

The Disemployment Effect of Minimum Wages in Canada Using Provincial Panel Data

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## **Abstract**

The effect of minimum wages on the employment rate has been a topic of great concern in recent studies. The mainstream view is that the minimum wage has a negative effect on teenage employment and this conclusion is consistent for Canada in previous studies. To verify the disemployment effect of minimum wages in Canada, this paper uses updated data for the time period 1983-2014 for nine provinces to estimate the effects of the minimum wage on teenage employment, and test provincial effects of the minimum wage and control variables. My results support the mainstream view of the disemployment effect of minimum wages, and this conclusion is robust to the specification of the model. Also, allowing province-specific effects of control variables helps to improve the performance of the model, while including provincial effects of the minimum wage may weaken the disemployment effect of minimum wages. The results imply that the upcoming increase in minimum wages in Ontario will have only a small impact on the teenage employment rate.

**Key Words:** minimum wages, disemployment effects, panel data, specification error

## **I. Introduction**

Since New Zealand first passed a minimum wage law in 1894, many countries have implemented minimum wages nationwide. Some countries, such as the US and Canada, have developed province-level or state-level minimum wages. The minimum wage has been regarded as a political tool for redistribution and a remedy for poverty, as policy makers always try to find a balance between efficiency and equity. In an attempt to efficiently improve the living standards of low-income people, the minimum wage in Canada has been revised and increased from time to time and the changes in the minimum wage have been more frequent since 2000. The federal minimum wage rate rises automatically whenever a province or a territory increases its minimum wage.<sup>1</sup>

According to economic theory, an increase in wages will lead to a decline in employment under the assumption of a perfectly competitive labour market. Thus, whether an increase in the minimum wage will efficiently improve the standard of living of the poor is an important question. One of the key issues is how severe the disemployment effect of the minimum wage is. There have been many previous studies of the effect of minimum wages on employment (e.g., Myatt and McDonald, 2010; Neumark and Wascher, 2004; Neumark and Wascher, 2007; Campolieti et al., 2006). My study focuses on the effect in Canada by replicating the work of Myatt and McDonald (2010), but using more recent data. Like Myatt and McDonald (2010), this paper uses panel data, which is more appropriate than the time series or cross-section data used in many previous studies (e.g., Bazen and Skourias, 1997; Chapple, 1997; Maloney, 1995). Due

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<sup>1</sup> Detailed information about minimum wages in Canada can be found on the website of Employment and Social Development Canada at <https://www.canada.ca/en/employment-social-development/services/labour-standards/reports/minimum-wages.html>

to different natural and economic conditions in different provinces, the effect of minimum wages may vary across provinces. Thus, in this paper, I allow for different effects of the minimum wage and control variables in each provinces. As provincial minimum wages have changed more frequently in recent years, this study addresses the consistency of the conclusions of Myatt and McDonald (2010) when the variation of the independent variables becomes larger.

By estimating different specifications and testing the province-specific effect of different variables, this paper leads to several insights. First, the coefficient estimates I obtain are quite similar to those of Myatt and McDonald (2010), but several models perform better with new the data set, as validated by Ramsey's RESET test. Next, I find that including province-specific effects of minimum wages improves the performance of the model, and that the specification with province-specific effects for minimum wages and all control variables is best suited to the new data set. Third, my results indicate a disemployment effect of the minimum wage; the magnitude of the significantly negative effect of the minimum wage varies across provinces, with an elasticity ranging from -0.0100 to -0.1280.

The remains of this paper is organized as follows. Section II provides some basic understanding of the issues and a preliminary expectation of the follow-up results, by summarizing arguments about the minimum wage made by previous studies. Section III provides a detailed description of the model and quantitative methods of Myatt and McDonald (2010), and presents their results for the period 1976-2004. Section IV introduces the definition and descriptive statistics for the dependent and independent variables used in the model. Section V replicates the reference models using data from 1983 to 2014 for nine provinces in Canada, and compares my results with those of Myatt and McDonald (2010). In this section, I also investigate

the province-specific effects of the minimum wage and control variables, and interpret the empirical results of my study. Section VI summarizes the conclusions of the empirical analysis and puts forward some issues that may require further study, given the results of my study.

## **II. Literature Review**

Since the implementation and popularization of minimum wages in many countries and industries, the effect of minimum wages on the employment rate and other labour market variables has become an increasingly important issue. According to economic theory, if the labour market is assumed to be a closed and perfectly competitive market with no regulation or minimum wages, an equilibrium is achieved as the result of the adjustment between the supply of and the demand for labour. When a federal or provincial government implements minimum wages above the market-clearing level in the low-skilled labour market, the market wage is politically pushed upward. Under these circumstances, the quantity of labour supplied will increase but the quantity of labour demanded will decrease, due to the increased production cost. The excess supply of low-skilled labour, the difference between labour supply and demand at the minimum wage, increases which implies there are new unemployed workers. With a further increase in the minimum wage, the quantity of labour supplied continue to increase and the quantity of labour demanded decrease further. As a result, the excess supply will be larger than before. Thus, a rise in minimum wages will lead to a further decrease in employment and increase the amount of excess supply of labour, at least theoretically. The scale of the problem is determined by many factors, such as the wage elasticity of labour demand and supply.

In empirical studies of minimum wages, one of the major changes is that more recent studies of the effect of minimum wages tend to use panel data (Burkhauser and Sabia, 2007; Myatt and McDonald, 2010; Neumark and Wascher, 2004; Neumark and Wascher, 2007), rather than simply using cross-section data or time-series data. The most obvious reason is the implementation of province-level or state-level minimum wages, which provide states or provinces with the right to set different minimum wage standards based on their own needs. In these circumstances, province-specific or state-specific effects should be considered in the model, but these would be difficult to capture in a time-series data set. Myatt and McDonald (2010) test for province-specific effects of minimum wages, and find that the inclusion of these effects is necessary to avoid specification error identified by Ramsey's RESET test. In addition, laws and regulations about the subminimum wage, which permit a wage rate below the minimum wage, make it more appropriate to use panel data when studying a certain group or a specific industry. As a result, models estimated using pure time-series data do not fit well. Another feature of the minimum wage is its slight but frequent variation over time, especially in recent decades. This makes panel data better suited to analyzing the effects of minimum wages than any other type of data, because it allows different minimum wages across provinces or states and also reflects changes in minimum wages.

In previous studies, there are mainly three dependent variables used. Some studies use the employment rates of different groups of people and judge the effect of minimum wages on employment through the sign of the coefficient of an independent variable related to the minimum wage (Bazen and Skourias, 1997; Card, 1992; Myatt and McDonald, 2010). Some studies also use the employment growth rate as the dependent variable (Dolado et al., 1996; Katz

and Krueger, 1992). Others use the unemployment rate as the dependent variable to study the effect of minimum wages on unemployment (Maloney, 1995; Mincer, 1976). For independent variables related to the employment or unemployment rate, different researchers use different indexes for the minimum wage variable. Some use the real minimum wage (Katz and Krueger, 1992; Campolieti et al, 2005) and some use a relative measure such as the adult minimum wage ratio (Baker et al., 1999; Myatt and McDonald, 2010). Due to the lagged effect of minimum wages, lagged terms also need to be considered in the model. Neumark and Wascher (1992) show that including the lagged minimum wage in the model leads to consistently adverse effects of the minimum wage on the employment-to-population ratio. The lagged minimum wage also has a significantly negative effect in the study of Myatt and McDonald (2010).

