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Provincial Response To Budgetary Shocks

by

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ABSTRACT

Following the work of Kneebone and McKenzie (1998), this thesis examines how Canadian provincial governments responded to unexpected budgetary shocks over the fiscal years 1965/66 through 1994/95. As in Kneebone and McKenzie's (1998) study, this thesis found that governments in Alberta tended to treat unexpectedly "good" budgetary shocks (increases in revenues and decreases in expenditures) as permanent and unexpectedly "bad" budgetary shocks (decreases in revenues and increases in expenditures) as temporary. This is despite some differences in methodology between the two studies. This pattern was also found to apply to a certain extent to five other provinces. Further analysis also revealed that provinces with higher debt levels and lower average budgetary shock sizes were found to be more likely to treat budgetary shocks as permanent.

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DEDICATION

To Mom and Dad

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CHAPTER ONE - INTRODUCTION

Introduction

This thesis examines government responses to budgetary shocks at the Canadian provincial level of government. It is an extension and modification of work done by Kneebone and McKenzie (hereafter, K & M) (1998a). Their research examined the issue at hand with respect to the province of Alberta. This thesis aims to conduct similar research on all 10 Canadian provinces with some modification in methodology and model.

Provincial governments can experience revenue and expenditure flows which are either higher or lower than anticipated. The manner in which they react to these shocks can have long term financial and hence political repercussions. In extreme cases, a large debt can leave no choice but to reduce the size of the government sector. Thus, basic knowledge of how provincial governments have reacted to revenue and expenditure shocks in the past is very important.

This topic is also interesting due to the fact that the economic characteristics of the Canadian economic union are very similar to those of the proposed European Monetary Union (EMU). Each province is largely an independent fiscal authority with, at least until recently, no legal constraints on the size of their deficits or debt. Like many European countries, Canadian provinces are parliamentary democracies. As K & M (1998a) state,

> As such, the executive branch of provincial governments (the Premier and individual members of the cabinet), are invested with a great deal of discretionary authority, particularly with regard to budget policy. This affects the dynamics of the budget-making process, as tensions between so-called "spending" ministers serving different constituencies and the provincial treasurer or finance minister may have a significant impact on the budgetary outcome. The experience of Canadian provinces to

> unexpected budget shocks may therefore offer important lessons for potential members of the EMU. (p. 3)

Thus, the way in which the Canadian provinces have responded to unexpected budgetary shocks may offer important insights into the possible future budgetary behaviour of many European countries.

The following section will discuss some of the literature relevant to this topic. In Chapter Two, the model to be used in this thesis will be presented. Chapter Three will discuss the data collection and transformation process. Chapters Four and Five will present empirical results based on the model from Chapter Two. Finally, Chapter Six will be a summary and conclusion.

Relevant Literature

A study examining issues similar to those dealt with in this thesis was conducted by Poterba (1994) on U.S. states. Poterba examined 27 U.S. states with annual budget cycles using data collected by the National Association of State Budget Officers (NASBO). The NASBO data contain information on actual revenues and expenditures in the last fiscal year, current fiscal year revenues and expenditures as projected at the beginning of the fiscal year, and any budget cuts or tax changes that have been enacted in the current fiscal year. From these data, Poterba was able to construct shock variables for revenue, expenditure, and the deficit which measure the difference between what was projected and what actually happened.

Poterba then used these variables to determine the states' responses to revenue and expenditure shocks during the fiscal year. States can respond to fiscal shocks by cutting spending, raising taxes, or some combination of both. Poterba's main finding was that about two-thirds of a deficit are made up through a combination of spending cuts and tax hikes in the current fiscal year and tax hikes in the next fiscal year. In the current fiscal year spending cuts were predominantly used to make up the shortfall but tax changes which take effect in the next fiscal year were more important than spending cuts in closing unexpected deficits. Another major finding in this paper was that states with anti-deficit rules cut spending much more dramatically in response to a deficit than did states with no such rules. Anti-deficit rules did not affect tax changes.

A key difference between U.S. states and Canadian provinces is that U.S. states typically have some kind of statutory or constitutional balanced budget rule. (Poterba, 1996) Thus, while Poterba's study may be interesting, it may have little explanatory power with respect to the fiscal behavior of Canadian provinces which until recently have not been hindered by anti-deficit rules. Canadian provincial governments do not have to respond to fiscal shocks with changes in spending or taxation. Rather, they can ignore the shocks, hold spending and taxation constant, allow the deficit to change in size and then respond as they choose in the next fiscal year. This, combined with the fact that there is no Canadian equivalent of the NASBO data, means that a different approach must be used to study how Canadian provinces respond to fiscal shocks.

Such an approach has been developed by K & M (1998a) and utilized to examine budgetary behaviour in Alberta over the fiscal years 1966/67 to 1992/93. They start by assuming that government spending and taxation has a great deal of continuity or inertia. Once government programs are introduced they are assumed to be very difficult to change in a significant way. As such, expenditures and revenues are assumed to be accurately forecasted by simple time series models which include lagged provincial GDP and the dependent variable lagged. These forecasts of expenditures and revenues can then be compared to what actually happened in order to form fiscal shocks; the difference between the forecast and the observed level of spending or revenue. The government's reaction to these shocks can then be examined. (The model used in the K & M article is the basis for the model used in this thesis and as such will be discussed in detail in the next chapter.)

K & M used their model to study the effect of past budget shocks on planned changes in provincial government revenue and spending. They found that unexpected revenue shocks were ignored but unexpected expenditure shocks were responded to when budgeting planned changes in spending. Their regression suggests that about $0.72 of every $1.00 in unexpected spending that occurred in the previous fiscal year was incorporated into the current year's spending plans. On the revenue side, expenditure shocks were ignored while revenue shocks were responded to. In this case, their regression suggests that about $0.42 of every $1.00 in unexpected revenues that occurred in the previous period were incorporated into the current period's revenue plans.

Noting that the above method imposes a symmetric response to both positive and negative shocks, the authors then proceeded to break the expenditure and revenue shocks into their positive and negative components and repeated the model estimation. When this was done, strong evidence was found to support the idea that governments in Alberta responded quite differently to positive as opposed to negative shocks.

With respect to planned spending changes, K & M found that neither positive nor negative revenue shocks had any effect. They also found that positive spending shocks had no effect. Negative expenditure shocks (lower than expected expenditures), however, were found to be quite influential. Their regression suggests that an unexpected decrease in spending of $1.00 in the previous fiscal year caused the government to budget for an additional decrease of about $0.83 this year. From this result, the authors conclude that "bad news (higher than expected program spending) was ignored and implicitly assumed to be temporary, while good news (lower than expected program spending) prompted a decrease in spending and was implicitly assumed to be permanent." (p. 24)

With respect to planned changes in revenue, the authors found that neither negative revenue shocks nor positive or negative spending shocks had any effect. Positive revenue shocks (higher than expected revenues) were found to cause the government to budget an additional $0.86 in revenue this period for every $1.00 of unexpected revenue last period. From this result, K & M conclude that, once again, good news (higher than expected revenues) is assumed to be permanent while bad news (lower than expected revenues) is seen as being temporary.

Thus, the final conclusion drawn from the K & M study is quite strong. This conclusion is that provincial governments in Alberta have been overly optimistic; good budgetary news has been seen as being permanent while bad budgetary news has been seen as being a temporary phenomenon.

This thesis aims to extend the work of K & M described above. As explained in the next chapter, their basic methodology will be followed with some modification. The results of this project will test the resiliency of their method to modification as well as testing whether their results for Alberta are common to most provinces.

CHAPTER TWO - THE MODEL

Initial Assumptions

As in the K & M (1998a) paper, this thesis will assume that government spending and revenues are subject to inertia. That is, they are difficult to alter once set in place or started. K & M note that one of the reasons for this is that a great deal of government spending goes to meet statutory commitments. In a survey of elected and appointed officials involved in budgeting at the federal and provincial levels of government, Hartle (1989) found a great deal of consensus among all respondents and a 91% agreement rate to the statement,

> The vast bulk of a typical expenditure budget is locked in by the requirements of basic services, statutory programs, intergovernmental agreements and the like. Only a small margin is typically adjustable on a short term basis. (p. 435)

Thus, statutory obligations determine a great deal of government spending.

A complementary yet slightly different idea is the notion that government operations are path dependent. North (1990) and Wilsford (1994) provide detailed explanations of path dependency. The basic idea, however, is that once we set off down a certain path it is difficult to change courses in a dramatic or expedient manner. In other words, pre-existing revenue and expenditure systems resist change or are difficult to change. An example of this as it relates to government expenditures would be an expenditure program which is defended by a vocal and well organized interest group. Any attempts to dramatically decrease expenditure on such a program would meet fierce political resistance and would therefore be difficult. Thus, spending on the program is likely to remain fairly constant for a great deal of time. Evidence of this is provided by a survey of provincial budget makers in Alberta conducted by Boothe (1995). Boothe notes,

> ... many participants noted that constituencies for new programs form very quickly. In other words, programs soon become "permanent." Because of this quick formation of constituencies, it is very difficult to eliminate programs. It is much easier to "shrink" programs by restricting their growth to less than the rate of inflation. (p. 93)

Thus, path dependency implies that government revenue collection and expenditures are fairly stable through time.

Given the above arguments that government budgets are relatively stable over time and involve predominantly incremental changes, it is assumed that forecasts of revenues, expenditures, and GDP made by the government can be closely approximated by simple time series models. Indeed, Bretschneider et. al. (1989) provide evidence from the U.S. states that revenue forecasts involving simple regression models like those employed here are more accurate than several alternatives, including complex econometric models. For revenues and expenditures the forecasting equations used here involve lagged provincial GDP and the variable itself lagged. For GDP, the forecasting equation is an autoregression. Details regarding the exact specifications are left to Chapter Three.

Regression Equations

Having found the aggregate forecasts of total revenue, ιotal expenditure, and GDP, a simple model can be developed which attempts to forecast in detail what the government's expected change in spending and revenue will be for fiscal year t. The model will allow for the fact that unexpected shocks during the previous fiscal year may have a large impact on this year's budget. As well, it will be recognized that the expected level of GDP will also determine the budget. The equation to model the government's forecast of the expected change in spending for fiscal year t is given by equation (2.1) below.

Equation (2.1)

$$[E(t-1)S_t - S_{t-1}] = \alpha_0 + \alpha_1 * [RSHOCK_{t-1}] + \alpha_2 * [SSHOCK_{t-1}] +$$

$$\alpha_3 * [E(t-1)GDP_t - GDP_{t-1}] + \varepsilon_t$$

In the above equation, E(t-1) is the expectations operator conditional on information available in period t-1, E(t-1)S_t is the level of spending expected to occur in period t based on information available in period t-1, and S_{t-1} represents observed spending in fiscal year t-1. Thus, the dependent variable in this equation is the expected change in expenditures between fiscal year t-1 and fiscal year t.

