The Impact of the Tax Mix on Economic Growth of Canadian Provinces, 1981-2010*

Pouya Ebrahimi and François Vaillancourt**

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**** respectively : PhD student, HEC Montréal; professor emeritus, Université de Montréal and fellow CIRANO**

1. INTRODUCTION

This paper examines the impact of the relative importance of the provincial personal income tax (PIT), consumption (retail or VAT) tax (CT) and corporate income tax (CIT) on economic growth of the Canadian provinces. Previous studies in this field have mainly examined the effect of taxation or the tax mix on growth from a cross-country perspective. Padovano and Galli (2001) find a negative relation between effective marginal tax rates and the economic growth of 23 OECD countries from 1951 to 1990. In addition, they show that the tax progressivity has a negative effect on growth. Arnold et al. (2011) use a sample of 21 OECD countries and suggest that the taxation of property and consumption are less harmful to the economic growth compared to personal and corporate income taxes. A higher CIT rate is associated with lower factor productivity and factor accumulation. Lee and Gordon (2004) report that a 10 percent increase in the CIT rate results in 0.82 percent lower rate of economic growth using statutory corporate and personal income tax rates for 70 countries. Their results indicate that an increase in CIT rate results in higher personal income tax revenues, due to the substitution of corporate income for personal income following an increase in CIT rate.

The study of taxation and economic growth has received much less attention at the subnational level. Ferede and Dahlby (2012) point out that the differences usually observed in the income tax base across countries are less pronounced at the level of subnational governments. Their study examines the impact of provincial taxes on the economic growth of the Canadian provinces and reports that 1 percent increase in CIT rate results in 0.1 to 0.2 percent decrease in the growth rate. Moreover, they do not find any significant negative effect of PIT on growth.

In section 2, we lay out the sources of data and the methodology of this study. Section 3 presents the regression results and robustness tests. Section 4 concludes.

2. DATA AND METHODOLOGY

The main data sources are CANSIM series from Statistics Canada (exact series indicated in the sources of each descriptive table) and tax rate information from the annual *Finances of the Nation* of the Canadian Tax Foundation. The starting point of the study,1981, is dictated by the availability of comparable provincial GDP data while the end point reflects the data available when the study was completed in 2012.We use both five-year average(six observations by province) and annual data(30 observations by province) in our empirical model.[1] Five-year averages reduce the effect of economic cycles on growth and capture the price adjustment and allocation of resources in the aftermath of a change in tax rates. A slight drawback of the use of five-year averages is the potential loss in the statistical significance of estimated coefficients. For this reason, we also use annual data and compare the regression results of five-year average data to annual data.

2.1 Empirical Approach

Our empirical approach is based on fixed effects panel estimation method of equation (1). This approach controls for the unobserved time-invariant variables.

$$Growth_{i,t} = \alpha_i + \mu_t + \rho \ln y_{i,t-1} + \beta_1 \ln k_{i,t} + \beta_2 h_{i,t} + \beta_3 trade_{i,t} + \gamma taxincome_{i,t-1} + \phi taxmix_{i,t-1} + \varepsilon_{i,t} \qquad (1)$$

In the left side of this equation, $Growth_{i,t}$ corresponds to the growth rate of real GDP per capita for province i at time t (one or five years). In the right side of the equation, α_i and μ_t are dichotomous variables that capture unobserved time and provincial fixed effects; $ln\ y_{i,t-1}$ denotes the natural logarithm of real GDP per capita at time t (at the beginning of each period t) and controls for the conditional convergence (Solow, 1956), since less developed economies grow faster than more advanced economies with higher income per capita; the variable $lnk_{i,t-1}$ designates the natural logarithm of fixed capital stock per capita (computed in real terms at the beginning of the period or for each year) and $h_{i,t}$ refers to the human capital measure while $trade_{i,t}$ stands for the trade openness, both being averages for five year period or annual values . We also use total provincial tax revenues, $taxincome_{i,t-1}$. This variable is lagged for one period in order to avoid any reverse

[1] However, we do not average the initial level of GDP per capita and physical capital over five years. We use instead the level of GDP per capital and physical capital at the beginning of each period of five years.

causality due to the relationship between the economic growth and the increase in fiscal revenue. The tax mix variables in the matrix $taxmix_{i,\,t-1}$ include two ratios: 1) the ratio of provincial consumption tax to personal income tax and 2) the ratio of provincial corporate income tax to personal income tax. Finally, $\varepsilon_{i,t}$ is the error term and we adjust the standard errors to allow for clustering for each province.