Besides a minimum wage variable, some models also include independent variables that capture business-cycle effects and economic conditions, like the age structure of the population, the school enrolment rate, etcetera. As most low-wage workers are teenagers and youth, the age structure of the population determines the size of the affected group and the overall impact of the changes in the minimum wage at the macroeconomic level. As for the school enrolment rate, researchers hold different opinions on whether the school enrolment rate should be included in the model. On the one hand, as the enrolment rate is correlated with the minimum wage, omitting the school enrolment rate may cause specification error, and a priori analysis and some studies indicate an ambiguous impact of minimum wages on school enrolment (Neumark and Wascher, 1992; Mincer and Leighton, 1980; Mincer, 1976). On the other hand, including the school enrolment rate may lead to endogeneity bias, as working outside the campus and continuing study are alternative use of time (Neumark and Wascher, 1992). For example, if the school

enrolment rate is positively correlated with the minimum wage, then the increase in the minimum wage associated with an increment in the school enrolment rate will affect the employment rate, which leads to misestimation of the effect of the minimum wage. However, Card (1992) used regional variation in wages to analyze the effects on school enrolment and found no evidence of a change in school enrolment among teenagers. According to the previous analysis and findings, it needs to carefully consider all these factors when building, extending and interpreting a model.

The effect of minimum wages on employment is one of the topics that attracts the most attention from researchers and politicians. The mainstream view on this issue is that the minimum wage has a negative effect on employment among teenagers and youth. Many papers and much research support the argument of an adverse employment effect for this group using different data sets and quantitative methods. Neumark and Wascher (1992; 2007) find that the elasticity of the employment-to-population ratio for teenagers is negative, ranging from -0.1 to -0.2, using state-specific panel data from 1973 to 1986. Sabia et al. (2012) reach a robust finding in a study of New York State that the median elasticity of employment with regard to the minimum wage is about -0.7. They also find that the adverse effect of the minimum wage on the demand for low-skilled workers has an elasticity between -0.1 and -0.3.

Despite this, a globally consistent conclusion on whether the employment effect of an increase in the minimum wage is positive or negative has not been reached, and the results of empirical analysis are inconsistent even for the same country. Some researchers have found a disemployment effect of minimum wages in France, New Zealand and Portugal (Bazen and Skourias, 1997; Maloney, 1995; Pereira, 2003), while others note that the adverse effect on

employment has little empirical support or is not robust (Dolado et al., 1996; Chapple, 1997; Portugal and Cardoso, 2006). Neumark and Wascher (2004) study the country-specific effect on employment among young workers using a dataset including 17 OECD countries during the 1975-2000 period and conclude that the impact differs substantially across countries. Also, the employment effect of minimum wages differs between developed countries and developing countries, but there are few studies that focus on developing countries other than Latin America and Brazil (Maloney and Mendez, 2004; Montenegro, 2004; Carneiro and Henley, 2001; Lemos, 2009).

Unlike those countries for which conclusions are ambiguous, in Canada the disemployment effect of the minimum wage is quite clear and consistent (Neumark and Wascher, 2004; Baker, 2005). Campolieti et al. (2005) find the elasticity of the disemployment effect ranges from 0.3 to 0.5 within the period 1993-1999, and ranges from 0.14 to 0.44 in another study based on Canadian data for the period 1981-1997 (Campolieti et al., 2006). Sen et al. (2011) show that a 10% increase in the minimum wage would lead to a 3%- 5% decrease in employment for teenagers, and these affected teenagers are associated with about 5% percentage of families living with low income.

Changes in the level of the minimum wage and its coverage will also affect labour mobility. Mincer (1976) uses different functions to briefly discuss the inflow and outflow of the labour force and equilibrium unemployment in the covered and uncovered sectors in the economy. The sectors covered by the minimum wage attract more low-wage workers from uncovered industries, while some workers in the covered sectors lose their job. The flow of labour and the wage gaps between different regions and industries facilitate the movement of the

labour market to a new stable point. Some papers have looked at the impact at the minimum wage on labor market transitions such as Brochu and Green (2013) and Portugal and Cardoso (2006). The increasing minimum wage also causes a transition from employment to non-employment of low-wage workers with wages above the minimums (Campolieti et al., 2005).

Another potentially important effect of the minimum wage is the change in school enrolment, as the minimum wage has a greater effect on teenagers and youth. Due to the attributes that determine the supply of and demand for labour in different industries, the minimum wage has a greater influence in certain industries including agriculture, wholesale, retailing, food and other service sectors in which the labour force, especially young workers, play an important role. Battle (2003) also concludes that about 60% of low-income workers are teenagers and young workers that live with their parents. Battle and Torjman (2012) find that minimum wage workers always have a lower level of education and a higher dropout rate, especially for high-school students. It is easy to understand that high paying positions always require more experienced and skilled workers. As educational background is a widely accepted signal in the labour market, highly educated workers tend to obtain job opportunities with higher wages. The teenagers who drop out of schools to find full-time jobs are less competitive in the labour market, which increases the possibility that they will get lower wages. The increase in the minimum wage will also prolong the length of schooling due to an increase in the number of part-time students (Mincer and Leighton, 1980).

Besides the effects on employment and schooling, the minimum wage has an influence on the cost of human capital incurred by employers. Intuitively, an increase in the minimum wage raises the income of low-wage workers, but it will also indirectly affect the non-wage

benefits of employees such as shuttle service, free lunches and on-the-job training. Mincer and Leighton (1980) show that the minimum wage has an unambiguous impact on on-the-job training in that the increase in the minimum wage creates obvious barriers to on-the-job training. Through the empirical analysis of the effect on training, they also note that the minimum wage would discourage not only general training but also firm-specific training, which reduces the opportunity for job advancement. Similarly, Carrington and Fallick (2001) study the career path of low-wage workers and find that most minimum wage workers usually regard a minimum wage job as a starting point, which implies that they tend to look for a better or higher-wage job after gaining experience and job-related training. Thus, an increase in the minimum wage and the associated reduction in training makes it harder for them to get these temporary stepping-stones, and may even block further development in their career path.

As mentioned above, the change in the minimum wage has an impact on the employment rate, the length of schooling and training opportunities. Some studies (Battle, 2003; Battle and Torjman, 2012) analyze the minimum wage and minimum wage workers throughout Canada compared with the US and other industrialized countries and discuss the relationship between the minimum wage and the Working Income Tax Benefit (WITB).<sup>2</sup> Battle(2003) shows that about one-fourth of minimum wage workers are couples and at least one of the pair earns a salary more than the minimum wage for most couples. Not many of the minimum wage workers are unattached individuals or single parents. Burkhauser and Sabia (2007) reach a similar conclusion that most minimum wage workers live in non-poor families with the family income above the

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<sup>2</sup> The working income tax benefit (WITB) is a refundable tax credit for working low-income individuals and families. Detailed information about WITB in Canada can be found on the website at <https://www.canada.ca/en/revenue-agency/services/child-family-benefits/working-income-tax-benefit-witb.html>

minimum. Combined with the disemployment effect, the increasing minimum wage has many side effects and may not be a desirable policy because it may not improve the standard of living as it was intended to do. Meanwhile, the effect on the employment could be smaller for the same reason that not many workers and families are influenced by the implementation of an increase in the minimum wage (Brown, 1988).

