I. Introduction

> *"When a government cuts taxes, it allows people to keep more of their money. That's a simple, clear incentive for hard work, expansion and growth."*
> *- Blueprint, Ontario Progressive Conservative Party, April 1999.*

At the onset of the 1990s, governments in Canada were compelled to constrain program spending as a consequence of the fiscal consolidation process. Currently, the budgetary position of most jurisdictions has improved considerably, enabling them to focus on the optimal size of government. Critics argue that altering the size of government could be detrimental to the distribution of disposable income, while proponents maintain that the economy will adjust to changes in the government's redistributional effort, such that inequality will not be adversely affected. The objective of this paper is to identify whether the economy will indeed adjust to changes in government intervention such that inequality in earnings remains relatively unaffected. In particular, we measure the magnitude and direction of any mitigating responses following a shift in selected fiscal policy aggregates. If containing the growth in earnings inequality is a valued social policy, then it is important to determine if the distribution of earnings will respond favourably to measures altering the size of government.

Fiscal policy exerts two effects on the distribution of earnings. The direct effect is the accounting difference between market earnings and disposable income. The indirect effect, also described as the general equilibrium effect, refers to the response of market earnings to a shift in fiscal policy. For example, government policies can be detrimental to economic growth because of adverse disincentives to work and save. The effects of a progressive tax system combined with benefits targeted to low-income earners may result in a sub-optimal level of private savings and labour effort. Government can also impede growth through its consumption of economic resources, which alters relative prices and ultimately affects income. To the extent that the aggregate effects of government policy impact economic agents heterogeneously, the distribution of earnings will also be affected.

Despite the possible distortionary incentives induced by fiscal policy, however, the direct effect of fiscal policy in mitigating more pronounced inequality could be quite important. The growing literature on income and earnings inequality confirms the role of

government policies in reducing inequalities. Although there has been an increase in market-income based inequality over the past few decades, income inequality based on disposable income has been relatively stable.[1] However, proponents of reduced taxes and size of government argue that the general equilibrium adjustment to reduced fiscal policies will outweigh the direct benefits that accrue to low-income households.

The objective of this paper is to study the empirical implications for earnings inequality following a shift in fiscal policy. The approach is to analyse the impact exerted by selected fiscal policies on the relationship between earnings inequality and growth. For instance, as earnings inequality has increased steadily over recent years, so has the size of government. This association may reflect a causal relationship, or it may simply represent a response by government to address growing market-income inequality. In terms of the current policy debate, a key issue is whether fiscal initiatives such as reducing the tax burden will "trickle down" into a broad-based improvement in terms of the inequality in market earnings.

These issues are first investigated using a time-series approach. This paper investigates whether a long-run equilibrium relationship exists between earnings inequality and economic growth. Subsequently, the paper examines the direction of causality between these variables by applying Granger causality tests. These results could shed new light on many existing theories in the literature that suggest the direction of causality between inequality and growth. Third, we assess how aggregate-level fiscal policy variables, such as government current expenditures on goods and services, personal income tax (PIT) revenues and program spending, interact with earnings inequality and growth. More precisely, the paper examines whether fiscal policy variables share a long-run relationship with earnings inequality and growth, and whether fiscal policy can predict future movements in these two variables. Finally, the paper infers the short- and long-term effects of a shift in fiscal policy for earnings inequality and growth using an error-correction regression approach.

In order to examine the implications of the estimates, we conduct a simulation exercise that computes dynamic responses in growth, earnings inequality and the fiscal

[1] See, for example, Beach and Slotsve (1996). For a comparison between Canada and the United States, see Beach and Slotsve (1996) and Wolfson and Murphy (1998).

variables. Further, the response of earnings inequality and economic growth is computed following several hypothetical fiscal policy strategies. In this manner, several conclusions may be drawn based on historical patterns about the impact of alternative fiscal strategies.

While there are some Canadian studies that have examined the empirical relationship between growth and inequality using a macroeconomic approach, to our knowledge, extensive time-series methods have not been applied to Canadian data. Failing to account for stationarity and cointegrating relationships between variables will lead to biased and inconsistent results. Moreover, there is little empirical evidence on the interaction between inequality, economic growth and fiscal policy. As a result, this paper represents a distinctive theoretical and empirical contribution to a literature investigating an important policy issue.

Due to the aggregate nature of the data and approach, this paper focuses *only* on the aggregate or macro-level effects of fiscal policy on earnings inequality, and does not consider the underlying micro-level effects of government policies. Such effects will be addressed in future work using micro data.

The paper is organised as follows. Section II presents a review of the empirical literature on inequality and economic growth, and in some instances, fiscal policy. Section III presents a brief summary of the evolution of income distribution in Canada in recent years. Section IV discusses the theoretical framework underlying this analysis and Section V describes the data. Section VI presents the empirical methodology and results, while Section VII presents the results from the simulation exercise. Finally, Section VIII provides some concluding remarks.

II. Literature Review

The literature on the empirical relationship between inequality and economic growth can be broadly divided into two categories based on the postulated direction of causality. The first category posits that the direction of causality runs from growth to inequality, while the second approach asserts that inequality affects growth. Arguments affirming the first view can be traced back to Kuznets (1955) who argued that earning inequality initially increases as an economy develops but declines afterwards.[2] In the early stages of

[2] This relationship is described as the Kuznets curve.

development, earning inequality increases as a result of a shift in labour from low-productivity (agriculture) sectors towards high-productivity sectors. As countries become more industrialised, the high-productivity sector expands and eventually dominates the economy, thereby reducing earnings inequality.[3]

Regression analysis has been used extensively to assess the effects on various measures of poverty and the income distribution resulting from the cyclical fluctuations of selected macroeconomic variables. Empirical results for Canada typically indicate that while unemployment increases inequality (or poverty), inflation does not tend to have a significant impact.[4,5] According to Sharpe and Zyblock (1997), about one-third of the increase in market inequality in Canada between 1975 and 1994 can be attributed to the increase in the unemployment rate over the same time period. Other macroeconomic factors also seem relevant. For instance, Buse (1982) and McWatters and Beach (1990) find that the participation rate plays an important role in reducing inequality. Richardson's (1994) decomposition analysis indicates that changes in the industrial and occupational composition of the work force, as well as the increase in the number of part-time workers between 1981 and 1989 have also led to a significant increase in inequality.

Within this growth-to-inequality framework, only a few studies have examined the impact of fiscal policy on inequality or poverty. Zyblock and Lin (1997) find that transfers reduce the incidence of low income among Canadian families. For instance, a $100-increase in per-capita transfers is estimated to reduce the incidence of low income among couples and single parents with children by 0.56 and 0.39 percentage points, respectively. The authors show, however, that the relationship between low income and transfers has weakened over time as a result of rising inequality.[6] Johnson (1995) assesses the influence of the tax and transfer system on unemployment and the income

[3] Empirical evidence on the Kuznets curve can be found in, for example, Anand and Kanbur (1993).

[4] See, for instance, Buse (1982), McWatters and Beach (1990), Beach and Slotsve (1996), Richardson (1994), Phipps (1995), Johnson (1995), Sharpe and Zyblock (1997), and Zyblock and Lin (1997). Erksoy (1994) used a micro-simulation approach to assess the impact of unemployment on income distribution and obtained similar results.

[5] Similar results are also found for the United States. See, for example, Blank and Blinder (1986). Powers (1995) shows, however, that when poverty rates based on the consumption of goods and services are used, inflation has a significant and positive impact on poverty.

[6] The authors also find that the relationship between low income and economic performance has weakened over time.

distribution. She concludes that the tax system is less important than the transfer system for redressing increased inequality related to higher unemployment.

While some of the studies mentioned above account for stationarity by differencing the data, none of these studies have presented an extensive time-series analysis that incorporates tests to verify the presence of unit roots and of long-term relationships between variables. However, Haslag and Slottje (1989) investigated these issues for the United States. The authors find that when taken individually, fiscal policy variables share a long-run relationship with inequality, while monetary policy variables do not. However, when fiscal and monetary policy variables are considered simultaneously, the authors find that a long-term relationship does exist, thus suggesting that the coordination of fiscal and monetary policy appears to be associated with changes in the size distribution of income in the United States. Results from an error-correction model indicate that the impact of monetary policy on inequality is statistically significant.

The second category of studies examining the empirical relationship between inequality and growth posits that changes in the distribution of income and redistributive policies affect economic growth. This stream of the literature can be traced back to Kaldor (1956) who argued that a relatively high level of savings is a prerequisite to growth. Given that wealthy individuals have a relatively higher propensity to save, redistributive policies hinder capital accumulation and impede growth. The empirical evidence examining this direction of causality between inequality and growth is essentially based on reduced-form regressions. These regression equations include inequality as an explanatory variable in standard growth regressions. The evidence suggests that inequality is detrimental to economic growth.[7] Given its reduced-form nature, this empirical evidence cannot shed any light on the underlying mechanisms linking inequality to growth. However, a number of theoretical explanations have been brought forward to fill this gap.

For example, Persson and Tabellini (1994) develop a theoretical framework whereby the level of inequality within a society determines the demand for redistributive fiscal policy through the political process. The impact of these policies is to lower

[7] See, for example, Persson and Tabellini (1994), Perotti (1994, 1996), Clarke (1995) and Alesina and Perotti (1996).

economic growth as they hinder the incentive to save and invest in both human and physical capital. Their empirical results confirm the negative relationship between inequality and growth. Similar arguments and results are also found in Bertola (1993) and in Alesina and Rodrick (1994). Generally, however, this channel lacks strong empirical support. The impact of inequality on transfers and taxes is rarely found to be significant, while the effect of transfer payments on growth is typically positive and statistically significant, rather than negative as predicted by the theory.[8]

Easterly and Rebelo (1993) examine the relationship between various fiscal policy variables, the level of development and economic growth. They find that the share of public investment in transportation and communication and the government's budget surplus are positively related to economic growth. However, the relationship between most other fiscal variables and economic growth is statistically fragile, as it depends heavily on the selection of control variables included in the regressions. They conclude that these results partly stem from multicollinearity, as fiscal policy variables are highly correlated among themselves and with the income level at the beginning of the sample period.

Alesina and Perotti (1996) investigate the effects of income distribution on investment through a socio-political instability channel. The authors argue that income inequality fuels social discontent and unrest, which in turn, increases political uncertainty. These events have a negative impact on investment and ultimately growth. Using a system of equations, the authors find that income inequality increases political instability and that the latter reduces investments. The authors also find that, after controlling for political instability, income distribution has little additional effects on investment. In this particular framework, redistributive policies would have a positive impact on growth, as they would reduce social tensions and create a more favourable climate for investing.

The presence of capital market failures is another channel that may affect the income distribution by discouraging investments in human capital (Galor and Zeira (1993), Bénabou (1996)). In the presence of such market failures, poor individuals

[8] See, for instance, Sala-i-Martin (1992), Persson and Tabellini (1994) and Perotti (1994, 1996). A survey of the empirical evidence can be found in Bénabou (1996).

cannot borrow against their future income to finance their education. Consequently, an individual's initial (inherited) wealth becomes an important determinant of her ability to invest in human capital. Within this framework, policies that redistribute from the rich to the poor will be beneficial to growth, as they facilitate investments in human capital at the lower end of the distribution. To test this theory empirically, Perotti (1994) uses the loan-to-value ratio for mortgages as an indicator of credit availability and finds that it has a positive and significant impact on investment. This effect is stronger in the presence of higher inequality.

In his 1996 paper, Perotti examines the robustness of the reduced-form relationship between income distribution and growth and empirically assesses the various channels through which income distribution impacts growth using a structural approach.[9] The author finds strong empirical support for the socio-political and fertility-education decision channels. The channel by which income distribution affects growth through imperfect capital markets is somewhat supported by the data. This channel, however, is the hardest to test empirically given the data available. Finally, as previously mentioned, the channel by which income distribution affects growth through fiscal policy appears to have the least amount of empirical support.

