12	−0.00404259	0.0276759	−0.1461	0.8871	
dt_13	−0.00023165	0.0263437	−0.008794	0.9932	
dt_14	−0.00204119	0.0245400	−0.08318	0.9355	
dt_15	−0.00309794	0.0289286	−0.1071	0.9171	
dt_16	−0.0151994	0.0257240	−0.5909	0.5691	
dt_17	−0.0167200	0.0239630	−0.6977	0.5030	
dt_18	−0.00374884	0.0261881	−0.1432	0.8893	
dt_19	−0.00352310	0.0220378	−0.1599	0.8765	
dt_20	0.00419566	0.0211629	0.1983	0.8473	
dt_21	0.00972366	0.0189514	0.5131	0.6202	
dt_22	0.00443355	0.0158732	0.2793	0.7863	
dt_23	−0.00342312	0.0164379	−0.2082	0.8397	
dt_24	0.0193381	0.0202623	0.9544	0.3648	
dt_25	0.0137868	0.0165520	0.8329	0.4264	
dt_26	0.0154711	0.0172333	0.8977	0.3927	
dt_27	0.0129566	0.0120206	1.078	0.3091	
dt_28	0.00639861	0.0136977	0.4671	0.6515	
dt_29	0.00285732	0.0145319	0.1966	0.8485	
dt_30	−0.00626877	0.00993601	−0.6309	0.5438	
dt_31	−3.00365e-05	0.0107869	−0.002785	0.9978	

```
      dt_32           0.00105983  0.0127983   0.08281     0.9358
      dt_33           0.00897552  0.0137344   0.6535      0.5298
      dt_34           0.0137190   0.0133803   1.025       0.3320
      dt_35           0.0138828   0.0159170   0.8722      0.4058
      dt_36           0.00183160  0.00928110  0.1973      0.8479
      dt_37           0.0152610   0.0110732   1.378       0.2014
      dt_38          −0.0566516   0.00802740  −7.057      <0.0001   ***
      dt_39          −0.00406321  0.00769248  −0.5282     0.6101

      Mean dependent var     0.681480   S.D. dependent var     0.068650
      Sum squared resid      0.183492   S.E. of regression     0.023369
      LSDV R-squared         0.899912   Within R-squared       0.718773
      Log-likelihood         940.6519   Akaike criterion      −1773.304
      Schwarz criterion     −1559.132   Hannan-Quinn          −1688.405
      rho                    0.625994   Durbin-Watson          0.747189

Joint test on named regressors -
 Test statistic: F(6, 9) = 27.5279
 with p-value = P(F(6, 9) > 27.5279) = 2.65763e-05

 Test for differing group intercepts -
 Null hypothesis: The groups have a common intercept
 Test statistic: Welch F(9, 153.9) = 27.8307
 with p-value = P(F(9, 153.9) > 27.8307) = 3.81027e-28

Hausman test -
  Null hypothesis: GLS estimates are consistent
  Asymptotic test statistic: Chi-square (6) = 513.753
  with p-value = 9.15514e-108

Wald joint test on time dummies -
  Null hypothesis: No time effects
  Asymptotic test statistic: Chi-square(38) = 126.218
  with p-value = 2.13622e-11
```

Model 3: Fixed-effects, using 390 observations
Included 10 cross-sectional units
Time-series length = 39
Dependent variable: EmpPop1524
Standard errors clustered by unit

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.372640	0.104103	3.580	0.0059	***
RealMinimumWage	0.00536741	0.00936904	0.5729	0.5807	
RealMinimumWage_1	−0.00541054	0.00831501	−0.6507	0.5315	
RealAverageHourlyWage	0.0201922	0.00863694	2.338	0.0442	**
Maleunemploymentrate2554	−0.0102922	0.00286027	−3.598	0.0058	***
RealPerCapitaIncome	6.16533e-06	1.24548e-06	4.950	0.0008	***
Populationfor1524in1000	−0.00017145	5.48075e-05	−3.128	0.0122	**
dt_2	−0.0497507	0.0322808	−1.541	0.1577	
dt_3	−0.0393728	0.0328297	−1.199	0.2610	
dt_4	−0.0259011	0.0349361	−0.7414	0.4774	
dt_5	−0.0212485	0.0324538	−0.6547	0.5290	
dt_6	−0.0170519	0.0322693	−0.5284	0.6100	
dt_7	−0.00059915	0.0320592	−0.01869	0.9855	
dt_8	0.00121729	0.0317785	0.03831	0.9703	
dt_9	0.00539097	0.0360103	0.1497	0.8843	
dt_10	−0.00514555	0.0355590	−0.1447	0.8881	
dt_11	−0.0102596	0.0363500	−0.2822	0.7841	
dt_12	−0.0193475	0.0356460	−0.5428	0.6005	
dt_13	−0.0228663	0.0353820	−0.6463	0.5342	
dt_14	−0.0302748	0.0344400	−0.8791	0.4022	
dt_15	−0.0414751	0.0364514	−1.138	0.2846	
dt_16	−0.0505986	0.0322031	−1.571	0.1506	
dt_17	−0.0460918	0.0314921	−1.464	0.1773	
dt_18	−0.0361221	0.0311066	−1.161	0.2754	
dt_19	−0.0336096	0.0261119	−1.287	0.2302	
dt_20	−0.0139310	0.0272085	−0.5120	0.6210	
dt_21	−0.00866079	0.0251625	−0.3442	0.7386	
dt_22	−0.0192554	0.0228071	−0.8443	0.4204	
dt_23	−0.0237853	0.0224269	−1.061	0.3165	
dt_24	−0.00407826	0.0236139	−0.1727	0.8667	
dt_25	0.000237437	0.0224183	0.01059	0.9918	
dt_26	0.00626900	0.0205976	0.3044	0.7678	
dt_27	−0.00221833	0.0176816	−0.1255	0.9029	
dt_28	−0.0125372	0.0161509	−0.7763	0.4575	
dt_29	−0.0173166	0.0141334	−1.225	0.2516	
dt_30	−0.0243512	0.0125530	−1.940	0.0843	*
dt_31	−0.0219393	0.0123619	−1.775	0.1097	
dt_32	−0.0236059	0.0103931	−2.271	0.0493	**

```
      dt_33           -0.0128970  0.0111661    -1.155      0.2778
      dt_34          -0.00923246  0.0106893    -0.8637     0.4102
      dt_35          -0.00991926  0.0107640    -0.9215     0.3808
      dt_36           -0.0158744  0.00677235   -2.344      0.0437   **
      dt_37          -0.00765922  0.00916994   -0.8353     0.4252
      dt_38           -0.0594461  0.00700338   -8.488     <0.0001   ***
      dt_39           -0.0112092  0.00507284   -2.210      0.0545   *

      Mean dependent var     0.560576   S.D. dependent var     0.072192
      Sum squared resid      0.185385   S.E. of regression     0.023489
      LSDV R-squared         0.908556   Within R-squared       0.758286
      Log-likelihood         938.6499   Akaike criterion      -1769.300
      Schwarz criterion     -1555.128   Hannan-Quinn          -1684.401
      rho                    0.769598   Durbin-Watson          0.473286

Joint test on named regressors -
 Test statistic: F(6, 9) = 139.96
 with p-value = P(F(6, 9) > 139.96) = 2.28687e-08

 Test for differing group intercepts -
 Null hypothesis: The groups have a common intercept
 Test statistic: Welch F(9, 153.6) = 22.7043
 with p-value = P(F(9, 153.6) > 22.7043) = 3.34505e-24

Hausman test -
  Null hypothesis: GLS estimates are consistent
  Asymptotic test statistic: Chi-square(6) = 863.691
  with p-value = 2.65163e-183

Wald joint test on time dummies -
  Null hypothesis: No time effects
  Asymptotic test statistic: Chi-square(38) = 168.098
  with p-value = 2.73041e-18
```