Finally, the minimum wage has always been regarded as an anti-poverty tool to help those with low income. Considering all of the above-mentioned factors, whether the increase in the minimum wage would effectively improve the standard of living of those whose wage is at the minimum wage level, as it is intended to do, remains to be discussed. Several studies show that the minimum wage may not work as efficiently as expected and is not necessary for anti-poverty (Sabia and Burkhauser, 2010; Burkhauser and Sabia, 2007; Card and Krueger, 1995). Sabia and Burkhauser (2010) study the relationship between the federal minimum wage and the degree of poverty and show that an increase in the minimum wage has no significant effect on the poverty rate in 2003-2007 period. All these results suggest that minimum wages may not be adequate to improve the lives of poor workers and their families.

### **III. Previous Base Model and Econometric Specifications**

Using new data sets to replicate a previously published study or model is a commonly used method to perform a comparative analysis of results and review the validation of a model. Usually, when a replicated experiment fails to reach results similar to the previous one, the reasons for the failure need to be carefully considered and interpreted. Any changes in the related policies, laws or other factors that affect the economic environment may lead to a mismatch

between the results of previous studies and subsequent ones. With this in mind, the analysis of this paper is mainly divided into two parts. In this section, I describe and analyze specifically the investigation and the results of Myatt and McDonald's study (hereafter referred to as MM) (2010). Then, in section V I replicate their model and methods to test whether their findings still hold using newer data and provide a detailed interpretation of my results.

The objective of MM is to test the robustness of the base model with respect to functional form and province-specific effects, so they mainly focus on whether different specifications of the model yield consistent results and pass Ramsey's regression specification error test (RESET). At the beginning of the study, they replicate the base model of Baker, Benjamin and Stanger (1999), and estimate the regression model in both linear and logarithmic forms to determine which form best fits with data. They rewrite the equation of the base model used by Baker, Benjamin and Stanger (1999) as:

$$E_{it} = \alpha + \beta_1 \cdot MW_{it} + \varphi \cdot X_{it} + \sum_{i=1}^{N-1} \pi_i \cdot PROV_i + \sum_{t=1}^{T-1} \phi_t \cdot YEAR_t + \varepsilon_{it} , \quad (1)$$

where  $i$  represents the province and  $t$  represents the year;  $N$  is the total number of provinces;  $T$  is the total number of year;  $E_{it}$  is the employment ratio among teenagers;  $MW_{it}$  is the ratio of the minimum wage to the average hourly wage in manufacturing;  $X_{it}$  is the vector of control variables that is used to capture business cycle effects and economic conditions, which includes the prime-aged male unemployment rate, provincial real GDP and the ratio of the population of teenagers to the population of working-aged people; and  $PROV_i$  and  $YEAR_t$  are dummy variables for provinces and years.

Then, they extend the time period of the data set from 1976-1993 to 1976-2004 and test for the existence of specification error by carrying out Ramsey's RESET test. They find that all specifications except for the basic linear model fail the RESET test, and suggest that the omission of the lagged minimum wage and the heterogeneity of province-specific cycle effects are two major reasons why the regressions for the time period 1976-2004 fail the specification error test. Based on this consideration, they add the one-period lag of the minimum wage term and variables to capture province-specific trends, which are also referred to as "province-specific year dummies" (Myatt and McDonald, 2010, p. 80), to study the time-lag effect of minimum wages and the provincial cyclical impact of the control variables. In the process, they use the AIC and F-tests to verify whether an independent variable should be included in or excluded from the model.

Table 1 presents their results for different specifications of the linear form of the model, in order to compare their findings with mine. However, the new models with added variables still fail to pass the RESET test in both linear and logarithmic versions, which indicates that changing the functional form of the model is not a valid solution to the problem of specification error. In their analysis, there is no great difference between the linear and logarithmic forms of the model. More specifically, they state: "the linear model is overwhelmingly preferred in the 1976-93 period, but there is only a slight preference for the linear model in the whole period (1976-2004)" (Myatt and McDonald, 2010, p. 81-82). Thus, in this paper, I choose to use the linear form to perform regressions and compare the results with those of MM.

**Table 1. Different Specifications and Datasets for The Disemployment Effect**

	Time Period	Minimum Wage Coefficient	Lagged Minimum Wage Coefficient	RESET Test (p-value)
<b>Base Model (1976-1993)</b>	1976-1993	-0.2992**	-	0.127 (PASS)
<b>Base Model (1976-2004)</b>	1976-2004	-0.3091**	-	0.000 (FAIL)
<b>Base Model + Lagged Minimum Wage</b>	1976-2004	0.0743	-0.4452**	0.000 (FAIL)
<b>Base Model + Lagged Minimum Wage + Provincial Time Trend</b>	1976-2004	0.1163	-0.3664**	0.001 (FAIL)

Source: Myatt and McDonald, 2010, p. 81

*Note: The independent variables in the base model include the minimum wage, control variables and dummy variables. The significance level is 1%, denoted as \*\*. I regard a p-value less than 0.05 as indicating a failure of the RESET test.*

As is well-known to all, Canada has a vast territory and a greatly uneven distribution of resources. These objective conditions and the federal governing structure lead to heterogeneity in the economic environments of the provinces. To test whether the effects of control variables and minimum wages on the employment rate vary greatly among nine provinces in Canada, MM explore four different specifications in which they replace the minimum wage term or control variables with province-specific interaction terms, and perform regressions using a data set that covers the time period 1976-2004. In particular, the four specifications are : 1) no province-specific effects included; 2) only the minimum wage and the lagged minimum wage have province-specific effects; 3) only the control variables have province-specific effects; 4) all of the minimum wage terms and control variables have province-specific effects. They estimate linear regressions for these four specifications both for the pre-specified model, which is the base

model with lagged minimum wages, and the model with province-specific time trends. Table 2 presents the results of MM with respect to the minimum wage elasticity of different specifications out of regard for including different provincial interaction terms. Comparing the minimum wage elasticity in nine provinces, they find that those provinces in which the minimum wage has significant effects on the teenage employment rate show adverse effects of the minimum wage on employment. As shown in Table 2, the fourth specification in which all independent variables are allowed for province-specific effects is the only one that passes the RESET test for both pre-specified model and the model with a provincial time trend. For results of this specification, minimum wages elasticities of the teenage employment rate are negative in all provinces except for Newfoundland and Labrador, though coefficients of some provinces are not significant at the 5% significance level. Due to the above findings, they conclude that the province-specific effects of minimum wage terms and control variables need to be carefully considered and cannot be excluded from the model, because otherwise there would cause the problem of specification error.