On the explanatory variable side, $RSHOCK_{t-1}$ represents the unexpected change in government revenue during fiscal year t-1 and is defined as $[R_{t-1} - E(t-2)R_{t-1}]$. Similarly, $SSHOCK_{t-1}$ represents the unexpected change in government spending during fiscal year t-1 and is defined as $[S_{t-1} - E(t-2)S_{t-1}]$. In other words, these variables measure the difference between observed revenue and spending in fiscal year t-1 and what was expected to be observed in year t-1 based on information available in period t-2. Thus, they measure the unexpected change, or shock, in revenues and expenditures. The definition of the term $[E(t-1)GDP_t - GDP_{t-1}]$ is similar to that of the dependent variable in that it represents the expected change in GDP from one fiscal year to the next. Finally, the error term ε_t captures random changes in current period planned expenditures which are not observable. The error term is assumed to have zero mean and be independent of the other variables. All variables are measured in real per capita terms.

Equation (2.1) specifies that the expected change in total spending budgeted for fiscal year t is a function of expected changes in economic conditions (measured by the expected change in GDP), and reactions to unexpected changes in revenues and expenditures that occurred in the previous year. This equation can be simplified by assuming equation (2.2) below.

Equation (2.2)

$$S_t = E(t-1)S_t + e_t$$

In equation (2.2), e_t defines an unexpected shock to S_t occurring in period t due to unexpected changes in current economic conditions. Thus, e_t measures the unexpected shock to expenditures in the current period. The coefficient on e_t is assumed to be unity which equates to an assumption that the government makes no policy response to shocks that occur within the current fiscal year. In other words, shocks are assumed to affect spending dollar-for-dollar in period t. Substituting this into equation (2.1) we get equation (2.3).

Equation (2.3)

$$\Delta S_t = \alpha_0 + \alpha_1 * [RSHOCK_{t-1}] + \alpha_2 * [SSHOCK_{t-1}] + \alpha_3 * [E(t-1)GDP_t - GDP_{t-1}] + \mu_t$$

In equation (2.3) $\Delta S_t = [S_t - S_{t-1}]$ and $\mu_t = \varepsilon_t + e_t$. The error term μ_t therefore captures the effects on spending of random unmeasured changes in planned expenditures (ε_t) and random unexpected changes in current economic conditions (e_t).

In a similar manner to the above, an equation modeling the government's budgeting procedure for changes in revenue is given by equation (2.4).

Equation (2.4)

$$\Delta R_t = \beta_0 + \beta_1 * [RSHOCK_{t-1}] + \beta_2 * [SSHOCK_{t-1}] + \beta_3 * [E(t-1)GDP_t - GDP_{t-1}] + \eta_t$$

Once again, η_t captures the effects on revenues of unobservable changes in planned revenues and unexpected changes in current economic conditions (which are again assumed to affect revenues dollar-for-dollar).

The model described above is quite similar to that used by Bohn and Inman (1996) in their study of the effect of balanced budget rules on deficits in U.S. states. In their model expenditures and revenues are combined to create the realized surplus or deficit for that fiscal year. They model the surplus/deficit as being a function of the economic conditions of the state and unexpected changes in revenues and spending. In other words, the authors of this paper utilize almost the exact same model structure as that used here.

Interpretation of the Coefficients

The coefficients of regression equations (2.3) and (2.4) can be interpreted in terms of a bygones be bygones hypothesis. A government that lets bygones be bygones will ignore past shocks to revenue and expenditure when budgeting for the upcoming fiscal year. In this situation the budget will act as an automatic stabilizer. What this means in terms of regression coefficients can be seen by examining the coefficients of equation (2.3), changes in spending.

Imagine a positive shock to revenue in fiscal year t-1. ($RSHOCK_{t-1} > 0$ so that actual revenues are higher than expected.) A government which let bygones be bygones would not plan for any change in spending in response to such a shock. This means that the coefficient α_1 should equal 0. A positive value for α_1 indicates that a past positive shock to revenue leads to a present increase in spending. As such, it is indicative of tax and spend behavior on the part of the government; an unexpected revenue gain prompts new spending. Such a coefficient would also indicate than an unexpected revenue loss prompts reduced spending.

Now, imagine a positive shock to expenditure in fiscal year t-1. ($SSHOCK_{t-1} > 0$ so that spending is higher than expected.) Again, a government which let bygones be bygones would not plan for any change in spending. Since a spending shock means that S_{t-1} increases, the dependent variable $\Delta S_t = [S_t - S_{t-1}]$ decreases. Thus, in order to counterbalance this effect, the coefficient on $SSHOCK_{t-1}$, α_2, must equal -1 for a government which ignores past shocks and lets bygones be bygones. Any value of α_2 which is different than 1 in absolute value indicates a government which is not ignoring past shocks. The degree to which the expenditure shock in the previous period affects current spending can be calculated as (1-α_2). For example, if α_2 was estimated to be -0.27, the interpretation would be that an unexpected increase/decrease in expenditures in the previous fiscal year of $1.00 caused the government to budget for a (1-0.27) or $0.73 increase/decrease in expenditures in the current fiscal year.

In the same logical fashion, it can be seen that a government which let bygones be bygones would behave in such a way that $\beta_1 = -1$ and $\beta_2 = 0$ in equation (2.4). A positive value for β_2 indicates spend and tax behavior on the part of the government; unexpected new expenditures prompt an increase in tax revenue. Again, the degree to which a revenue shock in the previous period effects current budgeted revenues can be calculated as (1-β_1).

The regression coefficient on the expected change in GDP (α_3 and β_3 in (2.3) and (2.4) respectively) also reveals something about the economic behavior of the government. When provincial GDP increases, the government expects revenue to increase because of a larger tax base. More specifically, revenues are expected to increase by the average value of the marginal tax rates of the province. Thus, it is expected that β_3 will be close to this average. In a similar manner, when GDP changes, spending should change by the average of the marginal spending rates of the province and α_3 is expected to approximate this average.

Outside estimates of the average marginal tax and spending rate for each province were obtained from K & M (1998b). Theoretically, the estimates obtained in this thesis should be similar to K & M's. If large discrepancies are found, however, one possible explanation may be that budget makers in the government do not trust the GDP projections given to them by the Treasury or Finance department in the province. Indeed, Boothe (1995) provides evidence to support the idea that budget decision makers may not always place full faith in forecasts.

Table 2.1 summarizes the interpretation of coefficients discussed above. In this table, the coefficients are listed along the left hand side while the top of the table lists the possible interpretations that may be made. The body of the table contains the coefficient values which would support the various interpretations.

Table 2.1: Interpretation of Coefficients

Coefficient	Bygones Be Bygones	Respond To Shocks
α_1	0	≠0 (Tax & Spend)
α_2	-1	≠-1
α_3	Marginal Spending Rate	≠ Marginal Spending Rate
β_1	-1	≠-1
β_2	0	≠0 (Spend & Tax)
β_3	Marginal Tax Rate	≠ Marginal Tax Rate

Thus, if governments let bygones be bygones and ignore past shocks, $\alpha_1 = 0$ and $\alpha_2 = -1$. Substituting these coefficients into equation (2.3) and rearranging gives the result that real per capita expenditures in the current period equal real per capita spending budgeted for last period plus any effects on spending due to unexpected changes in economic conditions as measured by GDP. Similarly, substituting $\beta_1 = -1$ and $\beta_2 = 0$ into equation (2.4) and rearranging demonstrates that revenues in the current fiscal year equal revenues budgeted for last period plus any effects on revenue due to expected changes in economic conditions. Again, such behaviour is indicative of governments which allow budgets to play an automatic stabilizing role in the economy.

Finally, the regression constants can also be interpreted in terms of government budgetary behavior. Recall that the regression equations are estimating the change in revenue and spending in real per capita terms. The regression constants therefore indicate the degree to which the provincial governments have sought to reduce (or increase) the size of their average per capita deficit. Thus, a positive constant in the revenue equation and a negative constant in the expenditure equation is an indication that, over the study period at least, the government has attempted to reduce the size of the deficit. The reverse also holds true.

Differences Between Kneebone and McKenzie's (1998a) Study

Although the basic methodology and general model used here and in K & M's (1998a) paper is extremely similar, there are some notable differences. One such difference arises in the forecasting of expenditures and revenues. In their study, K & M included several dummy variables in their forecast equations in an attempt to capture specific events which may have been accounted for in government spending and revenue expectations. This was not generally done in this thesis (except for the inclusion of one dummy variable designed to capture the effects of a municipal debt buy-back program in Alberta) due to the sheer magnitude of performing this process for all ten provinces. As a result of this omission, the shock variables constructed for this project will most likely not be as precise as possible. It is important to note, however, that when the forecasts were graphed with the actual data, no obvious large discrepancies were revealed in any of the forecasts made.

As well, unlike the K & M study, this thesis did not forecast revenues and expenditures as an aggregate. Rather, each province's revenues and expenditures were separated into categories (described in more detail in the next chapter) and then forecasts were made for each category. These forecasts were then added together to get an aggregate forecast of total revenue and total expenditure. This process more accurately represents the "real world" provincial budgetary process where budgets are made on a department by department basis and then aggregated into a larger provincial budget. (Boothe, 1995; Boothe, 1997) By forecasting the aggregates on a component by component basis, hopefully more accurate aggregate forecasts were achieved.

Another area of difference involves the treatment of debt service costs. K & M included debt service costs as a regressor in their versions of equations (2.3) and (2.4) to investigate whether debt service costs tended to crowd out program spending and/or cause tax increases. In this study, debt service costs were included as an expenditure category as part of total expenditures. Thus, this thesis deals with the broader category of total spending rather than just program spending. The decision was made to include debt charges in this manner as they are subject to a certain (though lesser) degree of uncertainty much like the other expenditure categories examined; the main focus in this project is to examine government response to budgetary shocks. Nevertheless, K & M found the effect of debt charges to be relatively minor.

Finally, K & M included several dummy variables in their versions of (2.3) and (2.4) in an attempt to capture events which may have affected discretionary spending or revenues in Alberta. For example, variables were included to account for periods of high real oil prices and election periods. No such variables were included in this thesis, again due mainly to the fact that all ten provinces were examined and to preserve simplicity. To the extent that such variables are significant, they will be imbedded or masked in the constant term in the regression equations in this thesis.

A way of testing the importance of the differences discussed above is to compare the results obtained for Alberta by K & M (1998a) against those obtained here. Thus, one of the interesting questions examined in this thesis will be: To what extent do the differences discussed above lead to different conclusions regarding budgetary behaviour in Alberta? We now turn to the third chapter which discusses the collection and preparation of the data needed to estimate the above model. Following this chapter, the empirical results of the model estimation will be presented.