Model 4: Fixed-effects, using 390 observations
Included 10 cross-sectional units
Time-series length = 39
Dependent variable: l_EmpPop1519
Standard errors clustered by unit

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−0.532214	0.865845	−0.6147	0.5540	
l_RealMinimumWage	0.122028	0.0781057	1.562	0.1526	
l_RealMinimumWage_1	−0.0214316	0.100196	−0.2139	0.8354	
l_RealAverageHourlyWage	0.210573	0.119321	1.765	0.1114	
l_Maleunemploymentrate2554	−0.235897	0.0322227	−7.321	<0.0001	***
l_RealPerCapitaIncome	0.249427	0.0766840	3.253	0.0100	***
l_Populationfor1519in1000	−0.658712	0.0617523	−10.67	<0.0001	***
dt_2	0.0664473	0.0379099	1.753	0.1135	
dt_3	0.0484912	0.0318026	1.525	0.1617	
dt_4	0.0722108	0.0423510	1.705	0.1224	
dt_5	0.0857158	0.0342452	2.503	0.0337	**
dt_6	0.0986801	0.0356501	2.768	0.0218	**
dt_7	0.134567	0.0356531	3.774	0.0044	***
dt_8	0.147257	0.0400309	3.679	0.0051	***
dt_9	0.162188	0.0379344	4.275	0.0021	***
dt_10	0.112768	0.0411708	2.739	0.0229	**
dt_11	0.0824636	0.0361067	2.284	0.0483	**
dt_12	0.0720441	0.0401738	1.793	0.1065	
dt_13	0.0488341	0.0394544	1.238	0.2471	
dt_14	0.0143723	0.0424543	0.3385	0.7427	
dt_15	−0.0648819	0.0478799	−1.355	0.2084	
dt_16	−0.0449402	0.0411505	−1.092	0.3032	
dt_17	−0.00425673	0.0414677	−0.1027	0.9205	
dt_18	0.00451397	0.0369925	0.1220	0.9056	
dt_19	0.0283832	0.0315288	0.9002	0.3914	
dt_20	0.101572	0.0312526	3.250	0.0100	***
dt_21	0.103092	0.0288719	3.571	0.0060	***
dt_22	0.0653938	0.0291469	2.244	0.0515	*
dt_23	0.0553964	0.0286691	1.932	0.0854	*
dt_24	0.0816848	0.0269152	3.035	0.0141	**
dt_25	0.114477	0.0265556	4.311	0.0020	***
dt_26	0.127569	0.0220387	5.788	0.0003	***
dt_27	0.105747	0.0161910	6.531	0.0001	***
dt_28	0.0581189	0.0214474	2.710	0.0240	**
dt_29	0.0229883	0.0194305	1.183	0.2671	
dt_30	−0.0100193	0.0205203	−0.4883	0.6370	

dt_31	−0.0353253	0.0190997	−1.850	0.0974	*
dt_32	−0.0566528	0.0159639	−3.549	0.0062	***
dt_33	−0.0191227	0.0187351	−1.021	0.3341	
dt_34	−0.0139208	0.0220753	−0.6306	0.5440	
dt_35	−0.0253225	0.0172440	−1.468	0.1760	
dt_36	−0.0403304	0.0188118	−2.144	0.0606	*
dt_37	−0.0479049	0.0217815	−2.199	0.0554	*
dt_38	−0.106694	0.0289468	−3.686	0.0050	***
dt_39	−0.0113238	0.0205443	−0.5512	0.5949	

Mean dependent var	−0.853100	S.D. dependent var	0.205882
Sum squared resid	1.157419	S.E. of regression	0.058692
LSDV R-squared	0.929805	Within R-squared	0.832218
Log-likelihood	581.5050	Akaike criterion	−1055.010
Schwarz criterion	−840.8381	Hannan-Quinn	−970.1111
rho	0.660687	Durbin-Watson	0.662865

```
Joint test on named regressors -
 Test statistic: F(6, 9) = 143.488
 with p-value = P(F(6, 9) > 143.488) = 2.04776e-08

 Test for differing group intercepts -
 Null hypothesis: The groups have a common intercept
 Test statistic: Welch F(9, 153.7) = 17.2232
 with p-value = P(F(9, 153.7) > 17.2232) = 1.88267e-19

Hausman test -
  Null hypothesis: GLS estimates are consistent
  Asymptotic test statistic: Chi-square(6) = 210.176
  with p-value = 1.29159e-42

Wald joint test on time dummies -
  Null hypothesis: No time effects
  Asymptotic test statistic: Chi-square(38) = 290.003
  with p-value = 1.52106e-40
```

