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THE IMPACT OF TAX CUTS ON ECONOMIC GROWTH: EVIDENCE FROM THE CANADIAN PROVINCES

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We examine the impact of the Canadian provincial governments' tax rates on economic growth using panel data covering the period 1977–2006. We find that a higher provincial statutory corporate income tax rate is associated with lower private investment and slower economic growth. Our empirical estimates suggest that a 1 percentage point cut in the corporate tax rate is related to a 0.1–0.2 percentage point increase in the annual growth rate. Our results also indicate that switching from a retail sales tax to a sales tax that is harmonized with the federal value-added sales tax boosts provincial investment and growth.

Keywords: tax structure, economic growth, private investment

JEL Codes: H20, H70, O51

I. INTRODUCTION

The impact of taxation on growth and investment has been hotly debated both in academic and political circles. Proponents of tax cuts point to the effects that lower taxes have on incentives to work, to save, and to invest, and argue that reducing tax rates boosts economic growth. The tax cuts introduced by the provincial government of British Columbia (BC) in 2001 are an example of this type of pro-growth tax policy. The tax reform was introduced in two stages. In an attempt to make its economy more competitive, the BC government reduced its corporate income tax (CIT) rate initially by 3 percentage points, with an additional 1.5 percentage point reduction to 12 percent in 2005. The government also cut personal income tax (PIT) rates by about 25 percent across all income tax brackets. The goal of these tax rate reductions was to boost investment and economic growth in the province.

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Taxes can affect growth through their impacts on factor accumulation and total factor productivity.[1] With regard to the first channel, taxes can raise the cost of capital and reduce incentives to invest. To the extent that higher tax rates discourage investment, economic growth will be adversely affected. Furthermore, by providing preferential incentives to some sectors, taxes can distort capital allocation and reduce the productivity of overall investment. Another channel through which taxes affect growth is through their influences on total factor productivity. Taxes distort factor prices and induce efficiency loss in resource allocation (Feldstein, 2006). This adverse effect of taxes on efficiency lowers total factor productivity. Another effect of taxes on total factor productivity is through their potential effects on entrepreneurship. Entrepreneurial activities generate new ideas that can raise total factor productivity. A number of studies indicate that taxes affect entrepreneurial activities adversely, as discussed in, for example, Gentry and Hubbard (2000) and Cullen and Gordon (2007). The adverse effect of taxes on entrepreneurship reduces the creation of new ideas and lowers total factor productivity.

A number of empirical studies have examined the effects of taxes on growth. Most have focused on cross-country analysis, while a few researchers have investigated the issue using data from sub-national governments, particularly the U.S. states. The effects of tax rates on growth may be easier to identify in an inter-state context since states have more similarities than different countries (Helms, 1985; Holcombe and Lacombe, 2004; Tomljanovich, 2004; Reed, 2008). In one strand of the empirical literature, researchers use aggregate average and effective marginal tax rates as measures of tax burden (see Engen and Skinner (1996) for a survey of some of the earlier empirical studies). Using such tax measures, Helms (1985), Mullen and Williams (1994), Miller and Russek (1997), Kneller, Bleaney, and Gemmell (1999), Bleaney, Gemmell, and Kneller (2001), Folster and Henrekson (2001), Padovano and Galli (2002), Tomljanovich (2004), Holcombe and Lacombe (2004), and Reed (2008) find a negative relationship between taxation and growth. Koester and Kormendi (1989) and Mendoza, Milesi-Ferretti, and Asea (1997), however, do not detect any significant negative impact of taxes on growth. In another strand of the literature, Katz, Mahler, and Franz (1983) and Lee and Gordon (2005) have used statutory tax rates as measures of the tax burden. For a sample of a cross section of countries, Lee and Gordon (2005) find that the corporate tax rate has a significant negative association with economic growth rate, but the effect of the top PIT rate on growth is insignificant. Katz, Mahler, and Franz (1983) also find that the top PIT rate has no significant effect on growth. Recent empirical analysis by the Organisation for Economic Co-operation and Development (OECD) also ranks the effects of various taxes on per capita gross domestic product (GDP) growth. OECD (2010) indicates that CITs have the most adverse effect on per capita GDP growth followed by personal income and consumption taxes.

[1] See Myles (2000, 2009a, 2009b, 2009c) and Johansson et al. (2008) for surveys of theoretical models of taxation and growth.

In cross-country studies, such as Lee and Gordon (2005), there is variation among countries in the way income tax bases are defined so that differences in tax rates may not have directly comparable effects on growth. Canadian provinces, on the other hand, use similar income tax bases and thus provide a good framework for the study of the effects of tax rates on growth. However, to the best of our knowledge, there have been no empirical studies of the effects of fiscal policies on the growth of Canadian provinces. Thus, the principal objective of this paper is to investigate the effects of tax rates on economic growth and private investment, using data from 10 Canadian provinces over the period 1977–2006. We also use the empirical results to assess the growth rate effects of the 2001 incentive-based tax cuts in BC, as well as its switch from a retail sales tax to a sales tax that is harmonized with the federal value-added tax.

We begin our analysis by exploring the effects of tax rates on growth and private investment. The results of this paper indicate that lower CIT rates are associated with higher private investment and faster economic growth. Our empirical analysis suggests that a 1 percentage point cut in the statutory CIT rate is associated with a temporary 0.1–0.2 percentage point increase in the per capita GDP growth rate. These growth effects from tax cuts are "temporary" because our empirical specification has the same property as the neo-classical growth model — in the long run, the growth rate returns to its steady state rate based on technological change, which is assumed to be exogenous. However, the growth rate effects persist over a long period of time and long-run output is substantially increased. Our results show that the negative relationship between the provincial CIT rate and growth is robust to various sensitivity checks and consistent with the OECD (2010) findings that the CIT has the most adverse effect on economic growth.

We use our econometric results to estimate the magnitude of the growth effects of the CIT rate cut in BC. Our model indicates that in the long run per capita output would be 16 percent higher with the 4.5 percentage point CIT rate cut. Obviously, due to possible decision and implementation lags associated with tax rate changes, the short-run effects of tax rate cuts on output and investment are lower. Our results suggest that in five years, BC's per capita output would be about 1.2 percent higher as a result of the CIT rate cut.

We fail to find a significant effect of the top marginal PIT rate on growth and investment once we control for provincial fixed effects, but we find that the total effect of a sales tax rate increase on growth is positive. This somewhat unexpected effect arises because, while the direct effect of a retail sales tax (RST) on growth is negative, the total effect is positive because higher sales tax rates are associated with higher private investment. This positive effect arises in our differential incidence context because higher sales tax revenues replace other forms of tax revenue (such as property taxes or resource royalties) that inhibit investment. We also find that a switch from a provincial RST to a provincial value added tax (known as the Harmonized Sales Tax or HST) promotes economic growth because of its favorable effects on private investment. Smart (2007) and Smart and Bird (2009) also find that the switch to an HST has a positive effect on Canadian provincial investment. Our model provides a strong endorsement of the decisions by the governments of Ontario and BC to switch their RSTs to HSTs in 2010. However, these tax reforms were controversial, and in a provincial referendum BC's voters rejected the adoption of the HST in August 2011. The government of BC has announced that it will revert to the RST in 2013.

The paper is organized as follows. In Section II, we first present the econometric results on the effects of provincial tax rates on growth through their effects on productivity, holding investment constant. We then investigate the effects of taxes on private investment. Based on these estimation results, in Section III we simulate the impacts of the 2001 tax reductions on BC's growth rate and its future output. Section IV concludes.

II. REGRESSION RESULTS

A. Data

The main sources of our dataset are the Statistics Canada database (CANSIM) and the *Finances of the Nation* (formerly *National Finances*) published by the Canadian Tax Foundation.[2] Our data on the statutory corporate tax rates, top PIT rates, and sales tax rates come from various issues of *Finances of the Nation.* Data on GDP and private investment in 1997 constant prices are obtained from Statistics Canada, *Provincial Economic Accounts.* Data on the remaining variables are also obtained from *CANSIM.* A brief description of the data and definitions of the variables used in our empirical analysis is provided in Table A1. The basic summary statistics for the key variables in the growth regression are shown in Table 1.