CHAPTER THREE - DATA

Data Collection

The first step in the data collection process was to obtain, for each province, raw budgetary data from which the revenue and expenditure categories could be formed. The data was collected on the basis of the Statistics Canada Financial Management System for public sector finance. The data were given in fiscal years ending March 31st and were collected for the fiscal years 1965/66 through 1995/96. The budgetary data collected for each province were: total revenue, personal income taxes, corporation income taxes, total consumption taxes, general sales taxes, natural resource revenues, return on investments, transfers from other levels of government, total expenditure, health expenditure, social services expenditure, education expenditure, and debt charges. In addition, resource conservation and industrial development expenditure was also collected for Saskatchewan, Alberta, and British Columbia. The above data were collected on a province by province basis from CANSIM from the following matrices: Newfoundland - 2782, Prince Edward Island - 2783, Nova Scotia - 2784, New Brunswick - 2785, Quebec - 2786, Ontario - 2787, Manitoba - 2788, Saskatchewan - 2789, Alberta - 2790, British Columbia - 2791.

From these data, the following revenue categories were formed: (1) personal income tax, (2) corporation income tax, (3) general sales taxes, (4) other consumption taxes (consisting mainly of fuel, alcohol, and tobacco taxes and formed by subtracting general sales taxes from total consumption taxes), (5) natural resource revenues, (6) return on investments, (7) transfers from other levels of government, and (8) other revenue (formed by subtracting the total of (1) through (7) from total revenue). The following expenditure categories were also formed: (1) health, (2) social services, (3) education, (4) debt charges, and (5) other expenditures (formed by subtracting the total of (1) through (4) from total expenditure). Resource conservation and industrial development was also included as an expenditure category for Saskatchewan, Alberta, and British Columbia due to the large role natural resources play in their economies.

In addition to the above budgetary data, data on Gross Domestic Product (GDP) and population were also collected for each province. Nominal annual GDP for the years 1961 through 1996 was obtained from CANSIM from the following matrices: Newfoundland - 2623, Prince Edward Island - 2624, Nova Scotia - 2625, New Brunswick - 2626, Quebec - 2627, Ontario - 2628, Manitoba - 2629, Saskatchewan - 2630, Alberta - 2631, British Columbia - 6950. This annual GDP data was then transformed to fiscal year data by taking a weighted average of the annual data. For example, the nominal GDP for fiscal year 1965/66 would be 0.75 * annual GDP for 1965 and 0.25 * annual GDP for 1966.

Annual population data was obtained for the years 1960 through 1996 from CANSIM under the following labels: Newfoundland - D31236, Prince Edward Island - D31237, Nova Scotia - D31238, New Brunswick - D31239, Quebec - D31240, Ontario - D31241, Manitoba - D31242, Saskatchewan - D31243, Alberta - D31244, British Columbia - D31245. The same procedure used to convert GDP from annual to fiscal was used to convert population from annual to fiscal.

Due to the lack of provincial level GDP deflators or Consumer Price Indexes (CPIs) for the years that the other variables were available, provincial CPIs had to be constructed based on the available CPIs for the major cities in each province. In provinces with only one major city, that city's CPI was used as a proxy for the province's. In provinces with two major cities, the province's CPI was calculated as a weighted average of the relative population of the two cities. The relative population was found by totaling the population of the two cities for each year from 1976-86. The percentage of the total population was then found for each city for each year. These eleven percentages were then averaged to get the relative weight of each city. Finally, the provincial CPI was calculated by multiplying these weights by the CPI for each city to get the weighted average. The base year of 1986 = 100 was used and series with 1971 = 100 were converted to this base year.

The sources for each city were: annual all-items CPI from 1940-75 (1971 = 100) from Statistics Canada Historical Statistics of Canada, annual all-items CPI from 1971-94 (1986 = 100) from CANSIM (series labels P490576 (St. John's), P490872 (Charlottetown), P491464 (Saint John), P491168 (Halifax), P492056 (Montreal), P491760 (Quebec City), P492648 (Toronto), P492352 (Ottawa), P49340 (Winnipeg), P493536 (Regina), P493832 (Saskatoon), P494128 (Edmonton), P494424 (Calgary), P494720 (Vancouver)), and annual all-items CPI from 1992-96 from Statistics Canada catalogue 62-001 XPB, April 1997, Table 9. City populations were found in CANSIM matrix 6496. Thus, the final provincial CPIs were: Newfoundland - St. John's all years, Prince Edward Island - St. John N.B. for 1965-73 as no PEI city index available, Charlottetown for 1974-96, New Brunswick - St. John all years, Nova Scotia - Halifax all years, Quebec - Montreal for 1965-70, weighted average of Montreal and Quebec for 1971-96 (Montreal = 0.832, Quebec = 0.168), Ontario - weighted average of Toronto and Ottawa all years (Toronto = 0.844, Ottawa = 0.156), Manitoba - Winnipeg all years, Saskatchewan - weighted average of Regina and Saskatoon all years (Regina = 0.515, Saskatoon = 0.485), Alberta - weighted average of Edmonton and Calgary all years (Edmonton = 0.531, Calgary = 0.469), British Columbia - Vancouver all years. Finally, each provincial CPI was converted from annual to fiscal year using the procedure described above for converting GDP and population.

Finally, the nominal well-head price of crude oil in Alberta in dollars per thousand cubic metres was obtained from Dr. Ron Kneebone who had compiled it from data he received from Dr. Robert Mansell, Paul Boothe, and from Statistics Canada catalogue 26-202.

Data Transformation

After all the data were collected, the next step was to transform them into the form required by the model. The first step in this process was to put all the expenditure, revenue, and GDP data into real per capita form. This was done using the provincial CPI and population figures discussed above. All variables were transformed so as to be in 1994 dollar terms. Thus, from this point on, all variables and calculations referred to are in real per capita terms.

The next step after this was to form the forecast equations upon which the model assumes that the provincial governments base their revenue and expenditure forecasts. As was noted in the previous chapter, the method by which this was done was to first create forecast equations and hence forecasts for each revenue and expenditure category. These forecasts were then combined to obtain a final forecast of total revenue and total expenditure for each year.

To reach a final forecasting equation in each category, all the collected data for that category were used as well as GDP. The forecasting method was to assume that government's forecast using simple time series models. These models were assumed to involve lagged GDP and the variable itself lagged. The major problem with this method is the use of the whole data set to develop the forecasting equation. In essence what this is doing is predicting what will happen in the future even though it is already known. The assumption being made is that the coefficients in the forecasting equation are constant over time. For example, it is being assumed that the coefficients on lagged GDP and lagged personal income tax are the same in fiscal year 1965/66 as they are in fiscal year 1994/95. Forecasts of GDP were made through lagged autoregressions.

For each category many different forms of the forecasting equation were tried. Starting from the simplest form with a one lag autoregression, additional lags of GDP and the variable itself were added in different combinations. All forecast equations tried included a constant term. The final forecast equation chosen was the form with the highest adjusted R-squared ($\overline{R}^2$) and the lowest Akaikie Information Criterion statistic. These final forecast equations were then used to generate forecasts of the variables. The forecasts were then graphically compared to the actual data as a quick visual check of their ability to forecast. The same basic procedure was followed for the GDP forecasts.

The following tables give the final forecast equations for each category for each province.

Table 3.1: Forecast Equations For Newfoundland

NEWFOUNDLAND			
Variable	Lagged Own Variable Terms Included	Lagged GDP Terms Included	$\bar{R}^2$
Personal Income Tax	1	1	0.981
Corporation Income Tax	1	0	0.290
General Sales Tax	1	1, 2	0.968
Other Consumption Taxes	1	0	0.856
Natural Resource Revenues	1	0	0.636
Return on Investments	1	1	0.689
Transfers	1	1, 2	0.933
Other Revenue	1	0	0.952
Health	1	0	0.979
Social Services	1	0	0.961
Education	1	1	0.887
Debt Charges	1	1, 2	0.978
Other Expenditures	1	1	0.373
GDP	1	N/A	0.986

Table 3.2: Forecast Equations For Prince Edward Island

Prince Edward Island			
Variable	Lagged Own Variable Terms Included	Lagged GDP Terms Included	$\bar{R}^2$
Personal Income Tax	1	1	0.977
Corporation Income Tax	0	1, 2	0.642
General Sales Tax	1	1	0.966
Other Consumption Taxes	1	0	0.855
Natural Resource Revenues	1	0	0.277
Return on Investments	1	0	0.975
Transfers	1	0	0.922
Other Revenue	1	0	0.880
Health	1	1	0.975
Social Services	1, 3	1	0.955
Education	1	0	0.972
Debt Charges	1, 2	0	0.987
Other Expenditures	1	1, 2	0.879
GDP	1	N/A	0.985

Table 3.3: Forecast Equations For Nova Scotia

NOVA SCOTIA			
Variable	Lagged Own Variable Terms Included	Lagged GDP Terms Included	$\overline{R}^2$
Personal Income Tax	1	1	0.983
Corporation Income Tax	1	1	0.281
General Sales Tax	1	1, 2	0.959
Other Consumption Taxes	1	1	0.863
Natural Resource Revenues	1	1, 2, 3	0.610
Return on Investments	0	1	0.780
Transfers	1	0	0.927
Other Revenue	1	1	0.938
Health	1	1	0.974
Social Services	1	1	0.977
Education	1	1	0.896
Debt Charges	1, 2	0	0.984
Other Expenditures	1	0	0.607
GDP	1, 2	N/A	0.988

Table 3.4: Forecast Equations For New Brunswick

NEW BRUNSWICK			
Variable	Lagged Own Variable Terms Included	Lagged GDP Terms Included	$\overline{R}^2$
Personal Income Tax	1	1	0.972
Corporation Income Tax	0	1	0.364
General Sales Tax	1	1, 2	0.960
Other Consumption Taxes	1	0	0.780
Natural Resource Revenues	1	0	0.685
Return on Investments	1	0	0.987
Transfers	1, 2	0	0.908
Other Revenue	1	1	0.944
Health	1	0	0.983
Social Services	1	1	0.978
Education	1	1	0.921
Debt Charges	1	0	0.987
Other Expenditures	1	1	0.866
GDP	1	N/A	0.971

Table 3.5: Forecast Equations For Quebec

QUEBEC			
Variable	Lagged Own Variable Terms Included	Lagged GDP Terms Included	$\bar{R}^2$
Personal Income Tax	1	1	0.986
Corporation Income Tax	1, 2	0	0.675
General Sales Tax	1	0	0.919
Other Consumption Taxes	1, 2	0	0.846
Natural Resource Revenues	1	1	0.713
Return on Investments	1	1	0.886
Transfers	1	0	0.900
Other Revenue	1	1	0.976
Health	1	0	0.985
Social Services	1	1, 2	0.995
Education	1	0	0.953
Debt Charges	1	0	0.976
Other Expenditures	1	0	0.955
GDP	1, 2, 3	N/A	0.977