Model 5: Fixed-effects, using 390 observations
Included 10 cross-sectional units
Time-series length = 39
Dependent variable: l_EmpPop2024
Standard errors clustered by unit

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−0.972849	1.01675	−0.9568	0.3636	
l_RealMinimumWage	0.0419313	0.0426796	0.9825	0.3515	
l_RealMinimumWage_1	0.0394244	0.0704139	0.5599	0.5892	
l_RealAverageHourlyWage	0.197149	0.0721280	2.733	0.0231	**
l_Maleunemploymentrate2554	−0.119899	0.0303185	−3.955	0.0033	***
l_RealPerCapitaIncome	0.133611	0.0809092	1.651	0.1331	
l_Populationfor2024in1000	−0.239140	0.0641371	−3.729	0.0047	***
dt_2	0.0254040	0.0710242	0.3577	0.7288	
dt_3	0.0470435	0.0734293	0.6407	0.5377	
dt_4	0.0606214	0.0696441	0.8704	0.4067	
dt_5	0.0554980	0.0665127	0.8344	0.4257	
dt_6	0.0543827	0.0563178	0.9656	0.3595	
dt_7	0.0627063	0.0541571	1.158	0.2767	
dt_8	0.0520542	0.0536811	0.9697	0.3575	
dt_9	0.0352518	0.0567697	0.6210	0.5500	
dt_10	0.0197229	0.0518114	0.3807	0.7123	
dt_11	0.0127389	0.0485666	0.2623	0.7990	
dt_12	0.00295462	0.0461951	0.06396	0.9504	
dt_13	0.00951943	0.0435526	0.2186	0.8319	
dt_14	0.00317917	0.0413877	0.07681	0.9405	
dt_15	−0.00499999	0.0437209	−0.1144	0.9115	
dt_16	−0.0198612	0.0372456	−0.5333	0.6068	
dt_17	−0.0184182	0.0325266	−0.5663	0.5851	
dt_18	−0.00246075	0.0357433	−0.06885	0.9466	
dt_19	0.00245850	0.0345389	0.07118	0.9448	
dt_20	0.0155966	0.0350867	0.4445	0.6672	
dt_21	0.0265080	0.0334893	0.7915	0.4490	
dt_22	0.0221634	0.0344789	0.6428	0.5364	
dt_23	0.00873538	0.0320294	0.2727	0.7912	
dt_24	0.0338274	0.0289869	1.167	0.2732	
dt_25	0.0261538	0.0254953	1.026	0.3318	
dt_26	0.0266475	0.0244387	1.090	0.3039	
dt_27	0.0322710	0.0269862	1.196	0.2623	
dt_28	0.0240947	0.0311074	0.7746	0.4585	
dt_29	0.0176614	0.0241903	0.7301	0.4839	

dt_30	0.00386935	0.0221569	0.1746	0.8652	
dt_31	0.0138254	0.0232598	0.5944	0.5669	
dt_32	0.0136219	0.0240854	0.5656	0.5855	
dt_33	0.0257096	0.0301863	0.8517	0.4165	
dt_34	0.0306257	0.0295809	1.035	0.3275	
dt_35	0.0267595	0.0293976	0.9103	0.3864	
dt_36	0.00866312	0.0145607	0.5950	0.5665	
dt_37	0.0294913	0.0160493	1.838	0.0993	*
dt_38	−0.0670757	0.0214490	−3.127	0.0122	**
dt_39	0.00604491	0.0128890	0.4690	0.6502	

Mean dependent var	−0.389114	S.D. dependent var	0.109273
Sum squared resid	0.370830	S.E. of regression	0.033221
LSDV R-squared	0.920164	Within R-squared	0.775023
Log-likelihood	803.4547	Akaike criterion	−1498.909
Schwarz criterion	−1284.738	Hannan-Quinn	−1414.010
rho	0.609317	Durbin-Watson	0.760810

```
Joint test on named regressors -
 Test statistic: F(6, 9) = 54.2285
 with p-value = P(F(6, 9) > 54.2285) = 1.47223e-06

 Test for differing group intercepts -
 Null hypothesis: The groups have a common intercept
 Test statistic: Welch F(9, 154.0) = 24.9715
 with p-value = P(F(9, 154.0) > 24.9715) = 5.11089e-26

Hausman test -
  Null hypothesis: GLS estimates are consistent
  Asymptotic test statistic: Chi-square(6) = 119.142
  with p-value = 2.46731e-23

Wald joint test on time dummies -
  Null hypothesis: No time effects
  Asymptotic test statistic: Chi-square(38) = 107.287
  with p-value = 1.58389e-08
```

Model 6: Fixed-effects, using 390 observations
Included 10 cross-sectional units
Time-series length = 39
Dependent variable: l_EmpPop1524
Standard errors clustered by unit

