Tax Reform and Economic Growth in Alberta

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1. Introduction

Would the elimination of the provincial income tax and, in its place, the introduction of a provincial sales tax boost the rate of economic growth in Alberta? This paper reviews the theoretical and empirical evidence regarding the potential growth effects of substituting a provincial sales tax for the provincial income tax in Alberta. A companion study by Professor Ken McKenzie (2000) has analyzed the effects that this tax reform would have on the level of economic activity in the province, as well as its distributional consequences. This paper focuses on the growth effects of tax reform because, even if these effects seem relatively small, they can have a major impact on per capita output, and therefore on living standards, over 20 or 30 years.

The paper analyzes the potential growth effects of tax reform by using as a framework a class of models that stresses the importance of investment in human capital – the skill and knowledge embodied in the workforce – in explaining the rate of economic growth. These so-called *endogenous growth models* focus on a central feature of the newly emerging knowledge-based economies – that success depends on having a highly skilled and educated workforce that can take advantage of the technological innovations, the scientific breakthroughs, and the communication revolution occurring throughout the world. The key mechanism driving the rate of economic growth in these models is individuals' decisions to invest in acquiring more education and training – which economists refer to as *human capital.* The model predicts that per capita output will grow at a faster rate in an economy with a higher savings rate because individuals will be investing in human capital at a faster rate. A more productive workforce stimulates investment in physical capital, and therefore per capita output will also grow at a faster rate.

The endogenous growth model predicts that the growth rate of per capita output will be higher when the tax rate on the return to savings is lower. Numerical simulations of these endogenous growth models predict that substituting a sales tax for an income tax will boost the rate of economic growth. These simulations also indicate that the growth effects are especially large in a small open economy such as Alberta.

Econometric studies of the determinants of economic growth rates indicate that income taxes adversely affect the rate of investment in the economy and the growth rate of per capita output, and that switching from an income tax to a consumption tax can boost the rate of economic growth. These studies also indicate that public expenditures on education, health care, and public infrastructure such as transportation systems are also productive and can enhance the rate of economic growth. Expenditures on education, health, and public infrastructure can increase the rate of economic growth by making private physical and human capital more productive.

McKenzie (2000) has estimated that substituting an Alberta sales tax for the Alberta personal income tax would reduce the average marginal tax rate on savings from 0.472 to 0.322, a reduction of 15 percentage points. Simulations using a simple version of an endogenous growth model indicated that this tax reform would increase the annual growth rate in Alberta by about a tenth of a percentage point. While this increase in the average annual growth rate may seem modest, it would over the course of time substantially improve living standards in Alberta. If per capita output in Alberta were to grow at an annual average rate of 2.1, instead of its historical average of 2.0%, then the present discounted value of our future per capita GDP would increase by $38,371 per capita, the equivalent to getting an extra

year's output. In other words, the gain would be equivalent to every Alberta household winning a lottery where the prize is their annual income.

This higher growth rate will also increase tax revenues from other tax sources. The model predicts that a cut in the tax rate on investment income would probably increase the present value of the stream of future tax revenues. In other words, there would be a "free lunch" from cutting the tax rate on investment income because more tax revenues would be generated in the future, allowing either further cuts in other taxes, greater provincial government expenditures, or some combination of tax cuts and expenditure increases.

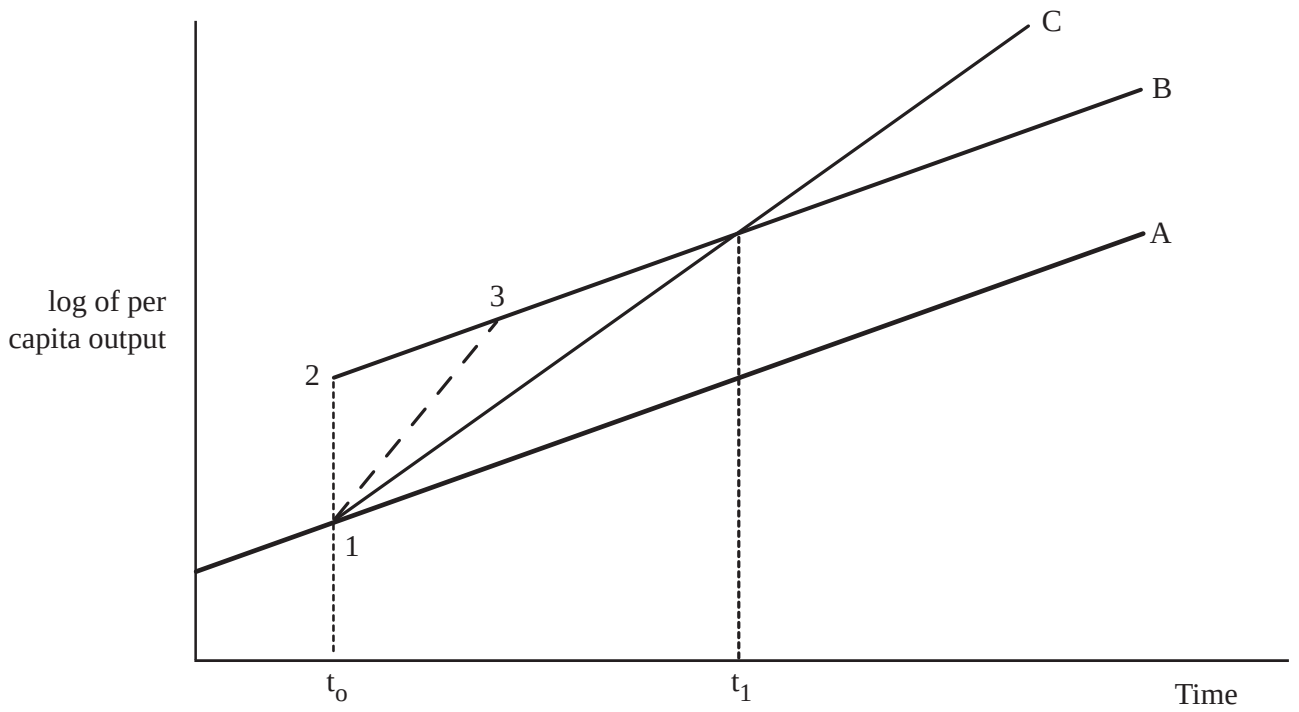
The paper also considers the impact of tax reform if individuals have to finance their education and training from their own, or their family's, savings because financial institutions are unwilling to lend funds to individuals who cannot pledge their human capital as collateral for loans. With this type of credit market imperfection, the taxes on wages and salaries, sales taxes, and source-based capital taxes (such as the corporate income tax and property taxes on structures) will reduce the rate of economic growth because they reduce the net rate of return on investment in human capital. In the case of source-based capital taxes, this disincentive effect occurs because in an economy such as Alberta where capital is highly mobile, higher taxes on the return on capital are shifted to the relatively immobile inputs of labour and land. In particular, the model predicts that a one percentage point reduction in the tax rate on capital would increase the economic growth rate by half a percentage point. Thus, there may be a very big payoff for Alberta from sharply reducing taxes on the return to physical capital.

The paper is organized as follows: Section 2 discusses the distinction between the effects of a tax reform on the level of economic output and on the growth rate of the economy. This distinction is important because some tax reforms will only affect the level of activity, but leave the long-term growth rate of the economy unaffected, while other tax reforms can affect the long-term rate of economic growth and have a substantial impact on per capita output over the long-term. Section 3 describes the human capital version of the endogenous growth model that is used as the framework for analyzing the growth rate effect of the tax reform. The predictions concerning the growth effects from substituting a sales tax for an income tax are contained in Section 4. Some of the extensions and caveats to the basic framework are described in Section 5, and the theoretical and empirical literature on the growth effects of taxes is reviewed in Section 6. Section 7 contains the conclusions.

2. Tax Reform: Level Effects and Growth Effects

We can think of the output of the economic system as an "economic pie," where the size of the pie is the total value of the goods and services produced in the economy, including non-market activities such as leisure and the quality of the environment. The tax system can affect the size and distribution of the economic pie because taxes affect the labour supply and savings decisions of households, and the output, employment, and investment decisions of firms. Taxes alter economic incentives by changing the net returns that households and firms receive from the inputs that they provide or from the products that they sell. If, in the absence of taxation, markets allocate resources to maximize the size of the economic pie, then the tax system, by changing the allocation of resources, will shrink the size of the

Figure 1
The Output and Growth Effects of Tax Reform



economic pie. The shrinkage of the economic pie is what economists mean by the efficiency cost of the tax system.[1]

In discussing how the tax system affects economic performance, it is important to distinguish between level effects and growth effects.[2] By a level effect, we mean the once-and-for-all impact of a change in the tax system on the size of the economic pie. This level effect is illustrated in Figure 1. Suppose that per capita output is initially growing at a constant rate along the path denoted by line A. (The faster the growth rate, the steeper the slope of A.) At time t_o, a tax reform is implemented which removes or reduces some of the disincentives to supply inputs or produce output. If the tax reform only has a "level effect" and if economic adjustments occur instantaneously, then the economy will jump from point 1 to point 2, and the economy will continue to grow along path B. Lines A and B have the same slope, indicating that the growth rate of per capita output has not changed. Thus, in its purest form, a level effect has a once-and-for-all impact on the size of the economic pie, but it does not affect the long-term growth rate of the economy.

Economic adjustments to a tax reform usually do not occur instantaneously. It takes time for households and firms to adjust their behaviour to a change in the tax regime and for changes in their decisions to have an impact on the economy. For example, Loayza, Schmidt-Hebbel, and Servén (2000, p.180) in a study of the determinants of savings across countries found that

changes in savings behaviour in response to changes in economic conditions "are fully realized only after a number of years, with long-run responses estimated to be more than two times larger than short-run (within a year) ones." If there is a gradual adjustment to a change in tax policy, then the economy will follow a transition path, such as from point 1 on A to point 3 on B. Along the transition path, the growth rate will increase, but once all of the economic adjustments have occurred at point 3, the growth rate of the economy will return to its previous rate. Thus, the defining characteristic of a level effect is that it only has a temporary impact on the growth rate of the economy. The long-term growth rate of the economy is unaffected.