Table 3.6: Forecast Equations For Ontario

ONTARIO			
Variable	Lagged Own Variable Terms Included	Lagged GDP Terms Included	$\bar{R}^2$
Personal Income Tax	1	1	0.970
Corporation Income Tax	1, 2	1, 2	0.742
General Sales Tax	1	1	0.882
Other Consumption Taxes	1	0	0.491
Natural Resource Revenues	1	1, 2	0.186
Return on Investments	1	0	0.925
Transfers	1	0	0.741
Other Revenue	1, 2	1	0.909
Health	1	0	0.981
Social Services	1	0	0.972
Education	1	0	0.670
Debt Charges	1	1	0.954
Other Expenditures	1	1	0.879
GDP	1, 2	N/A	0.960

Table 3.7: Forecast Equations For Manitoba

MANITOBA			
Variable	Lagged Own Variable Terms Included	Lagged GDP Terms Included	$\overline{R}^2$
Personal Income Tax	1	1	0.954
Corporation Income Tax	1	0	0.220
General Sales Tax	1	0	0.871
Other Consumption Taxes	1	0	0.885
Natural Resource Revenues	1	1	0.449
Return on Investments	1	1	0.982
Transfers	1	1	0.942
Other Revenue	1	0	0.953
Health	1	1	0.958
Social Services	1	1	0.973
Education	1	0	0.858
Debt Charges	1	1	0.970
Other Expenditures	0	1	0.918
GDP	1	N/A	0.971

Table 3.8: Forecast Equations For Saskatchewan

SASKATCHEWAN			
Variable	Lagged Own Variable Terms Included	Lagged GDP Terms Included	$\overline{R}^2$
Personal Income Tax	1	1	0.944
Corporation Income Tax	1	0	0.608
General Sales Tax	1	0	0.809
Other Consumption Taxes	1	1, 2	0.778
Natural Resource Revenues	1	0	0.692
Return on Investments	1	0	0.719
Transfers	1	0	0.799
Other Revenue	1	0	0.956
Health	1	1	0.959
Social Services	1	1	0.935
Education	1	1	0.832
Debt Charges	1	1	0.960
Other Expenditures	1	1, 2	0.916
Resource Conservation	1	1	0.545
GDP	1, 2	N/A	0.937

Table 3.9: Forecast Equations For Alberta

ALBERTA			
Variable	Lagged Own Variable Terms Included	Lagged GDP Terms Included	$\overline{R}^2$
Personal Income Tax	1	0	0.928
Corporation Income Tax	1	0	0.644
General Sales Tax	N/A	N/A	N/A
Other Consumption Taxes	1	1, 2	0.897
Natural Resource Revenues	1	0 (1 ON OIL)	0.868
Return on Investments	1	1	0.955
Transfers	1	0	0.648
Other Revenue	1	0	0.706
Health	1	1	0.967
Social Services	1	0	0.943
Education	1	1	0.556
Debt Charges	1	0	0.959
Other Expenditures	1	0	0.949
Resource Conservation	1	1	0.879
GDP	1, 2	N/A	0.946

** Note: Following K & M (1998a), the forecasting equations for Alberta were modified in two ways. First, rather than including real per capita GDP as a regressor in the forecast of resource revenue, the real well-head price of crude oil in Alberta in dollars per thousand cubic metres was used. This was used because of the extremely important role the oil and gas industry plays in Alberta. The price of oil was tried as a regressor in the other revenue forecasts but was found to have less predictive power than GDP and thus was not used. The second modification was to include a dummy variable for fiscal year 1979/80 in the forecast equation for Other Expenditures. This variable was needed because in this year the Alberta government purchased the debt of municipalities and thus caused a large one time increase in planned expenditures equal to 40% of expenditures for that year that would not have otherwise been taken into account in the expenditure forecasts.

Table 3.10: Forecast Equations For British Columbia

BRITISH COLUMBIA			
Variable	Lagged Own Variable Terms Included	Lagged GDP Terms Included	$\bar{R}^2$
Personal Income Tax	1	1	0.956
Corporation Income Tax	0	1, 2	0.530
General Sales Tax	1	1	0.661
Other Consumption Taxes	1	0	0.838
Natural Resource Revenues	1, 2	1	0.505
Return on Investments	1	0	0.900
Transfers	1	0	0.797
Other Revenue	1	1	0.894
Health	1	1	0.992
Social Services	1	0	0.949
Education	1	1	0.881
Debt Charges	1	1, 2	0.988
Other Expenditures	1	0	0.819
Resource Conservation	1	1	0.770
GDP	1, 2	N/A	0.947

The forecasts were then combined to form forecasts of total revenue, total expenditure, and provincial GDP. Thus, using the actual data and these forecasts, the variables $RSHOCK_{t-1}$, $SSHOCK_{t-1}$, and expected change in GDP which are used in the model were constructed.

Following the above step, unit root tests in the form of Augmented Dickey-Fuller tests were conducted on the change in real per capita spending (ΔS_t), the change in real per capita revenues (ΔR_t), the expected change in GDP, $RSHOCK_{t-1}$, and $SSHOCK_{t-1}$ for each province. For each variable, six versions of the Dickey-Fuller test were conducted. These were:

(1) $\Delta Y_t = \delta Y_{t-1} + \mu_t$ (No intercept or trend and no lags.)

(2) $\Delta Y_t = \beta_1 + \delta Y_{t-1} + \mu_t$ (Intercept but no trend or lags.)

(3) $\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \mu_t$ (Intercept and trend but no lags.)

(4) $\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \alpha_t \sum_{t=1}^{m} \Delta Y_{t-t} + \mu_t$ (Intercept and trend and one lag.)

(5) Same as above but with two lags.

(6) Same as above but with three lags.

Test statistics from each of the above were then compared to the critical value for that particular test to see if the test indicated stationarity or non-stationarity of the variable. The variable was judged to be stationary if at least three of the tests were satisfied at the 10% critical level or better. The results of this process for each variable in each province are given in table 3.11 below.

Table 3.11: Stationarity Test Results

Province	ΔS_t	ΔR_t	Expected Change in GDP	$RSHOCK_{t-1}$	$SSHOCK_{t-1}$
Newfoundland	Stationary	Nonstationary	Nonstationary	Stationary	Stationary
PEI	Nonstationary	Nonstationary	Nonstationary	Stationary	Stationary
Nova Scotia	Stationary	Stationary	Nonstationary	Stationary	Stationary
New Brunswick	Stationary	Stationary	Nonstationary	Stationary	Stationary
Quebec	Stationary	Stationary	Stationary	Stationary	Stationary
Ontario	Stationary	Nonstationary	Nonstationary	Stationary	Stationary
Manitoba	Nonstationary	Stationary	Nonstationary	Stationary	Stationary
Saskatchewan	Nonstationary	Stationary	Nonstationary	Stationary	Stationary
Alberta	Stationary	Stationary	Nonstationary	Stationary	Stationary
B.C.	Stationary	Stationary	Nonstationary	Stationary	Stationary

Thus, as table 3.11 shows, the majority of the variables tested (35/50 or 70%) were found to be stationary. Nine of the ten provinces had at least three of the five variables stationary. Given the extremely small size of the sample for each province, these results were taken to be reasonably indicative that the data used in the study is stationary.

We now turn to the next chapter which examines the results of the model when it is estimated in an aggregated form with no distinction made between positive and negative revenue or expenditure shocks. The following chapter will then examine the results when this distinction is made.

CHAPTER FOUR - EMPIRICAL RESULTS

Estimation Procedure

In order to estimate the model described in Chapter Two, the same estimation procedure was followed for each province. The aim of this procedure was to obtain statistically valid final estimates of equations (2.3) and (2.4).

The first step in the procedure was to estimate the general equation specification as given by equations (2.3) and (2.4) using Ordinary Least Squares (OLS). The estimated equation was then subjected to a battery of tests to check for correct equation specification, heteroscedasticity, and autocorrelation. The tests performed were the Ramsey RESET test, the ARCH test, the White test, the Breusch-Pagan-Godfrey (BPG) test, the LM test, and the Durbin-Watson *d* test. (NOTE: The following explanations of the tests employed draw heavily on Damodar Gujarati's *Basic Econometrics* and on Peter Kennedy's *A Guide To Econometrics*.)

The Ramsey RESET test is a general test of mis-specification. The general idea behind the test is to introduce the predicted value of the dependent variable back into the original regression in some form. If this reintroduction results in a significant increase in the R^2 statistic, a mis-specified equation is indicated.

Three different forms of the RESET test were employed, RESET(1), RESET(2), and RESET(3). RESET(1) involves introducing only the squared predicted value of the dependent variable. RESET(2) involves introducing the predicted value of the dependent variable in squared and cubed form. RESET(3) involves introducing the predicted value of the dependent variable squared, cubed, and raised to the fourth power. Each of these tests results in an F statistic. The null hypothesis of each test is that the given specification is correct against the alternative that some unspecified alternative is correct. Thus, if the calculated F statistic from the test exceeds a critical F with the appropriate degrees of freedom, mis-specification is indicated.

The ARCH, White, and BPG tests all test for the presence of heteroscedasticity. The ARCH (Autoregressive Conditional Heteroscedasticity) test is a specific test of heteroscedasticity in time series data. The basic idea of this test is that ARCH is present if the variance of the error term at time t depends on the size of the squared error term at time t-1. The test is carried out by regressing the square of the OLS residual on its lagged values. In this case two different forms of the ARCH test were employed, ARCH(1) and ARCH(2). ARCH(1) involves using only one lagged value of the squared OLS residual while ARCH(2) involves using two lagged values. Each test results in a χ^2 statistic and has the null hypothesis of a homoscedastic error term. Thus, if the calculated χ^2 is greater than a critical χ^2 with the correct degrees of freedom, heteroscedasticity is indicated.

The White and BPG tests are also used to test for heteroscedasticity. Both of these tests have the null hypothesis of a homoscedastic error term and result in a χ^2 statistic. Again, if the calculated χ^2 from either of these tests is greater than a critical χ^2 with the correct degrees of freedom, heteroscedasticity is indicated. It is also important to note that cross products were included in the White test.

The LM and the Durbin-Watson d tests both test for the presence of serial correlation or autocorrelation. The Durbin-Watson d test is the classic test for autocorrelation. A well known problem with this test is the possibility of an inconclusive result. Thus, the LM test developed by Breusch and Godfrey was also utilized. The basic idea behind this test is to include lagged values of the OLS residuals and test for their significance. Only one lagged value was included because of the common assumption that error terms follow a first-order moving average scheme (Gujarati, p. 407) and in order to preserve simplicity. The LM test follows a χ^2 distribution with the null hypothesis of no autocorrelation. Again, a χ^2 greater than a critical χ^2 indicates that autocorrelation is present.