2.2 GDP Growth per capita

Our dependant variable, the GDP growth rate per capita, is the ratio of the difference of the real GDP per capita of province i between two periods t and t-1:

$$Growth_{i,t} = \frac{y_{i,t} - y_{i,t-1}}{y_{i,t-1}}$$

The real GDP per capita is calculated by dividing GDP by the working population (age 15 to 64); its changes capture the effect of an increase in the productivity of labour, in the average number of hours worked per employee and in the employment rate.

2.3 Initial Level of GDP per capita

In equation (1) above, we have also included the initial level of GDP per capita (in natural logarithm form) in order to take into account possible conditional convergence. Solow (1956) suggests that economies with a low level of initial income grow faster that those with higher incomes and thus closer to their stationary level. Therefore, we predict that the coefficient for the initial level of GDP per capita is negative, since Canadian provinces with higher GDP per capita would grow slower compared to the provinces with lower GDP per capita. Table 1 presents the average per capita GDP growth from 1981 to 2010 (column 1) and real GDP per capita in 1961 (used as an instrument in some estimations) for the Canadian provinces.

Table 1: Real GDP per capita, by province, Canada

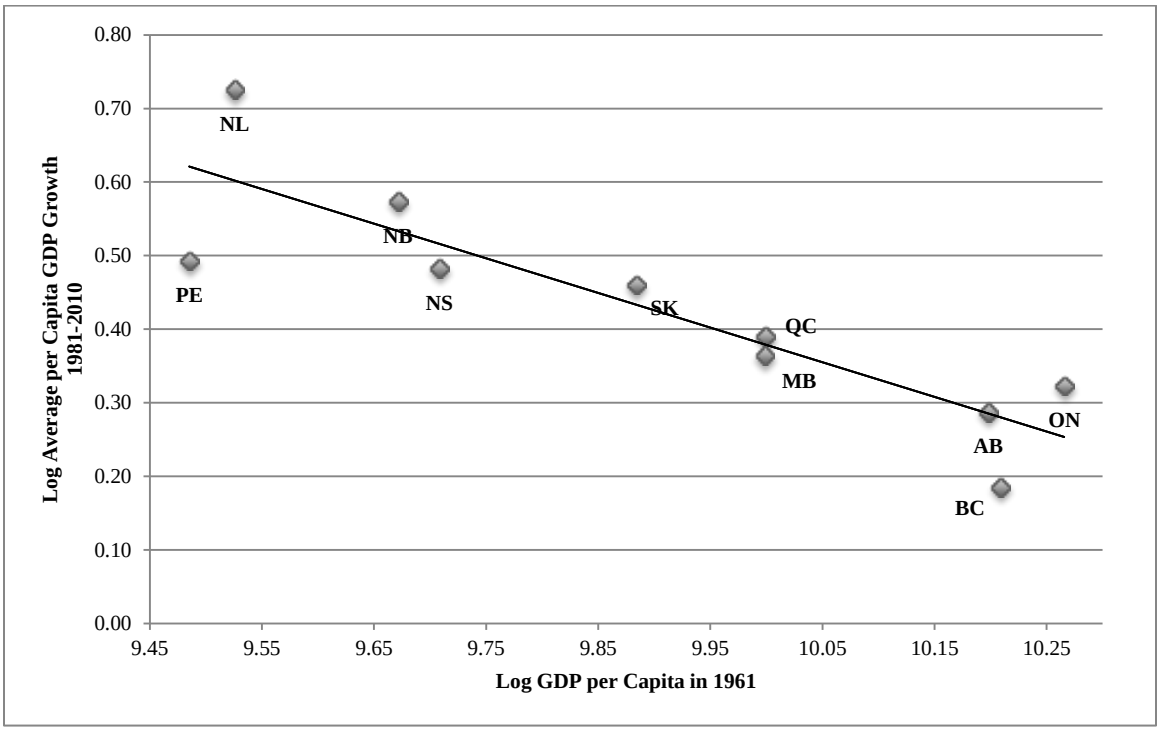
Province	1981-2010	1961
Newfoundland and Labrador	36,070	13,709
Prince Edward Island	35,793	13,164
Nova Scotia	36,798	16,452
New Brunswick	35,870	15,857
Quebec	41,326	22,010
Ontario	50,995	28,730