B. Growth Regressions

The neoclassical growth model provides the theoretical underpinning for our empirical specification (Barro and Sala-i-Martin, 1992; Mankiw, Romer, and Weil, 1992). Suppose the provincial aggregate production function at time t is

$$(1)\quad Y(t) = K(t)^{\theta}\left[A(t)L(t)\right]^{1-\theta},$$

where Y is output, K is capital stock, L is labor, A is a labor-augmenting technological parameter, and $0 < \theta < 1$ is capital's share of total income. We assume that L and A exogenously grow as $L(t) = L(0)e^{nt}$ and $A(t) = A(0)e^{gt}$.

Let s denote the fraction of income (Y) that is invested in physical capital which is assumed to be constant.[3] Then the evolution of the economy's capital per effective units of labor (k) is given by

$$(2)\quad k = sk(t) - (n + g + \delta)k(t),$$

[2] See http://www.ctf.ca/ctfweb/EN/CTF_Publications/Books/Finances_of_the_Nation.

[3] As the saving rate is not determined by individual optimization, there is no interest rate effect in this neoclassical growth model.

Table 1

Summary Statistics, 1977–2006

Variable	Mean	Standard Deviation	Minimum	Maximum
Corporate tax rate	0.1426	0.0264	0.0605	0.1700
Personal tax rate	0.1939	0.0404	0.1000	0.3200
Sales tax rate	0.0745	0.0305	0.0000	0.1200
Government consumption to GDP ratio	0.2988	0.0555	0.1728	0.4159
Deficit to GDP ratio	–0.0151	0.0115	–0.0102	0.0524
Private investment to GDP ratio	0.1287	0.0456	0.0710	0.2774
Population growth rate	0.0072	0.0089	–0.0139	0.0418
Export price growth rate	0.0365	0.0831	–0.1327	0.2878
Lagged export price growth rate	0.0720	0.1160	–0.1327	0.4642
U.S. GDP growth rate [1]	0.0031	0.0039	0.0001	0.0147
GDP per capita growth rate	0.0173	0.0115	–0.0100	0.0524
Initial GDP per capita (1997 dollars)	23,884	6,186	12,491	40,408

Notes: The number of observations is 60.

[1]This variable is the U.S. growth rate interacted with the respective GDP shares of provinces.

where $k = K/AL$ is capital per effective units of labor and δ is the rate of depreciation. The steady state capital per effective units of labor can be obtained from (2) as

$$(3)\quad k^* = \left[\frac{s}{n+g+\delta}\right]^{\frac{1}{1-\theta}}.$$

Substituting the above steady state value in the production function and taking logs we obtain an equation for the economy's output per capita

$$(4)\quad \ln(Y/L) = \ln A(0) + \frac{\theta}{1-\theta}\ln s - \frac{\theta}{1-\theta}\ln(n+g+\delta) + gt.$$

The above equation shows that output per capita depends on capital accumulation, population growth, and the productivity parameter. The neoclassical model predicts convergence to a steady state. More specifically, it predicts that close to the steady state, the economy converges at the rate

$$(5)\quad \frac{d\ln(y(t))}{dt} = \lambda\left[\ln(y^*) - \ln(y(t))\right],$$

where $\lambda = (n + g + \delta)(1 - \theta)$. This equation yields the following relationship

$$(6)\quad \ln(y(t_2)) = (1-e^{-\lambda t})\ln(y^*) + e^{-\lambda\tau}\ln(y(t_1)),$$

where $y(t_1)$ is the income per effective units of labor in the initial period and $\tau = (t_2 - t_1)$. Subtracting $y(t_1)$ from (6), substituting for the value of y^*, and rearranging we obtain an equation that is a basis for our empirical specification

$$\text{(7a)}\quad \ln(y(t_2)) - \ln(y(t_1)) = (1-e^{-\lambda\tau})\frac{\theta}{1-\theta}\ln(s) - (1-e^{-\lambda\tau})\frac{\theta}{1-\theta}\ln(n+g+\delta) - (1-e^{-\lambda\tau})\ln(y(t_1)).$$

The above equation can be more conveniently rewritten in terms of income per capita as

$$\text{(7b)}\quad \ln[\hat{y}(t_2)] - \ln[\hat{y}(t_1)] = (1-e^{-\lambda\tau})\frac{\theta}{1-\theta}\left[\ln(s) - \ln(n+g+\delta)\right] - (1-e^{-\lambda\tau})\ln(\hat{y}(t_1)) + \left[1-e^{-\lambda\tau}\right]\ln A(0) + g\left(t_2 - e^{-\lambda\tau}t_1\right),$$

where $\hat{y}(t)$ is income per capita. Above (7b) shows that capital accumulation, the population growth rate, initial income per capita, and overall productivity are important determinants of per capita income growth. Note that if we collect terms with $\ln(\hat{y}(t_1))$ on the right hand side, (7b) is a dynamic panel. As Mankiw, Romer, and Weil (1992) argue, $\ln A(0)$ accounts not only for technology but also other province-specific issues. In a growth regression these factors can be captured by province-specific fixed effects. In this neoclassical growth framework, taxes can affect economic growth through their effects on capital accumulation. Furthermore, taxes can affect growth because they can affect overall productivity or the way labor, capital, and other resources are used in the production process.[4] Other macroeconomic variables can also influence growth through the productivity parameter.

Finally, as in Barro and Sala-i-Martin (1992), we use a variant of (7b) that applies for discrete time periods for province *i* and augment it with the usual error term to obtain an estimable dynamic economic growth specification. Since we are using panel data, $\ln(\hat{y}(t_1))$ and $\ln(\hat{y}(t_2))$ correspond to the log of GDP per capita at the beginning and end of each five-year period, respectively. Thus, from the above equation, the specification for the growth regression takes the general form

$$\text{(8)}\quad \Delta \ln \hat{y}_{it} = \alpha_0 + \alpha_{CIT}CIT_{it} + \alpha_{PIT}PIT_{it} + \alpha_{PST}PST_{it} + \alpha_{RST}(RSTdummy \cdot PST)_{it} + \alpha' Z_t + \eta_i + \mu_t + \varepsilon_{it},$$

where $\Delta\ln\hat{y}_{it}$ is the per capita GDP growth rate, *CIT* is the top statutory corporate tax rate, *PIT* is the top marginal PIT rate, *PST* is statutory provincial sales tax rate, *RSTdummy* is a dummy variable that is equal to 1 in the years and provinces in which a RST was

[4] Reed (2008) provides a similar derivation.

in place and equal to 0 otherwise,[5] Z denotes a vector of control variables, ε_{it} is the error term, and μ_t denotes province-invariant time effects. The time-invariant unobserved province-specific effects are captured by η_i. We include private investment as one of our control variables. This approach is better than simply estimating a reduced form, with an investment equation substituted into the growth equation, because it helps us to identify the transmission channels through which taxes affect growth. Furthermore, exploring the effects of taxes on private investment is of considerable importance in its own right.

The dependent variable is the annualized average growth rate of real GDP per capita over the five-year periods 1977–1981, 1982–1986, 1987–2001, and 2002–2006. We use five-year averages rather than annual data in order to smooth out the business cycles. As discussed in Durlauf, Johnson, and Temple (2005), this approach is commonly used in the growth literature.[6] The control variables include initial income per capita, the government consumption to GDP ratio, the deficit-to-GDP ratio, the population growth rate, and the U.S. growth rate (interacted with the provincial GDP share). The control variables, with the exception of the U.S. growth rate interacted with the provincial GDP share, are commonly used in the growth literature (Barro, 1997; Bleaney, Gemmell, and Kneller, 2001). We include the interaction term to capture the potential effects of changes in the U.S. economy on Canadian provincial growth rates.

