

API 6319

Quantitative Research Methods for Public Policy

Marked Lab: Simple Linear Regression Analysis

Does the education return to wages differ between native-born and the foreign-born Canadians?

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1. Introduction

The return on investment in education based on human capital theory has been explored and systematically estimated since the 1950s. The concept of the rate of return to education equates the value of lifetime earnings of the individual to the net present value of costs of education (Psacharopoulos & Patrinos, 2018:3). The theory suggests that if the investment to education can be economically justified, the rate of return should be positive and should be higher than the alternative rate of return ((Psacharopoulos & Patrinos, 2018:3) Jacob Mincer (1974) establishes an equation model of private returns to education. The coefficient on years of schooling of the basic Mincer's function¹ gives an overall picture of how private investment in education can contribute an increase of earnings. Though Mincer's equation has been criticized for neglecting important variables (Psacharopoulos, 2018), many researchers still prefer to Mincer's equation due to its convenience. These studies include estimating direct returns to schooling (Psacharopoulos, 1981), estimating return to schooling quality (Behrman and Birdsall, 1983), and measuring how difference in the schooling and working experience contributes to gender wage gaps (Mincer and Polacheck, 1974).

Studies over the last three decades have implicated a decline of immigrant earnings compared to that of the Canadian born. Scholars have identified a series of determinants of earning gaps. Fortin et al (2016) finds that immigrants to Canada in the 1990s earned around 30 to 40 percent less than the Canadian-born workers upon arrival. Li (2000) implicates that immigrants, particular visible minority immigrants, earned substantially less than their British counterpart. Chiswick (1978) suggests that the lack of transferability of human capital is a key reason why immigrants tend to earn less than native born. Nakhaie (2006) suggests that some immigrants experienced a lower rate of return educational investments compared with the native born.

2. Research Questions

Using the empirical framework of the private return to education, this paper intends to test and explore the causal relationship between education and personal earnings of native-born and foreign-born Canadians. Specific research questions are as follows:

1. Whether and to what extent the increase of schooling contributes to the increase of wages?
2. Does the education return to wages differ between the native-born and foreign-born Canadians? Does the difference in the rate of education return accounts for the earning gaps between the native-born and foreign-born Canadians?
3. Does the education return to wages differ among immigrants with different residency experience and ethnic origins?

3. Empirical Strategies

The complete Mincer (1974) wage equation model include the following human capital variables:

$$\text{Log}(\text{Wages}_i) = \beta_0 + \beta_1 \text{education} + \beta_2 \text{experience} + \beta_3 \text{experience}_i^2 + U_i \quad (1)$$

¹ See section 3 Empirical Strategies

The term $Wages_i$ is an earnings measure for an individual, such as earnings per hour or per week. The coefficient β_1 represents a measure of the schooling, whereas the β_2 represents a series of variables assumed to affect earnings. The β_1 can be considered as the private financial return to schooling as well as being the proportionate effect on wages of an increment to the schooling (Harmon et al, 2003:117).

For the analytical purpose, I will only include education as the single predictor variable. Building upon the complete Mincer's equation, the basic simple log-linear regression model for this paper is as follows:

$$\text{Log}(Wages_i) = \beta_0 + \beta_1 \text{education}_i \quad (2)$$

To address the research questions in section 2, I will run the basic regression model (2) with different sub-groups. For example, to compare the income return to education between the native-born and foreign-born Canadian, I will run the basic regression model twice using the native-born sample and foreign-born sample. This strategy will be equally applied to the analysis of the sub-groups with different immigrant experience and ethnic origins. Specific regression models are as follows:

$$\text{Log wages}(\text{Foreign born}_i) = \beta_0 + \beta_1 \text{Years_of_Schooling}_i \quad (3.1)$$

$$\text{Log wages}(\text{Native born}_i) = \beta_0 + \beta_1 \text{Years_of_Schooling}_i \quad (3.2)$$

$$\text{Log wages}(\text{Length of Residency}_{it}) = \beta_0 + \beta_1 \text{Years_of_Schooling}_i \quad (4)$$

$$\text{Log wages}(\text{Ameirca and Europe}_i) = \beta_0 + \beta_1 \text{Years_of_Schooling}_i \quad (5.1)$$

$$\text{Log wages}(\text{Other Countries}_i) = \beta_0 + \beta_1 \text{Years_of_Schooling}_i \quad (5.2)$$

