

A Burden on the Low-Educated: Wage Implications of British Columbia's Revenue-Recycling Policy:

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Abstract

This paper inspects distributional wage effects arising from British Columbia's revenue-recycling carbon tax. I find the policy negatively affecting wages across all education-levels, with the low-educated being impacted most severely. Relative to the rest of Canada, British Columbia's low-, medium-, and high-educated experience a decrease in wages of 6.7%, 4.0%, and 3.9%, respectively. I conclude this to be a result of tax-inducing sectoral reallocation accompanied by a province-wide spillover effect. Hence, this paper suggests revenue-neutral carbon taxes may result in unequal distributional consequences.

1. Introduction

Carbon taxes have become an increasingly prevalent topic of study in recent years, with countries and regions implementing policy at a growing rate in hopes of decreasing emissions. This paper will attempt to examine the effect of British Columbia's revenue-neutral carbon tax on education-level wage distribution. While previous literature has deemed the tax successful in reducing emissions, little research has been done in investigating labor market outcomes. British Columbia's policy is intriguing for a couple of reasons. First, in accounting for approximately three-quarters of the province's total emissions, it provides an excellent opportunity to inspect environmental and labor market outcomes resulting exclusively from the tax. Second, with the policy both taxing emissions and recycling revenue, the effect on wage distribution remains ambiguous.

This notion relates to the double dividend hypothesis, in which a revenue-recycling environmental tax may improve welfare in two separate ways. First, benefits can be seen through the tax effect. By instilling a tax, the government creates a market for emissions resulting in a relative increase in the price of pollution. This price increase forces firms to either substitute away from the polluting good or scale down production, both of which will decrease total emissions. Labor is assumed to be a better substitute for energy than capital (Welsch 1996), indicating the tax effect is capable of having a positive impact on employment. Chiroleu-Assouline and Fodha (2006) suggest this outcome depends on the intertemporal elasticity of substitution. Hence, a market in which labor and energy are easily substitutable is likely to see an increase in employment and decrease in wages. These hypotheses are supported by Yamazaki (2017), which will be discussed later in the paper.

The second dividend is possible through the redistribution effect. With the government recycling all tax revenue, welfare may improve through the redistribution of income. Welsch (1996) notes that the goal of revenue recycling is to decrease the firm's price of labor while allowing workers to receive the same wage rate. This can be achieved through a reduction in the corporate income tax rate, with firms being provided an incentive to increase labor supply. In British Columbia, the high corporate tax rate was reduced from 11 percent in 2008, to 10.5 percent in 2010, to 10 percent in 2011. Similarly, the low corporate tax rate was reduced from 3.5 percent in 2008, to 3 percent in 2010, to 2.5 percent in 2011 (Ministry of Finance, 2008 – 2012). While this paper will not directly test the double dividend hypothesis, its premise is useful in evaluating wage effects of the two dividends.

Beck et al. (2015) use a static, competitive general equilibrium model to study the tax's effect on household-level income distribution. They find personal tax cuts for low and medium income households leading to a wage increase across all households, with those of higher income experiencing the greatest benefits due to their higher share of labor market income. On the contrary, their model shows lower income households capturing the majority of gains from lump-sum transfers, with lower income households having a greater dependency on transfer income. This paper differs from Beck et al. (2015) in a number of ways. First, I make use of individual-level microdata to empirically analyze distributional effects, allowing my model to include worker-specific characteristics. Second, I conduct a difference in difference analysis comparing the tax's distributional effect on British Columbia relative to the rest of Canada, providing a model better resistant to country-wide economic shocks.