Provinces differ in their resource endowments, climates, the structures of their economies, and so on. We attempt to capture such time-invariant effects using province-specific fixed effects. Note also that our specification excludes other tax rates (such as property taxes or resource royalties) in order to avoid collinearity in the fiscal variables because of the governments' budget constraints. The regression coefficients therefore measure the effect of a tax rate increase while simultaneously reducing other tax rates that have been excluded from the regression equation in order to maintain the same total revenue. See Kneller, Bleaney, and Gemmell (1999) on the interpretation of the coefficients of tax rates in light of governments' budget constraints.

In Canada, the federal government levies a value-added sales tax, the Goods and Services Tax (GST). All provinces, except Alberta, also impose sales taxes, but the sales tax bases can differ from province to province. Some provinces levy RSTs while others levy an HST, which is harmonized with the federal government's GST. The HST base includes many consumer services that are not taxed under provincial RSTs, while

[5] That is, the dummy variable is equal to one for Newfoundland, Nova Scotia, and New Brunswick (before 1997), Quebec (before 1992), Ontario, Manitoba, Saskatchewan, Prince Edward Island, BC, and Alberta, and zero otherwise.

[6] An alternative method is to use panel cointegration and an error-correction mechanism based on annual data. This method is appropriate if the goal is to identify short-run and long-run relationships. However, the focus of our paper, as in the majority of growth studies, is to explore the long-run investment and growth effects of taxes. The error-correction method has also its own serious shortcomings. In addition to the known limitations of unit root tests associated with this approach (Baltagi, 2008), the results from such approach may be driven by the time series properties of a small number of panel members.

the RST tax bases generally include business inputs, including capital goods.[7] Unlike the GST, RSTs have no provisions for rebating taxes paid on inputs. Thus, a good part of sales tax revenue in RST provinces essentially comes from taxing business inputs. Previous studies by Smart (2007) and Smart and Bird (2009) indicate that RSTs have a negative effect on investment and growth compared to HSTs. Thus to account for these variations in provincial sales tax system and their potentially different effects on economic activity, we also include the sales tax rate interacting with the *RSTdummy* in our specification. A statistically significant coefficient of the *RSTdummy* shows that sales taxes have different economic effects in the RST and HST provinces. If a sales tax increase has an adverse impact on economic activity in RST provinces, we expect the coefficient of *RSTdummy* to be negative. Such a result would imply that the value-added based HST is better for economic activity than the RST, as discussed in Smart and Bird (2009). Note that in our specification the effect of sales tax on growth can be shown to be the sum of the coefficients of sales tax and the *RSTdummy*.

There are some special factors that can stimulate growth and investment in particular provinces (in particular time periods). For example, the development of natural resource extraction responds to changes in the world prices of the exportable resources. To account for these kinds of environmental factors, we include the export price index of the province's major exporting commodities. Generally, an increase in the world price of major export commodities has favorable impacts on the total economic activity of the exporting province.[8] Thus, we expect the coefficient of the log of the export price to be positive.

Theoretical growth models indicate that marginal tax rates affect economic growth.[9] However, due to lack of data on marginal tax rates, many empirical studies have used overall average tax rates and effective marginal tax rates (e.g., Mendoza, Milesi-Ferretti, and Asea, 1997; Reed, 2008). Our investigation of the growth–tax nexus uses data on the statutory corporate tax rate and top PIT rates as in Lee and Gordon (2005). Since the marginal PIT rates change with income brackets, using PIT rates in empirical analysis is problematic. Previous studies used the weighted average statutory PIT rate (Easterly and Rebelo, 1993), and the effective average PIT rate (Mendoza, Milesi-Ferretti, and Asea, 1997). None of the above measures captures the effects of PIT rate on the growth rate precisely. The approach of Easterly and Rebelo (1993), although theoretically interesting, requires information on income distribution and all the tax rates. Due to lack of data on income distribution, this approach is not feasible. Furthermore, as Katz, Mahler, and Franz (1983) explained, the top marginal statutory PIT rate seems relatively more appealing because this rate affects the high-income group that has the most income and the highest propensity to save and invest. Thus, following Lee and

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7 See Kesselman (2011) on the differences between the RST base and the HST base in BC.

8 In some provinces (for example, Alberta) the boom-and-bust cycle of the economy is largely a reflection of fluctuations in the world price of major export commodities.

9 See for example Padovano and Galli (2002) who argue that empirical tests of the relationship between taxation and growth should use marginal tax rates, not average tax rates.

Gordon (2005) and Katz, Mahler, and Franz (1983), we use the statutory top PIT rate in our analysis. The tax rate variables enter the growth equation as an average for the corresponding five-year period.

The growth regression results are shown in Table 2. In column (1) we regress the growth rate on only the tax rates. The result shows that as expected the coefficient of the corporate tax rate is negative and statistically significant. The point estimate implies that a 1 percentage point reduction in the tax rate is associated with a 0.125 percentage point increase in the annual growth rate of GDP per capita. Our results also imply that the coefficient of the sales tax rate is positive and the coefficient of the *RSTdummy* interacted with the sales tax rate is negative, suggesting that the RST is distortionary. The coefficient of the PIT rate is positive but statistically insignificant.

Column (2) reports the regression results after controlling for government spending, the budget deficit, and other variables. Including the budget deficit in the control variables captures the financial stress of the provincial governments. But more importantly, as Kneller, Bleaney, and Gemmell (1999) and Bleaney, Gemmell, and Kneller (2001) argue, by controlling for government spending and budget deficit we explicitly take the government budget constraint into account. Thus, in our analysis, the coefficients of the tax rates can be interpreted as the effects of a unit change in the relevant tax rates with offsetting changes in fiscal variables that are omitted from the regression. The coefficient estimates on the government spending and deficit to GDP ratios are, consistent with results from previous studies, negative. The coefficients of the CIT and PST rates are still statistically significant with estimates slightly higher in absolute value than those in column (1), while the coefficient on the PIT rate remains statistically insignificant.[10]

As explained in Lee and Gordon (2005), tax rates may be endogenous. A growing economy can afford to reduce tax rates, while governments may be forced to raise taxes when their economies decline and their tax bases contract. If tax rates are endogenous, the point estimates of the coefficients of the tax rates from fixed effects estimation may be biased. To overcome this potential endogeneity problem, we treat the tax rates as endogenous. As is common in the growth literature, we also treat the government spending and investment ratios as endogenous. Thus in the results reported in columns (3–5), we employ the Two-Stage Least Squares (2SLS) estimation method to account for the potential endogeneity of tax rates and other variables.

The most common challenge in empirical studies is the determination of which instruments to use for the tax rates and other endogenous variables. A valid instrument should be correlated with the tax rate but not with the growth rate. As in Lee and Gordon (2005), we use contemporaneous and one-period lagged weighted-average CIT rates of other provinces (weighted by the inverse of the distance between the major cities of the provinces) as instruments for the corporate tax rate. The justification for the choice of these instruments is the presence of strategic tax competition between governments, as

[10] Lee and Gordon (2005) also find that the statutory top PIT rate and sales tax rate are insignificant. See also Katz, Mahler, and Franz (1983).