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−0.649667	0.873997	−0.7433	0.4762	
l_RealMinimumWage	0.0597508	0.0572470	1.044	0.3238	
l_RealMinimumWage_1	0.0289846	0.0785447	0.3690	0.7206	
l_RealAverageHourlyWage	0.226991	0.0878963	2.582	0.0296	**
l_Maleunemploymentrate2554	−0.170127	0.0275563	−6.174	0.0002	***
l_RealPerCapitaIncome	0.189185	0.0676636	2.796	0.0208	**
l_Populationfor1524in1000	−0.408456	0.0563720	−7.246	<0.0001	***
dt_2	0.0474559	0.0612398	0.7749	0.4583	
dt_3	0.0604599	0.0597454	1.012	0.3380	
dt_4	0.0758124	0.0584583	1.297	0.2269	
dt_5	0.0736171	0.0527461	1.396	0.1963	
dt_6	0.0696729	0.0503195	1.385	0.1995	
dt_7	0.0823100	0.0495328	1.662	0.1309	
dt_8	0.0762236	0.0509418	1.496	0.1688	
dt_9	0.0737886	0.0537702	1.372	0.2032	
dt_10	0.0467007	0.0519805	0.8984	0.3924	
dt_11	0.0318860	0.0492473	0.6475	0.5335	
dt_12	0.0173732	0.0474178	0.3664	0.7225	
dt_13	0.0105076	0.0469996	0.2236	0.8281	
dt_14	−0.00838601	0.0472105	−0.1776	0.8629	
dt_15	−0.0417385	0.0475696	−0.8774	0.4031	
dt_16	−0.0500465	0.0419712	−1.192	0.2636	
dt_17	−0.0355268	0.0368608	−0.9638	0.3603	
dt_18	−0.0228340	0.0357121	−0.6394	0.5385	
dt_19	−0.0114908	0.0323849	−0.3548	0.7309	
dt_20	0.0278442	0.0352697	0.7895	0.4501	
dt_21	0.0374429	0.0345918	1.082	0.3072	
dt_22	0.0209632	0.0358637	0.5845	0.5732	
dt_23	0.00865951	0.0308711	0.2805	0.7854	
dt_24	0.0325368	0.0305354	1.066	0.3144	
dt_25	0.0396261	0.0266425	1.487	0.1711	
dt_26	0.0459247	0.0252286	1.820	0.1020	
dt_27	0.0446933	0.0296271	1.509	0.1657	
dt_28	0.0244255	0.0302791	0.8067	0.4406	
dt_29	0.00952393	0.0230817	0.4126	0.6895	
dt_30	−0.00777803	0.0246315	−0.3158	0.7594	

```
     dt_31          -0.00625705  0.0175612    -0.3563     0.7298
     dt_32          -0.0136530   0.0198359    -0.6883     0.5086
     dt_33           0.00783035  0.0286263     0.2735     0.7906
     dt_34           0.0130109   0.0266614     0.4880     0.6372
     dt_35           0.00469406  0.0242710     0.1934     0.8509
     dt_36          -0.0101262   0.00949087   -1.067      0.3138
     dt_37           0.00315662  0.0123626     0.2553     0.8042
     dt_38          -0.0743437   0.0174272    -4.266      0.0021   ***
     dt_39           0.00293755  0.00747333    0.3931     0.7034

     Mean dependent var   -0.588404   S.D. dependent var    0.144714
     Sum squared resid     0.464354   S.E. of regression    0.037175
     LSDV R-squared        0.942999   Within R-squared      0.846697
     Log-likelihood        759.5986   Akaike criterion     -1411.197
     Schwarz criterion    -1197.025   Hannan-Quinn         -1326.298
     rho                   0.709755   Durbin-Watson         0.560756

Joint test on named regressors -
 Test statistic: F(6, 9) = 113.32
 with p-value = P(F(6, 9) > 113.32) = 5.82439e-08

Robust test for differing group intercepts -
 Null hypothesis: The groups have a common intercept
 Test statistic: Welch F(9, 153.4) = 26.6735
 with p-value = P(F(9, 153.4) > 26.6735) = 2.89107e-27

Hausman test -
  Null hypothesis: GLS estimates are consistent
  Asymptotic test statistic: Chi-square(6) = 213.291
  with p-value = 2.80193e-43

Wald joint test on time dummies -
  Null hypothesis: No time effects
  Asymptotic test statistic: Chi-square(38) = 165.934
  with p-value = 6.40183e-18
```

Model 7: Fixed-effects, using 390 observations
Included 10 cross-sectional units
Time-series length = 39
Dependent variable: EmpPop1519
Standard errors clustered by unit

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.717963	0.163503	4.391	0.0017	***
RealMinRealAve	−0.0121557	0.0824007	−0.1475	0.8860	
RealMinRealAve_1	−0.107333	0.105336	−1.019	0.3348	
Maleunemploymentrate2554	−0.0145303	0.00409930	−3.545	0.0063	***
RealPerCapitaIncome	5.28580e-06	2.63831e-06	2.003	0.0761	*
PopShare1519	−2.70966	0.859357	−3.153	0.0117	**
dt_2	0.0611192	0.0717890	0.8514	0.4166	
dt_3	0.0480841	0.0661148	0.7273	0.4855	
dt_4	0.0530457	0.0638190	0.8312	0.4274	
dt_5	0.0513136	0.0585821	0.8759	0.4038	
dt_6	0.0515459	0.0554487	0.9296	0.3768	
dt_7	0.0689108	0.0509130	1.354	0.2089	
dt_8	0.0725820	0.0484015	1.500	0.1680	
dt_9	0.0827308	0.0434539	1.904	0.0893	*
dt_10	0.0682217	0.0419218	1.627	0.1381	
dt_11	0.0557056	0.0403110	1.382	0.2003	
dt_12	0.0444980	0.0370151	1.202	0.2600	
dt_13	0.0296897	0.0352973	0.8411	0.4221	
dt_14	0.0181723	0.0380993	0.4770	0.6447	
dt_15	−0.00867876	0.0382888	−0.2267	0.8257	
dt_16	−0.0108877	0.0381240	−0.2856	0.7817	
dt_17	−0.00249095	0.0392281	−0.06350	0.9508	
dt_18	−0.00130803	0.0404565	−0.03233	0.9749	
dt_19	0.00789248	0.0406036	0.1944	0.8502	
dt_20	0.0332662	0.0399850	0.8320	0.4270	
dt_21	0.0311497	0.0352046	0.8848	0.3993	
dt_22	0.0105537	0.0346054	0.3050	0.7673	
dt_23	0.00845111	0.0338095	0.2500	0.8082	
dt_24	0.0241779	0.0328693	0.7356	0.4807	
dt_25	0.0385878	0.0319545	1.208	0.2580	
dt_26	0.0466074	0.0248857	1.873	0.0939	*
dt_27	0.0350650	0.0216972	1.616	0.1405	
dt_28	0.0145870	0.0183431	0.7952	0.4469	
dt_29	−3.11584e-05	0.0167829	−0.001857	0.9986	
dt_30	−0.0125802	0.0160715	−0.7828	0.4539	
dt_31	−0.0203571	0.0172060	−1.183	0.2671	
dt_32	−0.0305273	0.0134228	−2.274	0.0490	**
dt_33	−0.0142644	0.0138443	−1.030	0.3297	

```
      dt_34           -0.0111855  0.0146774    -0.7621     0.4655
      dt_35           -0.0126766  0.0133389    -0.9503     0.3668
      dt_36           -0.0181592  0.0125849    -1.443      0.1829
      dt_37           -0.0198959  0.00857334   -2.321      0.0454    **
      dt_38           -0.0382305  0.0162521    -2.352      0.0431    **
      dt_39           -0.00389939 0.00934337   -0.4173     0.6862

      Mean dependent var     0.434192   S.D. dependent var     0.076419
      Sum squared resid      0.283361   S.E. of regression     0.028997
      LSDV R-squared         0.875264   Within R-squared       0.714295
      Log-likelihood         855.9144   Akaike criterion      -1605.829
      Schwarz criterion     -1395.623   Hannan-Quinn          -1522.502
      rho                    0.757034   Durbin-Watson          0.485880

Joint test on named regressors -
 Test statistic: F(5, 9) = 15.9382
 with p-value = P(F(5, 9) > 15.9382) = 0.000306943

Robust test for differing group intercepts -
 Null hypothesis: The groups have a common intercept
 Test statistic: Welch F(9, 153.2) = 25.4929
 with p-value = P(F(9, 153.2) > 25.4929) = 2.29146e-26

Hausman test -
  Null hypothesis: GLS estimates are consistent
  Asymptotic test statistic: Chi-square(5) = 47.1869
  with p-value = 5.2043e-09

Wald joint test on time dummies -
  Null hypothesis: No time effects
  Asymptotic test statistic: Chi-square(38) = 193.47
  with p-value = 1.0255e-22
```