By contrast, a growth effect from a tax reform alters the long-term growth rate of the economy. In Figure 1, if a tax reform occurs at t_o which increases the long-term growth rate of the economy, then per capita output will grow along a new path such as C. The defining characteristic of the growth effect of a tax reform is that it has a permanent effect on the long-term growth rate of the economy.

It is useful to distinguish between level effects and growth effects because their long-term impacts on the economy may be quite different. Furthermore, some tax reforms will only have level effects, while other tax reforms may have a growth effect or both a level and a growth effect. To illustrate these differences, suppose that a tax reform only has a level effect which will increase per capita output, after any transition period, by X percent and shift the economy to growth path B. Suppose an alternative tax reform would increase the long-term growth rate of output by one-tenth of X percent along path C. Initially, per capita output would be higher along path B, but the two paths would intersect after about 10 years. After that, per capita output will be higher along path C, and the output gap will continue to grow. The important point is that even relatively small growth effects, such as adding a tenth of a percentage point to the annual growth rate, can have a major impact on per capita output, and therefore on living standards, over 20 or 30 years.

The study by Professor Ken McKenzie (2000) has analyzed the level effects, as well as the distributional consequences, of substituting a provincial sales tax for the provincial income tax in Alberta. The task of the this paper is to analyze the growth effects of the proposed tax reform.

3. A Framework for Analyzing the Growth Effects of Tax Reform

To analyze the growth effects of the proposed tax reform, we will utilize a model of economic growth that has been developed by economists over the last 15 years. This model, which is a member of a class of models called endogenous growth models, stresses the importance of investment in human capital – the skill and knowledge embodied in the workforce – in explaining an economy's rate of economic growth. While the human capital variant of the endogenous growth model is not the only model that has been developed to analyze the growth effects of government policies, it is the most widely studied endogenous growth model. Furthermore, it focuses on the central feature of the newly emerging knowledge-based economies – that success depends on having a highly skilled and educated workforce that can take advantage of the technological innovations, the scientific breakthroughs, and the communication revolution occurring throughout the world.

We use the framework of the human capital version of

the endogenous growth model to investigate the key behavioural relationships that determine the long-term growth rate of the economy. This framework yields predictions about the consequences of the proposed tax reform for the long-term growth rate of the economy. But we also use the human capital version of the endogenous growth model as a framework to examine a broader range of issues concerning the growth effects of tax reform.

Endogenous growth models have been developed over the last 15 years to explain how the private sector's savings and investment behaviour, and the public sector's fiscal policies, may affect an economy's long-term economic growth rate. These models were developed because the neo-classical growth model, which was developed in the mid 1950s by Robert Solow, a Nobel prize-winning economist, did not provide a useful framework for analyzing the growth effects of tax reform. The neo-classical model predicted the long-term rate of economic growth would be equal to the rate of productivity growth, and this productivity growth rate was assumed to be independent of government policy. In other words, the neo-classical model assumed, rather than explained, the long-term rate of economic growth, and could not be used to evaluate the impact of tax reform or other public policies on the growth rate of the economy. The endogenous growth models were developed to overcome this lacuna.

The human capital variant of the endogenous growth model is described in more detail in the technical appendix to this paper. Here we will only describe in broad-brush strokes the key features of the model. In using the human capital variant of the endogenous growth model to analyze the growth effects of tax reform in Alberta, we have had to adapt the model to reflect the fact that Alberta has a small open economy. For the most important industries in Alberta – oil, natural gas, beef, wheat, forestry products and coal – product prices are determined on world markets. In addition, the economy is open to capital flows. Investment funds will quickly flow into the Alberta economy from the rest of Canada, or elsewhere in the world, if the expected rate of return on investments in Alberta is above the rate of return that investors can get elsewhere in the world. Similarly, capital can readily flow out of Alberta if the expected after-tax rate of return is below the rate that investors can earn in other parts of the world. This high degree of capital mobility means that the rate of return on capital invested in Alberta will adjust in the long-run so that investors can earn the same net rate of return that can be earned on investments elsewhere in the world.

At the heart of any model of economic growth is the aggregate relationship between the growth rate of per capita output, the growth rates of inputs, the population growth rate, and the rate of technological change. This basic *growth accounting* relationship is presented below:

$$y' = (1 - \alpha)A' + \alpha K' + (1 - \alpha)H' - N' \qquad (1)$$

where

- y' is the growth rate of per capita output.
- A' is the productivity growth rate.
- α is a parameter equal to physical capital's share of the cost of production, which in most economies is around one third.
- K' is the growth rate of the physical capital stock.
- H' is the growth rate of the stock of human capital population.
- N' is the growth rate of the population.

Per capita output will grow at a faster rate the higher the productivity growth rate and the more rapid the growth

rate of physical and human capital. It will grow more slowly when the population growth rate is higher, assuming that the other variables that affect the rate of economic growth are unchanged, because a given level of output is spread over a larger population when the population growth rate is higher. For example, if the annual population growth rate is 1.0%, technological change is increasing labour productivity at an annual rate of 1.5%, physical and human capital stocks are growing at a rate of 2.0% per year (such that human capital per capita is growing at a rate of 1.0% per year), then the per capita output of the economy will grow at rate of (0.67)(0.015)+(0.33)(0.02)+(0.67)(0.02)-(0.01) = 0.02 or 2.0% per year.

The growth accounting relationship is useful for *describing* the sources of economic growth, but not for *explaining* the economic growth rate because it does not explain why each component of the accounting relationship grows at any particular rate. In order to explain how changes in public policy affect the growth rate of the economy, we need a model of the behavioural relationships between the variables in the growth accounting relationship.

The human capital variant of the endogenous growth model focuses on the behavioural relationships that determine the growth rates of human and physical capital. In a small open economy, H' is determined by the savings decisions of the residents of the economy who supply the human capital, and K' is determined by "foreign" investors (such as pension fund managers in Toronto and New York) who supply the funds for investment in physical capital.

The model assumes that individuals will invest in human capital (by, for example, undertaking education and training courses) up to the point where the after-tax return that they can earn from acquiring more human capital is equal to the after-tax return which they can earn from investing in financial assets. A higher after-tax rate of return induces individuals to save more. Therefore, they invest more in financial assets and human capital, and the economy's stock of human capital grows at a more rapid rate.

Investment in physical capital will be undertaken to maximize profits for shareholders. Investment will occur up to the point where the net rate of return on the investment equals the rate of return that investors can earn in the rest of Canada or in other countries. The key factors determining the profitability of investment are the productivity level, the stock of human capital (because a more productive workforce makes physical capital more productive), and output prices. Consequently, the physical capital stock will grow faster when the productivity growth rate is higher, when the growth rate of human capital is higher, or when output prices are growing at a faster rate. Conversely, the growth rate of the physical capital stock will be reduced when the gross rate of return that investments in the economy are required to earn is increasing.

From these relationships determining and H' and K', the growth accounting relationship can be transformed into the following predictive model of the growth rate of per capita output:

$$y' = A' + s \cdot (1 - \tau_K) \cdot r + \frac{\alpha}{1 - \alpha} P' - \frac{\alpha}{1 - \alpha} r'_g \qquad (2)$$

This equation predicts that the growth rate of per capita output will be affected by the productivity growth rate, A', the savings rate, s, the after-tax rate of return on savings, $(1 - \tau_K)r$, the rate of increase in the price of the economy's output, P', and the rate of increase in the required gross rate of return on investment, r'_g.

The model predicts that the growth rate of per capita output will be higher in economies that have a higher savings rate. A higher savings rate means that individuals will invest in human capital at a faster rate. A more rapid growth rate for human capital means that investment in physical capital will be more profitable and the stock of physical capital will also grow at this more rapid rate. The model assumes that there are constant returns to scale in production, and therefore per capita output will also grow at this faster rate. Thus the key mechanism linking a higher savings rate with faster economic growth is the decision of individuals to invest some of that additional savings in acquiring more education and training.

The fact that a higher savings rate is predicted to lead to a higher growth rate may seem obvious to the "man in the street." However, this is one of the distinguishing features of endogenous growth models because the neo-classical growth model predicts that a higher savings rate will not alter an economy's long-term growth rate. In terms of Figure 1, the neo-classical model predicts that an increase in the savings rate at t_o would temporarily increase the growth rate along the transition path from point 1 to point 3 as the capital-labour ratio in the economy increased, but once the higher capital-labour ratio was achieved, the growth rate would return to its previous rate and the economy would move along the growth path given by curve B.[3] In other words, the neo-classical model predicts that an increase in the savings rate would have a level effect, but not a growth effect.

The endogenous growth model also predicts that the growth rate of per capita output will be higher in economies where the after-tax rate of return on savings is higher. In particular, this means that a higher tax rate on the return to savings will reduce the growth rate of the economy through two mechanisms – first, by directly reducing the after-tax return on savings and second, by reducing the savings rate.

It is also important to note that the model predicts that taxes on consumption (such as a sales tax), taxes on wage and salaries, and source-based taxes on the return to physical capital (such as corporate income taxes, capital taxes, and property taxes) will not affect the long-term growth rate of the economy. Consumption taxes, wage taxes, and capital taxes do not affect the net rate of return on savings in a small open economy because r is determined on world capital markets. Therefore, while consumption, wage, and capital taxes may have level effects, they do not have growth effects in the small open economy version of the endogenous growth model.[4]

Finally, the endogenous growth model predicts that the long-term growth rate of the economy will be positively related to the rate of increase in real price of the output of the economy and negatively related to the rate of increase in the real gross rate of return on capital. Thus the model predicts that an economy such as Alberta will grow faster when its export prices are increasing and shrink when its export prices are expected to decline. Thus, the model explains the extreme fluctuations in the growth rate of the Alberta economy as a response to fluctuating resource prices. Note that it is the *rate of change,* and not the *level* of export prices, that affects the growth rate of the economy in this model. High, but stable, oil prices would have a temporary, but not a permanent, effect on the growth rate of the economy. Similarly, the model predicts that the per capita growth rate will be lower if gross rate of return to capital is increasing. Thus rising real interest rates will lower the growth rate, while high (but stable) real interest rates will not affect the long-term growth rate.