This paper closely follows the work of Yamazaki (2017) and Yip (2018). Both use a difference in difference approach in empirically examining labor market consequences of the tax,

with Yamazaki (2017) looking into overall labor market effects and Yip (2018) delving into distributional consequences. Similar to Yip (2018), I obtain data from the Canadian Labor Force Survey (via Statistics Canada) to observe education-level differences. On the contrary, Yamazaki (2017) conducts an industry-level analysis, assuming emission intensity and trade intensity accurately proxy each industry's energy intensity and labor demand elasticity, respectively. Yamazaki's research finds an overall increase in employment accompanied by a decline in the wage rate, indicating positive employment effects had in cleaner industries outweigh any negative employment effects had in polluting industries, and suggesting a rise in labor supply exceeding any increase in demand. Conversely, Yip (2018) finds an overall decrease in employment. While these conclusions are insightful, investigating the tax's distributional impact is important, with governments likely to avoid policy disproportionately harming the low-educated. Thus far, only Yip (2018) has examined distributional effects. Although he notes a decrease in employment across all education levels, his research fails to address wage rates. Hence, this paper will be informative to prospective policymakers considering a revenue-neutral carbon tax.

Although the low-educated capture the majority of redistribution gains (Beck et al., 2015), Yip (2018) finds they become worse off due to involuntary and voluntary job loss. When investigating labor market effects of the Clean Air Act, Walker (2013) finds sectoral reallocation leading to earnings losses, suggesting British Columbia's low-educated workers may experience a decline in their wage rate. Yip's research support this notion, as he finds an increase of the medium- and low-educated working temporary jobs following the tax. Gathering data through 2016, my model accounts for temporary layoffs following sectoral reallocation and thus provides an accurate population when examining distributional consequences.

While prior labor market analysis of carbon taxes has proven burdensome, British Columbia's policy creates an ideal scenario to isolate both wage and employment effects. Although this paper does not empirically examine employment, I consider the double dividend hypothesis when evaluating wages. Similar to Yamazaki (2017) and Yip (2018), I use a difference in difference approach, allowing my model to account for country-specific economic shocks. In addition, I make use of individual-level microdata to investigate distributional wage effects, whereas prior empirical work has been limited to examining overall labor market effects (Yamazaki, 2017) and distributional employment effects (Yip, 2018). Thus, this paper will build upon previous research and contribute new findings on the tax's labor market outcomes.

The rest of this paper will be structured as follows. Section two introduces data sources and corresponding methodology. Section three discusses empirical findings. Section four illustrates the hypothesized temporary employment effect. Section five concludes the paper and provides policy implications.

2. Data Descriptions and Methodology

I. Data Sources

My work makes use of individual-level microdata obtained from the Canadian Labor Force Survey, spanning from January 2001 – December 2016. The survey samples roughly 100,000 individuals per month, acquiring demographic characteristics such as age, education-level, and province in addition to labor force statistics such as hourly earnings, industry, and labor force status. This microdata is ideal for examining labor market outcomes, providing a sample size representative of the entire population while allowing for control of worker specific characteristics. In this study, the low-educated are those without a high school diploma, the

medium-educated are those with a high school diploma but without a bachelor's degree, and the high-educated are those with a bachelor's degree or higher certificate.

II. Methodology

I conduct a difference in difference analysis, estimating the effect on these three groups using the following multivariate regressions:

$$Low_Ed_W_{ipt} = \alpha + \beta_1(BC_p \times Post_t) + X^T_{ipt} + \eta_p + \delta_t + \varepsilon_{ipt}, \quad (1)$$

$$Med_Ed_W_{ipt} = \alpha + \beta_1(BC_p \times Post_t) + X^T_{ipt} + \eta_p + \delta_t + \varepsilon_{ipt}, \quad (2)$$

$$High_Ed_W_{ipt} = \alpha + \beta_1(BC_p \times Post_t) + X^T_{ipt} + \eta_p + \delta_t + \varepsilon_{ipt}, \quad (3)$$

Where W_{ipt} is the hourly earnings of individual i , in province p , at time t . BC_p is a dummy equaling one if the individual resides in British Columbia, and zero if not. $Post_t$ is a dummy equaling one if in July 2008 or later, and zero if prior. Hence, the term $(BC_p \times Post_t)$ takes on the value of one if the individual resides in British Columbia following implementation of the policy. X^T_{ipt} is a vector of individual specific variables containing the respondent's age, gender, marital-status, etc. η_p accounts for province fixed effects, and δ_t accounts for *Year x Month* fixed effects. β_1 is the difference in difference estimate of the model, representing the after-tax wage effect of living in British Columbia. To capture the causal effect by education-level, I separate the population into the three groups previously mentioned and obtain a corresponding β_1 for each.