The results from the specification, heteroscedasticity, and autocorrelation tests were then used to determine the next step. If either heteroscedasticity or autocorrelation were detected (based on failures in a majority of the tests), these problems were corrected using standard procedures before any further action was taken. In particular, autocorrelation was corrected using the Cochrane-Orcutt iterative procedure. If mis-specification was indicated on the basis of at least two of the three Ramsey RESET tests, the equation was simply not estimated.

The result of the above process, if all goes well, is twenty well specified final form equations. Each province will have an equation for change in expenditure and an equation for change in revenue. The next step was to estimate all twenty equations as a system using the Seemingly Unrelated Regression (SUR) approach. This was done because of the likelihood of contemporaneous correlation of disturbances in the equations. Contemporaneous correlation was deemed likely because of the fact that the ten provinces are all part of the bigger interconnected Canadian economy. Thus, a shock in one province or region is likely to spill over and affect other provinces. As well, all of the provincial economies are subject to common outside shocks such as monetary policy changes, exchange rate changes, and changes in the economy of the United States. In this case, the SUR technique will improve the efficiency of the estimated coefficients.

The following pages give the results of the above procedure on a province by province basis. For each province, summary statistics of $RSHOCK_{t-1}$ and $SSHOCK_{t-1}$ are provided. A table giving the results of the OLS estimations for each individual province is then presented. In these tables, the standard errors of the regression coefficients are in brackets. Asterisks on these standard errors denote rejection of the following null hypotheses at the 10% (*) and 5% (**) significance levels on a t-test: the null hypothesis on the coefficient of Revenue Shock when ΔR_t is the dependent variable and on Spending Shock when ΔS_t is the dependent variable is that the coefficient is equal to negative one, on all other coefficients the null hypothesis is that the coefficient is equal to zero. Asterisks on the specification, heteroscedasticity, and autocorrelation tests denote rejection of the null hypothesis at the 10% (*) and 5% (**) significance levels. An asterisk on the Durbin-Watson *d* indicates autocorrelation. Finally, the results of the SUR system regression are given and the final form coefficients from this are discussed in light of the interpretation of coefficients provided in Chapter Two.

OLS Results

Newfoundland

The summary statistics for $RSHOCK_{t-1}$ and $SSHOCK_{t-1}$ for Newfoundland are given in table 4.1 below. Recall that these variables are in real per capita dollar terms. The correlation coefficient between the two variables is 0.59. The OLS results are given in table 4.2.

Table 4.1: Summary Statistics For Newfoundland

	$RSHOCK_{t-1}$	$SSHOCK_{t-1}$
Mean	-4.82	-1.24
Standard Deviation	154.15	315.12
Maximum Value	255.91	919.51
Minimum Value	-343.69	-486.81
Positive/Negative Values	11/16	13/14

Table 4.2: OLS Results For Newfoundland

Dependent Variable	ΔS_t (1)	ΔR_t (2)
Constant	-33.91 (208.88)	-6.19 (101.81)
Revenue Shock	0.65 (0.56)	0.40 (0.27)**
Spending Shock	-0.66 (0.27)	-0.25 (0.13)*
Expected Change in GDP	0.51 (0.63)	0.50 (0.31)
$\overline{R}^2$	0.13	0.12
RESET(1)	0.805	0.272
RESET(2)	1.036	0.177
RESET(3)	0.660	0.334
ARCH(1)	0.192	0.147
ARCH(2)	0.247	0.366
White	8.300	10.204
BPG	3.238	4.088
LM	0.656	0.315
Durbin-Watson *d*	2.065	1.799
F test on Zero Restrictions	2.27	2.23

Prince Edward Island

The summary statistics for $RSHOCK_{t-1}$ and $SSHOCK_{t-1}$ for Prince Edward Island are given in table 4.3 below. The correlation coefficient between the two variables is 0.46. The OLS results are given in table 4.4.

Table 4.3: Summary Statistics For Prince Edward Island

	$RSHOCK_{t-1}$	$SSHOCK_{t-1}$
Mean	-2.42	20.46
Standard Deviation	151.58	169.57
Maximum Value	389.96	413.01
Minimum Value	-262.12	-231.77
Positive/Negative Values	13/14	15/11

Table 4.4: OLS Results For Prince Edward Island

Dependent Variable	ΔS_t (1)	ΔR_t (2)
Constant	-459.09 (303.87)	-33.48 (280.92)
Revenue Shock	0.49 (0.29)	-0.53 (0.23)*
Spending Shock	-0.78 (0.26)	0.003 (0.18)
Expected Change in GDP	1.78 (0.85)**	0.67 (2.11)
$\overline{R}^2$	0.30	0.14
RESET(1)	0.015	0.0001
RESET(2)	1.022	0.003
RESET(3)	0.948	0.195
ARCH(1)	1.008	0.675
ARCH(2)	0.987	1.095
White	5.568	8.900
BPG	1.641	0.682
LM	0.562	0.834
Durbin-Watson *d*	1.788	1.540
F test on Zero Restrictions	4.49	2.33

NOTE: Equation (2) in table 4.4 represents results after the equation was corrected for autocorrelation using the Cochrane-Orcutt procedure.

Nova Scotia

The summary statistics for $RSHOCK_{t-1}$ and $SSHOCK_{t-1}$ for Nova Scotia are given in table 4.5 below. The correlation coefficient between the two variables is 0.56. The OLS results are given in table 4.6.

Table 4.5: Summary Statistics For Nova Scotia

	$RSHOCK_{t-1}$	$SSHOCK_{t-1}$
Mean	-4.72	11.58
Standard Deviation	122.88	256.29
Maximum Value	201.09	657.59
Minimum Value	-265.55	-476.31
Positive/Negative Values	14/12	10/17

Table 4.6: OLS Results For Nova Scotia

Dependent Variable	ΔS_t (1)	ΔR_t (2)
Constant	199.35 (120.35)	7.66 (50.77)
Revenue Shock	1.56 (0.54)**	-0.32 (0.26)**
Spending Shock	-0.62 (0.23)**	-0.23 (0.12)*
Expected Change in GDP	0.07 (0.17)	0.34 (0.13)**
$\overline{R}^2$	0.29	0.33
RESET(1)	0.355	0.044
RESET(2)	0.472	0.943
RESET(3)	0.424	0.821
ARCH(1)	0.010	0.729
ARCH(2)	1.244	0.687
White	19.06**	19.3**
BPG	12.91**	7.993**
LM	2.587	0.911
Durbin-Watson *d*	2.141	2.107
F test on Zero Restrictions	4.17	5.08

NOTE: Equation (1) in table 4.6 represents results after the equation was corrected for autocorrelation using the Cochrane-Orcutt procedure. The White and BPG tests indicate heteroscedasticity is present in both equations (1) and (2). Several corrections for heteroscedasticity were tried for both but none were successful. Thus, due to this heteroscedasticity problem, neither a ΔS_t nor a ΔR_t equation for Nova Scotia will be included in the final system estimation.

New Brunswick

The summary statistics for $RSHOCK_{t-1}$ and $SSHOCK_{t-1}$ for New Brunswick are given in table 4.7 below. The correlation coefficient between the two variables is 0.05. The OLS results are given in table 4.8.

Table 4.7: Summary Statistics For New Brunswick

	$RSHOCK_{t-1}$	$SSHOCK_{t-1}$
Mean	3.24	6.76
Standard Deviation	122.01	168.70
Maximum Value	212.21	452.78
Minimum Value	-323.49	-269.97
Positive/Negative Values	15/12	11/15

Table 4.8: OLS Results For New Brunswick

Dependent Variable	ΔS_t (1)	ΔR_t (2)
Constant	-59.50 (154.39)	30.92 (156.44)
Revenue Shock	-0.26 (0.26)	-0.34 (0.27)**
Spending Shock	-0.42 (0.20)**	0.05 (0.20)
Expected Change in GDP	0.52 (0.38)	0.29 (0.39)
$\overline{R}^2$	0.15	-0.01
RESET(1)	0.141	0.505
RESET(2)	0.539	1.556
RESET(3)	0.597	1.037
ARCH(1)	0.170	0.030
ARCH(2)	2.062	0.369
White	6.617	8.278
BPG	1.970	3.841
LM	0.974	2.062
Durbin-Watson *d*	2.15	1.68
F test on Zero Restrictions	2.58	0.89

Quebec

The summary statistics for $RSHOCK_{t-1}$ and $SSHOCK_{t-1}$ for Quebec are given in table 4.9 below. The correlation coefficient between the two variables is 0.44. The OLS results are given in table 4.10.

Table 4.9: Summary Statistics For Quebec

	$RSHOCK_{t-1}$	$SSHOCK_{t-1}$
Mean	4.77	4.43
Standard Deviation	121.80	120.99
Maximum Value	225.55	229.32
Minimum Value	-189.33	-225.32
Positive/Negative Values	13/14	13/14

Table 4.10: OLS Results For Quebec

Dependent Variable	ΔS_t (1)	ΔR_t (2)
Constant	124.82 (33.5)**	55.89 (29.45)*
Revenue Shock	-0.21 (0.26)	-0.57 (0.23)*
Spending Shock	0.23 (0.25)**	0.28 (0.22)
Expected Change in GDP	0.11 (0.06)*	0.23 (0.05)**
$\overline{R}^2$	0.04	0.40
RESET(1)	1.722	2.643
RESET(2)	0.946	1.390
RESET(3)	0.769	0.920
ARCH(1)	0.275	0.667
ARCH(2)	1.516	2.427
White	16.099*	10.332
BPG	2.114	3.518
LM	1.612	0.018
Durbin-Watson *d*	1.716	1.943
F test on Zero Restrictions	1.40	6.78

Ontario

The summary statistics for $RSHOCK_{t-1}$ and $SSHOCK_{t-1}$ for Ontario are given in table 4.11 below. The correlation coefficient between the two variables is -0.15. The OLS results are given in table 4.12.

Table 4.11: Summary Statistics For Ontario

	$RSHOCK_{t-1}$	$SSHOCK_{t-1}$
Mean	-6.20	7.94
Standard Deviation	111.25	145.70
Maximum Value	173.22	319.55
Minimum Value	-271.94	-203.58
Positive/Negative Values	13/14	12/16

Table 4.12: OLS Results For Ontario

Dependent Variable	ΔS_t (1)	ΔR_t (2)
Constant	106.62 (41.0)**	17.89 (29.09)
Revenue Shock	0.33 (0.33)	-0.24 (0.24)**
Spending Shock	0.07 (0.25)**	-0.06 (0.17)
Expected Change in GDP	0.07 (0.07)	0.26 (0.05)**
$\bar{R}^2$	-0.01	0.48
RESET(1)	2.407	2.037
RESET(2)	2.028	4.270**
RESET(3)	1.404	3.593**
ARCH(1)	0.877	1.695
ARCH(2)	1.060	3.958
White	13.204	7.557
BPG	7.089*	1.518
LM	1.868	0.013
Durbin-Watson *d*	1.707	1.983
F test on Zero Restrictions	0.91	8.96

NOTE: Due to the failure of the Ramsey RESET tests in equation (2), a ΔR_t equation for Ontario will not be included in the final system estimation.