Coulombe and Tremblay (2000), who studied the narrowing of the provincial per capita income differentials since WWII, provide some indirect evidence in support of the human capital version of the endogenous growth model. They found that more than 80% of the convergence of income levels was explained by the convergence of educational levels across provinces. Thus rates of change in human capital (as measured by education levels) seem to be a major determinant of provincial economic growth rates.[5]

4. The Predicted Growth Effects of Tax Reform in Alberta

McKenzie (2000) has estimated that the substitution of an Alberta sales tax for the Alberta personal income tax would reduce the average marginal tax rate on savings from 0.472 to 0.322, a reduction of 15 percentage points. We can use the endogenous growth model to predict the effect of this tax change on the long-term growth rate. In order to do this, we need estimates of three parameters – the real rate of return on savings, the savings rate, and the responsiveness of the savings rate with respect to the after-tax rate of return on savings. As in the McKenzie study, we will assume that the real rate of return on savings is 5% and that the elasticity of the savings rate with respect to the after-tax return on savings is 0.3. The savings rate is assumed to be 10%. Using these parameter values, *the model predicts that a 15 percentage point reduction in the tax rate on return to savings would increase the annual growth rate by about a tenth of a percentage point.*[6]

While this increase in the growth rate may seem small, it would have a large impact on per capita output and average living standards over the course of several decades. We have calculated two measures of the impact of this growth rate increase in order to try to put its impact on living standards in perspective. First, we have calculated the increase in the per capita GDP in Alberta in 1998 that would have occurred if the tax rate on the return to savings had been eliminated in 1971 and the economy had grown at a rate of 2.1% a year instead of the actual rate of 2%. The calculations indicate that if the tax reform had occurred in 1971, per capita output in 1998 would have been $887 higher or an increase of $1,863 per household. This represents a 2.5% increase in output, a significant improvement in living standards.

An alternative way of measuring the significance of a tenth of a percentage point increase in the growth rate is to look forward, instead of backward, and measure the increases in GDP that would occur in future years if the economy grows at an average rate of 2.1% a year instead of 2.0%. The increase in the present discounted value of per capita GDP from this increase in the growth rate would be $38,371 per capita. Since the per capita GDP in 1998 was $33,965, these calculations indicate that *the present value of the gain from the tax reform is equivalent to getting an extra year's output. In other words, the gain is equivalent to every Alberta household winning a lottery where the prize is their annual income.*

Thus, the tenth of a percentage point increase in the growth rate that is predicted by this model would produce, over time, a major increase in output and living standards. This growth effect is roughly 10 times as large as the gains from the level effects calculated by McKenzie (2000), and it greatly reinforces the case for the proposed tax reform.

If the tax rate on investment income is cut by 15 percentage points, how much tax revenue would be lost? Or, would the higher rate of economic growth mean that more taxes would be generated? To calculate the

revenue consequences of a cut in the tax rate on investment income, we have calculated the investment income tax rate that maximizes present discounted value of tax revenues. If the tax rate exceeds this critical value, then a tax rate cut will actually increase the discounted value of the government's stream of tax revenues.[7] In other words, if the tax rate exceeds this critical value, then the government is on the downward sloping section of its Laffer curve for tax revenues, and a tax cut would increase total discounted tax revenues. The critical value for the tax rate will be lower when investment income is a relatively small share of total tax revenue (because in that case the direct revenue loss from lowering the tax rate is relatively small) or when the savings rate and the savings elasticity are high because higher values for these parameters increase the magnitude of the growth effect.

It should be noted that a higher growth rate will increase the tax revenues from all tax sources, including consumption, wage, and capital taxes, and therefore a small change in the investment tax rate can have a large positive effect on total tax revenues by changing the economy's growth rate. Taxes on investment income (broadly defined) represent less than 3% of total tax revenues in Alberta. Given this low share of total tax revenue, the critical tax rate is only about 2%. With current marginal tax rates on investment income in excess of 40%, *the model predicts that a cut in the tax rate on investment income would probably increase the present value of the stream of future tax revenues.* In other words, there would be a "free lunch" from cutting the tax rate on investment income because more tax revenues would be generated in the future, allowing either further cuts in other taxes, greater provincial government expenditures, or some combination of tax cuts and expenditure increases. The model predicts that cutting the tax on investment income would be a win-win situation.

5. Caveats and Extensions

The human capital version of the endogenous growth model makes strong predictions about the implications of substituting a sales tax for the provincial income tax. However, the human capital version of the endogenous growth model, like all economic models, abstracts from a large number of issues in order to focus on a few key relationships in order to explain economic growth. In this section, we examine some of the implications of relaxing some of the assumptions or neglected aspects of the economic model.

A. Constraints on Financing Human Capital

The model implicitly assumes that individuals have an unlimited ability to borrow funds to finance their education and training. However, financial institutions may not be willing to lend funds to individuals to finance education and training because they cannot pledge their human capital as collateral for loans. If individuals have to rely on their own, or their family's, savings in order to finance the education and training, then the effective rate of return on savings is the net rate of return on investments in human capital.[8] This has some profound implications for the predicted growth effects of taxes. Whereas the human capital version of the endogenous growth model predicted that only the tax on the return to savings would have a growth effect, when the constraints on financing human capital are included in the model, wage taxes, sales taxes and capital taxes will adversely affect the rate of economic growth because they will reduce the net rate of return on investments in human capital. We will consider the effects of each of these taxes in turn.

Taxes on Wages and Salaries reduce the net return on investments in human capital in two ways. First, a wage

tax directly reduces the net return from investments in human capital by taxing the additional wage income that the investment generates. (It is assumed that an individual with more education and training receives a higher wage and therefore pays more taxes.) This direct effect is offset to the extent that the costs of the investment in human capital, such as tuition and books, are deductible from the wage tax.[9] If all of the costs of investing in human capital were fully deductible, then at the margin, a flat-rate wage tax would not reduce the return on investing in human capital, and it would not discourage individuals from investing in human capital.[10]

Even though the income tax allows the deduction of tuition expenditures, many of the costs of investing in human capital, broadly defined, are not deductible. For example, one might argue that all books, newspapers, and computer software increase knowledge, and therefore increase individuals' human capital. Thus, all expenditures on these goods should be deductible. Obviously, the problem of defining for tax purposes what constitutes an investment in human capital means that only a narrow range of expenditures can be allowed as deductions in order to avoid widespread abuse of the deductions. Consequently, the taxation of wage and salaries under the personal income tax discourages to some degree investments in human capital formation.

Taxes on wages and salaries will also reduce the net return from investments in human capital if they reduce the amount of labour that individuals are willing to supply. Individuals only receive a return on their investment in human capital when they are working, and therefore a tax that reduces the incentive to work also reduces the incentive to acquire human capital. Thus, to the extent that higher taxes on wages and salaries have a disincentive effect on the supply of labour, they will reduce the return on investments in human capital and therefore reduce the growth rate.

Sales and Consumption Taxes also reduce the net return on investments in human capital in two ways that are analogous to the disincentive effects that are caused by taxes on wages and salaries. First, sales taxes directly reduce the incentive to invest in human capital to the extent that some of the goods and services that are used in the production of human capital are subject to the sales tax. As Davies et al. (2000, p. 2) noted:

> A wide range of goods and services have both a pure consumption and human capital investment component. Major commodities like food, shelter, and clothing, for example, are all in this category – they are essential for bringing children up and also for maintaining the human capital of adults. Also, books, magazines, computers, radio, TV, and private lessons are recreational as well as educational. In fact, it is easier to make a list of things which have very little human capital investment aspect – e.g. tobacco – than it is to list all the goods and services which people use to build up or maintain their human capital.

Thus, as in the case of the income tax, the inability of governments to identify to what extent goods and services are used to acquire human capital means that these goods are taxed under a broad sales tax, such as the GST, and therefore the net return from investing in human capital is reduced.

The second way in which a sales or consumption tax reduces the incentive to invest in human capital is by reducing the incentive to supply labour. By increasing the cost of consumer goods, a sales tax reduces the

incentive to work and makes leisure relatively more attractive. Thus, to the extent that sales taxes reduce individuals' willingness to supply labour, they reduce the return that individuals can earn from investing in human capital.

Taxes on the Return to Capital will also reduce the net return to investment in human capital because when capital is perfectly mobile and output prices are determined on world markets, the burden of any tax imposed on capital will be fully shifted to the relatively immobile inputs of labour and land. Consequently, higher corporate income taxes, capital taxes, or property taxes will be shifted to labour through reductions in wage rates and rental values for land. Thus higher taxes on the return to capital employed in the economy will directly reduce the return to human capital and the incentive to invest in human capital.

Furthermore, as in the case of taxes on wages and salaries, and sales taxes, there may be a secondary effect through a reduction in the supply of labour. To the extent that the reduction in wage rates caused by an increase in taxes on the return to capital induces workers to reduce their supply of labour, the net return on investments in human capital will be reduced.

To summarize, we have seen that taxes on wages and salaries, sales taxes, and source-based capital taxes may reduce the net return from investments in human capital. To the extent that these taxes reduce the rate of investment in human capital, the growth rate of the economy will be reduced. The growth effects from taxes on wages and salaries and from sales taxes are difficult to determine. We do not know to what extent the incomplete deductibility of the costs of human capital investments under the personal income tax, or the inclusion of human capital expenditures in the sales tax base, cause these taxes to reduce the net rate of return on human capital

However, it is relatively straight-forward to calculate the growth effect of a capital tax imposed in a small open economy. Using the same savings rate elasticity as in the calculation in Section 4, and a labour supply elasticity of 0.15 as in the McKenzie study, *the model predicts a one percentage point reduction in the tax rate on capital will increase the growth rate of the economy by half a percentage point.* This is a very substantial growth effect, and it indicates that there may be a very big payoff, in a small open economy such as Alberta, from sharply reducing taxes on the return to physical capital. Reductions in capital taxes are frequently opposed on distributional grounds either because the rich receive a disproportional share of investment income or because capital taxes are viewed as being borne by foreigners. Note, however, that in a small open economy a reduction in capital taxes increases residents' wage rates, and therefore these distributional concerns are misplaced. Economists who argue for a reduction in capital taxes have to overcome the atavistic and misguided urge to tax the rich and the foreigners.