To ensure validity of the estimates, a few key assumptions must be made. First, to compare differences across education-level, I must assume the differences between each β_1 from

(1), (2), and (3) to accurately depict the differences of wage effects between each education level. To allow for this comparison, I construct the following models:

$$W_{ipt} = \alpha + \beta_1(BC_p \times Post_t \times Low_Educ) + \beta_2(BC_p \times Post_t \times High_Educ) + X_{ipt}^T + \eta_p + \delta_t + \varepsilon_{ipt} \quad (4)$$

$$W_{ipt} = \alpha + \beta_1(BC_p \times Post_t \times Low_Educ) + \beta_2(BC_p \times Post_t \times Med_Educ) + X_{ipt}^T + \eta_p + \delta_t + \varepsilon_{ipt}, \quad (5)$$

Where the coefficients take on the values previously mentioned. I interact education-level with $(BC_p \times Post_t)$, now examining the differential wage effects between each group. With the focus of this study being to assess the impact on the low-educated, I choose to exclude interaction between the medium- and high-educated. β_1 is again the difference in difference estimate, in this model representing the after-tax differential wage effect between British Columbia's low- and medium-educated in (4), and low- and high-educated in (5). If robust, the β_1 estimate from (4) should approximate the difference between the β_1 estimates for the low- and medium-educated from (1) and (2). Similarly, the β_1 estimate from (5) should approximate the difference between the β_1 estimates for the low- and high-educated from (1) and (3).¹

Second, I must assume there being no anticipatory effects of the tax. That is, my results are not driven by the announcement of the policy prior to its implementation. I argue this to be a reasonable assumption on two accounts. First, the tax was announced only four months before its implementation, leaving firms with little time to make significant changes with respect to wages. In addition, the policy's revenue recycling measure likely lessened its negative perception, with firms being aware of a decrease in the corporate income tax rate.

¹ See Table 2 in the Data Appendix for additional robustness tests.

Third, I must assume a parallel wage trend between British Columbia and the rest of Canada during the pre-tax period. I find parallel trends dating back to 2001 with all provinces, allowing my model to control for the rest of Canada entirely.²

Lastly, with the policy being introduced July 1, 2008, I must assume the results of my model are not affected by the 2008 recession. I will discuss this assumption in further detail following analysis of the results.

3. Empirical Findings

Table 1: The Education-Level Wage Effect

Difference-in-Difference Analysis					
	(1)	(2)	(3)	(4)	(5)
	Low	Medium	High	Low-Medium	Low-High
Dependent Variable: ln(Hourly Wages)					
<i>BC x Post</i>	-0.067*** (0.002)	-0.040*** (0.001)	-0.039*** (0.002)		
<i>BC x Post x Low_Educ</i>				-0.029*** (0.002)	-0.033*** (0.003)

Notes: Equations (1), (2), and (3) separate the wage effect on the low-, medium-, and high-educated, respectively. Equations (4) and (5) represent the differential effect between the low- and medium-educated, and the low- and high-educated, respectively. All results contain province and *Year x Month* fixed effects, in addition to individual specific variables. The data used is from the Canadian LFS, spanning from January 2001 - December 2016, with July 2008 - December 2016 being the post-tax period. British Columbia is the treatment group, while the rest of Canada is the control group. In equations (1), (2), and (3), the number of observations are 1358207, 6614564, and 2039229, respectively. Equations (4) and (5) have 10012039 observations. For equations (1), (2), and (3), the Adjusted R-Squareds are 0.504, 0.372, and 0.221, respectively. Equations (4) and (5) have an Adjusted R-Squared of 0.444. Robust Standard Errors are clustered by province and included in parenthesis below each estimate. Significance Levels: *** = 1%, ** = 5%, * = 10%

Table 1 displays the individual effect on each education-level in addition to the differential effects between each education-level. The tax negatively affects wages across all education levels, causing wages of the low-, medium-, and high-educated to decrease by 6.7%, 4.0%, and

² See Figure 1 in the Data Appendix.