Model 8: Fixed-effects, using 390 observations
Included 10 cross-sectional units
Time-series length = 39
Dependent variable: EmpPop2024
Standard errors clustered by unit

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.877372	0.135070	6.496	0.0001	***
RealMinRealAve	−0.0178467	0.0774893	−0.2303	0.8230	
RealMinRealAve_1	−0.0758961	0.0486063	−1.561	0.1529	
Maleunemploymentrate2554	−0.0114777	0.00303108	−3.787	0.0043	***
RealPerCapitaIncome	4.95787e-06	1.44865e-06	3.422	0.0076	***
Popshare2024	−1.80157	0.628763	−2.865	0.0186	**
dt_2	0.0194545	0.0420375	0.4628	0.6545	
dt_3	0.0277911	0.0420659	0.6607	0.5254	
dt_4	0.0291878	0.0374139	0.7801	0.4553	
dt_5	0.0167206	0.0321731	0.5197	0.6158	
dt_6	0.0105121	0.0239670	0.4386	0.6713	
dt_7	0.0165264	0.0202787	0.8150	0.4361	
dt_8	0.00762945	0.0183612	0.4155	0.6875	
dt_9	0.000604289	0.0212134	0.02849	0.9779	
dt_10	−0.00186038	0.0226906	−0.08199	0.9364	
dt_11	−0.00559306	0.0224183	−0.2495	0.8086	
dt_12	−0.0170729	0.0194763	−0.8766	0.4035	
dt_13	−0.0171820	0.0131488	−1.307	0.2237	
dt_14	−0.0189461	0.0132452	−1.430	0.1864	
dt_15	−0.0244665	0.0111076	−2.203	0.0551	*
dt_16	−0.0375901	0.00845878	−4.444	0.0016	***
dt_17	−0.0406850	0.00877499	−4.636	0.0012	***
dt_18	−0.0323477	0.00787580	−4.107	0.0026	***
dt_19	−0.0274446	0.00715013	−3.838	0.0040	***
dt_20	−0.0208533	0.00781965	−2.667	0.0258	**
dt_21	−0.0149603	0.00643343	−2.325	0.0451	**
dt_22	−0.0194862	0.00653107	−2.984	0.0154	**
dt_23	−0.0263392	0.00568819	−4.630	0.0012	***
dt_24	−0.00386846	0.00895762	−0.4319	0.6760	
dt_25	−0.00774242	0.0118133	−0.6554	0.5286	
dt_26	−0.00407098	0.0102873	−0.3957	0.7015	
dt_27	0.00202371	0.00809973	0.2498	0.8083	
dt_28	−0.00191677	0.00924525	−0.2073	0.8404	
dt_29	−0.00354366	0.00738473	−0.4799	0.6428	
dt_30	−0.00991302	0.00912846	−1.086	0.3057	
dt_31	−0.00146361	0.00722740	−0.2025	0.8440	
dt_32	−0.00211707	0.00887936	−0.2384	0.8169	
dt_33	0.00683257	0.0106473	0.6417	0.5371	

```
      dt_34           0.0111503   0.0106077     1.051      0.3206
      dt_35           0.0120383   0.0134920    0.8923      0.3955
      dt_36          0.00170503  0.00587381    0.2903      0.7782
      dt_37           0.0191360  0.00933003     2.051      0.0705   *
      dt_38          -0.0393150  0.00865483    -4.543      0.0014   ***
      dt_39          0.00526505  0.00714909    0.7365      0.4802

      Mean dependent var     0.681480   S.D. dependent var     0.068650
      Sum squared resid      0.185356   S.E. of regression     0.023452
      LSDV R-squared         0.898895   Within R-squared       0.715915
      Log-likelihood         938.6807   Akaike criterion      -1771.361
      Schwarz criterion     -1561.156   Hannan-Quinn          -1688.035
      rho                    0.618735   Durbin-Watson          0.749869

Joint test on named regressors -
 Test statistic: F(5, 9) = 21.3888
 with p-value = P(F(5, 9) > 21.3888) = 9.4863e-05

Robust test for differing group intercepts -
 Null hypothesis: The groups have a common intercept
 Test statistic: Welch F(9, 154.1) = 25.1148
 with p-value = P(F(9, 154.1) > 25.1148) = 3.89397e-26

Hausman test -
  Null hypothesis: GLS estimates are consistent
  Asymptotic test statistic: Chi-square(5) = 22.7221
  with p-value = 0.000381461

Wald joint test on time dummies -
  Null hypothesis: No time effects
  Asymptotic test statistic: Chi-square(38) = 141.038
  with p-value = 9.17055e-14
```