B. Government Expenditures on Education, Training, and Infrastructure

Before discussing some other neglected aspects of the model, it is worthwhile to point out that the public sector plays a large role in the formation of human capital. The provincial government provides primary and secondary education, subsidizes post-secondary education and vocational training programs, and provides student loan programs. All of these activities reduce the cost of investing in education and training and therefore off-set, at least to some degree, the deleterious effects of the tax system. Therefore, balanced budget tax cuts that are

achieved through lowering public education expenditures may have very little net impact on economic growth and might even be detrimental. It should also be pointed out that not all education expenditures are especially productive and that increased expenditures on education and training programs should be justified using cost-benefit criteria. The key point is that expenditures on some education programs may be "productive" expenditures by contributing to a faster rate of economic growth.

Similarly, governments also increase the returns to physical and human capital by providing and maintaining infrastructure such as transportation systems. Expenditures on public infrastructure can increase the rate of economic growth by making private physical and human capital more productive.[11] Empirical studies have, however, produced a wide-range of results regarding the productivity of public infrastructure, and as in the case of education expenditures, infrastructure projects need to be justified using cost-benefit criteria. While many public infrastructure projects are no doubt highly productive, experience in Alberta and elsewhere indicates that governments often invest in "white elephants."

C. Natural Resources & Diminishing Returns to Scale

Another issue that should be briefly discussed is the question of the role of natural resources in economic growth in Alberta. Many of Alberta's important export industries are based on the extraction of a natural resource, for example oil, natural gas, and coal. The finite supplies of these resources mean that there may be diminishing returns to scale in the provision of physical and human capital.[12] Diminishing returns to capital is what distinguishes the neo-classical growth model from the endogenous growth model, which assumes that there are constant returns to scale in physical and human capital. Consequently, it might be argued that the neo-classical model may be a more appropriate framework for analyzing economic growth in Alberta, and one of the predictions of the neo-classical model is that the long-term rate of economic growth is independent of governments' tax and expenditure policies.

While it is true that the extraction of non-renewable resources forms an important part of Alberta's export base, technological advances have continually increased the productivity of labour and capital. For example, the cost of extracting oil from the bitumen deposits in the Athabasca Tar Sands has fallen dramatically over the last two decades as the companies have continually improved their methods of extracting, transporting, and processing the resource. This is a classic example of a "learning-by-doing" productivity improvement, which can sustain economic growth and provides another avenue by which governments' fiscal policies can affect the rate of economic growth.

D. The Productivity Growth Rate

Productivity growth can occur through learning-by-doing or through innovations based on the research and development activities of private firms or public research institutions. In most cases, research generates significant knowledge spillovers such that the firm undertaking the research cannot capture all of the benefits to society in terms of cost reductions or new products. For example, the research that lead to the development of microcomputers was undertaken by Xerox Corporation. Other firms, such as IBM, Microsoft, and Apple were able to apply the insights developed by the Xerox research team to develop and market desktop computers. The patent system provides

innovators with only a limited and temporary ability to reap gains from new knowledge, and therefore the social rate of return on innovative activity usually exceeds the private rate of return. To the extent that the tax system discourages firms from undertaking research and development, it will tend to reduce the economy-wide rate of productivity growth.

Concerns are often expressed about Canada's low R&D expenditures compared to other OECD countries. However, by international standards, the Canadian tax system provides very generous tax treatment for research and development activities.[13] Perhaps more important is our relatively high corporate tax rates which may discourage firms from adopting state-of-the-art technology that has been developed elsewhere in the world and is usually embodied in new machinery and equipment. Our high corporate tax rates may also encourage firms to shift production based on new innovations to off-shore locations where costs and taxes are lower.

From an Alberta perspective, the incentives to adopt new technology are likely to be much more important than the incentives to develop new technology because, even if R&D expenditures in Alberta were to double or triple, most of the technological advances that improve productivity will come from innovations that originate elsewhere in the world. This has two implications. One is that it is more important to have lower general corporate tax rates than it is to make the current tax treatment of R&D more generous. Second, it important to support, through tax and expenditure policies, individuals' and firms' investments in education and training so that Alberta's workforce is capable of adopting leading-edge technologies that are developed throughout the world.

6. The Literature on the Growth Effects of Tax Reform

The number of theoretical and empirical studies of the determinants of economic growth has multiplied in recent years. Three recent papers – Temple (1999), Ahn and Hemmings (2000), and Myles (2000) – provide up-to-date surveys of this literature, and therefore a comprehensive review of the literature is not presented in this paper.[14] Instead, we focus on the literature which is most directly related to the growth effects of tax reforms and especially to studies that may be relevant for analyzing tax reform in Alberta. We have divided our discussion of the literature into four subsections. Section A examines theoretical studies or simulation models of the effects of different types of taxes using the endogenous growth framework. Section B reviews some of the recent econometric studies of the effects of taxes and expenditures on growth rates using cross-sectional data from OECD countries. Section C reviews studies of the growth effects of tax policies for particular countries. Section D reviews studies of the growth effects of taxes at the sub-national level.

A. Results from Theoretical and Simulation Models

Lucas (1988; 1990) developed the proto-type endogenous growth model based on investments in human capital. This model was subsequently expanded and enhanced by King and Rebelo (1990) and others. These models are sufficiently complex that it is difficult to derive unambiguous conclusions based on the parameters of the model, and therefore the authors have had to rely on numerical simulations from their models in order to derive conclusions about the growth effects of tax reforms. One interesting result from the King and Rebelo (1990) simulations was that the growth effect of a tax increase was more than 10 times larger in a small

open economy version of the model than in a closed economy version. The reason for the difference can be explained as follows. In a small open economy, the gross rate of return on savings is determined on international markets. Therefore, a tax on the return to savings is fully reflected in a reduction in the return to savings, with the consequent negative growth effect. In a closed economy, a reduction in the net rate of return causes a reduction in savings and investment which leads to higher gross rates of return on capital, thereby partially offsetting the initial reduction in the net rate of return on savings. This is why the growth effect of switching to a consumption tax may be very powerful in a small open economy such as Alberta.

A number of papers, including Rebelo and Stokey (1995), Pecorino (1994), and Coleman (2000), have simulated the growth effects of consumption, wage, and capital taxes in closed economy models which replicate the basic characteristics of the US economy. These models have indicated that there are substantial positive growth rate effects from replacing an income tax with a consumption tax.[15] In particular, Coleman's model indicates that there are substantial improvements in living standards in switching from an income tax to a consumption tax. He notes that much of the efficiency gain from switching to a consumption tax arises from the fact that, although a consumption tax reduces the incentive to supply labour, it serves as a lump-sum, or non-distortionary, tax on the initial stock of wealth. The lump-sum tax aspect of the consumption tax can be viewed as enhancing equity, because the tax falls disproportionately on the wealthy, or as inequitable because the tax falls disproportionately on the retirement incomes of the elderly. We will further discuss the equity aspects of a shift to a sales tax in the concluding section of the paper.

Table 1
Simulations of the Growth Effects from Tax Reforms

	The Growth Effects of a One Percentage Point of GDP Shift	
Tax Reform	**Xu Model**	**Mérette Model**
From a capital tax to a sales tax	0.0302	0.0361
From a capital tax to a wage tax	0.0116	-0.0218
From a wage tax to a sales tax	0.0406	-0.0003

Source: OECD (1997, Tables A4.13 and Tables A4.11)

Models developed by Mérette (1997) and Xu (1997; 1999) have simulated the growth effects of tax reforms using endogenous growth models that mimic the characteristics of the Canadian economy. Table 1 shows the simulated growth rate effects from three alternative tax reforms involving a one percentage point of GDP shift in tax revenue from one tax base to another. The results from the Xu model are broadly in line with the simulation based on the US economy. There are positive growth effects in shifting from either a wage tax or a capital tax to a sales tax. Somewhat surprisingly, shifting from the wage tax produces a larger increase in the growth rate than does shifting from the capital tax. Shifting from a capital tax to a wage tax also produces a positive, but relatively smaller, growth effect.

The Mérette model also predicts that a shift from a capital tax to a sales tax would raise the long-term growth rate by almost the same magnitude as the Xu model. However, the Mérette model predicts that a shift from a capital tax to a wage tax or a shift from a wage tax to a sales tax would have a negative growth effect. (In the latter case, the overall growth effect is very small, indicating that wage and sales taxes have virtually identical impacts in the Mérette model.) Mérette's results differ from those obtained by Xu because the models differ in two key respects. First, Mérette

modeled the Canadian economy as a small open economy, whereas Xu modeled Canada as a closed economy. Second, and more importantly, Mérette modeled the savings behaviour of households within a life-cycle framework, in which individuals borrow to acquire human capital when they are young, save and work in their middle years, and retire and run down their savings in old age. By contrast, Xu modeled the savings behaviour of households as if they were part of an infinitely-lived dynasty making savings decisions over an infinite time horizon. (This is the most common way of modeling savings behaviour in endogenous growth models.) The differences in the tax substitutions involving taxes on labour income arise because the acquisition of human capital seems to be more sensitive to the return on investing in human capital in the life-cycle model.[16]

While the results from the Mérette and Xu models differ regarding the substitution of a tax on capital for a tax on labour, their predictions regarding the proposed tax reform, which would involve substituting a sales tax for both a tax on the return on savings and a tax on wages and salaries, are consistent – *there would be a significant positive growth effect from lowering the income tax and substituting a sales tax.*

B. Cross-Country Empirical Studies

Myles (2000, p.164) notes that "the theoretical models introduce a range of issues that must be considered, but that they do not provide any convincing or definitive answers." We therefore turn to the statistical studies of the growth effects of taxes, which try to determine whether international variations in growth rates can be explained by the level or the composition of countries' taxes.[17] Some early econometric studies found significant negative growth effect from taxation, but subsequent studies have concluded that these results are not robust because they are affected by the sample of countries, the time periods, or the conditioning variables (such as initial per capita income level or level of education) which are included the regression equation to reflect the other variables that affect the rate of economic growth.[18] Two recent studies by Mendoza et al. (1997) and Kneller et al. (1999) have overcome many of the problems that plagued the earlier studies, and their results are discussed in detail below.