3.9%, respectively. Equations (4) and (5) allow for comparison between education-levels and serve as a robustness check for equations (1), (2), and (3). The results indicate wages of British Columbia's low-educated decrease 2.9% relative to the province's medium-educated, and 3.3% relative to the province's high-educated.

4. The Temporary Employment Effect

I claim the observed wage effect to be a result of tax-inducing sectoral reallocation accompanied by a spillover effect into other industries. First, the policy causes job losers in energy intensive industries to pursue lower paying, temporary jobs. The low-educated are affected most severely, being heavily concentrated in these industries. The decrease in labor demand then causes wages to fall in industries province-wide, explaining the adverse effect on the medium- and high-educated. I hypothesize the 6.7% decrease in wages is not uniform across the low-educated. Those unaffected by the temporary employment effect likely experience a decrease in wages similar to the medium- and high-educated. Conversely, I believe workers forced into temporary employment see a decrease in wages greater than 6.7%. Although this paper does not empirically test the temporary employment effect, support of this hypothesis is provided in the following section.³

I. Tax or Recession Driven?

To confirm causal effect of the carbon tax, I must assume the results of my model are not driven by the 2008 recession. One could suggest British Columbia was hit harder by the recession than the rest of Canada, explaining the province's relative decrease in wages across all education-levels. I argue this to be an inaccurate conclusion for two reasons. First, in line with the parallel trend assumption, I observe British Columbia closely following the rest of Canada's wage trends

³ In addition, Walker (2013) and Yip (2018) discuss relevant findings in their research.

in prior, smaller-scale booms and recessions. Moreover, I examine unemployment and labor force participation rates of the two groups. I find no such trends of British Columbia being more vulnerable to previous recessions.⁴ Second, if caused by the recession, the differential increase in temporary employees between British Columbia and the rest of Canada would be greatest in the years immediately following the recession. Furthermore, the gap would likely close over time as these temporary employees found new, permanent jobs. Instead, the difference increases over time, suggesting causal effects by the carbon tax.⁵ With the carbon tax increasing at a fixed rate of \$5/ton each year from 2008 to 2012, I expect a gradual increase in layoffs during this period and the years following. Hence, the number of temporary employees in British Columbia relative to the rest of Canada would likely increase over time.

5. Policy Implications and Conclusion

Although the tax has proven successful in decreasing emissions, its negative wage effect provides valuable insight to policymakers considering implementation of a similar policy.

Relative to the rest of Canada, British Columbia's low-, medium-, and high-educated experience a fall in wages of 6.7%, 4.0%, and 3.9%, respectively. These results are backed by an additional analysis to allow for comparison, in which low-educated wages decrease 2.9% relative to the medium-educated, and 3.3% relative to the high educated. I conclude these findings to be a result of tax-inducing sectoral reallocation accompanied by a province-wide spillover effect.

The low-educated experience the greatest burden from sectoral reallocation, while the negative shock to labor demand produces a spillover effect lowering medium- and high-educated wages.

⁴ See Figures 2 and 3 in the Data Appendix. Consistent with Yip (2018), I observe a shock in early 2005 in which British Columbia's unemployment and LFP rates improve while the rest of Canada's worsen.

⁵ See Figure 4 in the Data Appendix.