III. The Evolution of Income Distribution in Canada

The literature on the evolution of inequality in Canada has proliferated over recent years.[10] Since the 1980s, there has been an increase in the inequality and polarisation of earnings for men in Canada, while women have generally experienced the opposite trend. Market income inequality has also increased for Canadian families over the same time period. This trend, however, is not as pronounced as what has been observed in the United States. This partly results from the fact that, unlike the United States, Canada did

[9] In addition to examining the three channels described in this section, Perotti (1996) also assesses a fourth channel linking income distribution, imperfect capital market, and education and fertility decisions. This channel has also been examined by Galor and Zang (1997).

[10] See, for instance, Burbidge, Magee and Robb (1993), Richardson (1994), Morissette, Myles and Picot (1994), Beach and Slotsve (1996), Picot (1997) and Finnie (1997).

not experience an increase in the premium of high-skilled workers in the last few decades.[11]

The evolution of inequality in Canada changes markedly when the transfer and tax system is taken into account. Figure 1 illustrates the evolution of inequality, measured by the Gini coefficient, over the last 25 years. The Gini coefficient is defined as the area between the 45-degree line and the Lorenz curve divided by the area under the 45-degree line.[12] The Gini is equal to zero when income is distributed equally, and is equal to one when there is complete inequality. As shown in Figure 1, inequality tends to evolve countercyclically with the business cycle. However, the responsiveness of inequality to increased economic activity seems to have diminished over recent years, as inequality failed to return to its pre-recession levels in the early 1980s and 1990s. This tendency is highlighted in Figure 1 by the grey-shaded regions. Casual observation suggests the possibility of structural shifts following each recession, or even the existence of hysteresis in earnings. From 1971 to 1996, the Gini coefficient based on family market income has risen from 0.39 to 0.43, a 10-per-cent increase over 25 years.[13] When government transfer payments are included in the income definition, the Gini is lower and remains relatively stable at about 0.35. Finally, when the tax system is also considered, the Gini coefficient slightly decreased over time, from 0.31 in 1971 to 0.30 in 1996.[14]

The impact of transfers is apparent from Figure 1. Transfers from governments result in a significant downward shift, in addition to a flatter time profile for inequality. In contrast, the impact of tax revenue for the earnings inequality of families is less pronounced. The vertical shift is less in magnitude, and the slope remains essentially unchanged relative to the total money-income profile. Although earnings inequality exhibits a strong upward trend, the impact of fiscal policy has been to stabilise the

[11] See Morissette, Myles and Picot (1994) and Murphy, Riddell and Romer (1998).

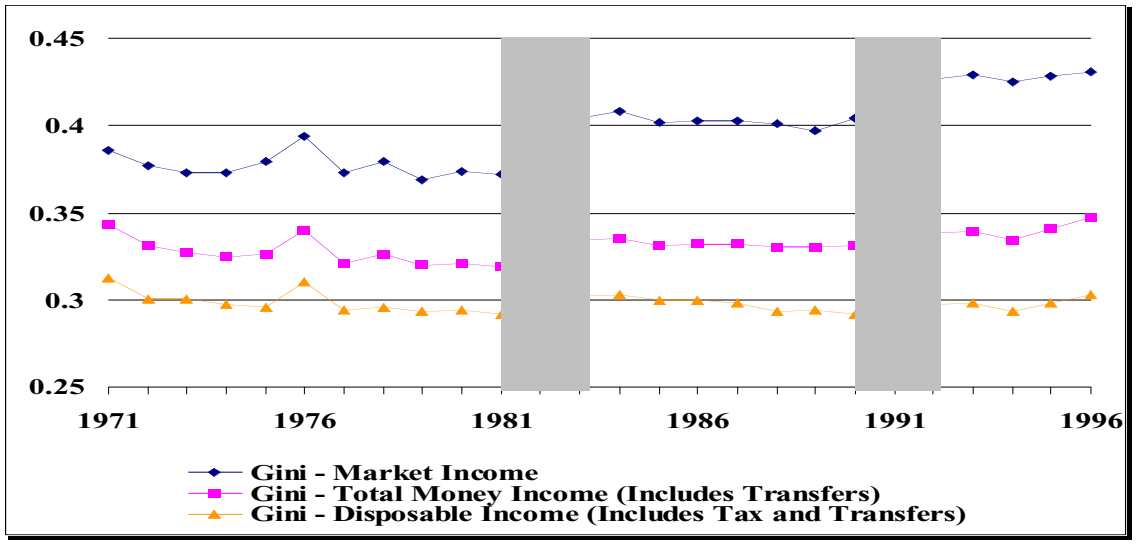
[12] The Lorenz curve maps the share of total income earned by percentile of workers.

[13] In what follows, market income (or earnings) is defined as pre-tax and pre-transfer income. More precisely, it is defined as wages, salaries, net income from self-employment, investment income, private pensions, alimony and other non-transfer income not included elsewhere.

[14] Measures based on total money income include market income and transfers received from governments. Inequality measures based on disposable income are post-tax and post-transfers.

inequality of family disposable income over the past twenty-five years. Thus, fiscal policy has played an important role in stabilising inequality, and transfers are largely responsible for this outcome.

Figure 1. Gini Coefficients by Type of Income, Families, 1971 to 1996



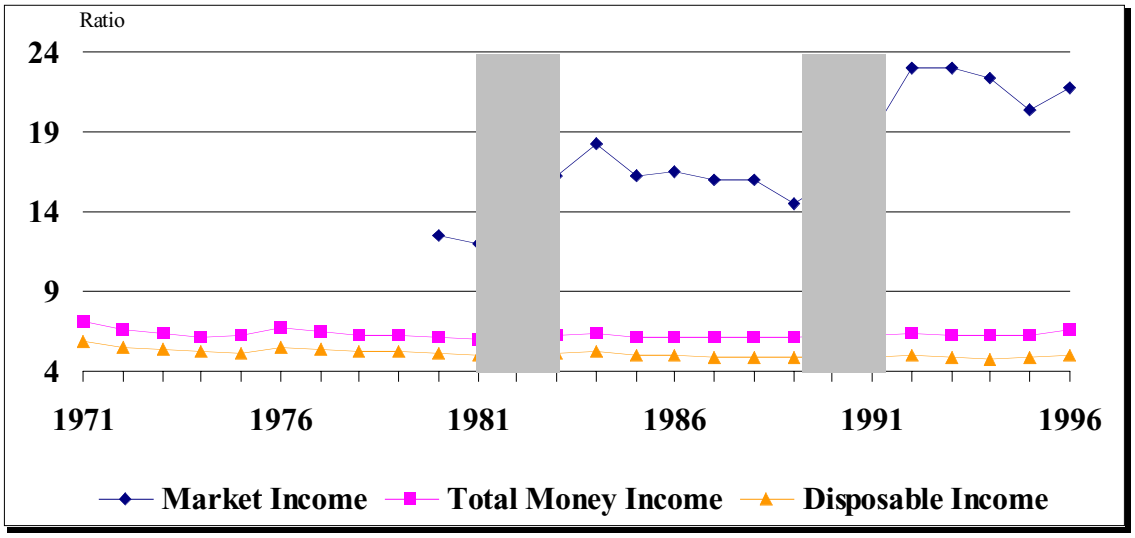
Source: Statistics Canada, Cat. 13-210.

Similar trends are found when we examine income quintile data. As shown in Figure 2, the ratio of the highest to the lowest quintiles based on family market income has risen significantly over the years to reach 22 in 1996. On the other hand, similar ratios based on total family money and disposable income have been relatively stable over time. In 1996, the highest quintile earned 7 times the income of the lowest quintile on the basis of total family money income. This ratio fell to 5 when calculated on the basis of family disposable income. The impact of fiscal policy has been to reduce the dispersion in earnings by 4.4 times between the upper and lower tails of the income distribution. The measure of earnings inequality depicted in Figure 2 illustrates the growing divergence in the income earned by the upper and lower tails of the income distribution. More importantly, Figure 2 reveals the strong impact of fiscal policy in maintaining a stable level of inequality based on family disposable income. Thus, over the years, the role of fiscal policy has been to contain the widening of the earnings distribution.

While the transfer and tax system remains an important redistributive mechanism in Canada, the dependence of Canadians on transfers has declined over recent years. The

share of transfer payments in total family money income has been steadily declining since 1993, when it peaked at 12.9 per cent.[15] In 1996, this share had fallen to 11.7 per cent, ranging from 59 per cent for the lowest income quintile to 3 per cent for the highest quintile. Taxes represented 20.5 per cent of total family money income payable in income tax in 1996, up from 19.2 per cent in 1993.

Figure 2. Ratio of Highest to Lowest Income Quintiles, Families, 1971 to 1996



Source: Statistics Canada, Cat. 13-210.

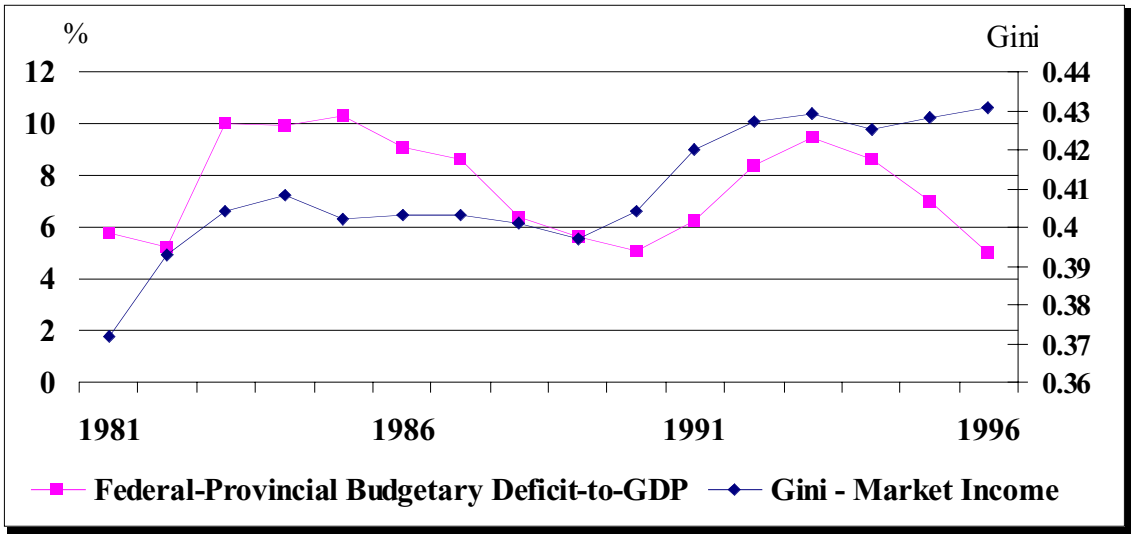
Figure 3 compares the evolution in the size of government, measured by the federal-provincial budgetary balance, with earnings inequality measured by the Gini coefficient. The consolidated federal-provincial fiscal position has been characterised by substantial deficits since the early 1980s. These deficits were more pronounced during the recessions of the early 1980s and 1990s as automatic stabilisers absorbed the impact of greater unemployment and displacement among workers. Although earnings inequality and the combined federal-provincial fiscal position are highly correlated over most years, the two variables diverge after the recent 1991-92 recession.

There are several factors that may account for this shift. Reduced program spending associated with the process of fiscal consolidation is one potential explanation. In that case, if the size of government declines as market inequality continues to rise, then inequality based on *disposable* income may also start to increase. This follows from an

[15] Statistics Canada, Cat. 13-210.

absence in the "direct effect" due to taxes and transfers that mitigate the impact of greater market-income inequality. If this assertion is correct, then the time profile of the data suggests that the general equilibrium adjustment is not sufficient to offset the impact of the shift in fiscal policy.[16]

Figure 3. Earnings Inequality and the Federal-Provincial Budgetary Balance-to-GDP Ratio, 1981 to 1996.



Sources: Statistics Canada, Cat. 13-210 and Public Accounts.

IV. Theoretical Framework

The purpose of this section is to provide a theoretical framework with respect to the relationship between fiscal policy, earnings inequality and growth from a *macroeconomic* perspective. The focus adopted in this paper is in sharp contrast to the preponderance of the existing literature. Consequently, a distinct set of empirical and theoretical tools are required. The empirical tools necessary to conduct our investigation are outlined in Section VI. This section provides the theoretical paradigm from which the empirical results are interpreted.