**Table 2. The Effect of Minimum Wages on Employment Ratio for Nine Provinces**

Specifications	Models	Number of Provinces with Significant Effects	Number of Provinces with Significant Negative Effects	RESET Test (p-value)
1)	Pre-specified Model	9/9	9/9	0.0001 (FAIL)
2)		3/9	3/3	0.0019 (FAIL)
3)		9/9	9/9	0.0024 (FAIL)
4)		5/9	5/5	0.2698 (PASS)
1)	Pre-specified Model + Provincial Time Trend	9/9	9/9	0.0014 (FAIL)
2)		2/9	2/2	0.0779 (PASS)
3)		9/9	9/9	0.1520 (PASS)
4)		2/9	2/2	0.3871 (PASS)

Source: Myatt and McDonald, 2010, page 83

*Note: The numbers in Column 1 indicate the four different specifications listed above. The significance level is 1% . I regard a p-value less than 0.05 as indicating a failure of the RESET test.*

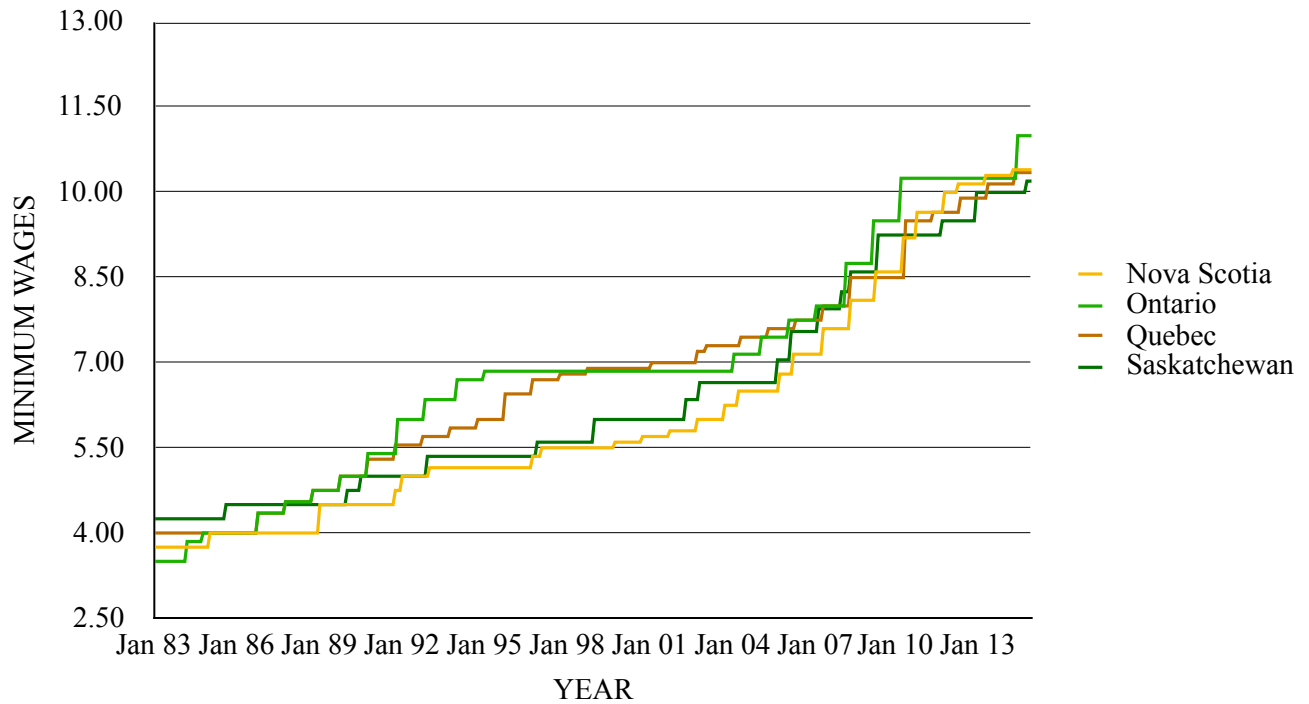
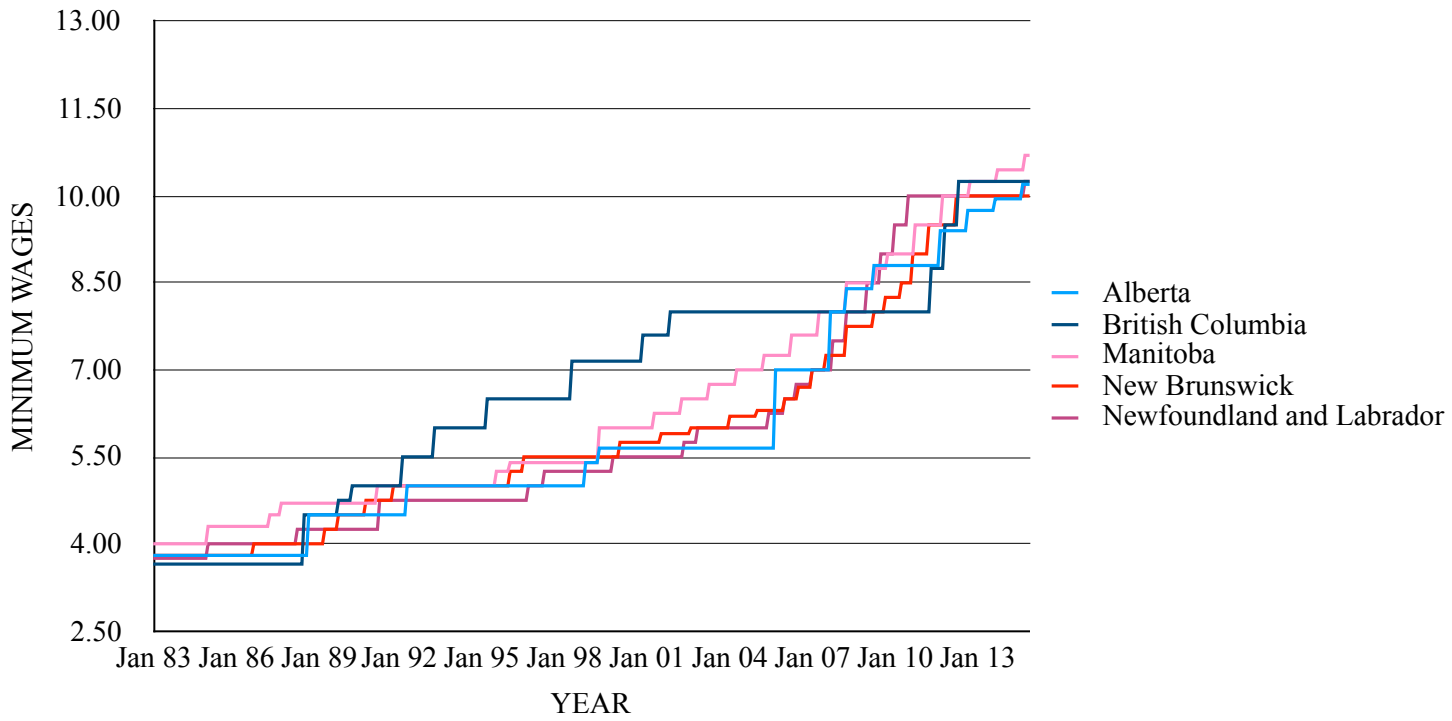
#### IV. Data