4. Data and Descriptive Analysis

Data

This paper uses the 2013 Canada General Social Survey, Cycle 27 targeting on persons aged 15 years and older living in private households in Canada, starting from June 2013 to March 2014. The 2013 GSS was the third cycle to collect information on social networks and social engagement in Canada. Data were collected on the respondent's main activity, including education, religion, income and other socio demographic characteristics.

Variables

The dependent variable is the logarithm of the hourly wage of selected respondents calculated based on the annual personal income (#INCM) divided by the numbers of weeks employed (#WET110), and then by the numbers of paid hours per week (#WKWEHRC).

The control variables include: (1) Years of schooling; (recoded #EHGALL "Highest Degree"); (2) Immigrant Status (recoded #BRTHREGC "Country or Region of Birth of the Respondent"; (3) Duration of immigration (recoded #YRARRI "Range of years when respondent first came to Canada); (4) Ethnic origins of immigrants (#BRTHREGC "Born outside Canada-North America and Europe" and "Born outside Canada-Other countries").

Recode Strategies

The real weekly wages are calculated by using the sum of all personal income from wages or salaries divided by the numbers of weeks employed last year. Since I am intending to limit the research scope to formal employment, I restrict the whole sample to respondents who **report 40 or more weeks of work**. The weekly wages are then divided by the numbers of paid hours per week to get the hourly wages. The logarithms of hourly wages are generated to normalize the distribution and satisfy the assumption of the log-linear regression.

Education is recoded to interval variables as years of schooling based on rough calculations, where a high school degree equals to 12 years of schooling, a bachelor's degree equals to 16 years of schooling, and a graduate degree equals to 18 years of schooling. The period of immigrant experience is recoded and measured in six categories: (1) pre 1974; (2) 1975-1989; (3) 1990-1999; (4) 2000-2004; (5) 2005-2009; (6) 2010-2013. As the 2013 GSS does not include questions asking the immigrant status or the citizenship of the respondents, I use the origins of the birthplace (#brthregc) as the proxy variable and recoded it as binary categories: (1) born in Canada (aggregated those born in Canada [#brthgrec=1,2,3]) (2) born outside Canada (aggregated those born outside Canada [#brthgrec=4,5,6]). The ethnic origins of immigrants are based on the results of survey questions of countries or regions of birth regions [#brthregc=4 "Born Outside Canada-North America and Europe", and #brthregc=5 "Born outside Canada-Other Countries"].

Descriptive Statistics Analysis

The last row of table 1 shows the proportion of the population of the foreign-born and native-born. The weighting adjusted proportion of population suggests that 22.37% of the Canadian population were foreign-born, and 77.63% were native-born. This tabulation does not include the proportion of non-permanent residents. The overall tabulation results in figure1 also suggest that the foreign-born have a higher level of schooling than the native-born. About 51.66% of the foreign-born have university degrees compared to 32.3% of the native-born Canadian. The percentage of the foreign-born with graduate degrees (18.17%) is almost twice that of the native-born Canadians (9.03%). When looking at the tabulation results of education and the years of residency of the foreign-born (see table 2), we can find that new immigrants are especially well-educated. The overall proportions of new immigrants (respondents who arrived in the 2000s) with bachelor or graduate degree are higher than old immigrants (respondents who arrived in the 1990s).

The tabulation analysis suggests that foreign-born has relative advantages in human capital compared with that of the native-born. The recent census analysis also suggests that Canada has the highest proportion of college graduate among the OECD countries partly because the increase of well-educated immigrants in recent years (Census, 2017).

However, as table 3 indicates, the mean hourly wage of the foreign-born (26.7\$) is lower than that of the native-born (31.17\$). The T-test result shows that the mean hourly wage of the native-born is different from that of the foreign born ($t=2.27$, $df=10848$, $p=.02<.05$) at a significance level of 0.05.