In order to consider the relationship between inequality, growth and fiscal policy from a macroeconomic perspective, it would be natural to use a dynamic general equilibrium model augmented with growth as a starting point. This environment typically

[16] There are other possible explanations for rising income inequality. For example, the restructuring of the Canadian industrial sector may have displaced workers with industry-specific human capital.

involves a specification of preferences, technologies and stochastic shocks that propagate their effects throughout the economy. In the standard model, households share identical preferences, which allows a tractable aggregation across individuals. Further, the usual assumption of complete asset markets eliminates wealth effects. The implication of these assumptions is that a meaningful analysis of the income distribution is sacrificed in the interest of simplifying technical problems involved in the solution method of these models.

Notwithstanding this factor, it is revealing to distinguish the economic adjustment to shocks in an environment with identical versus heterogeneous households. First, consider the adjustment to a favorable productivity shock consistent with standard models. The "marginal" value of private consumption decreases because consumption opportunities become more abundant.[17] The real interest rate acts as the "intertemporal" price of consumption goods, and thereby increases in response to the shock. This interest-rate response occurs because households desire to save less when the return is paid during a period of relatively high consumption.[18] The "intratemporal" relative price of goods is also affected due to shifting demand patterns, which impacts factor income and GDP. However, a welfare analysis with respect to the income distribution is not possible in this traditional framework because households are assumed to be identical.

In contrast to the standard analysis, consider the impact of introducing heterogeneous income earners that differ with respect to human capital, access to credit, initial wealth, cohort affiliations or other factors. In addition, assume incomplete asset markets allowing for wealth effects across households. Shocks in this environment will affect households differently, allowing for a meaningful welfare analysis of the income distribution.[19]

For example, in the previous case of a positive productivity shock, the welfare of each household varies according to its position along the income distribution. The real

[17] This follows from diminishing marginal utility, such that increasing consumption tends to decrease marginal utility.

[18] As a result, the real interest rate increases in order to induce saving by households. Households optimally desire a "consumption hedge", which pays off when consumption will be low.

[19] The theoretical foundation for these models is taken from important work put forward by Huggett (1993), Aiyagari (1994), Quadrini and Rios-Rull (1997) and Krussell and Smith (1998).

interest rate will continue to increase, but by a lesser degree. This outcome will result because risk-averse households undertake precautionary savings to insure themselves against adverse shocks. To the extent that the impact of a shift in the interest rate and intratemporal relative prices of goods affect households differently, the distribution of income will also be affected. As a result, the impact of shocks introduces welfare issues. For instance, if wages and the return to capital are affected by the general equilibrium adjustment to a shock, then households that predominantly supply only one factor (such as labour) will be more strongly affected.

An intuitive understanding of the propagation mechanism underlying this framework is provided as follows. Suppose that transfers are increased to lower-income households. These households purchase a different bundle of consumption goods as a result of their higher post-transfer income. For instance, fewer "inferior" goods are purchased in favour of more "normal" goods.[20] However, the workers involved in producing these items are affected by shifting demand patterns. Consequently, wages and other sources of income are affected, which translates into a movement along the distribution of income for the workers and households involved.

Fiscal policy enters this relationship through its effects on the budget set of heterogeneous households. The impact of transfer payments, progressive marginal tax rates and the provision of public goods exerts a strong role in determining demand patterns for goods within a period, as well as across time. For example, increasing transfers will augment consumption possibilities for lower-income households. The increase in demand will shift relative prices in the economy, factor incomes and thereby GDP. However, the combined impact of these general equilibrium effects is not borne proportionally by all households. Unfortunately, the long-run relationship between growth and inequality is not immediately apparent within this paradigm. The particular model specification will strongly determine the relationship between growth and income inequality, and the magnitude of responses to policy shocks.

As a result, the empirical work outlined in the subsequent section investigates the response of inequality based on market income following movements in policy variables.

[20] Recall that an inferior good is characterised as a commodity whereby an additional dollar of income results in less than proportional increase in spending on the commodity.

Several issues are examined. First, government absorption of economic resources reduces private consumption possibilities but provides additional public goods. Since both public and private goods generate utility, but are imperfect substitutes, a shock in government expenditures for goods and services affects relative prices and income. Second, the effect of aggregate social spending, measured by program spending, is evaluated. Finally, the aggregate effects of the personal income tax system are also considered.

V. Data

To conduct our empirical analysis, we selected a number of inequality and fiscal policy measures. Among the various inequality measures available, we selected the Gini coefficient as our principle measure of inequality. However, given that the Gini coefficient is recognised for being sensitive to changes in the middle of the distribution, we also use income quintile data as alternative measures of inequality. More precisely, we use the ratio of the highest and lowest quintiles as well as the sum of the two lowest quintiles. These latter measures are more sensitive to changes in the tails of the distribution, and thus will allow the robustness of the results to be confirmed. Gini and quintile data used in this paper were calculated from the Survey of Consumer Finances (SCF), and were taken from Statistics Canada's *Income After tax, Distribution by Size in Canada* publication.

Three fiscal policy measures were used to assess the interaction between inequality, growth and fiscal policy: program spending, personal income tax (PIT) revenues and government gross current expenditures on goods and services.[21] These variables were assessed for both the federal and consolidated federal-provincial governments.[22] The variables were selected primarily on the basis of their potential to influence relative prices and income, as discussed in Section IV.[23] Each fiscal variable was transformed into real terms using the GDP deflator.

[21] Program spending and PIT revenues are based on the Public Accounts, whereas government gross current expenditures on goods and services is from the National Accounts.

[22] The federal-provincial government sector includes the territories.

[23] A set of other possible fiscal variables were also considered, based on the ability to affect household income or utility. These included transfers to provinces and the federal budgetary balance. The variables cited above derived the most favourable results, as described later in the paper.

Statistics Canada publishes Gini and income quintile data based on three income concepts: earnings or market income, total money income and disposable income. This analysis focuses solely on the relationship between market-income based inequality, growth and fiscal policy. Fiscal policy entails two effects. First, fiscal policy impacts the budget constraint of individuals directly via taxes and transfers. Second, as discussed in Section IV, fiscal policies impact the relative price of goods and factors, which will in turn affect the income distribution as long as the effects are borne disproportionally. This paper focuses on market inequality because the measures based on total money and disposable income already embed the direct effect. At an aggregate level, the direct effect of fiscal policy on household budget constraints amounts primarily to an accounting relationship (as can be observed in Figure 1). Consequently, our objective is to identify the relationship between fiscal policy and the evolution of families' market earnings. The magnitude and direction of any economic spillover effects affecting earnings inequality that result from a shift in fiscal policy can then be inferred.[24]

The data used to conduct our analysis is reported annually, which implies a relatively small sample. For example, the Gini coefficients range from 1971 to 1996, and the income quintile data are only available from 1981 to 1996. To ensure the robustness of the results, we use various inequality and fiscal policy measures. The small sample size is not conducive to long dynamic lag structures that characterise many time-series processes. However, in this case, the effect of fiscal policy on growth and inequality should not involve a highly time-dependent process. As a result, the empirical method adopted for this paper is not significantly weakened by the small sample of data. Further, there are sufficient observations to identify short- and long-term effects.

[24] Thus, empirical attention is focused on the strength and direction of the general equilibrium effect.

VI. Empirical Methodology and Results

a) Methodology

The empirical investigation conducted in this paper is threefold. First, we investigate the existence of a long-run equilibrium relationship between economic growth and inequality. Second, we attempt to identify the direction of causality between growth and earnings inequality. Finally, we study the role played by fiscal variables in order to understand the impact of policy factors in the relationship between growth and inequality.

The possibility of a long-run equilibrium relationship between earnings inequality and growth is determined by applying cointegration methods. The existence of an equilibrium relationship between growth and inequality implies a dynamic interdependency. The possibility of a cointegration relationship is determined by testing whether the linear combination of two trending series is itself stationary. In this event, the two nonstationary series share a common long-run relationship.

In order to investigate cointegration, it is first necessary to establish whether the data are characterised by unit roots. In the context of the current empirical exercise, the exclusion of a unit-root analysis would have led to spurious estimates, and thereby to a misleading inference regarding the long-run relationship between fiscal policy, growth and inequality. The main empirical tool employed to investigate the possibility of unit roots is the augmented Dickey-Fuller test.[25] The following equation presents the test under the null hypothesis of a unit root:

$$\Delta X_t = \beta_0 + (\rho - 1) X_{t-1} + \sum_{j=1}^{N} \Delta X_{t-j} + \varepsilon_t \,, \qquad (1)$$

whereby the number of lags, N, is determined from the Schwarz Information Criterion (SIC). An information criterion penalises excessive parameterisation that fails to deliver

[25] The Phillip-Perron test was used to supplement the Dickey-Fuller test. It has been shown, however, that the Phillip-Perron test performs better in large samples (Handa and Ma (1989)).

sufficient additional explanatory power. The model structure that minimises the information criterion was selected under this procedure.

Once the nonstationary variables have been identified, two tests were applied to detect the presence of cointegration. First, the Johansen method entails estimating a vector error correction model (VECM) and identifying the rank of an estimated cointegration matrix. The rank of the matrix yields the number of cointegration relations that exist among the variables. This approach is not parsimonious given the limitations of an annual data set, and is used primarily as ancillary evidence. Due to our small sample size, only one lag was employed in the Johansen test. The procedure allows for a multitude of model specifications including trend and drift terms in both the short- and long-run dynamics. The model selected in our empirical work typically involved a drift and possibly a time trend in the short-run behaviour, but not with respect to the long-run cointegration equation.

The second method involves analysing the residual from a *static* least-squares regression incorporating the logged levels of the trending variables. A stationary residual indicates that the linear combination is stationary, and thus that there exists a cointegrating relationship between the two variables. This technique quickly identifies whether there is a relationship over the sample period between two variables. Unfortunately, there is nothing implied from this result about the direction of causality among the variables.

As a result, the second issue addressed in this paper regards the direction of causality. The concept of "Granger causality" is based on the notion that a *cause* precedes the *effect*. Consequently, the test equation for Granger causality amounts to a joint F-test on the significance of lagged values of the candidate causal variable. For example, if variable Y Granger causes X, then Y is simply a good predictor of X.

Finally, the impact of fiscal variables in affecting the relationship between growth and inequality is evaluated by means of an error-correction regression technique. An error-correction model (ECM) is a regression that corrects for any long-run cointegration relationships among the variables. Failing to account for these long-run conditions yields

biased and inconsistent estimates. As a result, inferences drawn about the impact of fiscal policy on the dispersion of income would be erroneous.

An advantage of the ECM regression technique is that the short-run dynamic behavior of explanatory variables is identified distinctively from longer-run equilibrium influences. This allows for the estimation of individual effects, such as fiscal policy factors and the importance of long-run equilibrium relationships, such as a cointegration relationship between inequality and growth. An error-correction model is outlined algebraically in equation (2):

$$\Delta X_t = \beta_0 + \sum_{j=1}^{\rho} \beta_j \Delta X_{t-j} + \sum_{j=1}^{\rho} \gamma_j \Delta Y_{t-j} + \Gamma \left(X_{t-1} - \varphi Y_{t-1} \right) + \varepsilon_t \ . \qquad (2)$$

Under this specification, the short-run dynamic multipliers are represented by β_j, and γ_j for the variables X and Y, respectively. While the short-run dynamic behaviour deviates from the long-run relationship, the parameter Γ draws the evolution of the variables back towards equilibrium. The parameter φ is the point estimate related to the long-run cointegration relation. The lag order of the ECM, denoted by ρ, is determined by the Schwarz Information Criterion (SIC). The ECM specification also permits Granger causality testing. For instance, the null hypothesis that Y does not Granger cause X is evaluated by the joint F-test, $\gamma_1 = \gamma_2 = \ldots = \gamma_\rho$.