The data and variables in this paper follow the definitions and data sources of MM. My entire data set includes the data from nine provinces in Canada: Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland and Labrador, Nova Scotia, Ontario, Quebec, and Saskatchewan, from 1983 to 2014.<sup>3</sup> As this paper mainly investigates the effects of minimum wages on employment, the dependent variable used in my model is the teen employment-

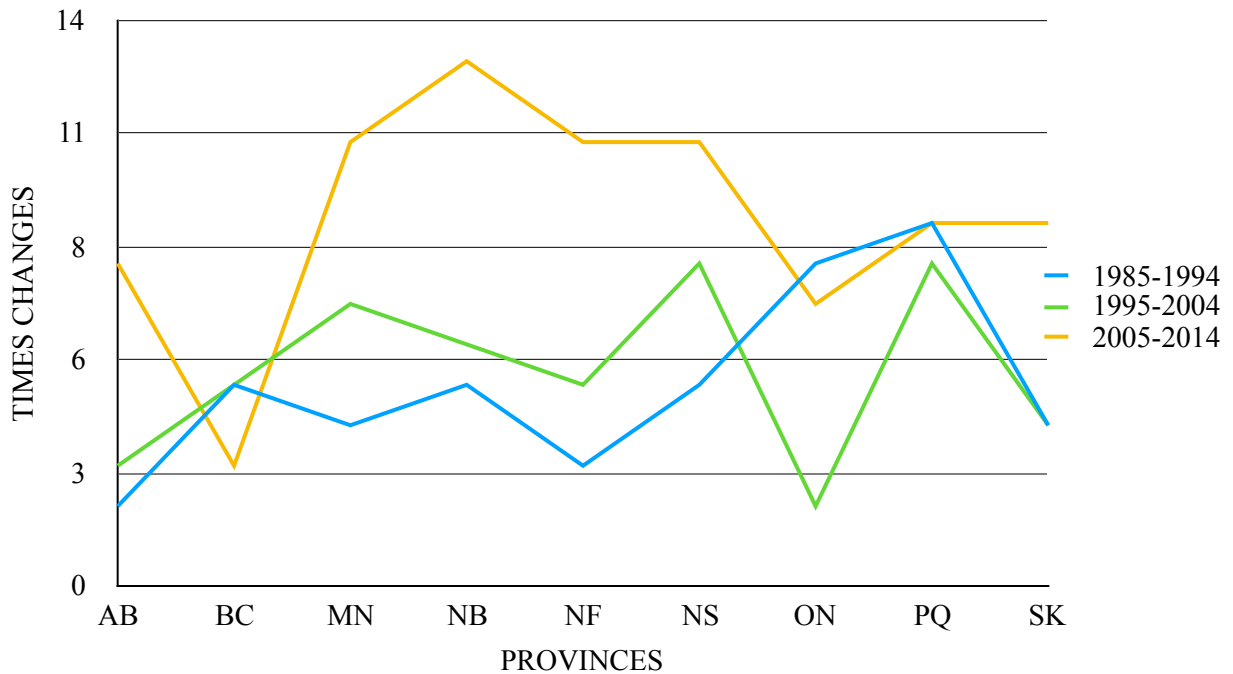
<sup>3</sup> Prince Edward Island and the Territories are not included in order to remain consistent with MM.

population ratio, which is an index of teenage employment. Following MM, it is calculated as the employment rate of teenagers over the population of teenagers and annualized by taking the average of monthly data.

The independent variable used as an index for the minimum wage level in the model is the ratio of the adult minimum wage to the average hourly wage in manufacturing. MM mention that “ the wage distribution for teens has a prominent spike at the adult minimum wage ”(Myatt and McDonald, 2010, p. 79). Thus, the hourly minimum wage for adult workers is used as the numerator, rather than the teen minimum wage. Provinces set and revise their own minimum wages and the hourly minimum wage for adult workers shows an upward trend in each province. Figure 1 shows the data of hourly minimum wages for adult workers in Canada. Changes in minimum wages have been more frequent in each province in recent ten years, except in British Columbia. I can see this by counting the number of changes in minimum wages during each ten-year period from 1985-2014. As figure 2 shows, in general provinces have changed their minimum wages more frequently as time goes by. During the period 1995-2004, as compared to the 1985-1994 period, Manitoba and Nova Scotia obviously changed their minimum wages more frequently than during the 1985-1994 period. During the period 2005-2014, five provinces including Alberta, Manitoba, New Brunswick, Newfoundland and Labrador, and Nova Scotia changed their minimum wages much more frequently than before.



**Figure 1. Hourly Minimum Wage For Adult Workers in Canada (1983-2014)**



**Figure 2. Changes in Minimum Wages For Each Provinces (1985-2014)**

Source: Author's calculations for figure 1 and figure 2 are based on data from Minimum Wage Database on the website <http://srv116.services.gc.ca/dimt-wid/sm-mw/rpt2.aspx?GoCTemplateCulture=en-CA>

As mentioned above, three control variables are used to capture the business cycle and economic conditions. They are the unemployment rate, real GDP and the population share of teenagers in MM's study. These three control variables respectively provide controls for demand and supply in the labour market; the unemployment rate and real GDP control for labour demand in each province and the age structure mainly reflects the effect of labour supply. The unemployment rate in the model is defined as the prime-aged male unemployment rate, where "prime-aged" means the age group 25 to 54 years. Real provincial GDP is a commonly used index to reflect local economic conditions and economic growth. The population share of teenagers is the ratio of the teenage population relative to the population of working age, which is defined as the age group 15 to 64 years by MM. Detailed information on data source is

provided in the appendix at the end of this paper. Table 3 shows descriptive statistics for the dependent and independent variables used in my study.<sup>4</sup>

**Table 3. Descriptive Statistics of Variables in Base Model**

<b>Variables</b>	<b>Obs</b>	<b>Mean</b>	<b>Standard Deviation</b>	<b>Min</b>	<b>Max</b>
Employment rate	288	0.4261	(0.0858)	0.1643	0.5848
Minimum wages	288	0.3767	(0.0478)	0.2461	0.5095
Unemployment rate	288	0.0832	(0.0358)	0.0240	0.1893
Real GDP (million)	288	138120.8	(152882)	13379.0	648890.0
Population share	288	0.1055	(0.0146)	0.0784	0.1668

## **V. Disemployment Effects of The Minimum Wage During 1983-2014**

MM replicate and extend the base model of Baker, Benjamin and Stanger (1999). They come to the conclusion that the minimum wage has an adverse effect on the employment rate of teenagers. They also find that the lagged minimum wage has a significantly negative effect on the employment ratio and that province-specific effects should be included in the model to avoid specification error. In this section, I follow the same procedures using new data to test whether similar conclusions can be reached to ensure the robustness of the model and support the mainstream opinion regarding the disemployment effect of minimum wages in Canada on teenagers. MM also note that the provincial time trend has little impact on the results of

<sup>4</sup> The base year for real GDP is 2007 and the unit of real GDP listed in the table is (dollars x 1,000,000). In order to remain consistent with MM's study, I divide the value of real GDP by 1,000,000 in the empirical analysis.