Manitoba

The summary statistics for $RSHOCK_{t-1}$ and $SSHOCK_{t-1}$ for Manitoba are given in table 4.13 below. The correlation coefficient between the two variables is 0.29. The OLS results are given in table 4.14.

Table 4.13: Summary Statistics For Manitoba

	$RSHOCK_{t-1}$	$SSHOCK_{t-1}$
Mean	-9.44	3.67
Standard Deviation	142.75	187.07
Maximum Value	446.16	398.23
Minimum Value	-241.33	-558.20
Positive/Negative Values	11/17	16/12

Table 4.14: OLS Results For Manitoba

Dependent Variable	ΔS_t (1)	ΔR_t (2)
Constant	43.11 (55.88)	53.19 (52.95)
Revenue Shock	0.24 (0.24)	-0.45 (0.23)**
Spending Shock	-0.85 (0.20)	-0.17 (0.19)
Expected Change in GDP	0.12 (0.41)	0.21 (0.29)
$\overline{R}^2$	0.37	0.13
RESET(1)	1.005	0.959
RESET(2)	1.146	0.458
RESET(3)	1.971	0.338
ARCH(1)	0.044	0.311
ARCH(2)	0.523	0.635
White	13.696	6.656
BPG	3.682	1.624
LM	0.693	1.475
Durbin-Watson *d*	1.633	1.661
F test on Zero Restrictions	6.03	2.24

NOTE: Equations (1) and (2) in table 4.14 represent results after the equations were corrected for autocorrelation using the Cochrane-Orcutt procedure.

Saskatchewan

The summary statistics for $RSHOCK_{t-1}$ and $SSHOCK_{t-1}$ for Saskatchewan are given in table 4.15 below. The correlation coefficient between the two variables is 0.11. The OLS results are given in table 4.16.

Table 4.15: Summary Statistics For Saskatchewan

	$RSHOCK_{t-1}$	$SSHOCK_{t-1}$
Mean	0.02	31.33
Standard Deviation	326.28	337.13
Maximum Value	743.10	1103.37
Minimum Value	-613.32	-367.63
Positive/Negative Values	12/15	13/14

Table 4.16: OLS Results For Saskatchewan

Dependent Variable	ΔS_t (1)	ΔR_t (2)
Constant	113.03 (71.08)	52.32 (70.93)
Revenue Shock	0.55 (0.20)**	-0.54 (0.22)**
Spending Shock	-0.67 (0.19)*	0.23 (0.18)
Expected Change in GDP	0.17 (0.12)	0.26 (0.16)
$\bar{R}^2$	0.44	0.20
RESET(1)	2.993*	0.146
RESET(2)	4.562**	0.579
RESET(3)	4.129**	0.399
ARCH(1)	0.056	0.038
ARCH(2)	0.109	1.180
White	9.562	2.240
BPG	1.623	0.823
LM	0.021	1.580
Durbin-Watson *d*	1.785	1.731
F test on Zero Restrictions	7.92	3.15

NOTE: Due to the failure of the Ramsey RESET tests in equation (1), a ΔS_t equation for Saskatchewan will not be included in the final system estimation. Equation (2) represents results after the equation was corrected for autocorrelation using the Cochrane-Orcutt procedure.

Alberta

The summary statistics for $RSHOCK_{t-1}$ and $SSHOCK_{t-1}$ for Alberta are given in table 4.17 below. The correlation coefficient between the two variables is -0.18. The OLS results are given in table 4.18.

Table 4.17: Summary Statistics For Alberta

	$RSHOCK_{t-1}$	$SSHOCK_{t-1}$
Mean	0.39	19.72
Standard Deviation	585.26	317.70
Maximum Value	1327.67	1108.78
Minimum Value	-1657.32	-693.35
Positive/Negative Values	11/16	16/12

Table 4.18: OLS Results For Alberta

Dependent Variable	ΔS_t (1)	ΔR_t (2)
Constant	85.00 (110.88)	19.42 (140.20)
Revenue Shock	0.13 (0.18)	-0.43 (0.23)**
Spending Shock	-0.28 (0.33)**	-0.33 (0.41)
Expected Change in GDP	0.09 (0.11)	0.28 (0.14)*
$\overline{R}^2$	0.03	0.14
RESET(1)	0.365	0.007
RESET(2)	0.281	0.004
RESET(3)	0.310	3.059*
ARCH(1)	0.063	0.015
ARCH(2)	1.507	0.589
White	6.755	8.017
BPG	2.943	2.173
LM	1.496	0.662
Durbin-Watson *d*	2.303	1.896
F test on Zero Restrictions	1.24	2.38

British Columbia

The summary statistics for $RSHOCK_{t-1}$ and $SSHOCK_{t-1}$ for British Columbia are given in table 4.19 below. The correlation coefficient between the two variables is -0.22. The OLS results are given in table 4.20.

Table 4.19: Summary Statistics For British Columbia

	$RSHOCK_{t-1}$	$SSHOCK_{t-1}$
Mean	-9.79	2.66
Standard Deviation	131.62	181.60
Maximum Value	252.80	404.18
Minimum Value	-335.25	-377.41
Positive/Negative Values	14/13	10/17

Table 4.20: OLS Results For British Columbia

Dependent Variable	ΔS_t (1)	ΔR_t (2)
Constant	101.42 (45.2)**	101.50 (39.4)**
Revenue Shock	0.56 (0.28)*	-0.25 (0.26)**
Spending Shock	-0.15 (0.24)**	-0.03 (0.20)
Expected Change in GDP	0.01 (0.11)	0.16 (0.07)**
$\overline{R}^2$	0.11	0.12
RESET(1)	0.044	0.640
RESET(2)	0.129	0.322
RESET(3)	0.121	0.384
ARCH(1)	1.121	0.265
ARCH(2)	2.259	0.449
White	8.617	13.001
BPG	4.758	5.770
LM	1.920	0.248
Durbin-Watson *d*	1.726	2.015
F test on Zero Restrictions	2.03	2.15

NOTE: Equation (1) in the table below represents results after the equation was corrected for autocorrelation using the Cochrane-Orcutt procedure.

SUR System Results and Interpretation by Province

The tables below give the regression results obtained when the sixteen well specified provincial equations were estimated as a SUR system with a total of 427 observations. The system results are given in an individual table for each province, however, it is important to note that these results are part of a larger system made up of regression equations for every province. Following each table is an economic interpretation of these coefficients for each province based on the discussion in Chapter Two.

Note that in these tables the standard errors of the estimated coefficients are in brackets. Asterisks beside the brackets indicate rejection of a null hypothesis at the 10% (*) and 5% (**) levels of significance. The null hypothesis on the coefficient of Revenue Shock when ΔR_t is the dependent variable and on Spending Shock when ΔS_t is the dependent variable is that the coefficient is equal to negative one. On all other coefficients, the null hypothesis is that the coefficient is zero.

Newfoundland

The SUR results for Newfoundland are given in table 4.21 below.

Table 4.21: SUR Results For Newfoundland

Dependent Variable	Constant	Revenue Shock	Spending Shock	Expected Change in GDP
ΔS_t	84.58 (169.19)	0.47 (0.39)	-0.56 (0.19)**	0.13 (0.50)
ΔR_t	-30.68 (80.72)	0.34 (0.17)**	-0.26 (0.08)**	0.58 (0.24)**

Examination of both the ΔS_t and the ΔR_t equations indicates that the constant is not significant. This suggests that governments in Newfoundland over the study period have tended, *ceteris paribus*, to hold real per capita spending and real per capita revenues relatively constant.

The coefficient on Revenue Shock in the ΔS_t equation is not significantly different from zero. Thus, this coefficient takes the value we expect to see if governments in Newfoundland did not alter their spending decisions in the face of an unexpected revenue shock. That is, this result supports the bygones be bygones hypothesis.

Upon examination of the estimated coefficient on Spending Shock in the ΔS_t equation, however, a different conclusion is reached. This coefficient is significantly different from negative one at the 5% level. As such, this coefficient provides evidence that governments in Newfoundland have been inclined to react to unexpected expenditures when making spending decisions. The estimated coefficient value of -0.56 indicates that an unexpected increase/decrease in spending in the previous fiscal year of $1.00 caused governments in Newfoundland to budget for an additional increase/decrease in spending of $0.44 in the current fiscal year.

K & M's (1998b) estimate of the marginal spending rate for Newfoundland is not significantly different from zero. Since the coefficient on Expected Change in GDP is also insignificantly different from zero, this result indicates that governments in Newfoundland did seem to trust GDP estimates when making expenditure decisions.

Turning to the ΔR_t equation, we see that the coefficient on Revenue Shock is significantly different from negative one, the value this coefficient should take if governments ignore past shocks. As such it indicates that Newfoundland governments treated unexpected revenue changes as permanent. The positive regression coefficient of 0.34 indicates that for each additional $1.00 of unexpected revenue collected last period, current period budgeted revenues increase by $1.34. In other words, all of the revenue shock and then some was seen by governments in Newfoundland to actually be permanent.

Meanwhile, the coefficient on Spending Shock in this equation is significantly different from zero at -0.26. This indicates a very curious reaction on the part of Newfoundland governments. In response to expenditures which were higher/lower than expected last period, the governments are budgeting for lower/higher revenues this period.

The coefficient on Expected Change in GDP is significantly different than zero at 0.58 with a standard error of 0.24. K & M's (1998b) estimate of the marginal tax rate for Newfoundland is 0.03. Thus, the coefficient estimated here seems to be significantly different from that estimated by K & M. One explanation for this discrepancy may be that budget makers in Newfoundland tended to mistrust GDP forecasts. This result contradicts the conclusion reached above for the Expected Change in GDP coefficient in the ΔS_t equation which suggested government trust of GDP forecasts.

Thus, the overall conclusion from the Newfoundland equations is that governments in this province appear to treat shocks as being permanent. We now turn to an examination of the results for Prince Edward Island.

Prince Edward Island

The SUR results for Prince Edward Island (PEI) are given in table 4.22 below.

Table 4.22: SUR Results For Prince Edward Island

Dependent Variable	Constant	Revenue Shock	Spending Shock	Expected Change in GDP
ΔS_t	-555.82 (244)**	0.48 (0.20)**	-0.79 (0.18)	2.08 (0.68)**
ΔR_t	-337.67 (198)*	-0.46 (0.13)**	-0.05 (0.10)	3.01 (1.45)**

Examination of the ΔS_t equation indicates that the constant is negative and significantly different from zero at the 5% level. The constant in the ΔR_t equation is also negative and significant at the 5% level. These coefficients indicate that governments in PEI over the study period have tended, *ceteris paribus*, to decrease expenditures and revenues, with expenditure decreases outweighing revenue decreases.