The revenue-neutral aspect of the policy is designed to compensate firms and workers for negative labor market outcomes arising from the tax. In this case, firms see a reduction in the corporate income tax rate while workers benefit from a reduction in the personal income tax rate. In addition, low-income households are provided lump-sum transfers in an attempt to counteract unequal distributional consequences. This paper proves the low-educated are disproportionately affected by the tax. While personal income tax cuts and lump-sum transfers remedy those unaffected by the temporary employment effect, the reimbursements are insufficient to job losers in energy-intensive industries. As such, prospective policymakers should consider additional compensation packages and employment programs to counteract the temporary employment effect.

Data Appendix

I. Labor Market Trends

Figure 1: Wage Trends

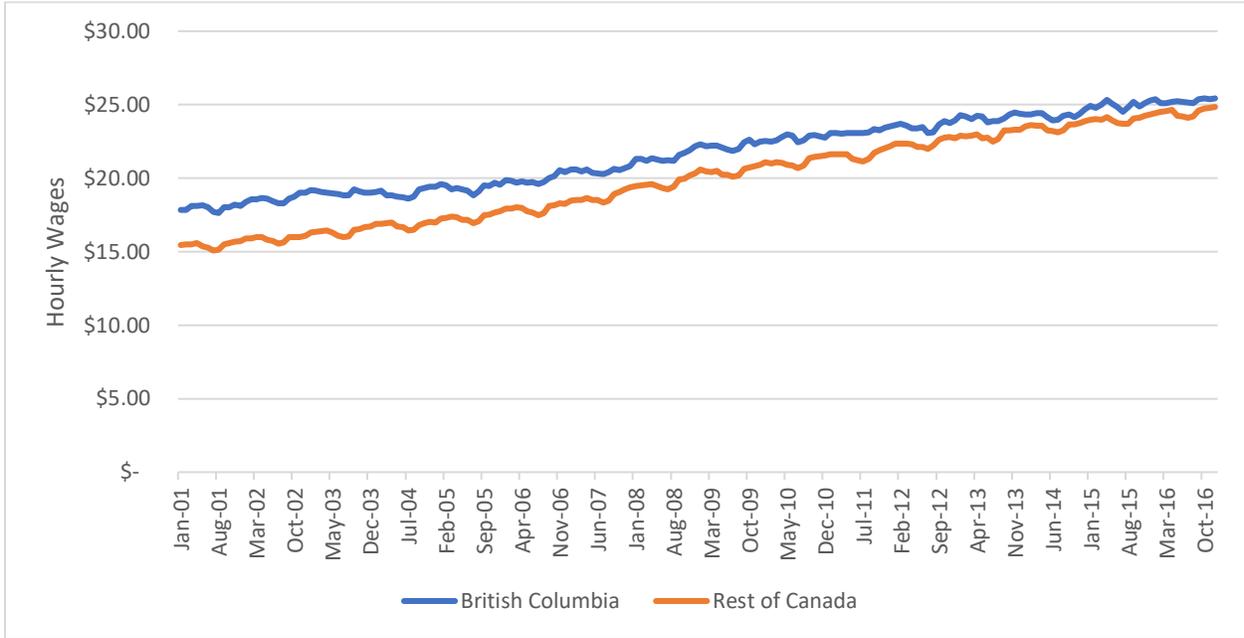


Figure 2: Unemployment Rate

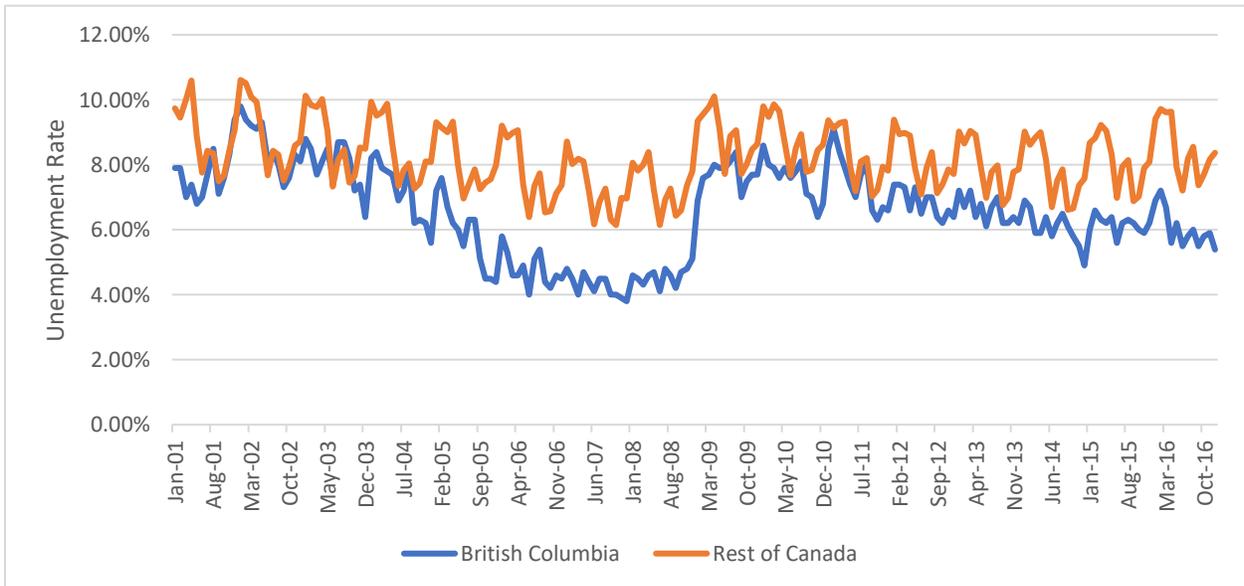


Figure 3: Labor Force Participation Rate

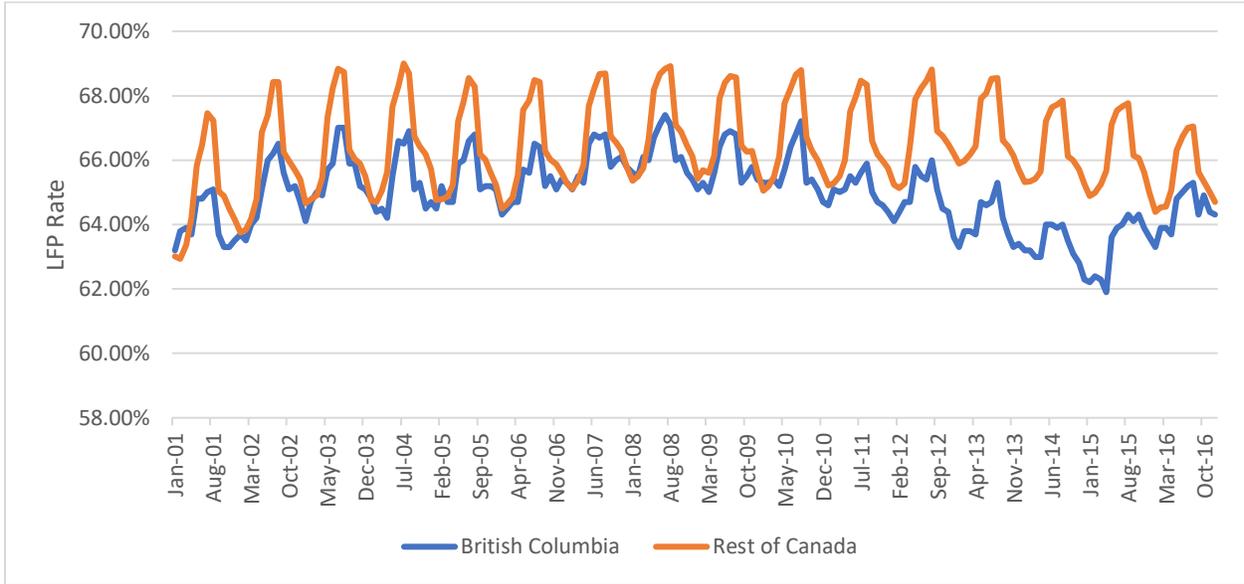
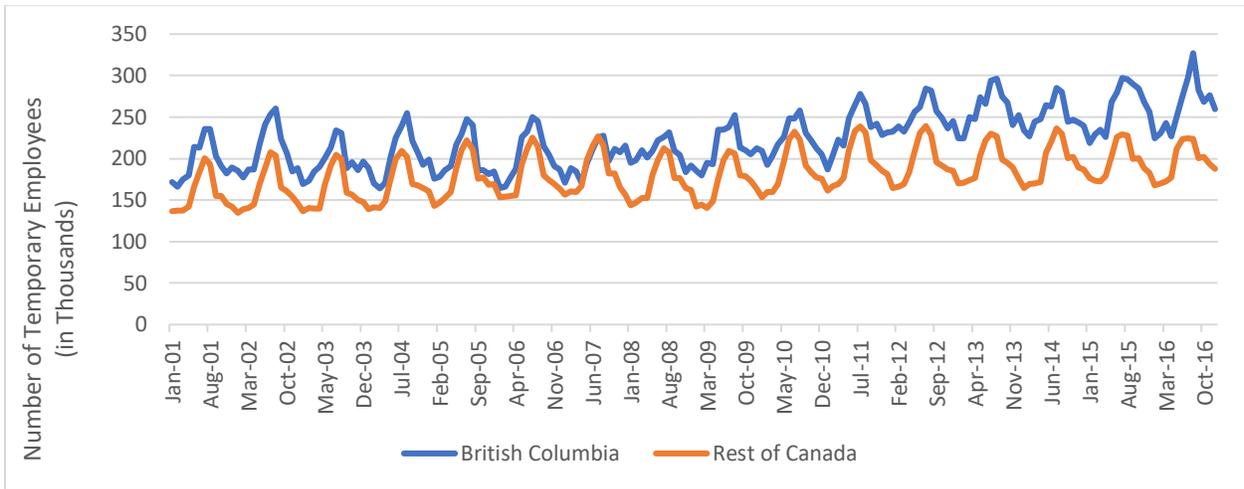