Alternatively, the dynamic relationship between growth, inequality and fiscal policy can be estimated by a multiple-equation approach. Estimating a system of equations, as opposed to a single-equation regression such as the ECM, may lead to an improvement of the efficiency of the estimates. Further, the full set of dynamic interdependencies is identified from matrices of estimated parameters. Unfortunately, we lack sufficient data to undertake this type of analysis. The vector error correction model is not very parsimonious, particularly if the lag order is increased by even a small amount. As a result, the equations that would compose a VECM are estimated individually. Proceeding in this manner permits sufficient degrees of freedom, and thereby a meaningful analysis of the results.

b) Results[26]

Unit Roots

The results of unit-root tests are revealing. First, all measures of earnings inequality were found to be consistent with unit roots. Specifically, the Gini coefficient based on family market income is identified as being nonstationary by the augmented Dickey-Fuller and Phillip-Perron tests. The ratio of the income shares corresponding to the highest and lowest quintiles as well as the share of the lowest two income quintiles are also found to be nonstationary by both tests.

In addition to the earnings inequality measures, the log level of real GDP is nonstationary with a unit root. Likewise, the fiscal policy variables incorporated in our analysis follow time-series processes containing unit roots.[27]

Cointegration

Following the unit-root analysis, we assessed the existence of a long-run equilibrium relationship between inequality and growth, and between inequality, growth and fiscal policy.[28] The hypothesis of cointegration between growth and our various measures of inequality could not be rejected. These results hold regardless of the specific cointegration test applied. Moreover, there is evidence that generally supports the presence of a long-run equilibrium relationship between growth, earnings inequality and our selected measures of fiscal policy. Federal and federal-provincial expenditures on goods and services share a long-run relationship with growth and inequality, regardless of the inequality measure used. Similar results are also found for federal and federal-provincial PIT revenues. Federal program spending shares a long-run relationship with

[26] Results were calculated using inequality measures based on "economic" family market income as well as on total family market income (that is, economic families and unattached individuals). An economic family is defined as a group of individuals related by blood, marriage or adoption who shares a common dwelling. For conciseness, this section only presents results calculated for economic families. Results for total families are available from the authors upon request.

[27] Results are on the basis of augmented Dickey-Fuller tests. In a number of cases, opposite results were found when using the Phillips-Perron test. For instance, federal program spending and consumption of goods and services were found to be stationary series based on the Phillips-Perron test.

[28] Due to the number of variables and combinations examined, specific statistical results are not reported for ease of exposition. However, these results are available from the authors upon request.

growth and inequality when the latter is defined as either the Gini coefficient based on family market income, or the ratio of the highest-to-lowest income shares. Conflicting results are found when the share of the first two income quintiles is employed as the inequality measure.[29] Finally, results relating to federal-provincial program spending confirmed the presence of a long-run relationship when the Gini coefficient measured inequality, but the results are ambiguous if the other inequality measures are considered.[30]

Granger Causality

Following the evidence presented above, a natural issue is to ascertain the direction of causality between growth, fiscal policy and inequality. The first result is that real GDP Granger causes all measures of earnings inequality, with the exception of the income share of the lowest two income quintiles. Inequality does not tend to Granger cause real GDP.[31] Thus, based on historical data, growth is a good predictor, one year ahead, of movements in inequality. This result tends to support studies presented in Section II that posit that the direction of causality between these two variables runs from growth to inequality.

We next examined the direction of causality between growth and our various measures of fiscal policy and inequality. In general, we find that earnings inequality is Granger caused by movements in real output and in our various measures of fiscal policy, regardless of the level of government examined. For instance, real GDP and federal program spending Granger cause earnings inequality when it is measured either by the Gini coefficient, or the ratio of the highest-to-lowest income quintiles. This result also holds for federal-provincial program spending and government current expenditures on goods and services. Moreover, we find some evidence that inequality measures Granger cause fiscal policy. For example, the Gini coefficient Granger causes federal-provincial

[29] More specifically, results obtained with the Johansen approach indicated the presence of a cointegrating relationship, while the opposite result was found using the static approach.

[30] In both cases, the Johansen tests indicated the presence of a cointegrating relationship, while the opposite result was found using the static approach.

[31] The lag order of the Granger test equations was determined by the Schwarz Information Criterion. In most cases, a single lag is identified as being optimal.

personal income tax revenues and program spending, while the ratio of the highest to the lowest income quintiles Granger causes federal and federal-provincial program spending, as well as the federal government's current expenditures on goods and services. Finally, real output was generally found to Granger cause current expenditures on goods and services, regardless of the inequality measure used.

Results from the bivariate and multivariate Granger causality tests suggest that based on observed patterns, growth, inequality and fiscal policy share a dynamic relationship. For instance, fiscal policy and earnings inequality tend to Granger cause each other. As discussed in Section IV, within a dynamic equilibrium context, one would expect that endogenous macroeconomic variables, such as inequality and fiscal variables, would Granger cause one another. The evidence presented above is generally consistent with this hypothesis. The following section pursues a multivariate regression approach to determine the short- and long-run impact of fiscal policy variables on growth and inequality.

Regression Results

a) Inequality and Growth

We first assess the relationship between various measures of earnings inequality and growth by estimating the following single-equation error-correction models:

$$\Delta \log(inequality)_t = \beta + \alpha ?\Delta \log(rgdp)_{t-1} + \delta ?\Delta \log(inequality)_{t-1} + \Gamma ?(\log(inequality)_{t-1} - \lambda ?\log(rgdp)_{t-1}) \quad (3)$$

$$\Delta \log(rgdp)_t = \alpha + \chi ?\Delta \log(inequality)_{t-1} + \varepsilon ?\Delta \log(rgdp)_{t-1} + \Theta ?(\log(inequality)_{t-1} - \phi ?\log(rgdp)_{t-1}), \quad (4)$$

where log*(rgdp)* is the logged value of real GDP, and log(*inequality)* represents the logged value of our various measures of inequality: the market-income based Gini coefficient (GFMI), the ratio of the highest to lowest income quintiles (HLFMI) and the sum of the two lowest income quintiles (Q12FMI). The Newey-West estimator was used to correct for the potential presence of heteroscedasticity and of serial correlation in the residuals. Moreover, ECMs were estimated using the Engle and Granger (1987) two-step

approach. The procedure entails first estimating the static cointegration equation, and then estimating the dynamic ECM model by using the lagged residual from the static equation as the error-correction term. This approach was preferred to direct estimation of the ECM equation due to the presence of collinearity between variables included in the error-correction term, particularly between the various measures of fiscal policy and real output.[32]

Results from equation (3) are found in Table 1, while those obtained from equation (4) are reported in Table 2.[33] Note that the marginal significance, or p-values, are reported below the respective coefficient estimates. We first find a general negative and significant relationship between earnings inequality and growth when inequality is the dependent variable (Table 1). Thus, in the short run, higher economic growth reduces earnings inequality. When real GDP is the dependent variable, the estimated coefficients on our various measures of earnings inequality also generally indicate a negative relationship between these two variables, but the relationship is no longer significant. Interestingly, earnings inequality and growth are significantly and positively related to each other over the long run, suggesting that greater earnings inequality leads to higher growth (Table 2).[34] This result basically reflects that, over the sample period, both real output and inequality have increased over time in a cointegrated manner.

[32] One problem that may arise from the Engle and Granger (1987) approach is the presence of a bias in the least-square estimates of the static cointegrating regressions in finite samples.

[33] The G in front of the variable mneumonic represents the first lag operator, or growth rate for log-differenced data.

[34] This result is captured by the estimated coefficient preceding the error-correction term (e.g., Γ in equation 3).

Table 1. Inequality and Growth, Point Estimates and P-Values

	Dependent variables		
	GGFMI	GHLFMI	GQ12FMI
CONSTANT	0.028	0.129	-0.026
	*0.000**	*0.000**	*0.071*
GRGDP(-1)	-0.681	-3.149	0.682
	*0.000**	*0.002**	*0.115*
GGFMI(-1)	-0.370	-	-
	*0.005**	-	-
GHLFMI(-1)	-	-0.113	-
	-	*0.537*	-
GQ12FMI(-1)	-	-	0.149
	-	-	*0.646*
Error-correction coefficient	-0.201	-0.285	-0.196
	0.147	*0.091*	*0.231*
Number of Observations	24	15	14
Standard Error of Estimate	0.018	0.080	0.024
R-Squared	0.471	0.591	0.550

The * indicates that the estimated coefficient is significant at the 5-per-cent level.

Table 2. Inequality and Growth, Point Estimates and P-Values

	Dependent variable		
	GRGDP	GRGDP	GRGDP
CONSTANT	0.022	0.015	0.019
	*0.01**	*0.001**	*0.019**
GRGDP(-1)	0.303	0.329	0.312
	0.100	*0.321*	*0.053*
GGFMI(-1)	-0.098	-	-
	0.631	-	-
GHLFMI(-1)	-	0.006	-
	-	*0.877*	-
GQ12FMI(-1)	-	-	0.027
	-	-	*0.900*
Error-correction coefficient	0.440	0.115	-0.229
	*0.003**	*0.001**	*0.019**
Number of Observations	24	15	14
Standard Error of Estimate	0.020	0.019	0.018
R-Squared	0.376	0.541	0.468

The * indicates that the estimated coefficient is significant at the 5-per-cent level.

b) Fiscal Policy, Inequality and Growth

To assess whether fiscal policy plays a significant role in determining the relationship between earnings inequality and growth, equations (3) and (4) were modified slightly to

include a fiscal policy variable in both the short- and long-run components of the regressions. We also estimated an ECM where each of the fiscal policy variable was used as the dependent variable (equation 5). Algebraically:

$$\Delta \log(inequality)_t = \varphi + \gamma ?\Delta \log(rgdp)_{t-1} + \eta ?\Delta \log(fiscal)_{t-1} + \Psi ?\left(\log(inequality)_{t-1} - \iota ?\log(rgdp)_{t-1} - \kappa ?\log(fiscal)_{t-1}\right) \quad (3')$$

$$\Delta \log(rgdp)_t = \lambda + \mu ?\Delta \log(inequality)_{t-1} + \nu ?\log(fiscal)_{t-1} + \Pi ?\left(\log(inequality)_{t-1} - o ?\log(rgdp)_{t-1} - \varpi ?\log(fiscal)_{t-1}\right) \quad (4')$$

$$\Delta \log(fiscal)_t = \pi + \theta ?\Delta \log(inequality)_{t-1} + \vartheta ?\log(rgdp)_{t-1} + \Xi ?\left(\log(inequality)_{t-1} - \rho ?\log(rgdp)_{t-1} - \sigma ?\log(fiscal)_{t-1}\right), \quad (5)$$

where *log(fiscal)* is the logged value of our selected fiscal policy variables: federal government gross current expenditures on goods and services (FGNA), federal-provincial government gross current expenditures on goods and services (FPGNA), federal personal income tax revenues (FPITPA), federal-provincial personal income tax revenues (FPPITPA), federal program spending (FPROGPA) and federal-provincial program spending (FPPROGPA).

Consistent with the literature, our empirical exercise reveals few significant relationships between economic growth, inequality and fiscal policy. This outcome occurred despite a distinctive empirical and theoretical approach. Tables 3, 4 and 5 present the results obtained for the federal government, while Tables 6, 7 and 8 present the results for the consolidated federal-provincial sector.[35]

For the federal government, we find a significant negative relationship between inequality and growth in the short run, regardless of the inequality measure used as the dependent variable (Tables 3 and A1). Moreover, the significance of the relationship between fiscal policy, earnings inequality and growth depends heavily on the inequality measure used. Federal program spending has a significant and positive relationship with

[35] For conciseness, only the results pertaining to the Gini coefficients are presented in the text. Results obtained using HLFMI and Q12FMI as our measure of earnings inequality can be found in Annex A.

earnings inequality in the short run when inequality is measured by the Gini coefficient or by the ratio of the highest to the lowest income quintiles (Tables 3 and A1). This result partly reflects the self-stabilising nature of certain social programs, such as Employment Insurance, over the period covered by our sample. In contrast, higher PIT revenues tend to significantly reduce inequality when measured by the share of the lowest two income quintiles (Table A1). The impact of government expenditure on goods and services is significant at the 10-percent level, and tends to increase positively with inequality.[36] Finally, the error-correction term is statistically significant only when real output is used as the dependent variable (Tables 4 and A2). This implies that our various measures of fiscal policy and earnings inequality are weakly exogenous and thus, in this particular case, the estimation of ECMs instead of a VECM does not lead to a loss of efficiency. The positive sign of the estimated coefficient confirms the positive relationship between earnings inequality and growth in the long run. Once again, this result reflects the fact that both variables have been trending up in a cointegrating manner over our sample period.