Table 2

Growth Regressions, 1977–2006

(Dependent Variable: Average Growth Rate of GDP Per Capita)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Independent Variables	Fixed Effects	Fixed Effects	2SLS	2SLS	2SLS	FULL(1)	Robust
Corporate tax rate	–0.125**	–0.163*	–0.227**	–0.205*	–0.185**	–0.184**	–0.121**
	(0.058)	(0.084)	(0.114)	(0.119)	(0.094)	(0.093)	(0.060)
Personal tax rate	0.079	0.048	–0.004	–0.023			
	(0.063)	(0.074)	(0.095)	(0.080)			
Sales tax rate	0.501**	0.587*	–0.034	0.038			
	(0.235)	(0.323)	(0.886)	(0.769)			
RSTdummy x Sales tax rate	–0.202***	–0.242**	–0.104	–0.128	–0.121***	–0.121***	–0.081***
	(0.070)	(0.080)	(0.215)	(0.186)	(0.040)	(0.040)	(0.030)
Government expenditure to GDP ratio		–0.021	0.104	–0.010	0.014	0.014	–0.212***
		(0.036)	(0.104)	(0.098)	(0.099)	(0.099)	(0.050)
Deficit to GDP ratio		–0.131	–0.180	–0.161	–0.159*	–0.159*	–0.169***
		(0.091)	(0.126)	(0.113)	(0.085)	(0.085)	(0.056)
Lagged export price growth rate		–0.011	–0.001	–0.016	–0.015	–0.015	–0.054***
		(0.028)	(0.025)	(0.020)	(0.022)	(0.022)	(0.012)
U.S. growth rate *x* GDP share		5.156*	5.815**	5.590**	5.420***	5.418***	1.983
		(2.925)	(2.503)	(2.205)	(1.977)	(1.975)	(1.835)
Investment to GDP ratio		0.104	0.214*	0.187*	0.197**	0.197**	0.054
		(0.078)	(0.120)	(0.109)	(0.089)	(0.089)	(0.051)

Population growth rate				0.078	0.105	0.105	–0.478**
				(0.304)	(0.306)	(0.306)	(0.188)
Log of initial GDP per capita				–0.061**	–0.057**	–0.057**	–0.090***
				(0.026)	(0.028)	(0.028)	(0.017)
Constant	–0.008	–0.027	–0.022	0.641	0.592*	0.592***	1.019***
	(0.022)	(0.021)	(0.050)	(0.299)	(0.312)	(0.312)	(0.188)
Provincial effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Over-identification test (p-value)			0.188	0.453	0.807	0.807	
Observations	60	60	60	60	60	60	60
Adjusted R-squared	0.422	0.473	0.319	0.445	0.471	0.471	0.780

Notes: Figures in parentheses are robust standard errors. In columns (3), tax rates, government spending, and investment ratios are treated as endogenous. See the text for a description of the instruments. In column (4), we use the same instruments as in column (3) and we also instrument the log of initial GDP per capita with its own one period lagged value. In columns (5) and (6), the relevant instruments are similar to those of the previous columns. Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels.

discussed for instance by Devereux, Lockwood, and Redoano (2007). Provinces tend to influence the tax rates of their neighbors. If this is the case, a province's tax rates will be correlated with the tax rates of other provinces making them valid instruments. We also use the average PIT rate of other provinces as an instrument for the PIT rate. Similarly, for the sales tax rate we use the contemporaneous and one-period lagged values of the weighted-average sales tax rates of other provinces and the interaction between other provinces' sales tax rate and *RSTdummy* as instruments. Furthermore, as in Mendoza, Milesi-Ferretti, and Asea (1997) and Barro (1997, 2000), the government expenditure and private investment ratios are treated as endogenous and instrumented with their respective one-period lagged values. We also include one-period lagged values of the public investment ratio, contemporaneous and one-period lagged values of the log of the share of mining in the economy as additional instruments for private investment. The common justification given for using lagged values as instruments is that once one controls for the variables, their lagged values do not have any effects on the dependent variable and hence are exogenous; such an approach is discussed in Mendoza, Milesi-Ferretti, and Asea (1997) and Barro (2000), among others. We conduct various diagnostic tests to check the validity of these instruments.

The results in column (3) show that, as expected, the coefficient of CIT rate is negative and statistically significant. The magnitude of the coefficient is, however, higher than what we obtain in column (2). The coefficients of the personal income and sales tax rates are still statistically insignificant. The coefficient of the interaction term between the sales tax rate and the *RSTdummy* is still negative but statistically insignificant.

In column (4), we use the 2SLS estimation method as described above and include the population growth rate and the log of initial per capita GDP as additional control variables. This econometric specification is a dynamic panel since it includes the log of initial per capita GDP as an explanatory variable. As is common in the literature, in addition to the variables we described above, we treat the log of initial per capita GDP as an endogenous variable. Following the general practice in the growth literature, we instrument this variable with its own one period lagged value (Mendoza, Milesi-Ferretti, and Asea, 1997; Barro, 1997, 2000).

The 2SLS estimates of column (4) indicate that the coefficient of the CIT rate is still negative and statistically significant even after including all the relevant control variables. Personal income and the sales tax rates continue to be insignificant.

In the results reported in column (5), we re-estimate the model after dropping the personal income and sales tax rates, which are statistically insignificant in the previous regressions. The coefficient of our key variable of interest, the CIT rate, is still negative and statistically significant. The coefficient of the sales tax rate, interacted with the *RSTdummy*, is also negative and statistically significant, suggesting that the retail sales tax in RST provinces reduces growth. Comparing these results with those of column (4), we see that the exclusion of the insignificant personal income and sales tax rates raises the explanatory power of the model as shown by a relatively higher adjusted R-squared.

Our results in column (5) show that the over-identification restrictions are valid as indicated by the Hansen J-statistic. One may still be concerned with the potential problem of weak instruments as this can pose problems to 2SLS estimates. The problem of weak instruments arises when the instruments are weakly correlated with the endogenous explanatory variables. The weak instrument literature provides statistical tests for the problem. The common way of testing for weak instruments is to compare the Kleibergen-Paap Wald F-statistic with the critical-values obtained in Stock and Yogo (2005). If the statistic is greater than the relevant critical value, the null hypothesis of weak instruments is rejected. In our case, however, such an exercise is not possible as there are no critical values computed by Stock and Yogo (2005) for more than three endogenous variables.[11]

In the absence of any formal tests, we rely on an inspection of the first-stage regressions to check for any potential problem of weak instruments; Temple and Wobmann (2006) use a similar approach. As Bound, Jaeger, and Baker (1995) suggest, one way to check the relevance of the instruments involves examining the partial R-squared from the first stage regression. Our first stage regressions show that the partial and Shea R-squared values are very close to each other and well above 0.5, indicating the relevance of the instruments. The F-statistics from the first stage regressions are also all statistically significant at one per cent level, suggesting the relevance of the excluded instruments in explaining the endogenous variables.

However, we are still concerned with the potential problem of weak instruments as the Kleibergen-Paap Wald F-statistic is less than five for our preferred regression.[12] There are some common solutions if one suspects potential weak instruments. The standard practice is to use estimation methods that are robust to the presence of weak instruments. In a weak instrument setting, the Fuller (1977) maximum likelihood (FULL) and the limited information maximum likelihood (LIML) estimation methods are preferred to 2SLS. As shown by Hahn, Hausman, and Kuersteiner (2004), FULL provides better results than LIML when the instruments are weak; Stock and Yogo (2005) also discuss this issue. For this reason, in column (6), we report estimation results using the FULL, which can greatly alleviate any potential problem of weak instruments. FULL can be estimated with a chosen constant of one or four. We use a constant of one that is generally considered to have a better performance. The similarities of the FULL results to those presented in column (5) are reassuring about the validity of the instruments and suggest the robustness of our findings. This is our preferred estimate. Our analysis of the effects of tax reform on the BC's growth in Section III will be based on the estimated results reported in column (6).

Results reported in column (6) show that the coefficient on our key variable of interest, the CIT rate, is negative and statistically significant. The point estimate implies that a 1 percentage point reduction in the tax rate is associated with a 0.18 percentage point increase in the annual growth rate of GDP per capita. This is well within the range of estimates found in Lee and Gordon (2005). The results are also consistent with the

[11] The Stock-Yogo critical values for weak identification tests are available for only up to three endogenous variables.

[12] The details of the first-stage regressions are available from the authors upon request.

empirical finding by OECD (2010) that corporate taxation is the tax instrument that is most harmful to economic growth. The sales tax rate, interacted with the *RSTdummy*, is negative and statistically significant suggesting that the retail sales tax in RST provinces reduces growth. As in many other empirical growth studies, our result also confirms that private investment affects growth positively. The coefficient of the log of initial GDP per capita is negative and statistically significant, consistent with the literature on conditional convergence. The Hansen test of overidentification supports the validity of the overidentification restriction.