In the ΔS_t equation, the coefficient on Revenue Shock is significantly different from zero at 0.48. This suggests that governments in PEI have been inclined to follow an unexpected tax and spend policy. The coefficient on Spending Shock is not significantly different from negative one. As such, it indicates that governments in PEI did not react to unexpected expenditure shocks and let bygones be bygones.

The significant coefficient on Expected Change in GDP of 2.08 is surprising. K & M (1998b) estimated the marginal spending rate in PEI to be 0.11. Again, this very large coefficient implies that PEI governments may not have trusted the forecasts of GDP given to them.

This rather extreme result, however, also has an alternative explanation. Because PEI is such a small province, the data collected from it may be subject to a number of errors such as small sample bias. This could explain such contrary results and should be kept in mind during the analysis of the estimated coefficients for this province. When the SUR system was estimated without the equations for PEI, little difference in the other estimated coefficients or their standard errors was found. Thus, the system does not appear overly sensitive to the inclusion of PEI and it was therefore left in the model.

Like the case for Newfoundland, examination of the ΔR_t equation indicates that the government has been apt to respond to unexpected increases/decreases in revenues. The estimated regression coefficient on Revenue Shock (-0.46) is significantly different from negative one. Again, this coefficient indicates that an unexpected increase/decrease in revenues of $1.00 last period caused the government to budget for a further increase/decrease in revenues of $0.54 this period.

The estimated coefficient on Spending Shock is not significantly different from zero. This is the expected result if governments in PEI did not respond to expenditure shocks in their revenue decisions.

K & M (1998b) estimated the marginal tax rate in PEI to be 0.01. Since the coefficient on Expected Change in GDP is estimated to be 3.01, this may also be symptomatic of government distrust of forecasts. This supports the conclusion reached above for the Expected Change in GDP coefficient in the ΔS_t equation which suggested government perception of inaccurate forecasts. Again, this discrepancy may be due to the small size of the province.

Thus, the overall conclusion from the PEI equations is that, like Newfoundland, governments in this province appear to treat shocks as permanent. We now turn to an examination of the results for Nova Scotia.

Nova Scotia

Recall that no equations for Nova Scotia were included in the final system estimation due to the inability to satisfactorily solve the heteroscedasticity problem and obtain well specified equations. We now turn to an examination of the results for New Brunswick.

New Brunswick

The SUR results for New Brunswick are given in table 4.23 below.

Table 4.23: SUR Results For New Brunswick

Dependent Variable	Constant	Revenue Shock	Spending Shock	Expected Change in GDP
ΔS_t	120.43 (111.11)	-0.02 (0.14)	-0.51 (0.11)**	0.07 (0.27)
ΔR_t	-49.65 (108.98)	-0.45 (0.13)**	-0.01 (0.09)	0.50 (0.26)*

In both the ΔS_t and ΔR_t equations above, the constant is not significantly different from zero. This indicates that governments in New Brunswick have tended to hold real per capita expenditures and revenues constant, everything else being equal.

Analysis of the ΔS_t equation shows that the coefficient on Revenue Shock is not significantly different from zero. This is consistent with the bygones be bygones hypothesis. The estimated coefficient on Spending Shock, however, is significantly different from negative one. Again, this indicates that governments in this province have behaved as if they viewed expenditure shocks as permanent. The coefficient's value of -0.51 indicates that an unexpected increase/decrease in spending of $1.00 last fiscal year caused the government to budget for an additional increase/decrease in spending of $0.49 this fiscal year.

K & M (1998b) estimated the marginal spending rate in New Brunswick to be -0.14. The estimate obtained here is 0.07 with a standard error of 0.27. Thus, the two estimates seem to be reasonably close. Government faith in GDP forecasts is indicated.

Turning to the ΔR_t equation we see that the estimated coefficient on Revenue Shock is significantly different from negative one at -0.45. As such, this coefficient indicates that governments in this province have also responded to revenue shocks. The insignificant estimated coefficient on Spending Shock is, however, consistent with the bygones be bygones hypothesis.

K & M (1998b) estimated the marginal tax rate in New Brunswick to be 0.01. The estimate obtained here is 0.50 with a standard error of 0.26. As such, these two estimates seem significantly different. This suggests that GDP forecasts may have been seen as being inaccurate. This contrasts with the conclusion reached above.

Thus, the New Brunswick equations reveal that governments in this province also appear to treat shocks as permanent. We now turn to an examination of the results for Quebec.

Quebec

The SUR results for Quebec are given in table 4.24 below.

Table 4.24: SUR Results For Quebec

Dependent Variable	Constant	Revenue Shock	Spending Shock	Expected Change in GDP
ΔS_t	113.17 (29)**	-0.29 (0.18)	0.36 (0.17)**	0.15 (0.05)**
ΔR_t	66.15 (24)**	-0.55 (0.13)**	0.28 (0.12)**	0.21 (0.04)**

Examination of the ΔS_t equation reveals a constant which is significantly different from zero at about 113. The conclusion from this is that Quebec governments tended to increase real per capita expenditures. Analysis of the ΔR_t equation reveals a significant constant of about 66. Thus, the overall pattern which emerges is that Quebec governments increased both spending and revenues but increased spending by more per capita than they increased revenues.

In the ΔS_t equation, the coefficient on Revenue Shock is not significantly different from zero. This supports the bygones be bygones hypothesis. In contrast, however, the estimated coefficient on Spending Shock is significantly different from negative one. Its' value of 0.36 indicates that $1.00 in unexpected expenditures the previous fiscal year led to a $1.36 change in planned expenditures in the current fiscal year. Thus, this indicates that governments in Quebec behaved as if they viewed expenditure shocks as permanent.

K & M (1998b) estimated the marginal spending rate in Quebec to be 0.00. Since the estimated coefficient on Expected GDP obtained here is significantly different from zero at 0.15, possible government distrust of GDP forecasts is indicated.

Turning to the ΔR_t equation, we see that the coefficient on Revenue Shock is significantly different from negative one at a value of -0.55. This indicates that governments in Quebec behaved as if they viewed $0.45 of every $1.00 of unexpected revenue to in fact be permanent.

The estimated coefficient on Spending Shock is significantly different from zero with a value of 0.28. This indicates an unexpected spend and tax policy on the part of Quebec governments.

K & M (1998b) estimated the marginal tax rate in Quebec to be 0.11. The estimate obtained here of 0.21 with a standard error of 0.04 looks to be significantly different from K & M's estimate. Less than full faith in GDP forecasts is therefore indicated, supporting the conclusion reached above.

Thus, examination of the equations for Quebec also reveals that governments in this province appear to treat shocks as permanent to one degree or another. We now turn to an examination of the results for Ontario.

Ontario

The SUR results for Ontario are given in table 4.25 below. Recall that no ΔR_t equation was included due to the inability to obtain a well specified equation.

Table 4.25: SUR Results For Ontario

Dependent Variable	Constant	Revenue Shock	Spending Shock	Expected Change in GDP
ΔS_t	118.21 (35.7)**	0.32 (0.23)	-0.14 (0.17)**	0.04 (0.05)
ΔR_t				

Analysis of the ΔS_t equation shows a positive constant that is significantly different from zero. This indicates that, *ceteris paribus*, governments in Ontario have tended to increase real spending by about $118 per person in each year of the study period.

The ΔS_t equation, like that for Quebec, also reveals a coefficient on Spending Shock which is significantly different from one. This indicates that governments in Ontario acted as if they viewed spending shocks as permanent and built them into subsequent budgets. The fact that the coefficient on Revenue Shock is not different from zero is consistent with the bygones be bygones hypothesis.

The coefficient on Expected Change in GDP was not significantly different from zero. K & M (1998b) also estimated the marginal spending rate in Ontario to be not significantly different from zero. Thus, this coefficient indicates that governments in Ontario did behave as if they viewed GDP estimates to be accurate.

Thus, once again, the results from the Ontario equation implies that shocks appear to be treated as permanent. We now turn to an examination of the results for Manitoba.

Manitoba

The SUR results for Manitoba are given in table 4.26 below.

Table 4.26: SUR Results For Manitoba

Dependent Variable	Constant	Revenue Shock	Spending Shock	Expected Change in GDP
ΔS_t	63.49 (45.46)	0.19 (0.14)	-0.84 (0.12)	-0.07 (0.29)
ΔR_t	63.74 (45.78)	-0.43 (0.16)**	-0.27 (0.13)**	0.14 (0.23)

Examination of both the ΔS_t and ΔR_t equations reveals an insignificant constant. Thus, *ceteris paribus*, governments in Manitoba have tended to hold real per capita spending and revenues constant.

Analysis of the ΔS_t equation reveals an estimated coefficient on Revenue Shock which is not significantly different from zero and a coefficient on Spending Shock which is not significantly different from negative one. Both of these coefficients therefore support the hypothesis that governments in Manitoba let bygones be bygones and did not react to unexpected shocks.

K & M (1998b) estimated the marginal spending rate in Manitoba to be -0.07. Since this is exactly the same as that estimated here, this result indicates that governments in Manitoba also seemed to trust GDP estimates when making expenditure decisions.

Examination of the ΔR_t equation, however, does not lend as much support to the bygones be bygones hypothesis. The coefficient on Revenue Shock is significantly different from negative one at -0.43. Once more, this alludes to the fact that governments in Manitoba responded to unexpected revenue changes in subsequent revenue budgeting.

The estimated coefficient on Spending Shock is significantly different from zero at -0.27. As such this is indicative of a rather curious policy of reducing revenues in response to unexpected increases in spending and increasing revenues in response to unexpected decreases in spending.

K & M (1998b) estimated Manitoba's marginal tax rate to be 0.05. The estimate obtained here is 0.14 with a standard error of 0.23 and as such the two estimates appear to be reasonably similar. Thus, government faith in GDP forecasts is indicated. This supports the conclusion reached above.

Thus, the equations for Manitoba reveal a mixed bag, with governments appearing to respond to shocks in their revenue decisions but not in their spending decisions. We now turn to an examination of the results for Saskatchewan.

Saskatchewan

The SUR results for Saskatchewan are given in table 4.27 below. Recall that no ΔS_t equation was included due to the inability to obtain a well specified equation.

Table 4.27: SUR Results For Saskatchewan

Dependent Variable	Constant	Revenue Shock	Spending Shock	Expected Change in GDP
ΔS_t				
ΔR_t	54.76 (61.04)	-0.56 (0.13)**	0.18 (0.11)*	0.23 (0.10)**

Examination of the ΔR_t equation reveals an insignificant constant. This indicates that, *ceteris paribus*, governments in Saskatchewan have tended to keep revenues constant over the study period.