Table 3. Inequality, Growth and Federal Fiscal Policy, Point Estimates and P-Values

	Dependent variable		
	GGFMI	GGFMI	GGFMI
CONSTANT	0.029	0.025	0.026
	*0.000**	*0.000**	*0.000**
GRGDP(-1)	-0.814	-0.663	-0.727
	*0.000**	*0.000**	*0.000**
GGFMI(-1)	-0.585	-0.400	-0.405
	*0.001**	*0.016**	*0.018**
FPROGPA(-1)	0.125	-	-
	*0.047**	-	-
FPITPA(-1)	-	0.053	-
	-	*0.167*	-
FGNA(-1)	-	-	0.156
	-	-	*0.090*
Error-correction coefficient	-0.157	-0.144	-0.141
	0.314	*0.381*	*0.305*
Number of Observations	24	24	24
Standard Error of Estimate	0.017	0.018	0.018
R-Squared	0.515	0.474	0.509

The * indicates that the estimated coefficient is significant at the 5-per-cent level.

[36] When earnings inequality is measured by the Gini coefficient (Table 3).

Table 4. Inequality, Growth and Federal Fiscal Policy, Point Estimates and P-Values

	Dependent variable		
	GRGDP	GRGDP	GRGDP
CONSTANT	0.019	0.020	0.025
	*0.015**	*0.002**	*0.007**
GRGDP(-1)	0.240	0.274	0.233
	0.199	*0.037**	*0.241*
GGFMI(-1)	-0.099	-0.227	-0.166
	0.653	*0.287*	*0.474*
FPROGPA(-1)	0.127	-	-
	0.119	-	-
FPITPA(-1)	-	0.077	-
	-	*0.086*	-
FGNA(-1)	-	-	-0.059
	-	-	*0.567*
Error-correction coefficient	0.295	0.654	0.524
	0.079	*0.003**	*0.006**
Number of Observations	24	24	24
Standard Error of Estimate	0.021	0.020	0.020
R-Squared	0.342	0.415	0.405

The * indicates that the estimated coefficient is significant at the 5-per-cent level.

Table 5. Inequality, Growth and Federal Fiscal Policy, Point Estimates and P-Values

	Dependent variables		
	GFPROGPA	GFPITPA	GFGNA
CONSTANT	0.039	0.015	-0.008
	*0.040**	*0.744*	*0.527*
GRGDP(-1)	-0.842	0.590	0.669
	0.056	*0.499*	*0.046**
GGFMI(-1)	0.017	0.754	0.712
	0.970	*0.435*	*0.066*
FPROGPA(-1)	0.449	-	-
	*0.004**	-	-
FPITPA(-1)	-	0.038	-
	-	*0.872*	-
FGNA(-1)	-	-	0.256
	-	-	*0.164*
Error-correction coefficient	0.070	-0.163	0.002
	0.889	*0.815*	*0.995*
Number of Observations	24	24	24
Standard Error of Estimate	0.056	0.084	0.037
R-Squared	0.281	0.029	0.225

The * indicates that the estimated coefficient is significant at the 5-per-cent level.

We obtain similar results for the consolidated federal-provincial sector. As with the results presented for the federal government, these results are sensitive to the measure of earnings inequality used. Higher economic growth typically leads, in the short run, to a reduction in earnings inequality, regardless of the earnings inequality measure used (Tables 6 and A4). Federal-provincial expenditures on goods and services are significantly and positively related to earnings inequality when measured either by the Gini coefficient or the ratio of the highest to the lowest income quintiles (Tables 6 and A4). A similar relationship was also found between federal-provincial program spending and the ratio of the highest to the lowest income quintiles. Conversely, we find some evidence that earnings inequality has a significant positive relationship with program spending but a significant negative relationship with PIT revenues (Tables 8 and A6).[37] Moreover, we find some evidence that federal-provincial program spending and expenditures on goods and services are significantly and positively related to growth (Table A5). Finally, the estimated coefficients on the error-correction terms indicate that there is a positive long-run relationship between inequality and growth (Tables 7 and A5).

[37] These results hold when fiscal policy is used as the dependent variable. When earnings inequality is used as the dependent variable, inequality and fiscal policy are significant related to each other only when the ratio of the highest to the lowest income quintiles measures inequality (Table A4).

Table 6. Inequality, Growth and Federal-Provincial Fiscal Policy, Point Estimates and P-Values

	Dependent variable		
	GGFMI	GGFMI	GGFMI
CONSTANT	0.012	0.017	0.019
	0.417	*0.033**	*0.001**
GRGDP(-1)	-0.289	-0.404	-0.724
	0.467	*0.037**	*0.000**
GGFMI(-1)	0.169	0.037	-0.455
	0.773	*0.890*	*0.006**
FPPROGPA(-1)	-0.004	-	-
	0.967	-	-
FPPITPA(-1)	-	-0.023	-
	-	*0.630*	-
FPGNA(-1)	-	-	0.113
	-	-	*0.028**
Error-correction coefficient	-0.347	-0.225	-0.119
	0.372	*0.200*	*0.435*
Number of Observations	14	14	24
Standard Error of Estimate	0.012	0.012	0.017
R-Squared	0.585	0.594	0.530

The * indicates that the estimated coefficient is significant at the 5-per-cent level.

Table 7. Inequality, Growth and Federal-Provincial Fiscal Policy, Point Estimates and P-Values

	Dependent variable		
	GRGDP	GRGDP	GRGDP
CONSTANT	0.012	0.002	0.021
	0.443	*0.851*	*0.031**
GRGDP(-1)	0.446	0.712	0.201
	0.274	*0.005*	*0.282*
GGFMI(-1)	0.113	0.525	-0.195
	0.827	*0.147*	*0.324*
FPPROGPA(-1)	0.130	-	-
	0.288	-	-
FPPITPA(-1)	-	0.046	-
	-	*0.476*	-
FPGNA(-1)	-	-	0.043
	-	-	*0.450*
Error-correction coefficient	0.619	0.464	0.605
	0.200	*0.048**	*0.000**
Number of Observations	14	14	24
Standard Error of Estimate	0.016	0.016	0.440
R-Squared	0.594	0.618	0.019

The * indicates that the estimated coefficient is significant at the 5-per-cent level.

Table 8. Inequality, Growth and Federal-Provincial Fiscal Policy, Point Estimates and P-Values

	Dependent variables		
	GFPPROGPA	GFPPITPA	GFPGNA
CONSTANT	-0.055	0.047	-0.024
	*0.028**	*0.306*	*0.033**
GRGDP(-1)	1.468	-0.452	1.017
	*0.028**	*0.689*	*0.000**
GGFMI(-1)	3.602	-2.102	0.173
	*0.000**	*0.035**	*0.275*
FPPROGPA(-1)	0.130	-	-
	0.525	-	-
FPPITPA(-1)	-	0.531	-
	-	*0.041**	-
FPGNA(-1)	-	-	0.855
	-	-	*0.000**
Error-correction coefficient	-1.676	0.150	-0.324
	*0.000**	*0.831*	*0.118*
Number of Observations	14	14	24
Standard Error of Estimate	0.025	0.056	0.027
R-Squared	0.757	0.329	0.835

The * indicates that the estimated coefficient is significant at the 5-per-cent level.

VI. Simulating the Estimated Regression Model

The primary objective of this paper is to assess the potential for fiscal policy to influence the relationship between economic growth and the distribution of earnings. In particular, the *indirect,* or general equilibrium, effect resulting from fiscal policy is increasingly cited as a rationalisation for reducing the size of government. However, as argued previously, the direction and magnitude of the general equilibrium effect is actually uncertain, owing to the multiplicity of effects that result from a change in fiscal policy. Our empirical results show that the magnitude of the indirect effect resulting from an aggregate change in fiscal policy was relatively weak and rarely significant up to the mid-1990s.

This section uses a simulation technique to determine the direction and magnitude of the economic adjustment to a change in the redistributional effort by governments. In this manner, the impact of various fiscal strategies can be assessed. The estimated coefficients and standard errors obtained in the previous section are used to calibrate the

simulation equations. Although these estimates generally lack strong statistical significance, they are useful in order to identify the general equilibrium effect resulting from fiscal policy. Consequently, this empirical exercise allows us to discern the magnitude and direction of the general equilibrium effect ***if*** the estimates had been strongly significant and thereby to assess the impact of fiscal policy on economic growth and earnings inequality.

The simulation exercise is analogous to an out-of-sample forecast based on the three-equation ECMs. It operates as follows. First, the regression equations from the previous section are calibrated by the estimated coefficients. Second, initial starting values for the lagged right-hand side variables are established at the 1996 values obtained from the data. This starting point for the simulation corresponds to the terminal date of our empirical sample. Finally, the simulation equations are subjected to random shocks.[38] These shocks are drawn from a pseudo random-number generator and are designed to replicate the influence of cyclical economic factors. In this regard, the simulation incorporates properties consistent with a Monte Carlo experiment.

Several differing policy strategies are analysed within this simulation exercise. The first strategy represents the *status quo* scenario. The system of simulation equations is in fact the estimated ECM regression equations developed in the previous section. Consistent with the empirical approach, there are three equations in the simulation, one for real GDP growth, growth in the fiscal variable (either government expenditures on goods and services, PIT revenues or program spending) and growth in earnings inequality. Beginning from the 1996 values, a predicted adjustment path is derived from the three simulation equations.

The second set of experiments drop the estimated equation for the fiscal measure, and instead imposes exogeneous policy "rules". For these experiments, two alternative fiscal strategies are considered. In the first case, the growth rate of the fiscal measure is augmented by five percent relative to the 1996 benchmark value. The other case involves

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[38] Each simulation was run under two parameter settings: the first case used all parameters, while the second only simulated using the statistically significant parameters. The results are generally similar. The reported results pertain to the case involving all parameters.

reducing the growth rate in the fiscal variable by five percent relative to the 1996 benchmark. These experiments are run over a ten-year horizon and indicate whether decreasing or increasing tax revenues, program spending or government expenditures exert asymmetric effects for the evolution of inequality and real GDP.[39] The measure of earnings inequality used in each case is the Gini coefficient for economic families. For the purposes of the simulations, only the total federal-provincial variables are considered.

There are several advantages to be gained from simulating the equations in the above manner. Perhaps the most important benefit is the ability to confront the model with alternative policy "strategies". For example, the impact of cutting growth in PIT revenue or program spending based on previously observed patterns can be identified. Another advantage of the simulation is that the stability of the estimates can be verified. For instance, an unstable model will generate projections that oscillate at increasing amplitude over time. In contrast, a well-behaved model should demonstrate mean reversion. Second, the stochastic shocks provide a sense of "cyclical" movements along the sample path predicted by the regression equations.[40]

Simulation Results

Several interesting results emerge from the simulations. Figures 4 through 6 present the dynamic adjustment predicted by the simulation system for the *status quo* fiscal strategy.[41] Based on historical patterns, federal-provincial program spending is forecast to continue its decline, and eventually level out at zero growth (Figure 4). From Figure 5, the predicted path for federal-provincial PIT revenues grows sharply for two years, and then decays geometrically until it levels at approximately 4.5 percent growth. The resulting impact for the growth rate of earning inequality in both cases is an initial increase, with a marginal decline thereafter. The response of inequality to the predicted

[39] The response may be asymmetric because the 1996 starting values are not steady-state values. As a result, the impact of increasing versus decreasing fiscal variables may exert asymmetric responses in economic and inequality growth.