Mendoza et al. (1997) studied the growth effects of taxes using data based on 5 year averages for 18 OECD countries (including Canada) for the period 1965-1991. They began by investigating the impact of the capital, wage, and consumption taxes on the ratio of private investment to GDP. Their scatter plot diagrams indicate a strong negative relationship between the investment rate and the rate of wage and capital taxation, and a positive relationship between the investment rate and the rate of consumption taxation. These relationships remained robust when other conditioning variables (such as the terms of trade, secondary education enrollment, and the share of government spending on goods and services in GDP) were included in the regression equations. Thus, Mendoza et al. concluded that the composition of tax burden has a significant impact on a country's investment rate, and their results indicate that shifting the tax burden from capital and wages to consumption will increase a country's investment rate.

An increase in a country's investment rate could be consistent with taxes having a level effect, but not a growth effect. Mendoza et al. therefore regressed the countries' five year average growth rates versus their capital, wage and consumption tax rates and the other conditioning variables noted above. None of the

coefficients of the tax rate variables were individually significant, although their joint influence on the growth rate was significant. The authors also included the tax rates in regression using annual growth rate data and found that they had statistically significant coefficients. From these results, Mendoza et al. concluded that rate of capital, wage, and consumption taxes have a level effect, which alters the transition growth rate of the economy, but does not have long-term growth effects.

Kneller et al. (1999) argued that previous studies have produced biased and unstable coefficient estimates of the growth effects of taxes because they failed to incorporate the implicit financing assumptions that are associated with a government's budget constraint. If one fiscal variable changes, such as the tax rate on labour income, then there must be a change in another fiscal variable, such as the level of expenditures or the government's budget surplus. The estimation and interpretation of the coefficient estimates in the regression models must take these interactions into account. They argue that Mendoza et al. (1997) may have found insignificant growth effects from taxes because their model implicitly assumed that an increase in taxes was offset by an increase in productive government expenditures, such as expenditures on infrastructure. Therefore, the coefficient estimates in the Mendoza et al. study actually reflect the difference between the effect of a tax increase and the effect of a productive expenditure increase, which may be small and not statistically significant.

Kneller et al. estimated a model that incorporated the governments' budget constraints using five year average data for 22 OECD countries (including Canada) for the period 1970-1995. The authors classified taxes on income, profit, payrolls, and property as distortionary taxes and taxes on domestic goods and services as non-distortionary taxes. They classified expenditures on defence, education, health, housing, and transportation and communication as productive expenditures and expenditures on social security, welfare, recreation, and economic services as non-productive. Their maintained hypothesis was that non-distortionary taxes (i.e. consumption taxes) and non-productive expenditures would have negligible growth effects, and therefore these fiscal variables were excluded from their main regression equations. Their results indicated that the distortionary taxes have significant negative growth effects, reducing the rate of growth rate by 0.41 percentage points for a 1.0% of GDP increase in the distortionary taxes. Productive expenditures were found to increase the growth rate by about 0.27 percentage points for a 1.0% of GDP increase in distortionary taxes. Their statistical results were not sensitive to the classifications of the fiscal variables, but they found that the magnitudes of the coefficients were sensitive to the start dates for the five year averaging process. Overall, Kneller et al. (1999, p.188) concluded that even their lowest coefficient estimates indicate that "increasing productive expenditures or reducing distortionary taxes by 1% of GDP can modestly increase the growth rate (by between 0.1 and 0.2% per year)."

C. Country Studies

Other countries' experience with tax reform may help us to draw some lessons for Alberta. Here we review studies of some recent success stories – Ireland, Korea, and Taiwan – to see what role tax policy has played in their rapidly growing economies. We also review studies from New Zealand and Australia because these countries have similar historical and cultural backgrounds, resource-based economies, and relatively small populations.

Ireland was one of the international success stories of the 1990s, with per capita GDP growing at an average annual rate of 5.5%.[19] This rapid expansion has produced a 40% increase in employment since the mid-1980s. A rising standard of living has resulted in net migration to Ireland, reversing a century-long trend of emigration and population decline. Foreign direct investment has played a major role in the expansion of output and employment, especially in high technology industries such as computer chips and software. (Intel has made Ireland its base for European manufacturing, employing 3,000 workers. In 1999, Ireland exported $3.29 billion in computer software, more than the United States.[20])

Many factors have undoubtedly contributed to the Irish success story, including a highly skilled English-speaking labour force, relatively low wage rates enforced through a centralized bargaining system, subsidies for agriculture and industrial development from the European Union (EU), a competitive exchange rate regime, and low taxes on profits generated by export activities.[21] Since the 1980s, Ireland has maintained a dual rate corporate tax structure with a preferential 10% rate applied to profits from manufacturing and internationally traded services and a standard rate, which in the 1980s exceeded 50%. The growth of the manufacturing and service sectors in the 1990s meant that more than half of corporate tax revenues were collected at the preferential rate (see Walsh 2000, p.17). Some of this buoyant revenue growth is attributable to the transfer pricing policies of multinational corporations. Transfer prices are the prices that companies use to value the exports and imports of goods between their subsidiaries. The low preferential corporate tax rate in Ireland has made it advantageous for multinational businesses to set these transfer prices so that profits are "earned" in their Irish subsidiaries, and therefore are taxed at a relatively low rate. The preferential tax rate has been criticized by the EU members as a form of unfair tax competition. The Irish government has responded by announcing that it will adopt a single corporate profit tax rate of 12.5% by 2003. Thus the Irish government seems committed to maintaining corporate tax rates which are well below international norms.

The role of the corporate tax incentives in promoting investment in Ireland remains controversial and uncertain. In his overview of the role of tax policy in the Irish economic boom, Walsh (2000, pp.27-28) has concluded that:

> A low corporate tax rate has formed an important component of Ireland's favourable environment for corporate investment and contributed significantly to raising the country's share of the flow of FDI into the EU. This inflow plays a very significant role in the country's current boom. Rapid growth allowed us to enter a virtuous circle in which tax cuts fuelled growth which the public finances improved dramatically. Under EU pressure we have steadily widened the scope of the low corporate tax rate and reduced its distortionary features. This has been a welcome development. Our experience suggests that the soundest basis for the long-run development of the country is a non-distortionary, low tax regime.

It is unclear what lesson Albertans can draw from the Irish experience regarding tax policy. Certainly, the "initial conditions" in Alberta seem quite different – Alberta is a relatively high wage, low unemployment, economy based on natural resource industries. Still, the

Irish experience seems consistent with the endogenous growth model with its emphasis on a highly skilled workforce as the engine for economic growth, and the potentially strong growth effects in a small open economy from reductions in source-based capital taxes.

Korea was the fastest growing country over the period 1960-90, with an average annual growth rate of 6.1%. [22] Lee (1996) studied the effect of export promotion policies, including tax incentives, on productivity in Korea from 1963 to 1983. He found that tariff protection and import restrictions reduced the growth rate of output, investment and total factor productivity. Tax incentives for key industries (special depreciation allowances, tax holidays, and rebates of indirect taxes) appear to have raised output and investment in those industries but did not raise total factor productivity. Lee (1996, p.402) concluded that the tax incentives "…did not accelerate overall growth of the economy and may have retarded it."

Taiwan is another Asian tiger that grew at an average annual rate of 5.8% over the period 1960-90. Wang and Yip (1992) investigated the effects of the level and composition of taxation on economic growth in Taiwan over the period 1954 to 1986. They found that the aggregate tax rate did not affect the overall growth rate, but that different types of taxes had different impacts on the growth rate. Specifically, they found that a one percentage point increase in the rate of capital taxation reduced the growth rate by 0.56 percentage points. (Note that this finding is very similar to the effects predicted in Section 5.A for a capital tax increase for a small open economy with a constraint on financing human capital.) They also found that taxes on wages did not have a significant growth effect while the growth rate of consumption had a positive effect on the growth rate of private sector output. The authors attribute the positive effect of consumption taxes to the import substitution effect of higher customs duties and increased personal savings. They also suggest that the positive effect may reflect the positive growth effects from increased public sector spending, especially on infrastructure. The authors did not control for the level of spending in their regression equations, and therefore the magnitude and signs of the coefficient regression coefficients in their study reflect both the effect of increased taxes and spending as discussed by Kneller et al.

New Zealand was one of the first OECD countries to under-take major fiscal reforms, deregulation, and down-sizing of the public sector in the mid-1980s, and its experience is of wide-spread interest. Scully (1996) developed a model in which government expenditures have a positive growth effect, which is subject to diminishing returns. Public expenditures are financed by taxes that reduce the growth rate. Thus, an increase in the tax rate may either increase or reduce the growth rate depending on whether the positive effect of increased expenditures outweighs the negative effect of increased taxation. Scully estimated a regression equation using data on the growth rate and the aggregate tax rate in New Zealand over the period 1927-1994. He found that the growth rate maximizing aggregate tax rate was about 20% of GDP. Since the aggregate tax rate in New Zealand in recent years has been in excess of 30%, Scully concluded that lower taxes (and therefore lower public expenditures) would increase economic growth in New Zealand.

A couple of comments on the Scully paper are in order. First, the only independent variable in his regression model was the tax rate, and therefore the estimated coefficient on the tax rate may also reflect the influence of other variables, such as demographic changes or

changes in New Zealand's export prices or terms of trade on world markets, if these variables are correlated with the level of taxation. The failure to include other conditioning variables means that the results on the tax rate may not be very robust. A second point is that the growth maximizing tax rate does not represent the "optimal" size of the public sector because the individuals in a society may be prepared to give up a faster rate of economic growth for higher levels of public services or income redistribution programs.

Australia is often considered an interesting comparison for Canada, given that both countries are former British colonies and have resource-based economies with relatively small populations. Grossman's (1988) study examined the growth effects of taxes as well as government expenditures on goods and services and transfer payments such as unemployment benefits and welfare, and taxes. He estimated the model using data for the Australian economy over the period 1949-50 to 1983-84 and found that expenditures on goods and services and transfer payments had positive growth effects while taxes had a negative growth effect. His study indicated that a 10% increase in transfer payments, financed by an increase in the aggregate tax rate, would reduce total economic output by 1.0%.