Model 9: Fixed-effects, using 390 observations
Included 10 cross-sectional units
Time-series length = 39
Dependent variable: EmpPop1524
Standard errors clustered by unit

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	0.878151	0.145852	6.021	0.0002	***
RealMinRealAve	−0.0319785	0.0815974	−0.3919	0.7042	
RealMinRealAve_1	−0.0796706	0.0585147	−1.362	0.2064	
Maleunemploymentrate2554	−0.0137113	0.00326160	−4.204	0.0023	***
RealPerCapitaIncome	4.90103e-06	2.09394e-06	2.341	0.0440	**
Popshare1524	−1.45460	0.339854	−4.280	0.0020	***
dt_2	0.0771608	0.0493348	1.564	0.1523	
dt_3	0.0752070	0.0473152	1.589	0.1464	
dt_4	0.0741043	0.0434439	1.706	0.1222	
dt_5	0.0613194	0.0393155	1.560	0.1533	
dt_6	0.0511294	0.0349831	1.462	0.1779	
dt_7	0.0564324	0.0303608	1.859	0.0960	*
dt_8	0.0491937	0.0285004	1.726	0.1184	
dt_9	0.0501451	0.0270332	1.855	0.0966	*
dt_10	0.0418894	0.0276632	1.514	0.1643	
dt_11	0.0334963	0.0263029	1.273	0.2348	
dt_12	0.0192096	0.0238637	0.8050	0.4416	
dt_13	0.00976159	0.0198669	0.4914	0.6349	
dt_14	0.00113683	0.0207150	0.05488	0.9574	
dt_15	−0.0156764	0.0188672	−0.8309	0.4275	
dt_16	−0.0260957	0.0171550	−1.521	0.1625	
dt_17	−0.0241883	0.0172138	−1.405	0.1935	
dt_18	−0.0203208	0.0168387	−1.207	0.2583	
dt_19	−0.0139180	0.0161185	−0.8635	0.4103	
dt_20	0.00408493	0.0160380	0.2547	0.8047	
dt_21	0.00638748	0.0121661	0.5250	0.6123	
dt_22	−0.00578688	0.0124782	−0.4638	0.6538	
dt_23	−0.0106953	0.0113933	−0.9387	0.3724	
dt_24	0.00758163	0.0106328	0.7130	0.4939	
dt_25	0.0114541	0.0114340	1.002	0.3426	
dt_26	0.0173382	0.00853247	2.032	0.0727	*
dt_27	0.0165137	0.0107633	1.534	0.1593	
dt_28	0.00550840	0.00919275	0.5992	0.5638	
dt_29	−0.00198070	0.00686866	−0.2884	0.7796	
dt_30	−0.0102393	0.00914194	−1.120	0.2917	
dt_31	−0.00786629	0.00823019	−0.9558	0.3641	
dt_32	−0.0134959	0.00862376	−1.565	0.1520	

dt_33	−0.00161622	0.00969690	−0.1667	0.8713	
dt_34	0.00162180	0.00877935	0.1847	0.8575	
dt_35	0.000615866	0.0116788	0.05273	0.9591	
dt_36	−0.00642675	0.00556892	−1.154	0.2782	
dt_37	0.00321893	0.00676396	0.4759	0.6455	
dt_38	−0.0339297	0.00780240	−4.349	0.0019	***
dt_39	0.00368320	0.00440005	0.8371	0.4242	

Mean dependent var	0.560576	S.D. dependent var	0.072192
Sum squared resid	0.176281	S.E. of regression	0.022871
LSDV R-squared	0.913047	Within R-squared	0.770157
Log-likelihood	948.4693	Akaike criterion	−1790.939
Schwarz criterion	−1580.733	Hannan-Quinn	−1707.612
rho	0.734962	Durbin-Watson	0.522735

```
Joint test on named regressors -
 Test statistic: F(5, 9) = 23.2367
 with p-value = P(F(5, 9) > 23.2367) = 6.76858e-05

Robust test for differing group intercepts -
 Null hypothesis: The groups have a common intercept
 Test statistic: Welch F(9, 153.9) = 25.4842
 with p-value = P(F(9, 153.9) > 25.4842) = 2.10782e-26

Hausman test -
  Null hypothesis: GLS estimates are consistent
  Asymptotic test statistic: Chi-square(5) = 34.4555
  with p-value = 1.93211e-06

Wald joint test on time dummies -
  Null hypothesis: No time effects
  Asymptotic test statistic: Chi-square(38) = 218.583
  with p-value = 3.16777e-27
```

Model 10: Fixed-effects, using 390 observations
Included 10 cross-sectional units
Time-series length = 39
Dependent variable: l_EmpPop1519
Standard errors clustered by unit