[40] Although it is not done in this paper, another feasible advantage is to run the simulation for a significant number of trials, and calculate average statistical outcomes such as the expected change in inequality or growth predicted by the estimated models. Further, confidence intervals could be computed in this manner in order to determine the significance of the simulated paths.

[41] The figures presented in this paper illustrate the non-stochastic dynamic responses in the interest of clearly presenting a typical adjustment path. A MATLAB program that computes the cyclical patterns can be obtained from the authors upon request.

path of federal-provincial government consumption is volatile, and weak after an initial adjustment period (Figure 6), a pattern which is found in other policy strategy experiments as well.

Figure 4. Forecast Growth Rates for Federal-Provincial Program Spending, Growth and Inequality, No Policy Change

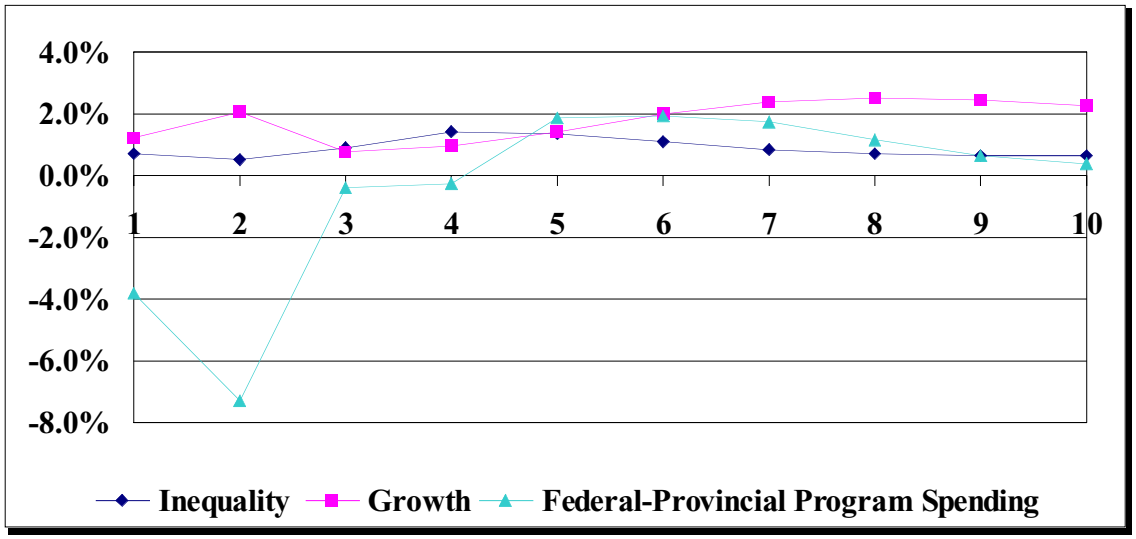


Figure 5. Forecast Growth Rates for Federal-Provincial PIT Revenue, Growth and Inequality, No Policy Change

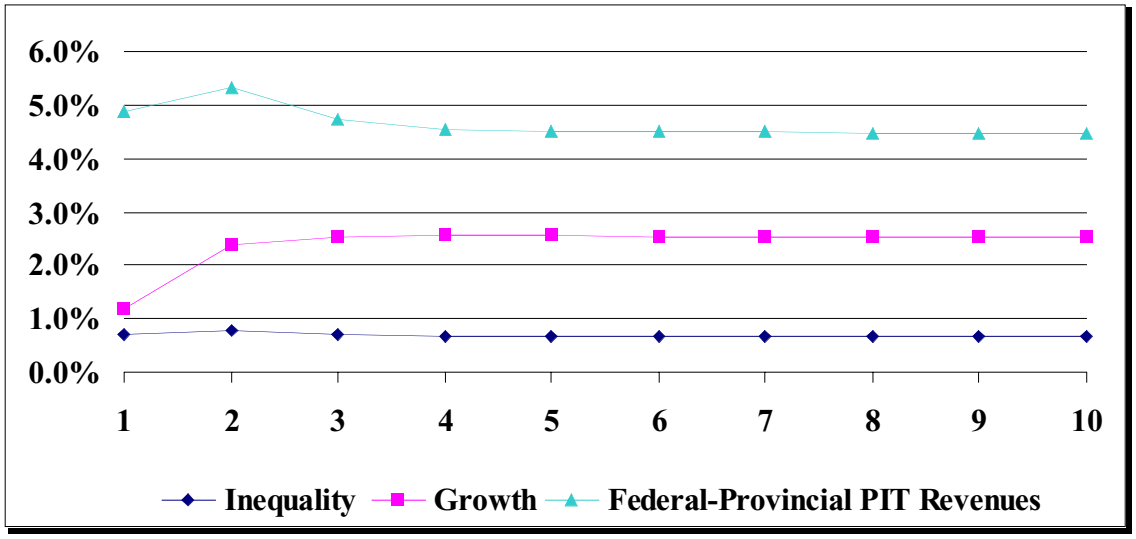
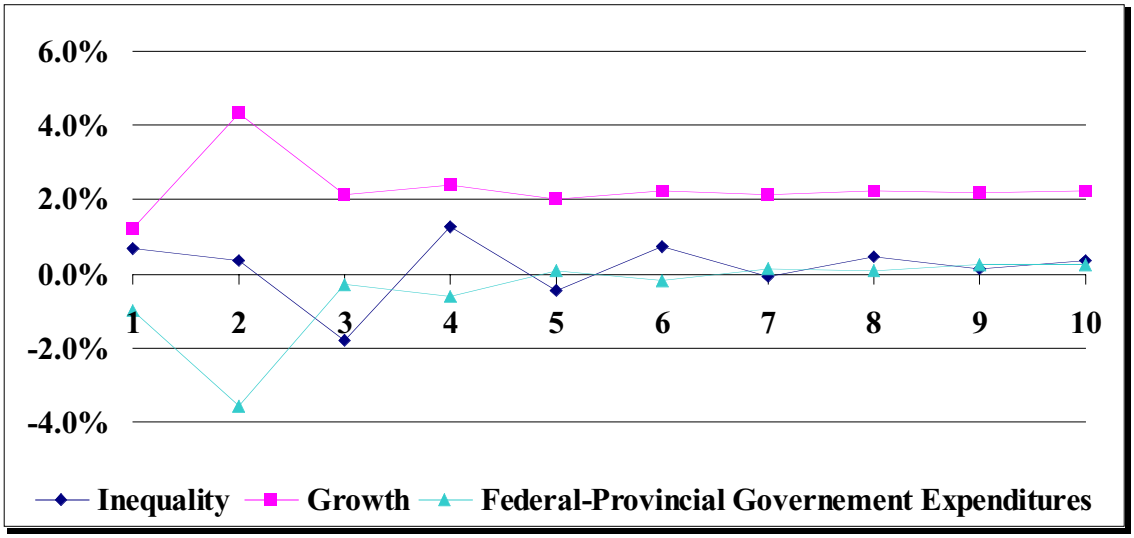


Figure 6. Forecast Growth Rates for Federal-Provincial Expenditures on Goods and Services, Growth and Inequality, No Policy Change



Figures 7 through 9 present the simulated responses under an alternative policy strategy entailing a 5-percent increase in the growth each fiscal variable relative to the 1996 benchmark. From Figure 7, one can observe the result of greater federal-provincial program spending, *ceteris paribus*. Following historical patterns, growth in real GDP increases and retains a higher level. However, growth in inequality lacks strong dynamic responses. After a period of adjustment following an initial decline in its growth, inequality reverts to its previous higher level of growth. This suggests that the policy lacks persistent effects with respect to inequality growth. Figure 8 presents the impact of higher growth in federal-provincial PIT revenues. Growth in earnings inequality increases incrementally, but later decays smoothly to its initial level of growth. Real GDP also responds favourably. The impact of increasing federal-provincial government consumption is beneficial to real GDP but ambiguous for inequality (Figure 9). Growth in the Gini coefficient is volatile, suggesting that government consumption does not exert a strong long-run influence over inequality.

Although the simulation paths are atheoretical, there is some intuition underlying their evolution. First, the data reveal that fiscal policy, earnings inequality and GDP are all cointegrated. Therefore, if real GDP follows a positive growth rate, then the other variables will also increase along the same stochastic trend. The simulation is calibrated with estimates derived from the data. Consequently, *the properties of the historical data*

will also characterise the predicted simulation paths. As a result, it is difficult for fiscal policy to reverse the trend towards greater inequality without simultaneously decreasing real GDP. These results suggest that governments faced a policy dilemma between encouraging economic growth, and mitigating greater inequality in earnings over the long run.

Figure 7. Forecast Growth Rates for Federal-Provincial Program Spending, Growth and Inequality, 5 per-cent Increase in Federal-Provincial Program Spending

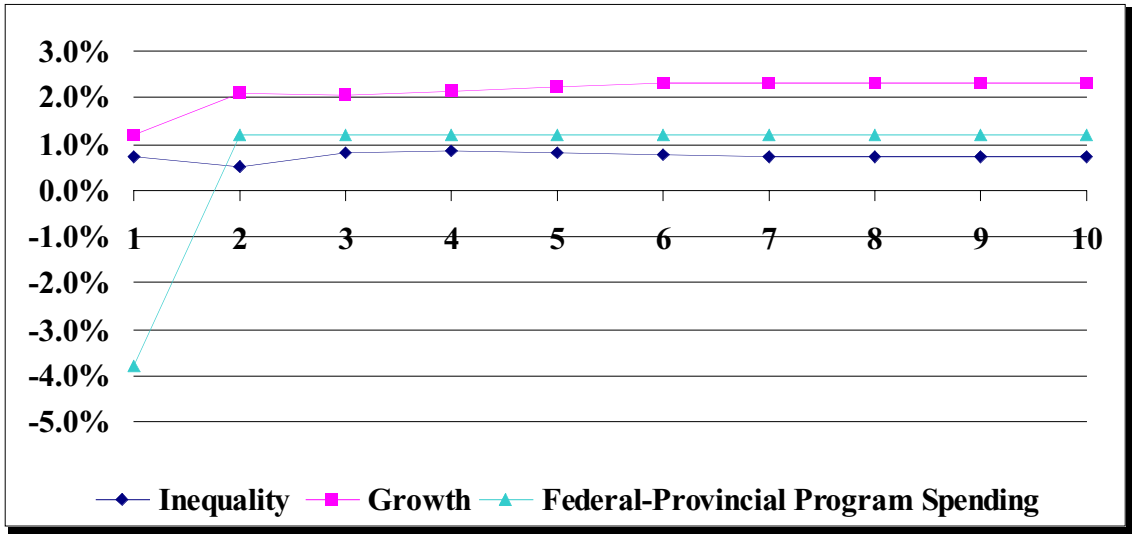


Figure 8. Forecast Growth Rates for Federal-Provincial PIT Revenues, Growth and Inequality, 5 per-cent Increase in Federal-Provincial PIT Revenues