Manitoba	43,727	21,995
Saskatchewan	48,674	19,608
Alberta	62,447	26,849
British Columbia	46,719	27,138

Source: Statistics Canada CANSIM 384-0002, 384-0015, 384-0036, 380-0056 and 051-0001

Figure 1 shows that the natural logarithms of the average per capita GDP growth and the level of GDP per capita in 1961 are negatively correlated. The Atlantic Provinces (Newfoundland and Labrador, Prince Edward Island, Nova Scotia and New Brunswick) with the lowest GDP per capita in 1961 are among the Canadian Provinces with highest average per capita GDP growth for 1981-2010 period.

Figure 1: Average per Capita Real GDP Growth 1981-2010, provinces ranked by 1961 Real GDP per Capita



Source: Statistics Canada, CANSIM 384-0002, 384-0015, 384-0036, 380-0056 and 051-0001

2.4 Human Capital

The share of qualified workers in the labour force is associated with higher productivity and growth. Mankiw, Romer and Weil (1992) measure the human capital in terms of the fraction of working-age population in secondary schools. We use the percentage of

working-age population with a university diploma instead to account for the increase in the number of highly qualified workers in Canada. We expect that an increase in available human capital will have a positive effect on economic growth in our estimations.

Column 1 of table 2 reports the average share of university graduates in the working age population over the 1981-2010 period. Ontario, British Columbia and Alberta have the highest average share of highly qualified workers compared to other provinces.

Table 2: Average human capital, physical capital and trade openness, by province, 1981-2010, Canada

	(1) Human Capital	(2) Physical Capital	(3) Trade Openness
Newfoundland and Labrador	11.28%	113	113.63%
Prince Edward Island	12.65%	68	118.81%
Nova Scotia	16.14%	53	108.34%
New Brunswick	13.08%	92	146.06%
Quebec	15.81%	86	101.92%
Ontario	18.98%	90	111.58%
Manitoba	14.92%	100	111.17%
Saskatchewan	12.59%	138	121.05%
Alberta	16.24%	170	104.02%
British Columbia	16.74%	97	89.05%

Source: Statistics Canada CANSIM 384-0002, 384-0015, 384-0036, 380-0056 and 051-0001

2.5 Physical Capital

In our model, physical capital consists of the ratio of the stock of fixed non-residential capital on the working-age population at the beginning of each period. The sign of the estimated coefficient for the physical capital depends on whether the conditional convergence, which translates into a negative relationship between the stock of capital and the rate of growth, prevails over the positive role of physical capital for economic growth. Column 2 of table 2 presents a ratio obtained by dividing the average real stock of physical capital per capita in each province by the average for Canada over 1981-2010. The province of Alberta had the highest ratio of physical capital during this period, whereas the province of Nova Scotia had the lowest ratio of physical capital per capita for the same period.

2.6 Trade Openness

The trade openness measures the importance of trade within Canadian provinces and with the rest of the world. It is defined as the sum of exports and imports, domestic and

international, in GDP. Column 3 of table 2 shows the significant share of interprovincial and international trade for Canadian Provinces' GDP. Therefore, we expect a positive and significant coefficient for trade openness in our estimations.