D. Studies of Subnational Governments

The studies that we have reviewed to this point have all dealt with the growth effects of taxes for countries. The results of these studies may not be particularly relevant for a province because the economies of subnational governments are generally more open to flows of capital, goods, and people than are national economies. In addition, subnational governments may place greater reliance on different forms of taxation, such as property taxes, than do national governments. There have been a number of studies which have examined the effect of taxes on the growth of state governments in the United States, and some of these studies such as Dahl and Gane (1980), Vedder (1990), and Yamarik (2000) have found negative growth rate effects from state and local taxes.[24] However, these studies suffer from the Kneller et al. critique that they ignore governments' budget constraints and therefore the estimated coefficients are not robust because they reflect the excluded fiscal variables. We will focus on studies by Helms (1985) and Mofidi and Stone (1990), which specified their regression models to take into account state and local government budget constraints.

Helms (1985) estimated his model using data from 48 states for the period 1965-79. The excluded fiscal variable in his regression equations was the state and local governments' transfers payments such as welfare and therefore the coefficients of his tax and expenditure variables are interpreted as the direct effect of the variable less the effect of a change in transfer payments. Helms (1985, pp.574-575) found that an increase in property taxes and other taxes:

> significantly retarded economic growth when the revenue is used to fund transfer payments…. On the other hand, when the revenue is used to finance enhanced public services (such as highways, education, and public health and safety), the favorable impact on location and production decisions provided by the improved services may more than counterbalance the disincentive effects of the concomitant taxes.

It is interesting to note that the expenditure category with the largest productive effect was health, followed (in order) by higher education, local schools, highways, and other expenditures.

A companion study by Mofidi and Stone (1990) attempted to uncover how state and local taxes affect net investment and manufacturing employment. Using a similar, although not identical, data set and framework as Helms, Mofidi and Stone (1990, p. 691) found that:

> state and local taxes have a significantly negative effect on net investment and employment in manufacturing when the revenues are devoted to transfer-payment programs and that (taxes held constant) increases in the proportion of state and local expenditures going toward other programs (health, education, highways, etc.) are positively related to net investment and employment.

Two points about the Helms and Mofidi and Stone results should be emphasized. First, the fact that the authors found that a state's economic performance was impaired when increases in transfer payments were financed by higher state and local government taxes does not imply transfer payments should be cut. Providing a higher level of income support for the poor may reduce economic growth, but this is a trade-off that the public may be prepared to accept. It also suggests that it may be more efficient for a central government to provide transfers programs, or at least to finance them through grants to the subnational governments. Second, it is not clear from the descriptions of their models whether Helms-Mofidi-Stone results should be interpreted as level effects or growth effects. In either case, however, their results indicate that the distortionary effects of taxes or the productive effects of some forms of public expenditures are very significant.

7. Conclusion

The theoretical models and econometric studies indicate that tax policy can affect the long-term growth rate of the economy by affecting the rate at which a workforce acquires new skills and knowledge. Most studies indicate that the *tax structure* has a more important impact on the rate of economic growth than does the *tax level*. In particular, consumption taxes are more conducive to economic growth than are taxes on the return to savings or source-based capital taxes. The growth effects of switching from an income tax to a consumption tax are likely to be especially large in a small open economy such as Alberta. Calculations using a simple version of the endogenous growth model suggest that switching from an income tax to a sales tax could boost the average annual rate of economic growth by a tenth of a percentage point. While this increase in the average annual growth rate may seem modest, it would be equivalent (in discounted value terms) to getting an extra year's output. This very substantial gain would be in addition to the gains that have been calculated in the McKenzie (2000) study.

These results suggest that there are significant economic gains to be obtained from switching from an income tax to a sales tax in Alberta. Opposition to such a tax reform is often based on distributional concerns – the view that sales taxes are regressive and hurt the poor more than the rich. Our research on the growth effects of switching to a sales tax should help to alleviate this concern for two reasons. First, "a rising tide floats all ships." A higher rate of economic growth will, over time, improve everyone's standard of living, rich as well as poor. Second, given the very substantial output gains that can be derived from switching to a sales tax, our society can afford to be generous to those who will not benefit from the faster rate of economic growth, such as the elderly

who are no longer part of the workforce. Growing a bigger economic pie means that we can provide higher transfer payments, such as social assistance payments and seniors' benefits, so that virtually everyone benefits from the tax reform. ■

Endnotes

1. The administration of the tax system and the compliance costs of taxpayers also uses up resources which contributes to the shrinkage of the economic pie. In this paper, we focus on the efficiency cost of the tax system caused by the reallocation of resources rather than on the administration and compliance costs.

2. See Myles (2000, pp.146-147) on the distinction between level and growth effects.

3. This is the neo-classical model's prediction for a closed economy. For a small open economy, the neo-classical model predicts that a higher savings rate will not affect per capita output or the long-term growth rate. It would only affect the degree to which the residents of the economy are net debtors (or net creditors) vis-à-vis the rest of the world.

4. In a closed economy, consumption, wage and capital taxes will have growth effects because they will affect the rate of return on capital.

5. See Ahn and Hemmings (2000, pp.25-31) on the linkage between human capital and economic growth.

6. As shown in the appendix, the predicted growth effect of the tax reform on the growth rate is not greatly affected by the value of the elasticity of the savings rate that is used in the calculation.

7. We are treating the federal and provincial governments as a single entity.

8. See Barro, Mankiw, and Sala-i-Martin (1995) for a discussion of the implications of this constraint on financing human capital on growth in the neo-classical model.

9. It should be noted that one of the major "costs" of post-secondary education is the individual's foregone earnings while in the education program. This cost is implicitly deducted because income that is not earned is not taxed.

10. For further discussion of the effects of taxes on investment in capital see Davies and St. Hilaire (1987, pp.75-92).

11. See Barro (1990) for a simple model that determines the growth rate maximizing level of investment in public infrastructure.

12. See Rebelo (1991) and Rodriquez and Sachs (1999) on the effects of natural resources on the rate of economic growth.

13. See Dept. of Finance (1998). *Report of the Technical Committee on Business Taxation.*

14. For other surveys of the literature, see Cashin (1995), Mankiw (1995), Slemrod (1995), McCallum (1996), Engen and Skinner (1996), and Tanzi and Zee (1997).

15. See Milesi-Ferretti and Roubini (1998) on the growth effects of income and consumption taxes in endogenous growth models.

16. Hendricks (1999) also found that the growth effects of tax reductions were reduced in a model with life-cycle savings behaviour.

17. For a review of these studies, see Ahn and Hemmings (2000).

18. See, for example, Koester and Kormendi (1989) and Garrison and Lee (1992).

19. See Scarpetta et al. (2000, p.11). By contrast, Canada's growth rate in the 1990s was about 1.1 percent.

20. See Vrazo (2000).

21. See Walsh (2000) for a discussion of these factors in Ireland's success.

22. See Temple (1999, p.116).

23. The underlying model is similar to that developed by Barro (1990).

24. There are no empirical studies of the growth effects of taxes for provincial governments.

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Technical Appendix:

An Endogenous Growth Model for Evaluating Tax Reform in a Small Open Economy

This appendix contains a concise description of the endogenous growth model that is used to derive equation (1). The model is based on endogenous growth models with human capital that have been developed by Lucas (1988, 1990), King and Rebelo (1990), Pecorino (1993, 1994, 1995) and others. (Not all of the equations of the model are described in this appendix. See Pecorino (1993) for the closed economy version of this model.) With few exceptions, endogenous growth models have been developed for closed economies that do not engage in trade or investment with the rest of the world. These models are therefore of limited use in analyzing tax reforms in a small open economy such as Alberta. The main innovation in this appendix is the application of the human capital endogenous growth model in the context of a small open economy.

The focus of the analysis is the growth rate effects of substituting a provincial sales tax for the provincial personal income tax in Alberta. The impact of this tax reform on the *level* of economic activity has been thoroughly analyzed in McKenzie (2000). The task of this paper is to analyze the impact of the proposed tax reform on the *growth rate* of economic activity.

Production

The model assumes that a small open economy produces a single commodity according to the following aggregate production function:

$$Y = K^{\alpha}(AH)^{1-\alpha} \qquad \text{(A1)}$$

where

Y is aggregate output.

K is the aggregate physical capital stock.

A is a productivity parameter that may increase over time due to technological change. Productivity growth is assumed to be labour-enhancing.

H is the aggregate stock of human capital. Human capital measures the amount of skill and knowledge embodied in the economy's work force. Let H=hN, where h is the average human capital per capita and N is the total population. (For simplicity, it is assumed that the labour force participation rate is a constant and equal to one.)

α is a parameter of the production function that is equal to physical capital's share of the cost of production. In most economies, capital's share is around one third.

The output produced by this economy trades on world markets at a price of P. It is assumed that changes in economy's output have no effect on P. In other words, firms in this economy face a perfectly elastic demand curve for their product. In the Alberta context, it is natural to think of P as a composite price index for the price of oil, natural gas, beef, wheat, forestry products, and coal. The net rate of return on investment in physical capital, r, is also determined on world markets. In other words, the supply of investment capital, net of taxes imposed on the use of capital in this economy, is perfectly elastic. Finally, it is assumed that human capital can be produced according to a constant returns to scale production function, which also uses inputs of K and H.

If y is equal to per capita output, Y/N, then the growth rate of per capita output will be determined by the following equation:

$$y' = (1 - \alpha)A' + \alpha K' + (1 - \alpha)H' - N' \qquad (A2)$$

where

y' is the growth rate of per capita output.

A' is the productivity growth rate (which is assumed to be exogenous in this model).

K' is the growth rate of the physical capital stock.

N' is the growth rate of the population (and labour force).

In this simple model, it will be assumed that A', the productivity growth rate, is exogenous. Therefore, the growth rate of per capita output will be determined by K', H', and N'. We will begin by focusing on the determinants of H' and K'. In discussing the determinants of the growth rates of human and physical capital, it will be convenient to think of physical capital stock used by firms as owned by foreign investors. The residents of the economy supply the human capital and the growth rate of human capital is determined by the residents' savings decisions.