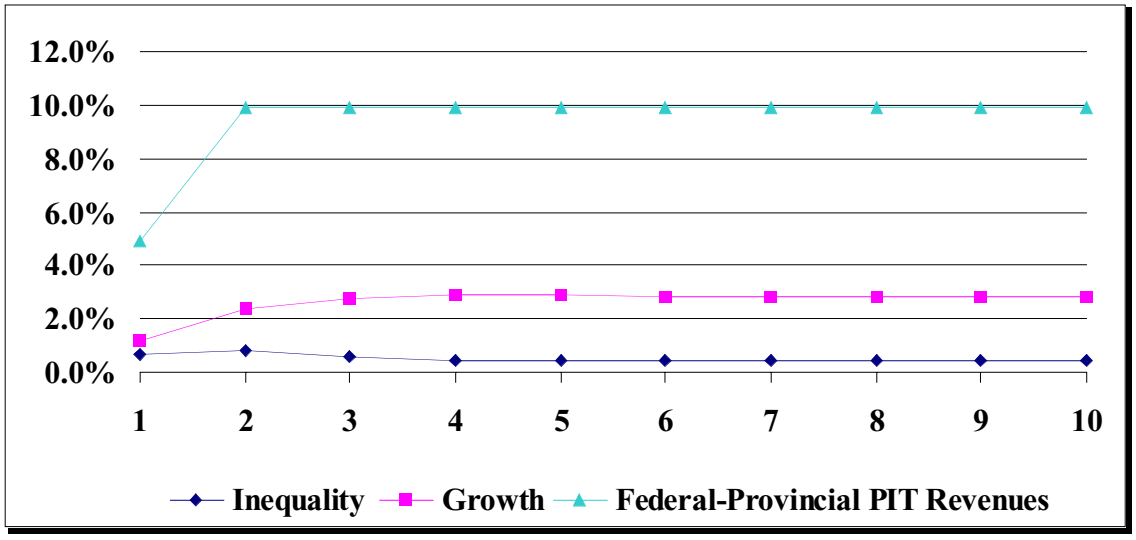
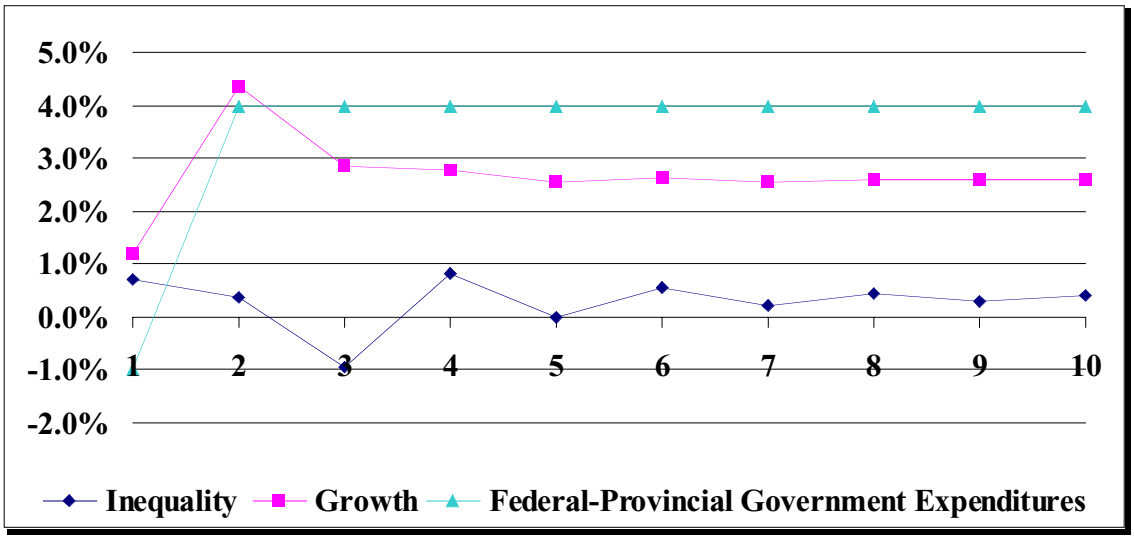


Figure 9. Forecast Growth Rates for Federal-Provincial Expenditures on Goods and Services, Growth and Inequality, 5 per-cent Increase in Federal-Provincial Expenditures on Goods and Services



Finally, Figures 10 through 12 present the simulation paths under the assumption that fiscal policy variables are cut by five percent relative to the 1996 benchmark. The possibility of an asymmetric policy effect is suggested by the extent to which the response from cutting growth in each of the fiscal policy variable is not a mirror image of the response from increasing the fiscal-policy growth rate. For example, compare the response of earnings inequality growth following an increase and a decline in federal-provincial program spending. Recall from Figure 7 that increased growth in program spending leads to some initial and small volatility, but not an increased long-run growth rate in inequality. In contrast, Figure 10 demonstrates that cutting program spending results in permanently higher earnings inequality growth. Moreover, the growth in real GDP increases during the transitional dynamics, but reverts to a lower growth rate after a period of adjustment. These patterns suggest that, based on historical data, declining program spending does not exert permanently higher effects for GDP, but will have an impact in terms of greater earnings inequality growth.

Simulation results observed in Figure 11 show that inequality growth steadily increases following diminished federal-provincial PIT growth. Further, inequality is characterised by a permamently and somewhat higher growth rate after the decline in PIT growth. In contrast, real GDP growth is predicted to increase sharply and retain the higher level of growth. These patterns of response suggest an asymmetry compared to a

policy of increasing tax or program spending growth. Comparing Figure 11 to Figure 8 illustrates that according to previously observed patterns, increasing PIT growth leads to *temporarily* higher inequality growth. In contrast, cutting PIT growth leads to *permanently* higher inequality growth. Under both policies, real GDP growth is forecast to increase permanently. Finally, the impact of decreasing federal-provincial government consumption is depicted in Figure 12. Under both policy regimes, the simulation paths for growth in earnings inequality and real GDP are essentially unchanged. The inequality measure follows a volatile short-run path, before settling to its initial long-run growth rate.

As before, the above results are based on an atheoretical simulation. Consequently, the forecast paths represent projections based on the properties of the historical data. A reduction in program spending, PIT revenue or government spending on goods and services is associated with reduced real GDP in the long run, and thereby *reduced* inequality. In contrast, over the short run, reduced real GDP growth *increases* growth in inequality. This pattern of responses can be observed in the previous figures.

Figure 10. Forecast Growth Rates for Federal-Provincial Program Spending, Growth and Inequality, 5 per-cent Decrease in Federal-Provincial Program Spending

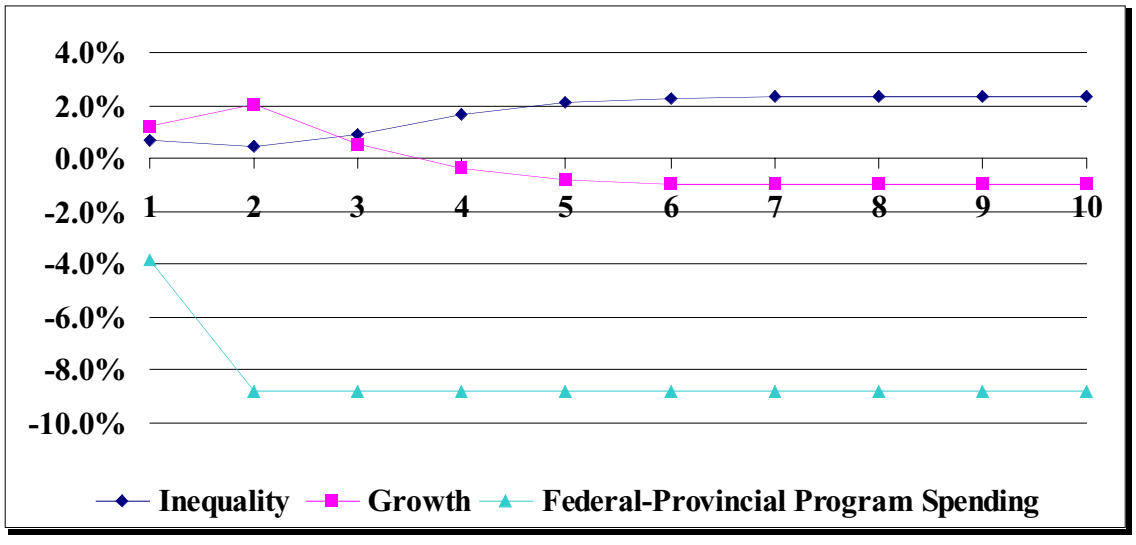


Figure 11. Forecast Growth Rates for Federal-Provincial PIT Revenues, Growth and Inequality, 5 per-cent Decrease in Federal-Provincial PIT Revenues

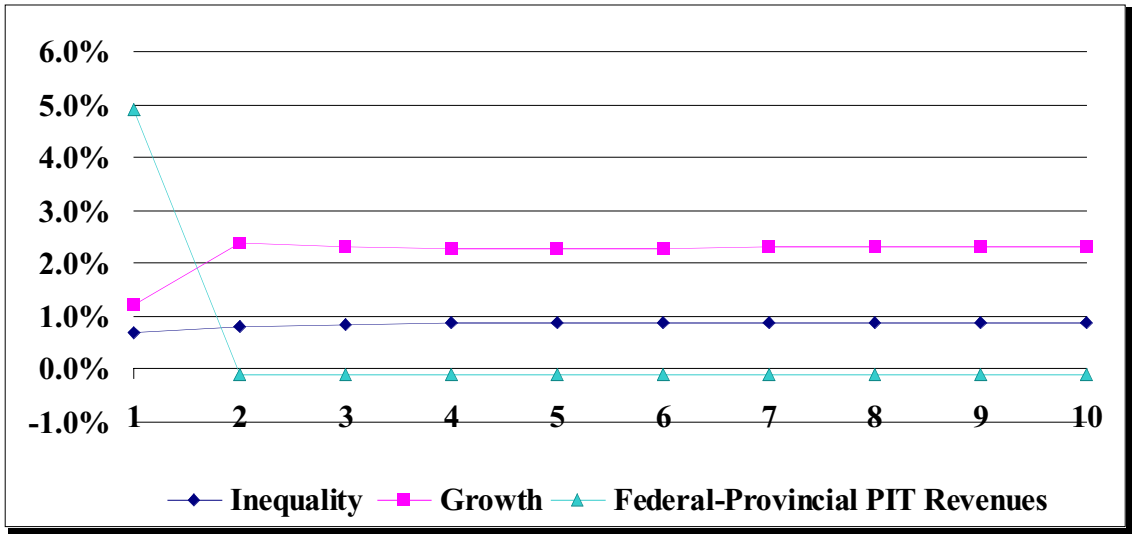
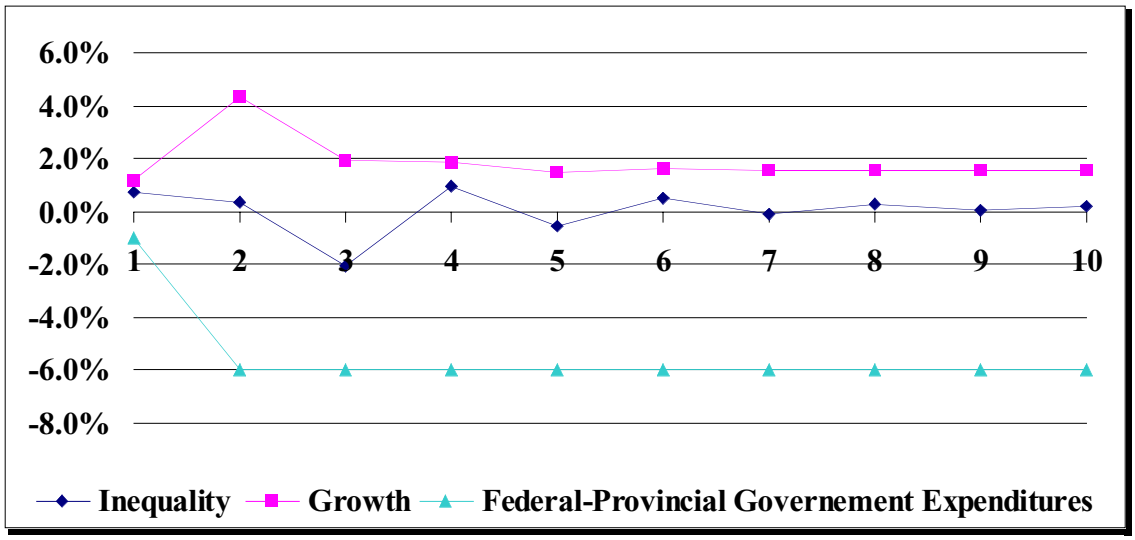


Figure 12. Forecast Growth Rates for Federal-Provincial Expenditures on Goods and Services, Growth and Inequality, 5 per-cent Decrease in Federal-Provincial Expenditures on Goods and Services



VIII. Summary and Future Work

The objective of this paper was to document the empirical relationship between fiscal policy, earnings inequality and growth. This study was motivated in part by the current policy debate regarding the optimal size of government. Changing the size of government could potentially affect the distribution of disposable income, and thereby

entails important equity considerations. Results presented in this paper indicate that the indirect effect resulting from an aggregate change in fiscal policy is weak and rarely significant. The main channel by which fiscal policy affects inequality is through the budget constraint of individuals via taxes and transfers. The empirical exercises presented in this paper are based on data ranging from 1971 to the mid-1990s. The main findings are summarised below.