2.7 Tax Revenues

Tax revenues are the sum of all sources of revenues from provincial taxes. We have included the tax revenues in equation (1) in order to account for the size of government and the potential distortions from the government intervention in the economy. However, as Widmalm (2001) suggests, public expenditures, which are derived mostly from tax revenues, might also be used to increase productivity in the private sector (for instance, financing new infrastructures). Therefore, we cannot predict with certainty the sign of the coefficient for tax revenues in our regressions. The first three columns of table 3 report the average share of PIT, CT and CIT tax revenues in the GDP of Canadian Provinces. The province of Quebec displays the highest share of personal income tax revenue to GDP[2] in comparison to other provinces (column 1), whereas the Newfoundland and Labrador has the highest share of consumption tax revenue to GDP and Alberta has the highest share of corporate income tax revenue to GDP.

Table 3: Average share of tax revenues in GDP for each province in Canada, 1981-2008

Province	(1) PIT/GDP	(2) CT/GDP	(3) CIT/GDP	(4) CT/PIT	(5) CIT/PIT
Newfoundland and Labrador	4.38%	6.94%	0.68%	1.58	0.16
Prince Edward Island	4.44%	6.84%	0.73%	1.55	0.16
Nova Scotia	4.95%	5.73%	0.77%	1.16	0.16
New Brunswick	4.54%	5.97%	0.78%	1.32	0.17
Quebec	7.55%	5.05%	0.86%	0.67	0.11
Ontario	4.60%	4.25%	1.21%	0.93	0.26
Manitoba	4.72%	4.86%	0.74%	1.03	0.16
Saskatchewan	4.07%	4.47%	0.73%	1.11	0.19
Alberta	3.26%	1.40%	1.23%	0.42	0.39
British Columbia	4.26%	4.56%	0.86%	1.09	0.21

Source: Statistics Canada, GDP at current prices: CANSIM 384-0002; Implicit price indexes: CANSIM 384-0036; Tax revenues: CANSIM 385-0001.

[2] This is due to a special arrangement with the federal government by which Québec occupies a larger share of the PIT field (16.5 % share) than all other provinces ; in exchange it receives less federal transfers of an equivalent amount

2.8 Tax Mix Ratios

To evaluate the effect of taxation on economic growth, we use the ratio of the consumption and corporate income tax revenues to the personal income tax revenue. Column 4 and 5 of table 3 shows the average of these ratios for 1981-2008 period in each province. A positive coefficient for the ratio of consumption and personal income tax revenues would indicate a more positive effect of the consumption tax compared to the personal income tax on economic growth. Many studies in the past have used the ratio of each type of tax revenues on GDP. However, this measure might introduce a negative bias in the estimations, since any unaccounted factors that positively affect the GDP will reduce the ratio of tax revenues on GDP (Engen and Skinner, 1996). In order to avoid the reverse causality that stems from such increase in GDP (which might also increase tax revenues), we use a one period lag for tax mix ratios (five-year lag for the first specification and three-year lag for the second).

The sign of the estimated coefficient for the ratio of consumption tax to personal income tax is expected to be positive, since the consumption tax is considered to offset the negative impact the tax progressivity and double taxation of savings on economic growth, which are often associated with the personal income tax. On the other hand, the coefficient for the ratio of corporate income tax to personal income tax is expected to be negative, since corporate income tax is considered more harmful for the economic growth than the personal income tax.

Column 4 and 5 of table 3 above presents the average tax mix ratios for each province in Canada from 1981 to 2008. Newfoundland and Labrador and Ontario have respectively the highest share of CT to PIT and CIT to PT[3].

[3] This raises the issue of the incidence of this tax as some of the amounts collected in Ontario a head office province may well be paid by non-Ontario residents; we do not address this issue in this paper.

3. REGRESSION RESULTS

3.1 Five-year Average Regression Results

Table 4 shows the regression results for six periods of five years. Column 1 and 3 show that the coefficient associated with the ratio of consumption tax to personal income tax is negative and statistically significant. The ratio of corporation income tax is not significant. These results suggest that the consumption tax has a negative effect on economic growth, after controlling for personal income tax and other control variables. This negative impact of consumption taxes relative to personal income taxes is puzzling given the international evidence noted above. One explanation may be that in the case of Canadian provinces, most consumption taxes over the period are retail sales taxes ; they are born in part by business inputs (Smart and Bird, 2009).