Ramsey's RESET test. Thus, in this study, I choose to use the linear version of the model and ignore the effect of provincial time trends when I perform regressions including province-specific interaction terms.<sup>5</sup> An improvement of my study is to use more recent data for nine provinces in Canada for the period 1983-2014, while MM use data for 1976 to 2004.

As previously mentioned, the linear version of the model is slightly preferred to the logarithmic version in MM's study. In order to better compare my results with MM and remain consistent with the methods used by them, I estimate the effect of independent variables on the teenage employment rate using the method of ordinary least squares (OLS), which minimizes the sum of the squares of differences between actual and predicted value. The main reason is to keep consistent with the reference study. Thus, ordinary least squares is an appropriate method for estimation in my study.

First of all, without allowing for province-specific effects of minimum wages and control variables, I estimate the effect of minimum wages on employment using the base model, equation (1), and test for the existence of specification error. Table 4 presents the regression results of both my study and MM's, and also indicates whether different specifications of the model pass the RESET test. Column (1) shows the results of MM's study for the base model, which includes the minimum wage, three control variables, provincial dummies and year dummies as independent variables and is estimated using data from 1976 to 2004. Column (2) represents my replication of the base model using new data. Though there exist deviations of the coefficients in Column (2) from those of MM due to differences in data sources and time period, the significantly negative effect of minimum wages on the teenage employment rate is consistent

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<sup>5</sup> The province-specific interaction terms are presented as multiplying province dummies with those variables of which I intend to study the provincial effects.

with the results of MM. More specifically, the coefficients of all four independent variables are negative and significantly different from zero at the 1% significance level in both study.

Although the regression results show many similarities with the previous study of MM, the most obvious difference is that the model with new data passes Ramsey's RESET test, while the p-value in MM's study is less than 0.05 which implies a failure of the specification error test, as the null hypothesis of RESET test is that there is no specification error or the model has no omitted variables. Thus, the base model has a better performance using new data.

Though the results are not shown in the table, I do re-estimate the model using data during the period 1983-2004, and the p-value of the RESET test becomes much smaller than the p-value in Column (2). Thus, one possible explanation for the different performances of the RESET test is the difference in the time period of the two data sets, as fluctuations in minimum wages have been more frequent in the most recent ten years. Adding a lagged minimum wage term or a provincial time trend may be a solution to the problem of specification error in column (1) in the analysis of MM.

**Table 4. Benchmarking to Base Model of Myatt and McDonald (2010)**

	(1)	(2)	(3)	(4)	(5)	(6)
Sample Period	1976-2004	1983-2014	1976-2004	1983-2014	1976-2004	1983-2014
<b>MW</b>	-0.3091** (-6.24)	-0.4867** (-7.97)	0.0743 (0.67)	-0.2282 (-1.78)	0.1163 (1.08)	-0.1452 (-1.87)
<b>MW(-1)</b>	-	-	-0.4452** (-3.96)	-0.3040* (-2.48)	-0.3664** (-3.62)	-0.2303** (-3.04)
<b>Unemployment Rate</b>	-1.7636** (-13.01)	-1.4840** (-9.32)	-1.7756** (13.66)	-1.5355** (-9.29)	-1.786** (-13.86)	-1.8016** (-14.26)
<b>GDP</b>	-0.2028** (-4.85)	-0.3695** (-7.80)	-0.2035** (-4.91)	-0.3828** (-7.58)	-0.2005 (-1.05)	-0.2520* (-2.19)
<b>Population Share</b>	-2.2554** (-6.47)	-1.8333** (-4.89)	-2.3768** (-7.03)	-1.7539** (-4.61)	-0.9127* (-2.22)	-0.4426 (-1.32)
<b>Province Dummies</b>	YES	YES	YES	YES	YES	YES
<b>Year Dummies</b>	YES	YES	YES	YES	YES	YES
<b>Provincial Time Trend</b>	-	-	-	-	YES	YES
<b>RESET test (p-value)</b>	0.000** (FAIL)	0.1336 (PASS)	0.000** (FAIL)	0.0776 (PASS)	0.001** (FAIL)	0.011* (FAIL)
<b>Adjusted R<sup>2</sup></b>	0.935	0.871	0.942	0.874	0.955	0.956
<b>Sample Size</b>	261	288	252	279	252	279

*Note: \*\* indicates a significance level of 1% and \* indicates a significance level of 5%. I regard a p-value less than 0.05 as indicating a failure of the RESET test. All regressions are weighted by province- and-year specific population. t statistics are shown in parentheses.*

Though the basic model passes the specification error test in estimation with new data, I still investigate the effects of adding the new independent variables mentioned above to the base model to determine which specification is best suited to the data. Column (3) shows MM's results when a lagged minimum wage term is added to the base model, while Column (4)

replicates this specification using the new data set. The regression coefficient of current minimum wages is negative in my study, although it is positive in the study of MM. However, this is not a severe problem because the null hypothesis that the coefficient of current minimum wage equals to zero cannot be rejected at the significance level of 5% in both estimations, which means the current minimum wage has no significant effect on the teenage employment rate at a 5% significance level. Other variables such as the lagged minimum wage and control variables all have significantly negative effects on the employment rate at the 5% significance level, even though the lagged minimum wage has a significant disemployment effect at a higher significance level than the control variables. The results of MM indicate that the lagged minimum wages is significant at 1% significance level, which is not the case in my study. This slight difference in the significance level of the lagged minimum wage may also due to the frequent changes in the minimum wage in recent years, which may have made the lagged-effect of minimum wages weaker and less important.

Similar to the results of Column (1) and Column (2), the results of MM indicate the existence of specification error identified by Ramsey's test, while the estimation of the same model passes the test. In general, the model performs better using the new data set, as both specifications in the study using the data from 1983 to 2014 pass the RESET test. Compared to the base model without the lagged minimum wage term, the lagged minimum wage in the extended model (base model with lagged minimum wage) using new data has a statistically significant effect on the employment rate at the significance level of 5%. Also, both base model and the extended model pass the specification error test identified by Ramsey's RESET test.

Thus, including the lagged minimum wage in the model does not lead to specification error and the time lagged-effect of minimum wage should be considered in the following analysis.

Column (5) shows the results of MM with the inclusion of a lagged term and province-specific time trends, while Column (6) contains my replication of this model. Three of the independent variables: the lagged minimum wage, the unemployment rate and the population share of teenagers all have significantly negative effects on the employment rate in MM's study, though at different significance level. An obvious difference is that the coefficient of real GDP is not significant in their results but it is significant at the 5% significance level using new data. MM suggest that the common year dummies may not capture provincial trends or shocks, and that the province-specific time trends should be included to alleviate this problem. Thus, the inclusion of the time trend may affect the estimation of the effect of real GDP. In the estimation with new data, the population share does not have significant effects on the teenage employment rate anymore, while the lagged minimum wage and the unemployment rate still have significantly negative effects at the 1% significance level on employment rate as shown in Column (6). As the data set in columns (4) and (6) is the same, the adjusted  $R^2$  can be used for comparison and the model with time trends obviously has higher value of the adjusted  $R^2$ . I then use the AIC score to evaluate which specification of the model is best suited and find that the specification with both the lagged minimum wage and provincial time trends has the lowest value, which is shown in table 5. However, this specification fails the RESET test with a p-value that is quite similar to that of MM. Thus, I speculate that provincial time trends are not of great concern in the new time period, which determines that my model used in the study of province-specific effects of independent variables in the following part will not include provincial time

trends. The RESET test is used to test whether some vital variables are omitted or the choice of function forms are inappropriate. As the model of columns (5) and (6) extends the specifications of columns (1)-(4) by adding new independent variables, the reason for failing the specification error test may be an inappropriate choice of function form, which needs further study.