Figure 4: Number of Temporary Employees (In Thousands)



II. Additional Robustness Tests

In Table 2, various controls are omitted to ensure validity of the estimates. The results are qualitatively similar.

Table 2: Robustness

Difference-in-Difference Analysis					
	(1)	(2)	(3)	(4)	(5)
	Low	Medium	High	Low-Medium	Low-High
A. Excluded Control: (Age * Tenure)					
<i>BC x Post</i>	-0.066***	-0.037***	-0.037***		
	(0.002)	(0.001)	(0.002)		
	0.422	0.294	0.158		
<i>BC x Post x Low_Educ</i>				-0.027***	-0.031***
				(0.002)	(0.003)
				0.379	0.379
B. Excluded Control: Hours Worked					
<i>BC x Post</i>	-0.063***	-0.039***	-0.039***		
	(0.002)	(0.001)	(0.002)		
	0.490	0.364	0.218		
<i>BC x Post x Low_Educ</i>				-0.029***	-0.033***
				(0.002)	(0.003)
				0.438	0.438
C. Excluded Control: Gender					
<i>BC x Post</i>	-0.071***	-0.041***	-0.039***		
	(0.002)	(0.001)	(0.002)		
	0.458	0.339	0.208		
<i>BC x Post x Low_Educ</i>				-0.032***	-0.037***
				(0.002)	(0.003)
				0.419	0.419
D. Excluded Control: Marital Status					
<i>BC x Post</i>	-0.067***	-0.039***	-0.039***		
	(0.002)	(0.001)	(0.002)		
	0.501	0.366	0.217		
<i>BC x Post x Low_Educ</i>				-0.030***	-0.034***
				(0.002)	(0.003)
				0.440	0.440

Notes: Dependent variable is ln(Hourly Wages). Robust Standard Errors are clustered by province and included below each estimate in parenthesis. Adjusted R-Squareds are included below each Standard Error.

Significance Levels: *** = 1%, ** = 5%, * = 10%

References

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