Moreover, the impact of human capital on GDP growth rate is positive but not significant despite the increase in the number of university graduates in all the Canadian provinces for 1981-2010. The reported results also indicate that trade openness is highly significant in all three specifications.

Table 4: Impact of Provincial Tax Mix on the Economic Growth of Canadian Provinces, six periods of 5 years (N=60), 1981-2010

Dependant variable: **GDP growth rate**	**(1)** **Five-year average**	**(2)** **Five-year average**	**(3)** **Five-year average**
Control variables:			
Log initial GDP	-0.074 (0.028)**	-0.050 (0.048)	-0.064 (0.040)
Physical capital	0.008 (0.027)	-0.006 (.035)	-0.004 (0.036)
	0.127 (.124)	-0.004 (0.155)	0.123 (0.121)
Trade openness	0.072 (0.015)***	0.070 (0.012)***	0.068 (0.014)***
Total tax revenue	-0.077 (0.071)	0.033 (0.132)	-0.045 (0.118)
Tax mix variables:			
Ratio of CT to PIT	-0.027 (0.010)**	-	-0.028 (0.011)**
Ratio of CIT to PIT	-	-0.018 (0.033)	-0.023 (0.028)
R-squared	0.5307	0.4716	0.5410
N	60	60	60

Notes: *** denotes 1% significance level; ** 5% significance level; * 10% significance level. Standard errors are in the parentheses.

3.2 Annual Regression Results

Table 5 reports the results of our regressions based on annual data. There is a sharp decrease in the R-squared in the annual specification in comparison to the five-year specification. The coefficient of the ratio of corporate income tax to personal income tax is negative and significant. This result is comparable to the negative impact of corporate income tax on economic growth suggested by Lee and Gordon (2004) and Ferede ad Dahlby (2012). However, the coefficient for the ratio of consumption tax to personal income tax is no longer significant. Lee and Gordon (2004) suggest that higher rates of the value-added consumption tax can discourage entrepreneurs since, in practice, the VAT do not compensate them for any unsold products.

We also observe that the coefficients of initial GDP (negative) and physical capital are both statistically significant in table 4 and 5. The first result is evidence of the conditional convergence at the subnational level in Canada.

Table 5: Impact of Provincial Tax Mix on the Economic Growth of Canadian Provinces, twenty-nine periods of 1 year (N=290), 1982 à 2010

Dependant variable: **GDP growth rate**	**(1)** **Annual**	**(2)** **Annual**	**(3)** **Annual**
Control variables:			
Log initial GDP	-0.146 (0.023)***	-0.135 (0.022)***	-0.136 (0.020)***
Physical capital	0.125 (0.047)**	0.110 (0.042)**	0.109 (0.043)**
Human capital	0.149 (0.117)	0.165 (0.143)	0.191 (0.117)
Trade openness	0.049 (0.016)**	0.050 (0.015)***	0.048 (0.016)**
Total tax revenue	-0.094 (0.072)	-0.067 (0.101)	-0.081 (0.090)
Tax mix variables:			
Ratio of CT to PIT	-0.008 (0.014)	-	-0.010 (0.014)
Ratio of CIT to PIT	-	-0.070 (0.021)***	-0.071 (0.020)***
R-squared	0.0730	0.0996	0.1027
N	290	290	290

Notes: *** denotes 1% significance level; ** 5% significance level; * 10% significance level. Standard errors are in the parentheses.

3.3 Robustness Tests

The presence of endogeneity is always an important issue to consider in empirical studies on the determinants of growth, since a large number of factors might have a direct or indirect impact on economic growth. This problem arises from the omission of those factors in the estimations. The use of fixed-effect panel method controls for time-invariant factors that affect the growth, but the endogeneity can persist if there are non-observed time-variant factors.

Hausman-Taylor method offers a potential solution to deal with the endogeneity in our regression results. This method requires specifying the explanatory variables that are most susceptible to be endogenous. We identified trade openness and tax revenues as the potential endogenous variables. Moreover, we use the natural logarithm of GDP per capita in 1961 as an instrument variable. Table 6 presents the regression results of equation (1) based on Hausman-Taylor method. Although there is a sharp decrease in the value of the coefficients associated with tax mix variables, the results of this table are comparable to the previous tables.