**Table 5. AIC Score for Three Specifications Using Data During 1983-2014**

	(2)	(4)	(6)
<b>Sample Size</b>	288	279	279
<b>AIC Score</b>	-1291.091	-1259.835	-1548.793

*Note: The column number in the table matches with that in table 4 and indicates different specifications estimated using data during the period 1983-2014. Specifications of (4) and (6) include the lagged minimum wage, which reduces the sample size from 288 to 279.*

To test for provincial effects in employment, I next add several province-specific interaction terms to the base model, which allows for different effects of the independent variables on the teen employment rate in the nine provinces. Following the same procedures as MM, I consider province-specific effects of different independent variables and investigate four additional specifications in my study. My study of province-specific effects replicates the four specifications used by MM, which includes : (1) no province-specific effects; (2) only the minimum wage and the lagged minimum wage have province-specific effects; (3) only the control variables have province-specific effects; (4) all minimum wage terms and control variables have province-specific effects. The number of these four specifications matches the column number noted in table 6. The method used to incorporate province-specific effects is to add interaction terms between the provincial dummy variables and the independent variables I

focus on. As the regression equation is linear, the minimum wage elasticity is calculated as the average marginal effect given by:

$$\epsilon = \frac{dY}{dX} \frac{X}{Y} = b \frac{X}{Y}$$

where X is average minimum wages and Y is the average value of predicted dependent variable.

This study analyzes the impact of the minimum wage on the teen employment rate in nine provinces individually and pays relatively more attention to the following three aspects of the results: (1) the sign of the minimum wage elasticity, which represents statistically positive or negative effects of the minimum wage on the employment rate on teenagers; (2) whether the provincial effects of the minimum wage are significantly different from zero; (3) whether the specification of the model passes Ramsey's RESET test; and (4) which specification is best suited to the new data based on the adjusted R<sup>2</sup> and AIC score as all specifications are estimated using the same data set.

Table 6 presents the minimum wage elasticity in nine provinces for four different specifications, using data from 1983 to 2014. Column (1) shows results for the extended base model (base model with lagged minimum wages) with no province-specific interaction terms included. In this specification, the effect of the minimum wage on the employment rate is restricted to be the same for all provinces. The minimum wage results in a significant disemployment effect and the specification passes the RESET test at a significance level of 5%. Column (2) presents a specification where provincial effects of only current and lagged minimum wages are included. For five provinces where the minimum wage has a significant effect on the employment rate, the minimum wage elasticity is negative except for Quebec,

which means in other four provinces an increase in the minimum wage will lead to a decrease in the employment rate of teenagers. This specification also passes the specification error test at a significance level of 5% and has a much higher value for the adjusted  $R^2$  compared to the result in column (1). Column (3) shows the results for a specification where only control variables are allowed to have province-specific effects. As the provincial effects of minimum wages are ignored, the minimum wage elasticity does not vary by province. The elasticity is around -0.28 and significantly different from zero. However, the specification with province-specific effects for control variables only does not pass the RESET test, even with a lower AIC score and a higher value of the adjusted  $R^2$ . Column (4) is a specification that includes province-specific effects of all control variables and minimum wages. It passes the RESET test as well, and has the highest value of the adjusted  $R^2$  and the lowest AIC score. All the significant minimum wage elasticities for Alberta, British Columbia, Manitoba, New Brunswick, Nova Scotia, Ontario and Quebec imply a disemployment effect of the minimum wage.

**Table 6. The Minimum Wage Elasticity for Nine Provinces in Different Specifications**

	(1)	(2)	(3)	(4)
	MW Elasticity	MW Elasticity	MW Elasticity	MW Elasticity
<b>AB</b>	-0.4810** (-8.35)	-0.0639** (-5.53)	-0.2820** (-6.51)	-0.0408** (-2.98)
<b>BC</b>	-0.4810** (-8.35)	-0.0710** (-9.38)	-0.2820** (-6.51)	-0.0256** (-2.98)
<b>MN</b>	-0.4810** (-8.35)	-0.0269** (-3.81)	-0.2820** (-6.51)	-0.0191* (-2.25)
<b>NB</b>	-0.4810** (-8.35)	-0.0057 (-1.48)	-0.2820** (-6.51)	-0.0124** (-3.90)
<b>NF</b>	-0.4810** (-8.35)	-0.0051 (-1.09)	-0.2820** (-6.51)	0.0013 (0.33)
<b>NS</b>	-0.4810** (-8.35)	-0.0042 (-0.88)	-0.2820** (-6.51)	-0.0100* (-2.44)
<b>ON</b>	-0.4810** (-8.35)	-0.0867** (-3.27)	-0.2820** (-6.51)	-0.1280** (-5.22)
<b>PQ</b>	-0.4810** (-8.35)	0.1711** (5.26)	-0.2820** (-6.51)	-0.1123** (-3.55)
<b>SK</b>	-0.4810** (-8.35)	-0.0127 (-1.65)	-0.2820** (-6.51)	0.0036 (0.50)
<b>Sample Size</b>	279	279	279	279
<b>Adjusted R<sup>2</sup></b>	0.8739	0.9267	0.9668	0.9693
<b>RESET</b>	0.0776 (PASS)	0.2573 (PASS)	0.0340 (FAIL)	0.1615 (PASS)
<b>AIC</b>	-1259.835	-1398.873	-1613.92	-1625.984

*Note: \*\* indicates a significance level of 1% and \* indicates a significance level of 5%. I regard a p-value less than 0.05 as indicating a failure of the RESET test. All regressions are weighted by province- and-year specific population. t statistics are shown in parentheses.*

Whether province-specific effects should be included in the model is another question to be considered. To determine the necessity of allowing the effect of minimum wages to vary by province, I compare the results between column (1) and (2), as well as those between column (3)

and (4). After adding the provincial effects to the minimum wage terms in the extended base model, the new specification has a higher value of the adjusted  $R^2$  and passes the RESET test. When extending the specification of column (3) to the one of column (4) that minimum wages and control variables have province-specific effects, the new specification passes the RESET test and has a higher value of  $R^2$  and a lower value of AIC score. Based on these findings, I suggest that the provincial effects of the minimum wage should be included. However, adding provincial effects of minimum wages seems to weaken the argument about the disemployment effect of the minimum wage, as all provinces show significantly negative effects of the minimum wage on the employment rate in column (1) and (3) which no longer holds in column (2) and (4). The inclusion of province-specific effects of minimum wages reduces the number of provinces where minimum wages present significantly negative effects on employment.