To sum up, our descriptive statistics analysis shows that: (1) the foreign-born have relative high level of schooling compared to the native-born; (2) new immigrants are well-educated compared to old immigrants; (3) the mean hourly wage of the foreign-born is lower than that of the native-born at a significance level.

**Table 1 Tabulation of Education between Native-born and Foreign-Born
(Weighting Adjusted)**

Education	Native born (%)	Foreign born (%)
<High school	6.7	4.48
High school	26.39	16.67
Trade certificate	10.26	5.82
College	24.34	21.35
University	3.54	3.61
Bachelor's degree	19.73	29.88
Graduate Degree	9.03	18.17
Total	77.63	22.37

**Table 2 Tabulation of Education and Years of Residency
(Weighting Adjusted)**

	Education-Highest Degree (%)						
	<High School	High School	Trade Certificate	College	University	Bachelor	Graduate
Pre 1974	9.45	21.69	8.84	21.94	3.81	21.24	13.03
1975-1989	4.28	16.24	5.62	30.56	3.66	26.17	13.47
1990-1999	3.84	18.42	6.32	24.60	2.71	28.38	15.74
2000-2004	1.73	12.44	3.29	15.48	5.04	36.24	25.78
2005-2009	3.63	15.70	6.62	10.43	3.59	35.54	24.48
2010-2013	5.42	6.08	2.56	20.87	2.87	42.02	20.18
Total	4.47	16.42	5.93	21.53	3.61	29.93	18.11

Table 3 Two Sample Paired T-test Comparing Hourly Wage by Immigrant Status

Origins of Birthplace	Observation	Mean	Standard Deviation	Standard Error	95%CIs
Native Born	6,747	31.17	122.42	1.49	28.24-34.08
Foreign Born	4,103	26.70	38.80	.61	25.51-27.89

T (10848) =2.27

P*=0.02<.05

5. Regression Results and Interpretation

A scatterplot of the logarithms of hourly wages and schooling indicates a positive relationship between the two variables (Figure 1). Overall, for the native-born and foreign-born Canadians, the increase of schooling is both positively associated with the increase of wages. However, the differences of the two slopes implicates that the foreign-born Canadian may experience a low rate of education returns to wages compared to the native born. The difference of the two intercepts may also suggest that the earning wage gap exists between the native born and the foreign born with the schooling level. This visualization can

help address the first research question, while we still need more empirical evidence to specify the difference.

Table 4 presents the estimates results based on the predefined empirical strategies. The probability value for the F-test of all models is less than 0.01, suggesting that we have sufficient evidences to conclude that all the regression models fit the data better than the models with no independent variables. All the coefficients and intercepts have the probability value for the T-test less than 0.01, which suggests that all our estimates are significant at a significance level of 0.01.

First, the values of R square for the first regression model are both 0.1, which suggests that the variations of the schooling explain 10% change of hourly wages of the native born and foreign-born Canadians. Column (1) shows that for the native born, with one unit increase of schooling, we would expect an increase of the real hourly wages by $e^{0.087}=1.09$ (or 9% increase ($e^{0.087} - 1 = 0.09$)). Similar, with one unit increase of schooling, we would also expect the hourly wages increase by $e^{0.084} = 1.087$ or 8.8% ($e^{0.084} - 1 = 0.088$) increase for the foreign-born. The comparison of the two coefficients show that there is a tiny difference of the private education returns between the native-born and foreign-born Canadians. However, as figure 2 indicates, the predicted real wages based our regression models show clear earning gaps between the native born and the foreign-born Canadians with the same level of schooling. For person with 9 years of schooling, his or her predicted hourly wage will be approximately $e^{0.087*9+2.0}=16.25$ for the native born or $e^{0.084*9+1.87}=13.81$ for the foreign born, resulting a wage gap of 2.44.