Table 6: Impact of Provincial Tax Mix on the Economic Growth of Canadian Provinces, Hausman-Taylor Method, 1982 to 2010

Dependant variable: GDP growth rate	**(1) Annual**	**(2) Five-year average**
Control variables:		
Log GDP in 1961	-0.010 (0.015)	0.003 (0.024)
Physical capital	0.004 (0.008)	-0.028 (0.012)**
Human capital	-0.007 (0.060)	-0.088 (0.063)
Trade openness	0.023 (0.016)	0.059 (0.014)***
Total tax revenue	-0.026 (0.095)	0.054 (0.083)
Tax mix variables:		
Ratio of CT to PIT	-0.009 (0.008)	-0.018 (0.010)*
Ratio of CIT to PIT	-0.065 (0.022)***	-0.030 (0.020)
N	290	60

Notes: *** denotes 1% significance level; ** 5% significance level; * 10% significance level. Standard errors are in the parentheses.

To further test the robustness of our regression results, we examine alternatives specifications of equation (1). In table 7, we replaced the stock of capital by the flows of capital in order to control for the effect of physical capital on economic growth. We also included the median age and the government expenditures as respectively a substitute to human capital and a different measure of the size of government in the economy respectively. The results of table 7 indicate that the coefficients associated with tax mixed ratios remain similar to the initial specification used in table 4 and 5.

Table 7: Impact of Tax Mix on the Economic Growth of Canadian Provinces, Alternative Specifications, 1981-2010

Dependant variable: GDP growth rate	(1) Annual	(2) Annual	(3) Annual	(4) Five-year average	(5) Five-year average	(6) Five-year average
Control variables:						
Log initial GDP	-0.004 (0.021)	-0.293 (0.021)***	-0.127 (0.017)***	-0.049 (0.025)*	-0.123 (0.039)**	-0.052 (0.033)
Physical capital: Flows of capital	-0.050 (0.018)**	-	-	-0.013 (0.009)	-	-
Physical capital: Stocks of capital	-	0.019 (0.040)	0.105 (0.036)**	-	-0.035 (0.035)	-0.006 (0.029)
Human capital: Median age	-	0.368 (0.056)***	-	-	0.150 (0.062)**	-
Human capital: University diploma	0.302 (0.100)**	-	0.167 (0.114)	0.134 (0.127)	-	0.091 (0.105)
Trade openness	0.041 (0.014)**	0.052 (0.020)**	0.049 (0.015)**	0.066 (0.015)***	0.069 (0.016)***	0.067 (0.013)***
Total tax revenue	-0.006 (0.059)	-0.277 (0.116)**	-	-0.050 (0.103)	-0.149 (0.131)	-
Gvt expenditures	-	-	0.038 (0.091)	-	-	0.071 (0.045)
Tax Mix variables:						
Ratio of CT to PIT	-0.008 (0.011)	-0.011 (0.016)	-0.009 (0.014)	-0.026 (0.010)**	-0.026 (0.012)*	-0.027 (0.011)**
Ratio of CIT to PIT	-0.052 (0.025)*	-0.036 (0.021)	-0.066 (0.023)**	-0.005 (0.026)	0.015 (0.033)	-0.010 (0.023)
R-squared	0.1133	0.2011	0.1016	0.5535	0.6073	0.5532
N	290	290	290	60	60	60

Notes: *** denotes 1% significance level; ** 5% significance level; * 10% significance level. Standard errors are in the parentheses.

4. CONCLUSION

The objective of this study was to evaluate the impact of the tax mix on the economic growth of Canadian provinces. We find varying results according to the estimation period used, one of five years. In general a greater use of either the corporate income tax or the consumption tax with respect to the personal income seems negatively linked to the economic growth of Canadian provinces from 1981 to 2010. Moreover, the regression results indicate that the openness to trade has played a significant role in the economic prosperity of the provinces in Canada.

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