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−8.37730	1.36776	−6.125	0.0002	***
l_RealMinimumWage	0.0387336	0.0896244	0.4322	0.6758	
l_RealMinimumWage_1	−0.135545	0.0990757	−1.368	0.2045	
l_RealAverageHourlyWage	0.0679975	0.203159	0.3347	0.7455	
l_RealAverageHourlyWage_1	0.00128049	0.246700	0.005190	0.9960	
l_Maleunemploymentrate2554	−0.227096	0.0439282	−5.170	0.0006	***
l_RealPerCapitaIncome	0.538239	0.199708	2.695	0.0246	**
l_PopShare1519	−1.05754	0.240865	−4.391	0.0017	***
dt_2	0.173542	0.175067	0.9913	0.3474	
dt_3	0.131251	0.164853	0.7962	0.4464	
dt_4	0.142242	0.160741	0.8849	0.3992	
dt_5	0.142814	0.155241	0.9199	0.3816	
dt_6	0.150791	0.153748	0.9808	0.3523	
dt_7	0.187483	0.146806	1.277	0.2335	
dt_8	0.200814	0.140716	1.427	0.1873	
dt_9	0.221618	0.123859	1.789	0.1072	
dt_10	0.166655	0.119258	1.397	0.1958	
dt_11	0.128874	0.107245	1.202	0.2602	
dt_12	0.105081	0.111686	0.9409	0.3713	
dt_13	0.0772012	0.102625	0.7523	0.4711	
dt_14	0.0447814	0.105438	0.4247	0.6810	
dt_15	−0.0444217	0.106193	−0.4183	0.6855	
dt_16	−0.0336470	0.104112	−0.3232	0.7539	
dt_17	−1.12219e-05	0.111586	−0.0001006	0.9999	
dt_18	0.00100215	0.112574	0.008902	0.9931	
dt_19	0.0251830	0.111250	0.2264	0.8260	
dt_20	0.0849443	0.107219	0.7923	0.4486	
dt_21	0.0792208	0.0928744	0.8530	0.4158	
dt_22	0.0308182	0.0926208	0.3327	0.7470	
dt_23	0.0196364	0.0954106	0.2058	0.8415	
dt_24	0.0456609	0.0888320	0.5140	0.6196	
dt_25	0.0789443	0.0918126	0.8598	0.4122	
dt_26	0.0966913	0.0779873	1.240	0.2464	
dt_27	0.0829842	0.0562897	1.474	0.1745	
dt_28	0.0304700	0.0572037	0.5327	0.6072	
dt_29	−0.00508350	0.0582530	−0.08727	0.9324	

```
      dt_30            -0.0392549  0.0537035   -0.7310     0.4834
      dt_31            -0.0733124  0.0533421    -1.374     0.2026
      dt_32             -0.100924  0.0506737    -1.992     0.0776   *
      dt_33            -0.0615087  0.0367737    -1.673     0.1287
      dt_34            -0.0541642  0.0363987    -1.488     0.1709
      dt_35            -0.0654986  0.0403688    -1.623     0.1391
      dt_36            -0.0739000  0.0435958    -1.695     0.1243
      dt_37            -0.0773913  0.0349030    -2.217     0.0538   *
      dt_38             -0.116258  0.0322134    -3.609     0.0057   ***
      dt_39            -0.0199961  0.0219436   -0.9112     0.3859

      Mean dependent var    -0.853100   S.D. dependent var     0.205882
      Sum squared resid      1.600860   S.E. of regression     0.069128
      LSDV R-squared         0.902912   Within R-squared       0.767936
      Log-likelihood         518.2570   Akaike criterion      -926.5141
      Schwarz criterion     -708.3760   Hannan-Quinn          -840.0429
      rho                    0.762912   Durbin-Watson          0.481840

Joint test on named regressors -
 Test statistic: F(7, 9) = 178.786
 with p-value = P(F(7, 9) > 178.786) = 6.27018e-09

 Test for differing group intercepts -
 Null hypothesis: The groups have a common intercept
 Test statistic: Welch F(9, 153.8) = 26.7969
 with p-value = P(F(9, 153.8) > 26.7969) = 2.20919e-27

Hausman test -
  Null hypothesis: GLS estimates are consistent
  Asymptotic test statistic: Chi-square (7) = 91.6106
  with p-value = 5.7749e-17

Wald joint test on time dummies -
  Null hypothesis: No time effects
  Asymptotic test statistic: Chi-square (38) = 208.563
  with p-value = 2.05943e-25
```

Model 11: Fixed-effects, using 390 observations
Included 10 cross-sectional units
Time-series length = 39
Dependent variable: l_EmpPop2024
Standard errors clustered by unit

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−4.18321	0.521604	−8.020	<0.0001	***
l_RealMinimumWage	0.0141289	0.0593457	0.2381	0.8172	
l_RealMinimumWage_1	0.000954200	0.0624249	0.01529	0.9881	
l_RealAverageHourlyWage	0.00211531	0.0979659	0.02159	0.9832	
l_RealAverageHourlyWage_1	0.189756	0.104084	1.823	0.1016	
l_Maleunemploymentrate2554	−0.123795	0.0360496	−3.434	0.0075	***
l_RealPerCapitaIncome	0.270892	0.0844997	3.206	0.0107	**
l_Popshare2024	−0.359851	0.140974	−2.553	0.0311	**
dt_2	0.0602555	0.106130	0.5678	0.5841	
dt_3	0.0762361	0.107618	0.7084	0.4966	
dt_4	0.0860403	0.102496	0.8395	0.4230	
dt_5	0.0731866	0.0949594	0.7707	0.4606	
dt_6	0.0695763	0.0828359	0.8399	0.4227	
dt_7	0.0757319	0.0769190	0.9846	0.3506	
dt_8	0.0623191	0.0738430	0.8439	0.4206	
dt_9	0.0513556	0.0742765	0.6914	0.5067	
dt_10	0.0399363	0.0711277	0.5615	0.5882	
dt_11	0.0279189	0.0698212	0.3999	0.6986	
dt_12	0.0106393	0.0648390	0.1641	0.8733	
dt_13	0.0134512	0.0571778	0.2353	0.8193	
dt_14	0.00846763	0.0543797	0.1557	0.8797	
dt_15	−0.00874049	0.0533373	−0.1639	0.8735	
dt_16	−0.0254040	0.0466547	−0.5445	0.5993	
dt_17	−0.0307036	0.0421134	−0.7291	0.4845	
dt_18	−0.0220273	0.0411133	−0.5358	0.6051	
dt_19	−0.00931991	0.0419488	−0.2222	0.8291	
dt_20	−0.00589459	0.0399585	−0.1475	0.8860	
dt_21	0.00590333	0.0378787	0.1558	0.8796	
dt_22	−0.00052009	0.0377187	−0.01379	0.9893	
dt_23	−0.0148530	0.0365373	−0.4065	0.6939	
dt_24	0.00706207	0.0348960	0.2024	0.8441	
dt_25	0.000629069	0.0275022	0.02287	0.9823	
dt_26	0.00206306	0.0256666	0.08038	0.9377	
dt_27	0.0168014	0.0303468	0.5536	0.5933	
dt_28	0.00673333	0.0317881	0.2118	0.8370	
dt_29	0.00292285	0.0266436	0.1097	0.9151	

dt_30	−0.00738102	0.0248151	−0.2974	0.7729	
dt_31	0.00209443	0.0269852	0.07761	0.9398	
dt_32	−0.000421093	0.0272763	−0.01544	0.9880	
dt_33	0.0142953	0.0298044	0.4796	0.6429	
dt_34	0.0181208	0.0277722	0.6525	0.5304	
dt_35	0.0142573	0.0298681	0.4773	0.6445	
dt_36	−0.000559867	0.0159676	−0.03506	0.9728	
dt_37	0.0238963	0.0167720	1.425	0.1880	
dt_38	−0.0561053	0.0252941	−2.218	0.0537	*
dt_39	0.00543000	0.0154310	0.3519	0.7330	