Second, the values of R square for the third regression models are 0.08 for the immigrants from British and North America and 0.1 for immigrant from other regions. This indicates that the variation of schooling explains 8% of changes of wages for British and North American immigrants, and 10% of changes of wages for the immigrants from other countries and regions. Similar to previous interpretation, we would expect the hourly wages increase by 1.07 or 7% as the schooling increase by one unit for the British and North American immigrants (See column (3)). As for the immigrants from other countries or regions, an increase of the schooling contributes to an increase of hourly wages by 1.09/9%. For a British or North American immigrant with 9 years of schooling, his or her predicted wages will be $e^{0.072*9+2.16}=16.58$. Similarly, the predicted wages a non-British immigrant will be $e^{0.09+1.72}=12.55$. The results suggest a wage gap of 4.03 between the two groups.

Last, the values of R-square for the second regression models range from 0.13 (pre 1974 group), 0.08(1975-1984 group), 0.12(1990-1999 group), 0.15(200-2004 group), to 0.18 (2005-2009 group and 2010-2013 group). The regression model based on 2010-2013 group has the highest value of R-square, with the variation of schooling accounting for 18% of changes of wages. Figure 3 plots the exponentiated regression coefficients based on the coefficient estimates in column (2). It also directly compares the rate of education return among the immigrant groups with different residency experience. We can find that the rate of education returns to new immigrants is higher than that of old immigrants.

6. Discussions and Conclusion

To conclude, all our models find empirical evidence to justify the positive causal impact of education on wages. As the schooling increase, we would also expect increases of wages. The first model suggests that there is a slight difference in the rate of education return to wages between the foreign-born and native-born, while we do find the earnings gaps between the two groups under the same level of schooling. The estimate results of the second model implicate that new immigrants enjoy a higher rate of education return

compared to the old immigrants. The last model suggests that immigrants from other countries have a higher rate of return compared to their British or North American counterparts. Nevertheless, similar to the wage gap between the native-born and foreign-born, non-British immigrants earn less than British and North American immigrants with the same level of schooling.

There are also some limitations of this paper. First, as Fortin et al (2015:104) indicate, the immigrant wage gap is highly heterogeneous across places of birth even after including location of studies fixed effects. In particular, the source of human capital of the foreign-born helps to account for a large share of the immigrant vs. native-born wage gap. Nevertheless, the measurement of education used in this paper does not implicate the source and quality of schooling for the foreign-born. Second, model 3 in this paper suggests some degree of geographical heterogeneity of ethnic origins, while due to the limitation of data sources, this model cannot specify the heterogeneity in the category “other countries” (such as Asia, Africa, Central and South America). Building upon these limitations, a multivariate regression model that includes at least the source and equality of education, specific ethnic and cultural background of the respondents may better capture the difference in the rate of education return and wages gaps between the native-born and foreign-born Canadians.

Table 4 Regression Outputs

	Model 1	Model 2	Model 3
Control Variables	Years of Schooling	Years of Schooling	Years of Schooling
Immigrant Identity	Coefficients		
Native born	.087***(t=27.09) (.003)		
Foreign born	.084***(t=21.27) (.0040)		
Native Born	Constant		
	2.01***(t=45.69) (.053)		
Foreign Born	1.87***(t=32.21) (.058)		
Length of Residency		Coefficients	
Pre 1974		.071*** (t=5.63) (.013)	
1975-1989		.070***(t=9.53) (.007)	
1990-1999		.10**(t=12.21) (.007)	
2000-2004		.11***(t=11.10) (.009)	
2005-2009		.12***(t=12.96) (.009)	
2010-2013		.12***(t=6.55) (.02)	
		Constants	
Pre 1974		2.40***(t=13.25) (.18)	
1975-1989		2.24***(t=21.2) (.11)	
1990-1999		1.77***(t=16.61) (.11)	
2000-2004		1.50* ** (t=10.15) (.14)	
2005-2009		1.20***(t=9.50) (.16)	
2010-2013		0.91***(t=3.24) (.28)	
Regions of Birth			Coefficients
North America and Europe			.072***(t=10.67) (.006)
Other Countries			.09***(t=18.7) (.005)
North America and Europe			Constants
			2.16***(t=21.86) (.10)
Other countries			1.72***(t=24.46) (.08)
R-Squared	Native Born .10	Pre1974 .13	North America and EU .08