Finally, in column (7) we check the robustness of our preferred regression to the presence of outliers by using a robust estimation method.[13] We use the Least Absolute Deviation estimation method, which is generally less sensitive to the presence of outliers in the data. The coefficients of our key variables of interest continue to have the expected signs and are statistically significant. Under the robust estimation method, the coefficients of the corporate tax rate and the sales tax rate interacted with the *RSTdummy* are significant at the 5 and 1 percent levels, respectively. Thus our result suggests that the strong negative effect of tax rates on growth is not influenced by the presence of outliers.

In general, our regression results indicate that a higher CIT rate is associated with a lower per capita GDP growth rate.[14] The negative impact of the corporate tax rate on growth is robust to the estimation method employed and various sensitivity checks. In particular, we find that the corporate tax rate affects growth negatively when one controls for investment. This suggests that a higher corporate tax rate affects growth by discouraging innovations that lead to productivity improvements (Baldacci, Hillman, and Kojo, 2004; Djankov et al., 2008). In the next section, we explore the other main transmission channel through which taxes can affect growth: private investment.

C. Investment Regressions

Tax rates raise the user cost of capital and hence can affect investment adversely (Hulten, 1984; Hubbard, 1998; Feldstein, 2006).[15] For instance, McKenzie and Thompson (1997) indicated that over the period 1971–1996 the user cost of capital in Canada was higher than that of the United States partly because of higher Canadian tax rates. Using Canadian data, Parsons (2008) and Smart and Bird (2009) also find evidence of negative effects of higher tax rates on private investment.

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[13] We also used the alternative approach of median regression which yielded results (not reported in Table 2) that were somewhat similar to those of the robust estimation reported.

[14] In Dahlby and Ferede (2008) we find that when when we do not control for provincial effects, the top marginal PIT reduces economic growth rate indirectly through investment. This effect of PIT rate disappears once we control for provincial effects. The CIT rate however seems to have a strong negative effect on growth whether one controls for provincial effects or not.

[15] Mintz (1995) also provides an excellent survey of the literature on the effects of corporate taxation on investment. See also Zodrow (2010) for a discussion of the literature on capital mobility in response to differences in capital taxes.

Ideally, an analysis of the response of investment to tax rate changes would be performed using disaggregated data on investment by sector to capture the potential differential effects of tax rates on investment levels in different sectors, preferably using marginal effective tax rates. However, since our principal objective is to identify the channels through which tax rates affect the growth rate, we have focused on aggregate private investment.[16] Furthermore, due to lack of sufficient data on marginal effective tax rate for most of the sample period, we use statutory tax rates.

Our empirical analysis relies on the works of previous studies such as Barro (1997), Mendoza, Milesi-Ferretti, and Asea (1997), and Baldacci, Hillman, and Kojo (2004) among others in estimating a structural equation of aggregate private investment. The investment regression equation is specified as

$$(9)\quad INV_{it} = \beta_0 + \beta_{CIT} CIT_{it} + \beta_{PIT} PIT_{it} + \beta_{PST} PST_{it} + \beta_{RST}\left(RSTdummy \cdot PST_{it}\right) + \beta' X_{it} + \varepsilon_{it},$$

where *INV* is the average gross private investment to GDP ratio over the five-year periods and the other explanatory variables are the same as those used in our growth regression.[17] The estimated coefficients from the above regression show the indirect effects of tax rates on the growth rate through their impact on the level of investment. The direct effects of tax rates on growth through the productivity channel are shown through the growth regressions that control for investment.[18]

The baseline ordinary least squares (OLS) estimates of the investment equation are given in column (1) of Table 3. As expected the coefficient of the corporate tax rate is negative and statistically significant. On the other hand, the coefficient of the PIT rate is positive but insignificant. The results also indicate that while the coefficient of the sales tax rate is positive, the coefficient of the sales tax rate interacted with the *RSTdummy* is negative and statistically significant. The overall effect of sales tax rate on private investment is positive. However, value-added taxes are more private investment-friendly than RSTs.

In columns (2) and (3) we use the instrumental variable estimation method, treating the tax rates as endogenous. We use the average tax rates of other provinces, the U.S. CIT rate (interacted with GDP shares of provinces), the *RSTdummy*, and the share of population age 65 and above as instruments. The validity of the instruments is checked

[16] For a theoretical explanation why tax rates may affect growth with or without controlling investment, see Easterly et al. (1991).

[17] In the neoclassical investment framework, there are various ways to obtain estimable investment models. For the sake of brevity, we do not discuss these theoretical possibilities here; see Hassett and Hubbard (2002) for a detailed theoretical discussion of such approaches. We focus on a structural equation of investment following many previous studies.

[18] For similar approaches involving isolating direct and indirect effects on growth, see Knight, Loayaz, and Villanueva (1996) and Papyrakis and Geralgh (2007).

Table 3

Investment Regressions, 1977–2006

(Dependent Variable: Average Private Investment to GDP Ratio)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Independent Variables	OLS	2SLS	2SLS	2SLS	2SLS	FULL (1)	Robust
Corporate tax rate	–0.297*	–0.499**	–0.342**	–0.469**	–0.332**	–0.336**	–0.311**
	(0.162)	(0.220)	(0.168)	(0.228)	(0.162)	(0.163)	(0.142)
Personal tax rate	0.157	0.210	0.181	0.272	0.151	0.154	0.121
	(0.116)	(0.194)	(0.159)	(0.286)	(0.133)	(0.135)	(0.108)
Sales tax rate	1.124***	1.550*	1.928*	1.602**	1.736**	1.787*	1.028**
	(0.442)	(0.806)	(1.036)	(0.732)	(0.863)	(0.914)	(0.448)
RSTdummy x Sales tax rate	–0.231**	–0.317**	–0.387	–0.357**	–0.374*	–0.385*	–0.291**
	(0.107)	(0.158)	(0.240)	(0.160)	(0.211)	(0.221)	(0.124)
Government expenditure to GDP ratio	–0.392***	–0.424***	–0.386***	–0.395***	–0.351***	–0.355***	–0.497***
	(0.172)	(0.127)	(0.134)	(0.148)	(0.114)	(0.115)	(0.091)
Deficit to GDP ratio	0.392***	0.366**	–0.383	–0.328*	–0.226	–0.226	0.181
	(0.123)	(0.177)	(0.243)	(0.186)	(0.236)	(0.237)	(0.128)
Export price growth rate				–0.031	–0.085*	–0.086*	–0.003
				(0.041)	(0.045)	(0.045)	(0.029)
Population growth rate				0.699	1.170**	1.165**	0.974**
				(0.487)	(0.531)	(0.530)	(0.434)
U.S. growth rate *x* GDP share				–0.207			
				(3.899)			

Log of initial GDP per capita				0.008			
				(0.033)			
Constant	0.167***	0.174**	0.128*	0.056	0.116*	0.115*	0.193***
	(0.048)	(0.073)	(0.066)	(0.390)	(0.065)	(0.066)	(0.040)
Provincial effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yearly effects	No	No	Yes	No	Yes	Yes	No
Test of over-identification (p-value)		0.508	0.183	0.188	0.162	0.165	
Observations	60	60	60	60	60	60	60
R-squared	0.856	0.851	0.835	0.843	0.851	0.850	0.888

Notes: Figures in parentheses are robust standard errors. In columns (2) to (6) the tax rates are treated as endogenous. The instruments used are one-period lagged values of other provinces' average CIT rate and sales tax rate. We also include the contemporaneous U.S. CIT rate (interacted with provincial GDP share), other provinces' CIT rate, the PIT rate, the sales tax rate (interacted with the *RSTdummy*), the *RSTdummy*, and the share of population age 65 and above as additional instruments. Asterisks denote significance at the 1% (***), 5% (**), and 10% (*) levels.

with the standard Hansen over-identification test. The results are generally similar to those presented in column (1).