With regard to the necessity of including provincial effects of control variables, the conclusion is a little ambiguous. Comparing the results in column (1) and (3), when adding province-specific effects of control variables to the extended base model, the model in column (3) has a higher value of the adjusted  $R^2$  and a lower AIC score but fails the Ramsey's RESET test. As for the results presented in column (2) and (4), the specification, with an inclusion of province-specific effects for all independent variables, indicates a higher value of  $R^2$  and lower value of AIC score and passes the Ramsey's RESET test. Adding province-specific effects of control variables to the specification of column (2) also increases the number of provinces in which the minimum wage has significantly negative effects on the teenage employment rate.

Among all four specifications, the one which allows the effects of all variables to vary by province seems to be the best-suited specification, as it has the lowest AIC score and highest

value of the adjusted  $R^2$  and passes Ramsey's RESET test. Combined with the previous results, I suggest that the province-specific effects of all independent variables should be included, especially the provincial effects of minimum wages which should not be omitted. Whether provincial effects of control variables need to be included in the model still remains to be discussed. From my results for the best suited specification, the disemployment effect of the minimum wage is quite consistent, as in seven of nine provinces there is a significant disemployment effect of minimum wages. Also, the magnitude of the effect of minimum wage on employment differs among provinces, ranging from -0.0100 to -0.1280. Whether or not the province-specific effects of the minimum wage and control variables are considered in the model, all the significant results for the minimum wage elasticity are negative except for Quebec. As the third specification in column (3) fails the RESET test, I come to a more conservative conclusion that in my study all specifications that pass the RESET test indicate an adverse effect of the minimum wage on teenage employment.

## **VI. Conclusion**

The recent mainstream argument is that the minimum wage has a negative effect on employment rate among teenagers and youth. To estimate effects of the minimum wage on the teenage employment rate in Canada and test provincial effects of the minimum wage and control variables, this paper replicates the methods and procedures used in the study of MM in 2010 and uses updated data during the time period 1983-2014. By performing regressions on different specifications, I find that the coefficients of the base model are quite similar in both studies and the coefficients of either the minimum wage or the lagged minimum wage are significantly

negative in all three specifications without the province-specific effect. Compared to the previous results of MM, the models perform better with new data, as two of the three specifications pass Ramsey's RESET test. The empirical results also show that including province-specific effects of minimum wages improves the performance of the model, as measured by a higher value adjusted  $R^2$  and a lower AIC score. Adding province-specific effects of minimum wages reduces the number of provinces in which the minimum wage has significantly negative effects on employment.

The results of my study generally accord with the mainstream argument about disemployment effects of minimum wages, which is a robust result and does not change with the specification of the model. I also find that province-specific effects of minimum wages should not be omitted. Though Ramsey's RESET test may not indicate a specification error when they are omitted, the model performs less well statistically, with a higher AIC score and a lower value of the adjusted  $R^2$ . However, the necessity of including provincial effects of control variables in the model remains unresolved, because in certain cases the inclusion of province-specific effects of control variables makes the model fail Ramsey's RESET test. Based on all the above findings, the specification with province-specific effects for minimum wages and all control variables is best suited to the new data set in my study. In this best-suited model, the conclusion that there is a disemployment effect of minimum wages still holds, and the magnitude of significantly negative effects of minimum wages varies among provinces ranging from -0.0100 to -0.1280.

The minimum wage in some provinces, such as Alberta, British Columbia, Manitoba and Ontario, has a significantly negative effect on the teenage employment rate in all four specifications. In March 2017, Ontario announced plans to increase the general minimum wage

from \$11.40 per hour to \$11.60 per hour, and the special minimum wage will increase by the same percentage as the general minimum wage students under 18. Using results for the “best” specification of this study, the estimated long-run minimum wage elasticity of Ontario is -0.1280, which implies a decrease of 0.128% in the teenage employment rate as a result of a 1% increase in the minimum wage, holding the average hourly wage constant. Thus, increasing the minimum wage from \$11.40 to \$11.60, which is an increase of 1.75%, is expected to lead to a decrease of 0.224 percentage points in the teenage employment rate, holding other factors constant. Therefore, the disemployment effect of the change is unlikely to be large.

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## **Data Appendix**

I refer to the definition of variables and data source of Myatt and McDonald (2010). My entire data set includes the data from nine provinces in Canada (Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland and Labrador, Nova Scotia, Ontario, Quebec, Saskatchewan) during the time period from 1983 to 2014. The data sources are listed below.

### **The teenage employment-population ratio**

The data is obtained from the website: <http://www5.statcan.gc.ca/cansim/a47#F10>

Detailed information is obtained from Table 282-0001 (Labour force survey estimates (LFS), by sex and detailed age group, unadjusted for seasonality, monthly) on the above website. Selected items are: Labour force characteristics = Employment rate; Sex = Both sexes; Age group = 15 to 19 years. I obtain the monthly data in teenage employment ratio. The annualized data is the average of the monthly data.

### **The ratio of adult minimum wage to the average hourly wage in manufacturing**

The data of hourly minimum wage for adult workers in Canada is from the website:

<http://srv116.services.gc.ca/dimt-wid/sm-mw/rpt2.aspx?GoCTemplateCulture=en-CA>

The average hourly wage in manufacturing industry is obtained from the website:

<http://www5.statcan.gc.ca/cansim/a47>

For data of the average hourly wage in manufacturing industry, the data during 1983-2000 is from Table 281-0004 (Average hourly earnings and average weekly hours of employees paid by the hour, (SEPH), \*Archived\*) and the data during 2000-2014 is obtained from Table 281-0029 (Survey of Employment, Payrolls and Hours (SEPH), average hourly earnings for employees paid by the hour, by overtime status and detailed North American Industry Classification System (NAICS), unadjusted for seasonality, monthly (current dollars)). I obtain the monthly data and the annualized minimum wage ratio is the average of the monthly data.

### **Control variable 1: The prime-aged male unemployment rate**

The data is obtained from the website: <http://www5.statcan.gc.ca/cansim/a47>

Detailed information is obtained from Table 282-0001 (Labour force survey estimates (LFS), by sex and detailed age group, unadjusted for seasonality, monthly). Selected items are: Labour force characteristics = Unemployment rate; Sex = Male; Age group = 25 to 54 years.

### **Control variable 2: The level of real provincial GDP**

The data of real GDP is obtained from website: <http://www5.statcan.gc.ca/cansim/a47>

Data from 1983 to 2014 is from Table 384-0038 (Gross domestic product, expenditure-based, provincial and territorial, annual (dollars x 1,000,000)) . Selected items: Prices = Chained (2007) dollars; Estimates = Gross domestic product at market prices. Here, the data source I use is different from Myatt and McDonald (2010), as they use chained 2002 dollars and the table they use only include data from 1981 to 2010.

### **Control variable 3: Population share of teenagers relative to working age population 15-64**

The data is from the website: <http://www5.statcan.gc.ca/cansim/a47>

The population share of teens = population of teens/ population of working age people.

The population of teenagers and working age group is obtained from Table 282-0001 (Labour force survey estimates (LFS), by sex and detailed age group, unadjusted for seasonality, monthly). For the population of teenagers, the selected items are: Labour force characteristics = Population; Sex = Both sexes; Age group = 15 to 19 years. For the population of working age group, the selected items are: Labor force characteristics = Population; Sex = Both sexes; Age group = 15 to 64 years.