First, we find that, in the short run, economic growth reduces earnings inequality. However, this relationship is reversed in the long run. This result reflects the fact that real GDP and earnings inequality have been increasing over time in a cointegrated manner. Moreover, consistent with findings in the literature, fiscal policy is only weakly affected by the relationship between earnings inequality and economic growth. Consequently, the magnitude of the general equilibrium adjustments to a shift in fiscal policy that affects the distribution of earnings is not sufficient to mitigate the detrimental effect on equity.

Results from the simulation exercise indicate that based on historical patterns, fiscal policy has an asymmetric effect on earnings inequality: more generous redistribution permits only short-run general equilibrium effects in reducing inequality growth; however, reductions result in *permanently* higher inequality growth. According to the results presented in this paper, aggregate or across-the-board measures to reduce the size of the government is likely to lead to a higher level of earnings inequality. This increase in earnings inequality, however, could be lessened if the reduction in the size of government is performed such that the government's redistributive role is left relatively unchanged. Moreover, from an equity perspective, targeted measures are likely to be preferable to across-the-board measures.

Several important extensions remain to be explored. First, examining the robustness of our results is necessary given our sample size. This situation could be improved by constructing a pooled time-series sample by combining the federal, provincial and perhaps even international data. In addition, the relevance of fiscal policy variables should be investigated. Although several variables were considered and tested in this paper, there remains other variables related to Employment Insurance and the provincial-local sector that may also prove to be important. Finally, a study involving a

micro-level dataset would reveal more interesting incentive effects resulting from particular programs and tax structures. Understanding the underlying incentive effects may partially mitigate adverse movements in the distribution of income following policy shifts. For example, it may well be possible that a tax cut focused at the lower income would be less effective than an equivalent enrichment of program spending. Moreover, if aggregate taxes and program spending are to be reduced, then the specific programs and taxes affected will determine if fiscal policy can reverse the historical link between increasing inequality in market earnings and economic growth.

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ANNEX A

Table A1. Inequality, Growth and Federal Fiscal Policy

	Dependent variables					
	HLFMI	HLFMI	HLFMI	Q12FMI	Q12FMI	Q12FMI
CONSTANT	0.136	0.140	0.130	-0.029	-0.035	-0.028
	*0.000**	*0.000**	*0.000**	*0.043**	*0.004**	*0.071*
GRGDP(-1)	-3.998	-3.459	-3.693	0.869	0.803	0.832
	*0.000**	*0.001**	*0.000**	*0.030**	*0.013**	*0.097*
GHLFMI(-1)	-0.479	-0.225	-0.288	-	-	-
	0.064	*0.168*	*0.129*	-	-	-
GQ12FMI(-1)	-	-	-	-0.077	0.159	-0.002
	-	-	-	*0.814*	*0.496*	*0.995*
FPROGPA(-1)	0.818	-	-	-0.123	-	-
	*0.003**	-	-	*0.365*	-	-
FPITPA(-1)	-	-0.032	-	-	0.154	-
	-	*0.875*	-	-	*0.034**	-
FGNA(-1)	-	-	0.704	-	-	-0.129
	-	-	*0.115*	-	-	*0.450*
Error-correction coefficient	-0.225	-0.261	-0.168	-0.177	-0.253	-0.127
	0.187	*0.104*	*0.238*	*0.414*	*0.059*	*0.441*
Number of Observations	15	15	15	14	14	14
Standard Error of Estimate	0.077	0.085	0.081	0.025	0.023	0.025
R-Squared	0.656	0.577	0.615	0.556	0.625	0.544

The * indicates that the estimated coefficient is significant at the 5-per-cent level.

Table A2. Inequality, Growth and Federal Fiscal Policy

	Dependent variable					
	GRGDP	GRGDP	GRGDP	GRGDP	GRGDP	GRGDP
CONSTANT	0.007	0.024	0.007	0.014	0.014	0.021
	0.376	*0.017**	*0.285*	*0.070*	*0.089*	*0.049**
GRGDP(-1)	0.520	0.130	0.479	0.423	0.491	0.318
	*0.008**	*0.496*	*0.001**	*0.007**	*0.107*	*0.092*
GHLFMI(-1)	0.078	-	0.042	-	0.063	-
	0.328	-	*0.352*	-	*0.329*	-
GQ12FMI(-1)	-	0.213	-	-0.056	-	-0.002
	-	*0.372*	-	*0.812*	-	*0.991*
FPROGPA(-1)	0.061	0.203	-		-	-
	0.639	*0.086*	-		-	-
FPITPA(-1)	-	-	0.066	0.049	-	-
	-	-	*0.214*	*0.313*	-	-
FGNA(-1)	-	-	-	-	-0.184	-0.050
	-	-	-	-	*0.189*	*0.606*
Error-correction coefficient	0.056	-0.252	0.116	-0.203	0.081	-0.240
	0.214	*0.055*	*0.003**	*0.094*	*0.037**	*0.056*
Number of Observations	15	14	15	14	15	14
Standard Error of Estimate	0.024	0.018	0.021	0.020	0.020	0.018
R-Squared	0.333	0.525	0.494	0.415	0.532	0.496

The * indicates that the estimated coefficient is significant at the 5-per-cent level.

Table A3. Inequality, Growth and Federal Fiscal Policy.

	Dependent variable					
	FPROGPA	FPROGPA	FPITPA	FPITPA	FGNA	FGNA
CONSTANT	-0.001	-0.004	0.043	0.057	-0.021	-0.025
	0.960	*0.908*	*0.299*	*0.204*	*0.144*	*0.386*
GRGDP(-1)	-0.044	-0.106	0.073	-0.442	0.966	1.109
	0.944	*0.911*	*0.946*	*0.704*	*0.010**	*0.151*
GHLFMI(-1)	0.340	-	-0.210	-	0.221	-
	*0.026**	-	*0.258*	-	*0.056*	-
GQ12FMI(-1)	-	-0.972	-	1.135	-	-0.772
	-	*0.240*	-	*0.114*	-	*0.278*
FPROGPA(-1)	0.266	0.221	-	-	-	-
	0.135	*0.351*	-	-	-	-
FPITPA(-1)	-	-	0.196	0.266	-	-
	-	-	*0.408*	*0.260*	-	-
FGNA(-1)	-	-	-	-	0.172	-0.002
	-	-	-	-	*0.303*	*0.990*
Error-correction coefficient	-0.100	0.289	-0.114	-0.035	-0.066	0.230
	0.198	*0.291*	*0.349*	*0.918*	*0.213*	*0.168*
Number of Observations	15	14	15	14	15	14
Standard Error of Estimate	0.041	0.045	0.077	0.078	0.035	0.038
R-Squared	0.613	0.545	0.239	0.226	0.311	0.235

The * indicates that the estimated coefficient is significant at the 5-per-cent level.

Table A4. Inequality, Growth and Federal-Provincial Fiscal Policy

	Dependent variables					
	HLFMI	HLFMI	HLFMI	Q12FMI	Q12FMI	Q12FMI
CONSTANT	0.089	0.131	0.074	-0.022	-0.037	-0.022
	*0.020**	*0.000**	*0.051*	*0.174*	*0.009**	*0.189*
GRGDP(-1)	-3.211	-3.426	-3.151	0.714	0.829	0.636
	*0.000**	*0.000**	*0.009**	*0.102*	*0.015**	*0.157*
GHLFMI(-1)	-0.292	-0.123	-0.279	-	-	-
	0.181	*-0.442*	*0.196*	-	-	-
GQ12FMI(-1)	-	-	-	0.025	0.191	0.159
	-	-	-	*0.946*	*0.378*	*0.617*
FPPROGPA(-1)	1.083	-	-	-0.157	-	-
	*0.002**	-	-	*0.377*	-	-
FPPITPA(-1)	-	-0.162	-	-	0.187	-
	-	*0.513*	-	-	*0.058*	-
FPGNA(-1)	-	-	0.868	-	-	-0.023
	-	-	*0.010**	-	-	*0.794*
Error-correction coefficient	-0.369	-0.256	-0.153	-0.259	-0.295	-0.240
	0.079	*0.036**	*0.471*	*0.301*	*0.017**	*0.215*
Number of Observations	14	14	15	14	14	14
Standard Error of Estimate	0.057	0.071	0.076	0.025	0.023	0.025
R-Squared	0.787	0.671	0.665	0.565	0.638	0.560

The * indicates that the estimated coefficient is significant at the 5-per-cent level.

Table A5. Inequality, Growth and Federal-Provincial Fiscal Policy

	Dependent variable					
	GRGDP	GRGDP	GRGDP	GRGDP	GRGDP	GRGDP
CONSTANT	0.017	0.021	0.001	0.012	0.022	0.016
	*0.006**	*0.017**	*0.229*	*0.137*	*0.035**	*0.178*
GRGDP(-1)	0.289	0.146	0.489	0.428	0.292	0.217
	*0.033**	*0.384*	*0.000**	*0.007**	*0.076*	*0.152*
GHLFMI(-1)	-0.040	-	0.011	-	0.017	-
	0.480	-	*0.814*	-	*0.757*	-
GQ12FMI(-1)	-	0.285	-	-0.006	-	0.167
	-	*0.230*	-	*0.978*	-	*0.389*
FPPROGPA(-1)	0.182	0.251	-	-	-	-
	0.117	*0.049**	-	-	-	-
FPPITPA(-1)	-	-	0.121	0.092	-	-
	-	-	*0.015**	*0.114*	-	-
FPGNA(-1)	-	-	-	-	-0.084	0.141
	-	-	-	-	*0.545*	*0.249*
Error-correction coefficient	0.131	-0.336	0.119	-0.258	0.132	-0.374
	*0.006**	*0.009**	*0.000**	*0.018**	*0.002**	*0.001**
Number of Observations	14	14	14	14	15	14
Standard Error of Estimate	0.016	0.016	0.016	0.018	0.02	0.017
R-Squared	0.616	0.591	0.605	0.481	0.571	0.584

The * indicates that the estimated coefficient is significant at the 5-per-cent level.

Table A6. Inequality, Growth and Federal-Provincial Fiscal Policy

	Dependent variables					
	FPPROGPA	FPPROGPA	FPPITPA	FPPITPA	FPGNA	FPGNA
CONSTANT	0.006	0.008	0.033	0.046	-0.022	-0.016
	0.728	*0.720*	*0.288*	*0.204*	*0.002**	*0.176*
GRGDP(-1)	-0.130	-0.209	0.052	-0.319	0.865	0.705
	0.792	*0.724*	*0.950*	*0.743*	*0.000**	*0.026*
GHLFMI(-1)	0.262	-	-0.244	-	0.095	-
	*0.004**	-	*0.071*	-	*0.163*	-
GQ12FMI(-1)	-	-0.642	-	1.123	-	-0.133
	-	*0.102*	-	*0.049**	-	*0.666*
FPPROGPA(-1)	0.252	0.315	-	-	-	-
	*0.040**	*0.068*	-	-	-	-
FPPITPA(-1)	-	-	0.367	0.425	-	-
	-	-	*0.129*	*0.064*	-	-
FPGNA(-1)	-	-	-	-	0.798	0.772
	-	-	-	-	*0.000**	*0.000**
Error-correction coefficient	0.124	0.282	-0.069	-0.030	-0.093	0.208
	0.110	*0.110*	*0.464*	*0.923*	*0.001**	*0.015**
Number of Observations	14	14	14	14	15	14
Standard Error of Estimate	0.028	0.031	0.052	0.052	0.017	0.018
R-Squared	0.699	0.629	0.421	0.439	0.878	0.809

The * indicates that the estimated coefficient is significant at the 5-per-cent level.