In column (4), in addition to the fiscal variables, we include other control variables that are generally considered to affect private investment. The effects of the tax rates are similar to those shown in columns (2) and (3). The additional control variables are however statistically insignificant. Thus in column (5), we drop these control variables which increases the explanatory power of the model, as indicated by the increase in the adjusted R-squared. The coefficients on all of the variables of interest with the exception of the PIT rate are significant and have the expected signs. The Hansen test shows that the instruments used are valid.

As discussed before, we are concerned with the potential problem of weak instruments, even though the statistical tests show that there are no over-identification or under-identification problems. Thus in column (6), we use the FULL estimation method that is robust to the presence of weak instruments. The coefficient estimates are close to those of column (5). Column (6) is our preferred investment regression, which is used in the policy analysis in Section III.

The results indicate that a 1 percentage point reduction in the corporate marginal tax rate is associated with a 0.34 percentage point increase in the private investment to GDP ratio. Our estimates of the investment effects of CIT rate are generally consistent with those of Parsons (2008) and Vartia (2008) who use industry-level data for Canada and OECD countries, respectively. However our estimates are slightly larger than those of Djankov et al. (2008) who use data from a cross-section of 85 countries and find that raising the effective corporate tax rate by 1 percentage point reduces the investment to GDP ratio by 0.22 percentage points. They, however, used an effective corporate tax rate applicable for a hypothetical mid-size manufacturing firm rather than statutory rates.

A number of studies indicate that investment responds positively to the reductions in the user cost of capital associated with lower tax rates (Cummins and Hassett, 1992; Cummins, Hassett, and Hubbard, 1996). There are a few studies of investment using firm-level data from the U.S. states. The studies generally focus on the effects of the user cost of capital on investment. A survey of these studies by Hassett and Hubbard (1997) indicates that the estimated elasticities of investment with respect to the cost of capital are generally between –0.5 and –1.0. Hassett and Newmark (2008) also provide an excellent survey of the recent literature on tax reform and investment in the United States. Obviously it is difficult to directly compare our results to those of such studies given differences in methodology and level of aggregation. However, since the user cost of capital is inversely proportional to one minus the CIT rate, we can calculate the implied elasticity for our preferred result.[19] Our preferred result for the coefficient of the CIT rate implies an elasticity of investment with respect to the user cost of capital of about –2.6. While this is outside the typical range of values obtained in firm-level

[19] To obtain a result comparable to those from firm-level data, we assume that depreciation allowances are provided based on economic depreciation. This simplifying assumption makes the usual user cost of capital definition to depend inversely with one minus the CIT rate (Auerbach, 2002).

data studies for U.S. states as surveyed by Hassett and Hubbard (1997), this calculation is based on the assumption that an increase in the CIT rate only affects investment through an increase in the user cost of capital. However, studies by Hubbard (1998) and others indicate that the reduction in cash flow caused by a CIT rate increase also affects the level of investment. Our results reflect both a user cost of capital effect and a cash flow effect.

Our empirical results are also related to the literature on the investment effects of corporate rate cuts in small open economies; Wilson (1999) and Zodrow (2003, 2006) discuss the implications of tax competition in small open economies. In small open economies, the increase in investment as a result of tax cuts comes from both higher domestic business activity and an inflow of foreign direct investment.[20] While most previous studies focus on how corporate taxation affects foreign direct investment flows, we focus on how taxes affect total provincial investment. Although the corporate tax rate is only one of the many factors that can influence the choice of firms' location in a province, a cut in the provincial CIT rate is likely to increase inflows of capital from other countries because the Canadian economy is integrated in world capital markets; see OECD (2010) for a similar discussion.

While Smart (2007) and Smart and Bird (2009) found that the sales tax discourages private investment in RST provinces, our results in column (5) seem to indicate that sales taxes encourage private investment because the sum of the coefficients of the sales tax rate and the *RSTdummy* interacted with the sales tax rate is positive.[21] This positive effect on investment can arise because, as noted before, our regression equations exclude other tax rates (such as property taxes or resource royalties) in order to avoid collinearity in the fiscal variables because of the governments' budget constraints. Other studies, such as Mendoza, Milesi-Ferretti, and Asea (1997), also find that the marginal consumption tax rate has a positive effect on private investment.

In column (7) we check the robustness of our results by using the robust estimation method that is not affected by the presence of outlier observations. The results are generally similar to those presented in column (6), suggesting that our preferred estimation results are not driven by possible extreme values in the data.

III. POLICY SIMULATIONS

Our econometric results indicate that provinces that have lower CIT rates have higher investment rates and faster economic growth. In this section, we use parameter estimates from our preferred growth and investment regressions in Tables 2 and 3 to simulate

[20] See Zodrow (2006, 2010) and references contained therein for a discussion of the effects of the CIT in a small open economy.

[21] Smart (2007) and Smart and Bird (2009) do not include the sales tax rate directly. They use a dummy variable for the HST provinces to examine the effects of RSTs. The HST dummy is found to be positive and significant in the investment regression indicating that provincial RSTs affect investment adversely and HST provinces benefit by harmonizing their sales tax with the federal GST.

both the direct and indirect effects of BC's 2001 CIT rate cuts on its long-term growth rate.[22] Then we use our econometric results to simulate the potential growth effects of BC's switch from an RST to an HST assuming a permanent switch.

A. The Growth Effects of the BC CIT Rate Cut

In this section we explore the economic growth effects of a cut in the CIT rate using BC as a case study, taking into account both the direct and indirect effects of the CIT rate cut on growth; see Helliwell (1994), Knight, Loayaz, and Villanueva (1996), and Papyrakis and Gerlagh (2004, 2007) among others for a similar methodology.

Let α_Y, α_{CIT}, and α_{INV} denote the coefficients of initial GDP per capita, the corporate tax rate, and investment in the growth regression, respectively. Let β_{CIT} and β_Y denote the coefficients of the corporate tax rate and the log of initial GDP per capita in the investment regression. The impact of a change in the statutory corporate marginal tax rate on the growth rate j years after the tax cut, g_{t+j}, can be calculated as[23]

$$\text{(10a)} \quad \Delta g_{t+j} = \left(1 + \alpha_Y + \alpha_{INV}\,\beta_Y\right)^j \left[\alpha_{CIT} + \alpha_{INV}\,\beta_{CIT}\right] \Delta CIT.$$

The expression in square brackets indicates how a change in the CIT rate directly affects the growth rate (α_{CIT}) and indirectly affects it through its effect on the investment rate ($\alpha_{INV}\beta_{CIT}$). The expression in parentheses indicates that the effect of the tax rate change diminishes over time because $0 < 1 + \alpha_Y + \alpha_{INV}\beta_Y < 1$. In other words, the growth impact of the CIT rate cut diminishes over time because of the conditional convergence effect. Recall that our specification has the characteristic of the neo-classical growth model that fiscal policy only has a temporary effect on the growth rate, although (as we will see) the "temporary" effect occurs over a very long period of time.

Our computations are based on the values of the coefficients in column (6) of Table 2 and column (6) of Table 3, assuming a 4.5 percentage point reduction in the CIT rate. We assume that, in the absence of the CIT cut, the BC economy would grow at an average annual rate of 1.275 percent.[24] The solid line in Figure 1 shows the simulated growth rate with the 2001 and 2005 CIT rate cuts compared to the baseline growth rate of 1.275 percent, the dashed line. Given our parameter estimates, it takes a very long time for the economy to return to the baseline growth rate. Therefore, although the growth rate effect of the tax cut is temporary, it is long lasting. Figure 2 shows output with the CIT rate cut relative to the no-tax-cut output. Our result indicates that in the long-run per capita output would be about 16 percent higher with the 4.5 percentage point CIT rate cut.