Mean dependent var	−0.389114	S.D. dependent var	0.109273
Sum squared resid	0.434908	S.E. of regression	0.036031
LSDV R-squared	0.906369	Within R-squared	0.736148
Log-likelihood	772.3735	Akaike criterion	−1434.747
Schwarz criterion	−1216.609	Hannan-Quinn	−1348.276
rho	0.665903	Durbin-Watson	0.654377

```
Joint test on named regressors -
 Test statistic: F(7, 9) = 106.53
 with p-value = P(F(7, 9) > 106.53) = 6.24359e-08

Robust test for differing group intercepts -
 Null hypothesis: The groups have a common intercept
 Test statistic: Welch F(9, 154.3) = 19.4067
 with p-value = P(F(9, 154.3) > 19.4067) = 1.88152e-21

Hausman test -
  Null hypothesis: GLS estimates are consistent
  Asymptotic test statistic: Chi-square(7) = 25.2131
  with p-value = 0.000695519

Wald joint test on time dummies -
  Null hypothesis: No time effects
  Asymptotic test statistic: Chi-square(38) = 117.709
  with p-value = 4.40305e-10
```

Model 12: Fixed-effects, using 390 observations
Included 10 cross-sectional units
Time-series length = 39
Dependent variable: l_EmpPop1524
Standard errors clustered by unit

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	−5.23235	1.03932	−5.034	0.0007	***
l_RealMinimumWage	−0.0103925	0.0776087	−0.1339	0.8964	
l_RealMinimumWage_1	−0.0456227	0.0643821	−0.7086	0.4965	
l_RealAverageHourlyWage	0.0282818	0.100559	0.2812	0.7849	
l_RealAverageHourlyWage_1	0.0997505	0.140839	0.7083	0.4967	
l_Maleunemploymentrate2554	−0.183154	0.0336805	−5.438	0.0004	***
l_RealPerCapitaIncome	0.344015	0.126525	2.719	0.0236	**
l_Popshare1524	−0.796049	0.172877	−4.605	0.0013	***
dt_2	0.186713	0.115588	1.615	0.1407	
dt_3	0.182371	0.113117	1.612	0.1414	
dt_4	0.183518	0.107871	1.701	0.1231	
dt_5	0.162194	0.101596	1.596	0.1449	
dt_6	0.144584	0.0966774	1.496	0.1690	
dt_7	0.147433	0.0913877	1.613	0.1411	
dt_8	0.133221	0.0892683	1.492	0.1698	
dt_9	0.132879	0.0834560	1.592	0.1458	
dt_10	0.105483	0.0824083	1.280	0.2325	
dt_11	0.0833525	0.0787985	1.058	0.3177	
dt_12	0.0567326	0.0776596	0.7305	0.4836	
dt_13	0.0428032	0.0695313	0.6156	0.5534	
dt_14	0.0233825	0.0686970	0.3404	0.7414	
dt_15	−0.0217263	0.0662589	−0.3279	0.7505	
dt_16	−0.0359209	0.0604800	−0.5939	0.5672	
dt_17	−0.0282954	0.0592975	−0.4772	0.6446	
dt_18	−0.0253014	0.0563602	−0.4489	0.6641	
dt_19	−0.00909021	0.0560902	−0.1621	0.8748	
dt_20	0.0203596	0.0565651	0.3599	0.7272	
dt_21	0.0264520	0.0494945	0.5344	0.6060	
dt_22	0.00415679	0.0494904	0.08399	0.9349	
dt_23	−0.0100025	0.0489778	−0.2042	0.8427	
dt_24	0.0107385	0.0466684	0.2301	0.8232	
dt_25	0.0182458	0.0396771	0.4599	0.6565	
dt_26	0.0265310	0.0346202	0.7663	0.4631	
dt_27	0.0376439	0.0344191	1.094	0.3025	
dt_28	0.0151872	0.0331776	0.4578	0.6580	
dt_29	0.000255455	0.0307868	0.008298	0.9936	

```
      dt_30            -0.0157667  0.0306665   -0.5141     0.6195
      dt_31            -0.0179328  0.0282654   -0.6344     0.5416
      dt_32            -0.0311223  0.0305819    -1.018     0.3354
      dt_33           -0.00820672  0.0290114   -0.2829     0.7837
      dt_34           -0.00344620  0.0255704   -0.1348     0.8958
      dt_35            -0.0120103  0.0290999   -0.4127     0.6895
      dt_36            -0.0225576  0.0201593    -1.119     0.2921
      dt_37           -0.00435320  0.0182243   -0.2389     0.8166
      dt_38            -0.0592764  0.0223664    -2.650     0.0265   **
      dt_39            0.00791791  0.0133072    0.5950     0.5665

      Mean dependent var    -0.588404   S.D. dependent var     0.144714
      Sum squared resid      0.580931   S.E. of regression     0.041643
      LSDV R-squared         0.928689   Within R-squared       0.808210
      Log-likelihood         715.9216   Akaike criterion      -1321.843
      Schwarz criterion     -1103.705   Hannan-Quinn          -1235.372
      rho                    0.761889   Durbin-Watson          0.465779

Joint test on named regressors -
 Test statistic: F(7, 9) = 389.128
 with p-value = P(F(7, 9) > 389.128) = 1.94248e-10

Robust test for differing group intercepts -
 Null hypothesis: The groups have a common intercept
 Test statistic: Welch F(9, 154.0) = 18.8012
 with p-value = P(F(9, 154.0) > 18.8012) = 6.65544e-21

Hausman test -
  Null hypothesis: GLS estimates are consistent
  Asymptotic test statistic: Chi-square(7) = 49.0672
  with p-value = 2.20123e-08

Wald joint test on time dummies -
  Null hypothesis: No time effects
  Asymptotic test statistic: Chi-square(38) = 254.241
  with p-value = 8.46246e-34
```