	Foreign born	1975-1989	Other Countries
	.10	.08	.11
		1990-1999	
		.12	
		2000-2004	
		.15	
		2005-2009	
		.18	
		2010-2013	
		.18	
Numbers of Observations	Native Born	Pre 1974	North America and EU
	6,701	364	1,329
	Foreign Born	1975-1989	Other Countries
	4,048	967	2,711
		1990-1999	
		1,077	
		2000-2004	
		681	
		2005-2009	
		762	
		2010-2013	
		187	

Probability < $F=0.01$

$P^{***} < .01$ (Significance at 1% level)

**Figure 1 Scatterplot of Log (hourly Wages) and Years of Schooling
($n=N<.01$)**

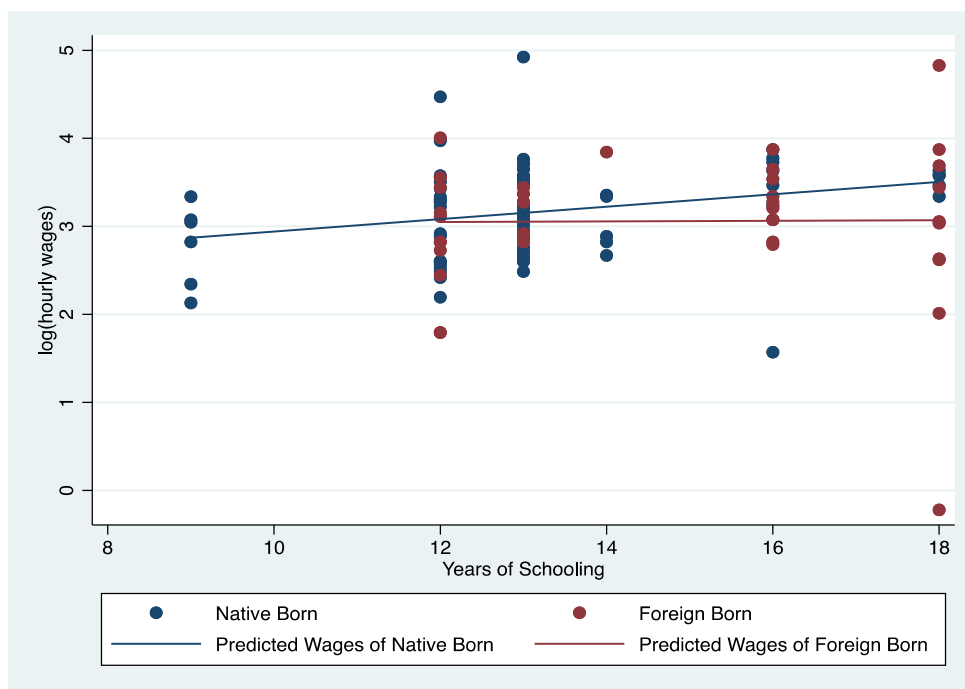


Figure 2 Predicted Wage Gaps between Native Born and Foreign Born

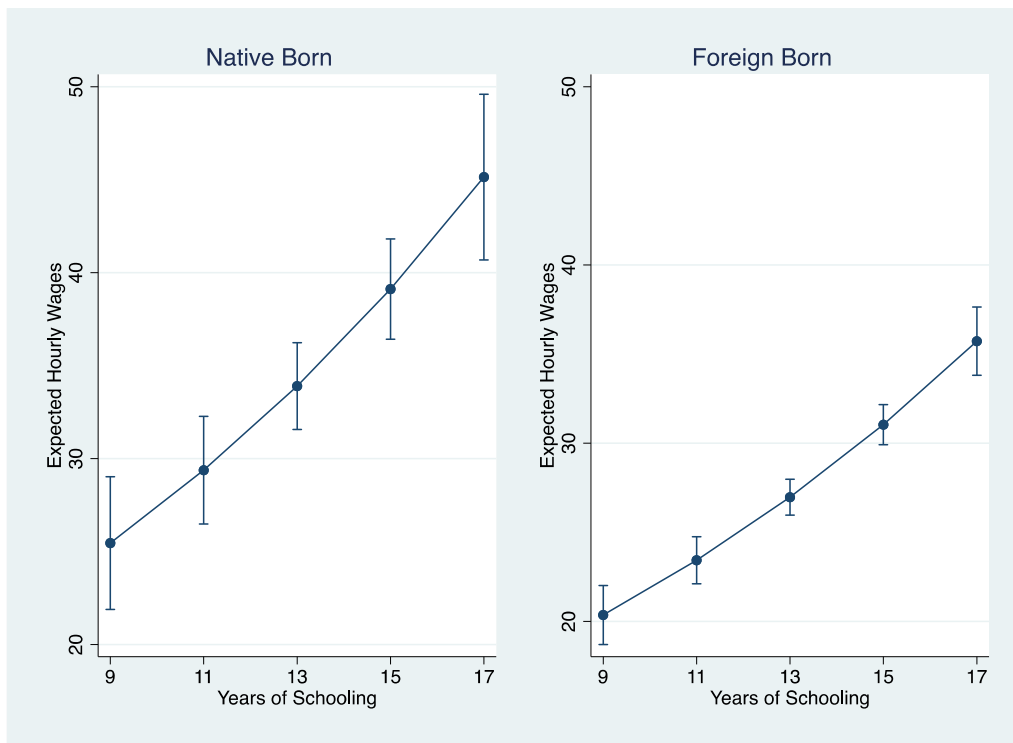
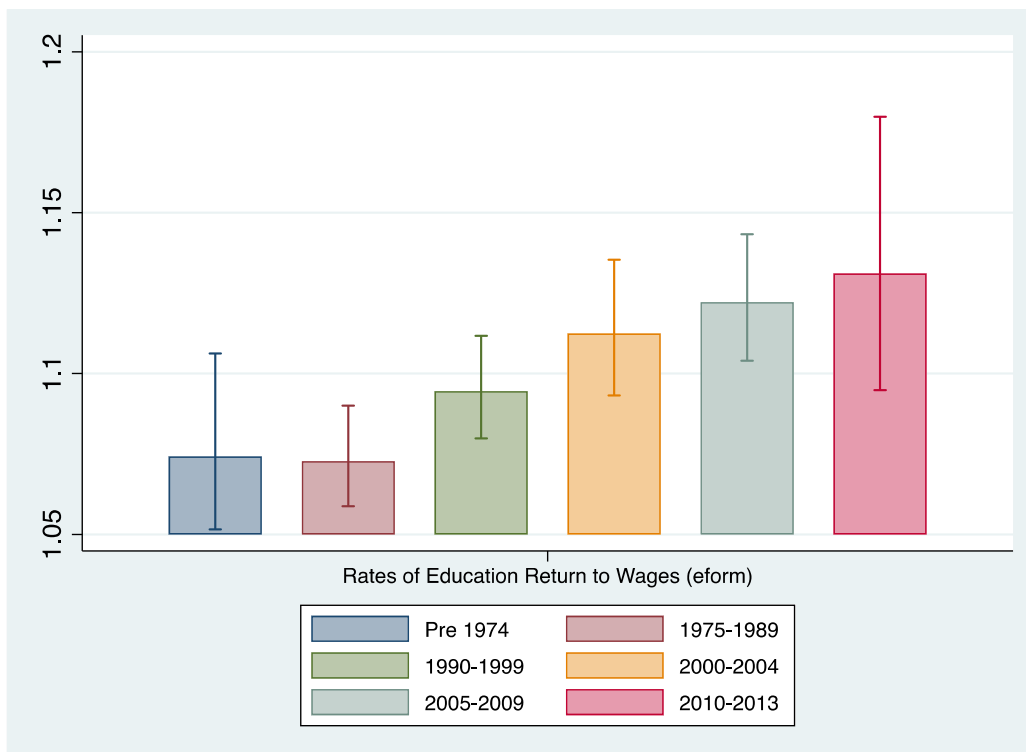


Figure 3 Rate of Education Return to Wages



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