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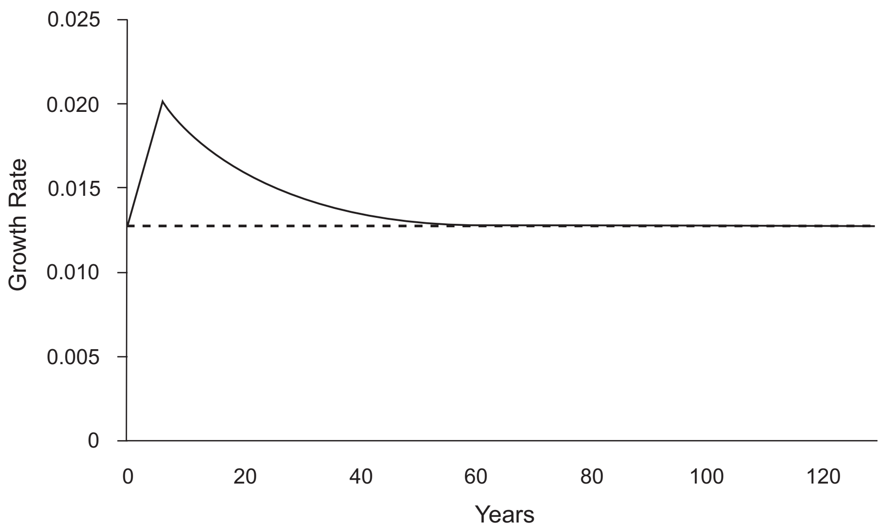
[22] We choose to use BC as a case study because the province embarked on a comprehensive pro-growth tax reform in 2001.

[23] See a second appendix, available upon request from the authors, for the details of the derivations.

[24] This is BC's average real per capita GDP growth rate over the period 1997–2001, the five-year period prior to the tax cut.

Figure 1

The Effect of BC's CIT Rate Cut on Growth

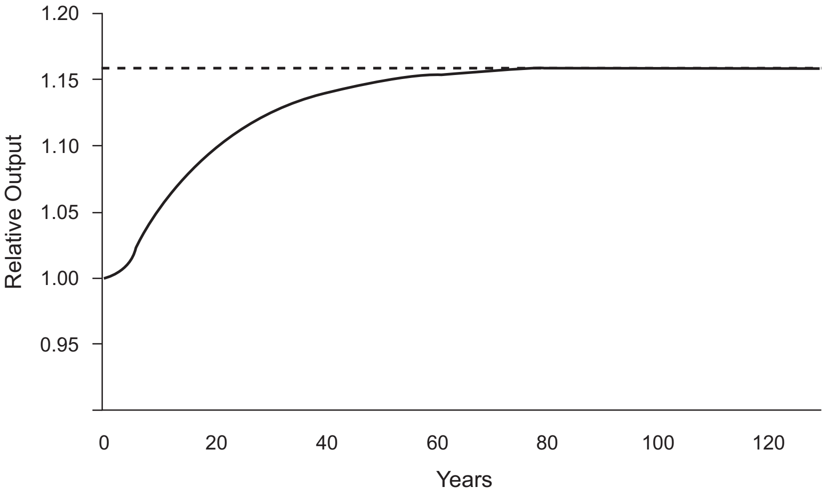


Of course, this increased output occurs only after a long delay, so a better measure of the effect on total output is the increase in the present value of per capita output that occurs with a CIT rate change. In particular, we can calculate the elasticity of the present value of per capita output with respect to the CIT rate. This elasticity, γ_{CIT}, indicates the percentage change in the present value of output from a 1 percent increase in the CIT rate. Of course, the present value of increased output depends on the discount rate used to calculate the present value of a future income stream, and there is a lot of controversy concerning the appropriate public sector discount rate (Jenkins and Kuo, 2007). We use the public rather than private discount rate because we have assumed that governments would decide on the potential benefits of tax cuts from the perspective of society.[25] In order to address the concern surrounding variation in real discount rates, we have calculated γ_{CIT} with both a "low" real discount rate of 4 percent and a "high" real discount rate of 10 percent. A real discount rate of 10 percent is consistent with the recommendation of the Treasury Board of Canada (2007). However, many people argue that this discount

[25] There is no unique private discount rate for Canada as estimates exhibit wide variation due to differences in such factors as risk and form of finance. The discount rate also tends to vary across sectors. Brean et al. (2005) show that the average real private discount rate for Canada is on the order of 10 percent, so our high real public discount rate is in fact similar to the average real private discount rate for Canada.

Figure 2

Relative Output with BC's CIT Rate Cut



rate is unrealistically high for public investment decisions. For instance, Jenkins and Kuo (2007) estimate that the real public discount rate for Canada is 8 percent. For the low discount rate, $\gamma_{CIT} = -0.357$ and with the high discount rate, $\gamma_{CIT} = -0.183$. These parameters measure, in present value terms, the long-run impact of the CIT rate changes. For example, γ_{CIT} based on the low discount rate implies that a 10 percent reduction in the CIT rate will increase the present value of per capita output by 3.6 percent. The γ parameter is the best way of expressing the long-run output effect of a tax rate change.

It is important to emphasize the implications of our empirical results for other provinces. In the above simulation exercise, we attempt to quantify the growth effects of BC's tax cut for the province. However, the results do not necessarily imply that the same growth effects would occur if other provinces simultaneously cut their CIT rates.[26] Capital is mobile and business location decisions may be at least partly influenced by tax considerations (Zodrow, 2010). When a province cuts its CIT rate and others keep their rates constant, some mobile capital may be attracted from other provinces.[27] Note,

[26] It is possible for governments to engage in strategic tax competition. For example, using data from U.S. cities, Brueckner and Saavedra (2001) find evidence that local governments engage in strategic interaction in the choice of property tax rates. Devereux, Lockwood, and Redoano (2007) also provide evidence that OECD countries compete over corporate tax rates.

[27] Mintz and Smart (2004) indicate that income shifting by firms across provinces may make real investment by firms less sensitive to tax rates as they can avoid higher taxes by simply shifting their income across provinces using various methods; see also Zodrow (2010) for a discussion of the literature on the incidence of CIT.

however, that the increase in total investment in a province that cuts its CIT rate comes from within the province (by encouraging more capital formation by local businesses), from attracting capital from other provinces, and from an increase in foreign investment. If other provinces also cut their CIT rates by the same amount, then the part of the increase in private investment that is attributable to "capital flight" from other provinces may not materialize. This is because a simultaneous equal change in tax rates by all jurisdictions essentially leaves the provincial tax differences unchanged and gives no incentives for capital to move across provinces. However, there would be an increase in total investment due to increases in investment by local businesses and foreign investors. This implies that the growth effects of CIT rate cuts may be somewhat lower than what we have measured if other provinces also engage in similar tax cuts, but we would expect an overall increase in investment. Furthermore, our results indicate that a CIT tax cut is not a zero-sum game because of the increase in the provincial growth rate that arises from an increase in productivity.[28]

Our simulation exercise is based on a case study of just one province to highlight the potential gains from tax cuts. Nonetheless, our results have a more general message that is applicable to other economies. The empirical results imply that economies can achieve a higher per capita GDP growth rate by cutting their CIT rates. This is in fact consistent with, among others, the empirical results of Lee and Gordon (2005) and the policy recommendations of OECD (2010). We obtain empirical support for the general belief that the CIT is the most harmful tax for economic growth. The gain in per capita GDP growth as a result of CIT cut arises from its positive effects on the total productivity of factors of production and an increase in private investment. It should also be noted that since we use sub-national data, the responsiveness of investment to changes in the CIT is likely to be higher than the response that is measured when one uses a cross-section of countries. This is because capital can move more easily within a country than across countries.