Savings and Investment in Human Capital

Residents can invest their savings in human capital and in financial assets. These financial assets trade on world markets and offer a pre-tax return of r and an after-tax rate of return of $r_n = (1 - \tau_K)r$ where τ_K is the tax rate imposed on the residents' world-wide investment income. Consumption taxes, τ_c, taxes on wages and salaries (the return to human capital), τ_w, and source-based taxes on capital income earned in the economy (such as the corporate tax, capital taxes and property taxes), t_K, may also imposed. These other taxes will, in general, affect the economy's level of output, but they do not affect growth rate of output in this model. The only tax that affects the growth rate of output in this model is the tax on the return to savings, τ_K.

Each resident of the economy maximizes the following inter-temporal utility function:

$$U = \int_0^{\infty} e^{-\rho t} \frac{(c_t \cdot l_t^{\Omega})^{1-\sigma}}{1-\sigma} dt \qquad (A3)$$

where

l_t is leisure.

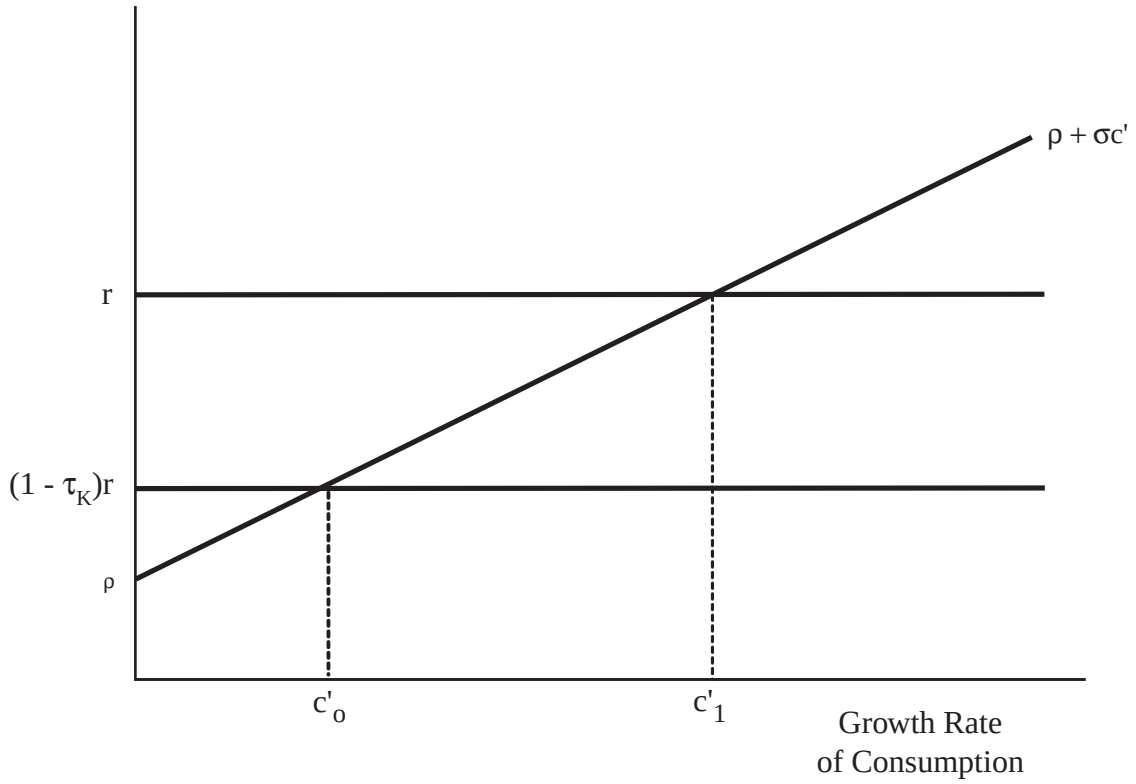
$\Omega > 0$ is a parameter reflecting the value of leisure for the individual.

$\rho > 0$ is a parameter indicating the rate at which an individual discounts future utility.

$\sigma > 0$ is a parameter indicating the rate at which the individual is willing to substitute current consumption for future consumption. The elasticity of substitution between c_t and c_{t+1} is $1/\sigma$. Therefore, the larger the value of σ the less willing the individual is to give up current consumption for future consumption.

The individual chooses the time paths of consumption and leisure that maximize this inter-temporal utility function subject to an inter-temporal budget constraint and a time allocation constraint. For our purposes, it is sufficient to note that a dollar invested in financial assets or human capital will earn the individual a net rate of

Figure A1
Tax Reform and the Growth Rate of Consumption



return of $(1 - \tau_K)r$. Given this after-tax rate of return on savings, the individual would like consumption to grow at the following rate:

$$c' = \frac{(1 - \tau_K)r - \rho}{\sigma} \qquad \text{(A4)}$$

The individual will save in order to achieve the growth rate of consumption indicated by the above equation. It can be shown that the log of the individual's marginal rate of substitution between consumption in two periods, the MRS, is equal to $\rho + \sigma c'$. The log of the rate at which consumption increases between two periods if the individual saves an extra dollar is $(1 - \tau_K)r$. Therefore, the rate at which an individual is willing to exchange consumption between two periods is equal to the rate at which he can exchange consumption in the two periods through savings is satisfied when $\rho + \sigma c' = (1 - \tau_K)r$ and therefore c' is determined by (A4).

The determination of c' is illustrated in Figure A1. Initially the MRS is equal to the after-tax rate of return on savings when the individual achieves a consumption growth rate of c'_0. If tax rate on the return to savings is removed, the individual would like to change the time path of consumption so that it would grow at the faster rate of c'_1. In order to achieve this more rapid consumption growth rate, the individual would have to increase his savings.

We will restrict our attention to the steady state

behaviour of the economy. Along this balanced growth path, an individual will want to acquire financial assets, f, and human capital, h, so that both of these assets grow at the rate c'. Therefore, along the balanced growth path h' = f' = c'. The individual's savings rate along this balanced growth path is equal to the following:

$$s = \frac{df + dh}{r_n f + w_n h} = \frac{\frac{df}{f} f + \frac{dh}{h} h}{r_n f + w_n h} = \frac{f'f + h'h}{r_n f + w_n h} = \frac{c'}{r_n} \qquad \text{(A5)}$$

where df is the annual change in the individual's stock of financial assets, dh is the annual change in the individual's stock of human wealth, and $w_n = (1 - \tau_w)w$ is the after-tax rate of return on human wealth. Since individuals will invest in human wealth up to the point where $r_n = w_n$, the savings rate will be equal to c'/r_n. Along the balanced growth path, the total stock of human capital will grow at the rate H' = h' + N' = c' + N'.

In computing the effect of reducing the tax on the return to savings, it will be useful to relate the basic behavioural parameters, ρ and σ, to two empirically estimated variables – the savings rate, s, and the elasticity of the savings rate with respect to the net rate of return on savings, η. Using equation (A4) and the fact that $c' = sr_n$, the savings rate is equal to the following:

$$s = \frac{1}{\sigma}\left(1 - \frac{\rho}{(1 - \tau_K)r}\right) \qquad \text{(A6)}$$

Therefore it can be shown that the elasticity of savings with respect to r_n is:

$$\eta_S = \frac{r_n}{s}\frac{ds}{dr_n} = \frac{\rho}{r_n - \rho} \qquad \text{(A7)}$$

This implies that $\rho = (\eta_S r_n)(1 + \eta_S)^{-1}$. Substituting this value for ρ in equation (A6), it can then be shown that $1/\sigma = s(1 + \eta_S)$. We use these relationships between σ and ρ and s and η_S to parameterize the model and calculate the impact of a reduction in the tax rate on the return to savings.

To summarize, the key behavioural relationship in this model is the relationship between the after-tax rate of return on savings and the growth rate of consumption. A higher after-tax rate of return means that individuals would like consumption to grow at a faster rate, which implies that savings must increase. It is this relationship which makes the growth rate of per capita output depend on the tax rate on the return on savings.

Investment in Physical Capital

The growth rate of the physical capital will be determined by the profit maximizing condition for the capital stock which is that the value of the marginal product of capital, $P\partial Y/\partial K$, equals the cost of capital $r_g = r(1 + t_K)$ where t_K is source based tax on capital arising from corporate, capital and property taxes. This condition is given below:

$$\alpha P A^{1-\alpha}\left(\frac{K}{H}\right)^{\alpha - 1} = r_g \qquad \text{(A8)}$$

This equation can be solved to find the profit-maximizing capital stock:

$$K = \left(\alpha \frac{P}{r_g}\right)^{\frac{1}{1-\alpha}} \cdot A \cdot H \qquad \text{(A9)}$$

From this equation, the growth rate of the stock of physical capital along the balanced growth path will be equal to:

$$K' = A' + H' + \frac{P' - r'_g}{1 - \alpha} \qquad \text{(A10)}$$

Thus K' is the sum of the labour productivity growth rate, A', the growth rate of the stock of human capital,

H', and the difference between the growth rates of the price of output and the gross rate of return on capital, $P' - r'_g$, multiplied by the factor $(1 - \alpha)^{-1}$.

The Growth Rate of Per Capita Output

Substituting (A10) into (A2), we obtain the following reduced-form equation for the growth rate of per capita output along the balanced growth path:

$$\begin{aligned} y' &= A' + H' + \frac{\alpha}{1-\alpha} P' - \frac{\alpha}{1-\alpha} r'_g - N' \\ &= A' + c' + \frac{\alpha}{1-\alpha} P' - \frac{\alpha}{1-\alpha} r'_g \\ &= A' + s\cdot(1 - \tau_K)\cdot r + \frac{\alpha}{1-\alpha} P' - \frac{\alpha}{1-\alpha} r'_g \end{aligned} \qquad \text{(A11)}$$

This equation is equation (2) in the text. It indicates that the growth rate of per capita output will be equal to the productivity growth rate plus three other terms which depend on the savings rate, the after-tax rate of return on savings, the rate of increase in the price of the economy's output, and the rate of increase in the gross rate of return on investment.

This model predicts that growth rate of per capita output will be higher in economies that have a higher savings rate. This prediction may seem obvious to the "man in the street" but the neo-classical growth model, which was the framework that most economists used to study economic growth up until the 1990s, predicted that a higher savings rate would not alter an economy's long-term growth rate. According to the neo-classical model, a higher savings rate would raise the equilibrium capital-labour ratio in a closed economy and therefore raise equilibrium per capita output but it would not change the equilibrium growth rate, which in the neo-classical model is determined by the rate of productivity growth. A higher savings rate would, however, have a temporary effect of raising the growth rate in the transition from one steady state equilibrium to another. For a small open economy, the neo-classical model predicts that a higher savings rate would not affect either equilibrium per capita output or the long-term growth rate. It would only affect the degree to which the residents of the economy are debtors (or creditors) vis-à-vis the rest of the world. In contrast, this endogenous growth model predicts that growth rates will be higher in economies with higher savings rates.

The model also predicts that the growth rate of per capita output will be higher in economies where the after-tax rate of return on savings is higher. In particular, this means the growth rate of output will be lower the higher the tax rate on the return to savings or:

$$\frac{dy'}{d\tau_K} = -s(1 + \eta_S)r < 0 \qquad \text{(A12)}$$

Note that even if the savings elasticity is zero and therefore the savings rate is constant, a reduction in the tax rate on return to savings would still increase the long-term growth rate. (If the savings rate is constant, then an increase in r_n would increase total income which would imply an increase in total savings and an increase in the growth rate of the economy.) In the next section, we use this equation to predict the effect of substituting an Alberta sales tax for the Alberta personal income tax.

Before turning to those calculations, we note in passing that this endogenous growth model also predicts that the long-term growth rate of the economy will be positively related to the rate of increase in real price of the output of the economy and negatively related to the rate of increase in the real gross rate of return on capital. Thus the model predicts that an economy such as Alberta will tend to grow at a faster rate when resource prices are

anticipated to increase in the future and to shrink when resource prices decline. Thus the model is consistent with the extreme fluctuations in the growth rate of the Alberta economy in response to changes in resource prices. (Note that it is the *rate of change* and not the *level* of resource prices that affects the growth rate of the economy in this model. High, but stable, oil prices would have a temporary, but not a permanent, effect on the growth rate of the economy.) Similarly, the model predicts that the per capita growth rate will be lower if gross rate of return to capital is increasing. Thus rising real interest rates would lower the growth rate, while high, but stable, real interest rates would not affect the long-term growth rate. This also means that higher source based taxes on the return to capital in the economy (such as higher corporate income taxes, capital taxes, and property taxes) would not affect the long-term growth rate of the economy.

Calculating the Effects of Tax Reform on the Growth Rate of the Alberta Economy

McKenzie (2000) has estimated that the substitution of an Alberta sales tax for the Alberta personal income tax would reduce the average marginal tax rate on savings from 0.472 to 0.322, a reduction of 15 percentage points. To calculate the predicted effect of this change in the tax rate on the long-term growth rate, we have to supply three parameter estimates, r, η_S, and s. As in the McKenzie study, we will assume that r is equal 0.05 and we use as our base case an estimate of 0.3 for η_S. We will also assume that the savings rate is 0.10%. If we substitute these values for the parameters in equation (A12), the calculated increase in the long-term growth rate is 0.0009, i.e. an increase of slightly less than a tenth of a percentage point.

While this increase in the growth rate may seem small, it would have a large impact on total output and average living standards. We have calculated two measures – a retrospective measure and a prospective measure – to put the magnitude of this increase in the growth rate in perspective. First, we have calculated the increase in the per capita GDP in Alberta in 1998 that would have occurred if the tax rate on the return to savings had been eliminated in 1971 and the economy had grown at a rate of 0.0209 instead of the actual rate of 0.02 since 1971. The calculation indicates that if the tax reform had occurred in 1971, per capita output in 1998 would have been $887 higher or an increase of $1,863 dollars per household. This represents a 2.4% increase in output, which would represent a significant improvement in output, total employment, and standards of living.

An alternative way of measuring the significance of the increase in the growth rate is to look forward, instead of backward, and measure the increases in GDP that would occur in future years if the economy grows at a rate of 0.0209 instead of 0.02. The increase in the present discounted value of per capita GDP from this increase in the growth rate would be $38,371 per capita. Since the per capita GDP in 1998 was $33,965, these calculations indicate that *the present value of the gain from the tax reform is equivalent to getting an extra year's output.* In other words, the gain is equivalent to every Alberta household winning a lottery where the prize is their annual income. Thus, even the modest increase in the growth rate that is predicted by this model, would represent a major increase in output and living standards. These growth rate effects from tax reform are roughly 10 times as large static efficiency gains calculated by McKenzie (2000) and further strengthen the case for the proposed tax reform.

Table A1 shows that the predicted effect of the tax reform on the growth rate or its significance in terms of

Table A1
Predicted Growth Rate Effects from Substituting a Sales Tax for the Provincial Income Tax in Alberta

Savings Rate Elasticity η_S	Predicted Change in the Growth Rate of Real Per Capita GDP $\Delta y'$	Increase in the 1998 Per Capita Real GDP if the Tax Reform had Occurred in 1971	Present Discounted Value of the Increase in Future Real Per Capita GDP with the Tax Reform
0.0	0.00075	$681	$29,288
0.3	0.000975	$887	$38,371
0.4	0.00105	$957	$41,431

Notes: The calculations are based on the assumption that r = 0.05, s = 0.10, and the tax reform would reduce the marginal tax rate on the return to savings from 0.472 to 0.322.

output is not greatly affected by the value of the elasticity of the savings rate that is used in the calculation. Even with a zero savings rate elasticity, the growth rate is predicted to increase by 0.00075, the per capita gain from a 1971 tax reform would have been $681 and the present discount value of the increase in per capita GDP would be $29,288. With a savings rate elasticity of 0.4, the per capita gain from a 1971 tax reform would have been $957 and the present discount value of the increase in per capita GDP would be $41,431.

In conclusion, this human-capital variant of the endogenous growth model predicts an increase in the annual economic growth rate on the order of a tenth of a percentage point. This seemingly modest improvement in the growth rate would, over time, have a very substantial impact on economic output and living standards in Alberta.

The Intertemporal Laffer Curve For Taxes on Investment Income

If the tax rate on investment income is cut by 15 percentage points, how much tax revenue would be lost? Or would the higher rate of economic growth mean that more taxes would be generated? To gain insight into this issue, we will first define the government's inter-temporal Laffer curve, which shows the relationship between the present discounted value of the stream of future tax revenues and the tax rate on investment income. If all tax bases grow at the same rate y' along the balanced growth path, then the present value of the stream of tax revenues is:

$$PVR = \frac{\tau_K B_K + \tau_o B_o}{r - y'} \qquad (A13)$$

where B_K is the initial size of the investment income tax base, B_o represents all other tax bases, and τ_o is the average tax rate on the other tax bases. An increase in τ_K affects PVR as follows:

$$\frac{dPVR}{d\tau_K} = \frac{B_K}{r - y'} + \frac{\tau_K \cdot \frac{dB_K}{d\tau_K} + \tau_o \cdot \frac{dB_o}{d\tau_K}}{r - y'} + \frac{\tau_K B_K + \tau_o B_o}{(r - y')^2} \cdot \frac{dy'}{d\tau_K} \qquad (A14)$$

The first term, which we will call the tax base effect, is the direct effect of an increase in τ_K on tax revenues, and it is proportional to B_K. The second term is the static efficiency effect, and it measures the effect of the tax rate change on the tax bases. While we expect $dB_K/d\tau_K$ to be negative, $dB_o/d\tau_K$ may be positive or negative. Overall we expect the static efficiency effect to be negative. The third term reflects the effect of the increase in τ_K on the growth rate of the total tax base. This term will be negative if an increase in τ_K reduces the growth rate of the tax bases as predicted by the endogenous growth model. If the static efficiency effect and the growth rate effects are negative and larger in absolute value than the tax base effect, then an increase in τ_K will reduce the PVR and the Laffer curve will have a negative slope.

Assuming that the output effect is small, compared with

the growth effect, then it can be shown that the tax rate that maximizes PVR is equal to the following:

$$\tau^*_K = \frac{\phi_K(1 - s)}{1 + \eta_s - \phi_K} \qquad \text{(A15)}$$

where ϕ_K is the share of total tax revenue obtained from taxing investment income. Equation (A15) indicates that the τ^*_K will be lower when ϕ_K is low because, in that case the tax base effect is relatively weak, and when the savings rate and the savings elasticity are high because higher values for these parameters increase the magnitude of the growth rate effect. Taxes on investment income (broadly defined) only represent less than 3% of total tax revenues. Given this share of total tax revenue, the τ^*_K would be 2.3% if the savings rate is 10% and the savings rate elasticity is 0.2. Thus the endogenous growth model predicts that w*ith* τ_K *in excess of 0.40, a cut in the tax rate on would increase the present value of the stream of future tax revenues.*

Constraints on Financing Human Capital

If there is a capital market failure in the financing of human capital, then the relevant rate of return on savings for individuals is the net rate of return on human capital. In a small open economy, an increase in a source-based capital tax, t_K, reduces wage rates:

$$\frac{dw}{dt_K} = -\frac{\alpha}{1-\alpha} \cdot \frac{w}{1 + t_K} < 0 \qquad \text{(A16)}$$

This implies that the capital taxes are fully shifted to labour since $(H/r_gK)(dw/dt_K) = -1$. An increase in a capital tax reduces the net rate of return on human capital, r^H_n, and therefore reduces the steady state rate of growth as follows:

$$\frac{dy'}{dt_K} = \frac{1}{\sigma}\left(\frac{\alpha}{1-\alpha}\right)\left[\frac{r^H_n + \eta_L(1-\tau_w)wL}{1 + t_K}\right] \qquad \text{(A17)}$$

where η_L is the elasticity of labour supply and L is the fraction of time spent working. This equation is used to calculate the growth effect of a reduction in the rate of capital taxes. If $r^H_n = 0.05$, $1/\sigma = s(1 + \eta_S) = 0.13$, $w = 0.20$, $L = 0.40$, $\tau_w = 0.44$, $\eta_L = 0.15$, then dy'/dt_K is equal to –0.004697.

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