B. Potential Growth Effects of Switching from an RST to an HST in British Columbia

As pointed out previously, BC switched from an RST to an HST in 2010. This tax reform was, however, a short-lived one as voters rejected it in a referendum in August 2011. The government also announced that it would reinstate the RST in 2013 reflecting the referendum decision of voters. Accordingly, in this section, we compute the potential growth and output gains that BC could obtain with a permanent switch to an HST. Although the actual tax switch is a short-lived one, the simulation exercise is important as it highlights the potential benefits from permanent adoption of an HST. In our computation, we assume that the tax reform would be long-lasting so that one can

[28] In such a setting of tax competition, the cutting of the CIT by provinces can be considered as a zero-sum game only in regard to attracting capital from other provinces (not to the overall effects of raising private investment and growth). Other things remaining constant, an equiproportionate change in the CIT rate by all provinces is not expected to motivate capital to move across provinces. Such actions, however, can stimulate more investment from within the province. See Cummins, Hassett, and Hubbard (1996) for an analysis of the response of investment to tax changes in the OECD countries.

view the results as being indicative of the potential growth and output gains that the province missed out by not making the switch to the HST permanent.

The change in the rate of economic growth *j* years after a switch from an RST to an HST is given by

$$\text{(10b)} \quad \Delta g_{t+j} = \left(1 + \alpha_Y + \alpha_{INV}\beta_Y\right)^j \left[-\alpha_{RST} - \alpha_{INV}\beta_{RST}\right] RST,$$

where α_{RST} and β_{RST} are the coefficients on the *RSTdummy* interacted with the sales tax rate in our preferred growth rate and investment regressions in Tables 2 and 3. *RST* is the provincial RST rate, and the other coefficients are the same as in (10a). The first term in square brackets is the direct effect of an RST on economic growth, while the second term is its indirect effect through its impact on investment. Our simulations, with $\alpha_{INV} = 0.197$, $\alpha_Y = -0.057$, $\alpha_{RST} = -0.121$, $\beta_Y = 0$, $\beta_{RST} = -0.385$, and $RST = 0.07$ (the RST rate in BC prior to adopting the HST), indicate that the growth rate would increase by about 1.3 percentage points with a switch to an HST (Figure 3). Some of the increase in the growth rate would arise from the induced increase in investment. Although the growth rate effect slowly declines, in the very long-run output would be 25 percent higher under the HST than under the RST (Figure 4).

Our results also indicate that the short-run impact of adopting the HST is non-negligible. In five years, the province's per capita output would be about 6 percent higher as

Figure 3

Growth Rate in BC with a Switch to an HST

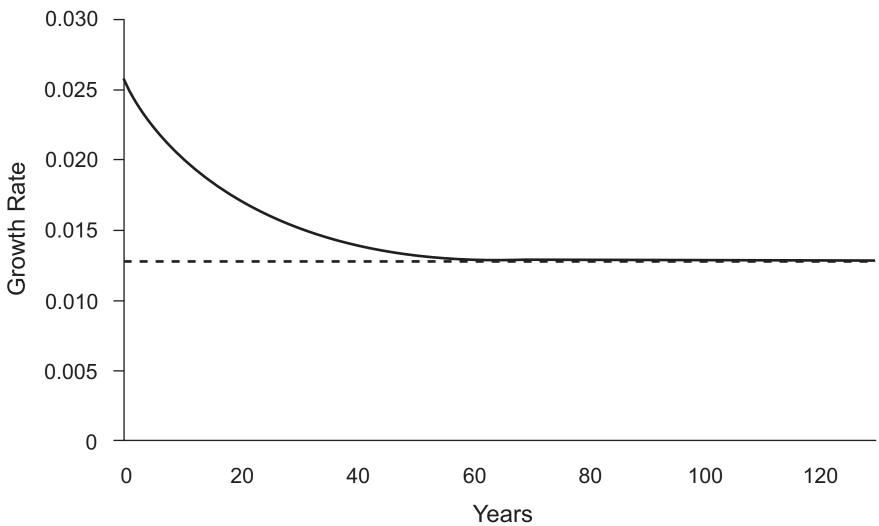
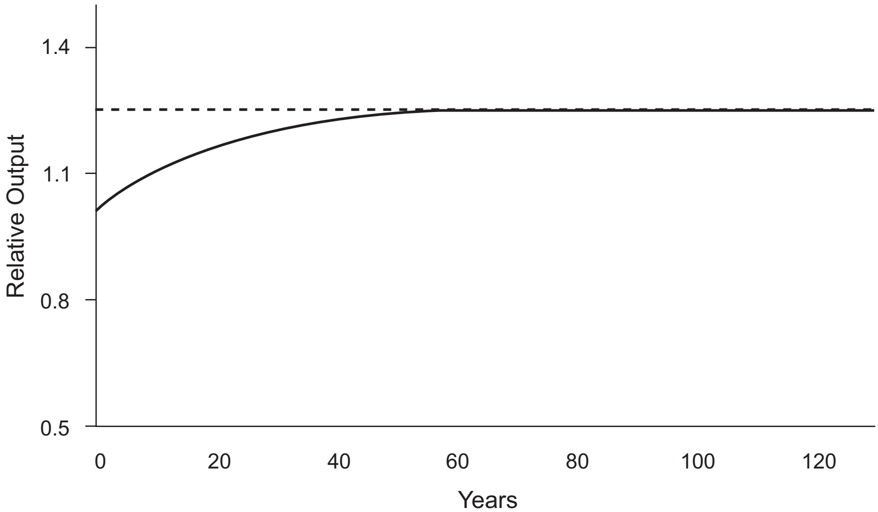


Figure 4

Relative Output with BC`s Switch to an HST



a result of the switch to the HST. Thus our result provides a very strong endorsement for BC's and Ontario's recent adoption of the HST. The implication of our simulation exercise is that BC would have benefited significantly from the switch to the HST, had the reform been permanent as it was in Ontario. The results also suggest that the remaining provinces with RSTs can boost their economies by switching to the HST.

IV. CONCLUSIONS

This paper examines the impact of tax rates on economic growth rate using panel data from Canadian provinces over the period 1977–2006. Our empirical analysis indicates that a higher CIT rate is associated with lower private investment and slower economic growth. However, the PIT rate does not affect the growth rate and investment once one controls for provincial fixed effects. Our empirical estimates suggest that a 1 percentage point cut in the CIT rate is related to 0.1–0.2 percentage point increase in the transitional growth rate.

We use the empirical results to assess the impacts of BC's 2001 tax cuts on the province's output and growth rate. The results indicate that in the long run BC's per capita GDP with the CIT tax cut will be about 16 percent higher than in the absence of the tax cut. Thus, in the long run, the small "temporary" increase in the per capita growth rate translates into a significant long-run output gain for the province. Our results also indicate that there are potentially large increases in growth and private investment when provinces switch from a RST to a sales tax that is harmonized with the federal value-added tax, the GST. An important implication of our results is that Canadian provinces will see output gains if they adopt these pro-growth tax policies.

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APPENDIX A

Table A1

Definitions of Variables and Data Sources

Variable	Description	Source
Real GDP	Gross domestic product in 1997 dollars	Statistics Canada, *Provincial Economic accounts*
Investment	Total private investment in 1997 dollars	Statistics Canada, *Provincial Economic accounts*
Population	Total provincial population	CANSIM Table 051-0001.
Corporate marginal tax rate	Provincial statutory top marginal CIT rate (general rate)	*Finances of the Nation* (formerly *National Finances*)
Top personal marginal tax rate	Provincial income tax rate of the top income bracket	*Finances of the Nation* (formerly *National Finances*)
Sales tax rate	Provincial sales tax rate (PST)	*Finances of the Nation* (formerly *National Finances*)
Export price	Export price index of provinces' major exporting commodities	Statistics Canada CANSIM Table 176-0006 and Table 228-0044)
Budget deficit	Provincial government budget deficit	Statistics Canada CANSIM Table 385-0001
Government expenditure to GDP ratio	Provincial and local government expenditures to GDP ratio	Statistics Canada CANSIM Table 385-0001
U.S. growth rate	Growth rate of U.S. GDP in 2000 dollars	Statistics Canada CANSIM II, Table 451-0010

Figure A1

Average per Capita GDP Growth and CIT Rates, 1977–2006