Analysis of the ΔR_t equation shows that the coefficient on Revenue Shock is significantly different from negative one at -0.56. Thus, governments in Saskatchewan appear to behave as if they viewed revenue shocks as permanent. Again, this value indicates that an unexpected increase/decrease in revenues of $1.00 in the previous period caused the government to budget for an additional increase/decrease in revenues of $0.44 this period.

The estimated coefficient on Spending Shock is significantly different from zero at the 10% significance level, taking a value of 0.18. This points to the conclusion that governments followed an unexpected spend and tax policy.

Finally, the estimated marginal taxation rate for Saskatchewan is 0.23 with a standard error of 0.10. K & M (1998b) estimated a marginal tax rate of 0.09. These estimates do not appear to be dramatically different and as such this indicates that Saskatchewan governments viewed GDP forecasts as being accurate.

Thus, examination of the equation for Saskatchewan reveals that governments in this province tended to treat shocks as if they were permanent. We now turn to an examination of the results for Alberta.

Alberta

The SUR results for Alberta are given in table 4.28 below.

Table 4.28: SUR Results For Alberta

Dependent Variable	Constant	Revenue Shock	Spending Shock	Expected Change in GDP
ΔS_t	121.16 (96.56)	0.20 (0.11)*	-0.74 (0.20)	0.02 (0.08)
ΔR_t	31.39 (123.63)	-0.29 (0.16)**	-0.03 (0.28)	0.25 (0.11)**

As can be seen, in both the ΔS_t and the ΔR_t equations, the constant is insignificant. This implies that governments in Alberta tended to keep spending and revenues constant over the study period.

The ΔS_t equation has a coefficient on Revenue Shock which is significantly different from zero. This implies an unexpected tax and spend policy on the part of Alberta governments. The estimated coefficient on Spending Shock, however, is not significantly different from negative one. This supports the bygones be bygones hypothesis.

K & M (1998b) estimated the marginal spending rate in Alberta to be -0.08. The estimate obtained here is 0.02 with a standard error of 0.08. Again, the relative similarity of the estimates is taken as an indication of government faith in GDP forecasts.

Turning to the ΔR_t equation, we see that the coefficient on Revenue Shock is significantly different from negative one at -0.29. The standard interpretation of government response to unexpected shocks holds. The estimated coefficient on Spending Shock is insignificant and therefore supports the bygones be bygones hypothesis.

The estimated coefficient on Expected Change in GDP is similar to that obtained by K & M (1998b). The coefficient in this model is estimated at 0.25 with a standard error of 0.11 while their coefficient estimate was 0.19. This result confirms that from above that GDP forecasts were trusted by Alberta governments.

British Columbia

The SUR results for British Columbia are given in table 4.29 below.

Table 4.29: SUR Results For British Columbia

Dependent Variable	Constant	Revenue Shock	Spending Shock	Expected Change in GDP
ΔS_t	103.96 (40)**	0.68 (0.20)**	-0.19 (0.17)**	-0.001 (0.08)
ΔR_t	108.70 (34)**	-0.26 (0.15)**	0.15 (0.12)	0.13 (0.05)**

Analysis of the ΔS_t equation shows a significant constant of about 104 while the constant in the ΔR_t equation is significant at about 109. This means that governments in British Columbia have tended to increase spending and revenues by about the same amount per capita, *ceteris paribus*.

In the ΔS_t equation the coefficient on Revenue Shock is significantly different from zero at 0.68. This points to an unexpected tax and spend policy on the part of governments in British Columbia.

The coefficient on Spending Shock is significantly different from negative one at -0.19. The conclusion drawn from this is that governments in British Columbia have behaved as if expenditure shocks were permanent by partially building them in to subsequent budgets.

The marginal spending rate for British Columbia was estimated by K & M (1998b) to be -0.08. The coefficient on Expected Change in GDP is estimated here to be

-0.001 with a standard error of 0.08. These two estimates are sufficiently similar that government faith in GDP forecasts is indicated.

Examination of the ΔR_t equation shows an estimated coefficient on Revenue Shock which is significantly different from negative one. As with the other provinces discussed above, the interpretation of this is that governments in British Columbia responded to unexpected changes in revenues. The estimated coefficient on Spending Shock is not significantly different from zero as hypothesized.

K & M (1998b) estimated the marginal tax rate in British Columbia to be 0.06. The marginal tax rate estimated here seems similar enough to K & M's estimate to conclude that government faith in GDP forecasts is indicated. This concurs with the conclusion reached above.

Results Summary and Concluding Remarks

The following two tables summarize, for all ten provinces, the spending and revenue responses to an unexpected increase in spending or revenue in the previous fiscal year. Table 4.30 concentrates on the spending response to shocks and represents results obtained from the ΔS_t equations reported in the previous section. Recall that the spending response to a \$1.00 revenue shock is zero when the bygones be bygones hypothesis is true. The spending response to a \$1.00 spending shock represents the amount of the \$1.00 shock that is built into next year's spending. This response was calculated by subtracting -1 from the estimated coefficient on spending shock. Thus, an estimated coefficient of -0.67 would translate into a \$1.00 spending shock resulting in an increase in spending budgeted for the next fiscal year of \$0.33 (-0.67 -(-1) = 0.33). Note that under the bygones be bygones hypothesis this value should be zero.

Table 4.30: Change in Spending Response to Budgetary Shocks

Province	To a $1 Revenue Shock	To a $1 Spending Shock
Newfoundland	0	0.44
PEI	0.48	0
Nova Scotia	N/A	N/A
New Brunswick	0	0.49
Quebec	0	1.36
Ontario	0	0.86
Manitoba	0	0
Saskatchewan	N/A	N/A
Alberta	0.20	0
B.C.	0.68	0.81

NOTE: All values in table 4.30 represent statistically significant coefficients.

Table 4.31 concentrates on the revenue response to shocks and represents results obtained from the ΔR_t equations reported in the previous section. Similar to table 4.30, the revenue response to a $1.00 revenue shock represents the amount of the $1.00 shock that is built into next year's budgeted revenues. This response was again calculated by subtracting -1 from the estimated coefficient on revenue shock. Again, the revenue response to a $1.00 revenue or spending shock is zero if the bygones be bygones hypothesis holds.

Table 4.31: Change in Revenue Response to Budgetary Shocks

Province	To a $1 Revenue Shock	To a $1 Spending Shock
Newfoundland	1.34	-0.26
PEI	0.54	0
Nova Scotia	N/A	N/A
New Brunswick	0.55	0
Quebec	0.45	0.28
Ontario	N/A	N/A
Manitoba	0.57	-0.27
Saskatchewan	0.44	0.18
Alberta	0.71	0
B.C.	0.74	0

NOTE: All values in table 4.31 represent statistically significant coefficients.

These two tables show a tendency for all provincial governments to behave as if they view expenditure and revenue shocks as permanent. In other words, the bygones be bygones hypothesis does not, as a rule, appear to hold.

Examining the spending response table (table 4.30), we see that a $1.00 expenditure shock results in increased spending in the next fiscal year by governments in five of the eight applicable provinces. Only in Prince Edward Island, Manitoba, and Alberta do unexpected expenditures appear to have no long term effect. Governments in three of the eight provinces demonstrated unexpected tax and spend policies in their spending responses to a $1.00 revenue shock. Of these, British Columbia's appears to be the most extreme with Prince Edward Island's coming in second. Thus, on the whole, the bygones be bygones hypothesis does not appear to hold upon examination of spending response to shocks.

Examining the revenue response table (table 4.31), we see that an unexpected increase in revenues of $1.00 in the previous fiscal year results in increased budgeted revenue collection in the next fiscal year by governments in all of the eight applicable provinces. Of these provinces, Newfoundland demonstrates the most extreme reaction with the two westernmost provinces having the next largest reactions. This is possibly a reflection of the resource based nature of these province's economies. Governments in four of the eight applicable provinces did not exhibit any revenue response to unexpected expenditures. Governments in Newfoundland and Manitoba exhibited the unusual policy of reducing revenues in response to higher than expected spending and vice versa. Finally, governments in Quebec and Saskatchewan appear to have followed the more conventional unexpected spend and tax policy. Thus, on the whole, the bygones be bygones hypothesis does not appear to hold upon examination of revenue response to shocks. This is particularly true in terms of the response to revenue shocks.

Table 4.32 summarizes the results with regards to the estimated coefficients on Expected Change in GDP. In this table, the columns "Spending Side" and "Revenue Side" represent the estimated marginal spending rate and taxation rate respectively. The word "Trusted" indicates that the estimated marginal spending or tax rate was not judged to be significantly different from that estimated for the province by K & M (1998b). In other words, budget makers in the province tended to view GDP estimates as accurate. The word "Mistrusted" indicates that the relevant value was judged to be different and hence that budget makers may have viewed GDP estimates as being inaccurate.

Table 4.32: Marginal Spending/Tax Rate Response

Province	Spending Side	Revenue Side
Newfoundland	Trusted	Mistrusted
Prince Edward Island	Mistrusted	Mistrusted
Nova Scotia	N/A	N/A
New Brunswick	Trusted	Mistrusted
Quebec	Mistrusted	Mistrusted
Ontario	Trusted	N/A
Manitoba	Trusted	Trusted
Saskatchewan	N/A	Trusted
Alberta	Trusted	Trusted
British Columbia	Trusted	Trusted

Thus, table 4.32 shows that GDP forecasts appear to be trusted more in the western part of the country than in the eastern. Only in Quebec and Prince Edward Island, however, were GDP expectations seen as always being incorrect. Keeping in mind the caveat regarding the results from PEI, GDP forecasts do seem to be trusted more often than not. As well, GDP forecasts seem to be trusted more when budgeting expenditures as opposed to revenues. This indicates that budget makers in spending departments tended to take GDP expectations at face value while those responsible for revenues were not so trusting.

Table 4.33 summarizes the long term trends, holding all else equal, of per capita spending and revenue generation in each province. These results are obtained from the constant in the estimated equations. In this table, a 🡅 represents an increase, 🡇 a decrease, ■ no change, and N/A means no equation was estimated for this province.

Table 4.33: Long Term Spending and Revenue Trends

Province	Expenditures	Revenues
Newfoundland	■	■
Prince Edward Island	🡇	🡇
Nova Scotia	N/A	N/A
New Brunswick	■	■
Quebec	🡅	🡅
Ontario	🡅	N/A
Manitoba	■	■
Saskatchewan	N/A	■
Alberta	■	■
British Columbia	🡅	🡅

As can be seen from table 4.33, governments in three of the eight applicable provinces increased spending. Governments in two of the eight applicable provinces increased revenues. As well, both expenditures and revenues tend to remain constant if they do not increase. Only in Prince Edward Island have expenditures or revenues been reduced. No regional patterns appear to be apparent.

Thus, the central conclusion reached in this chapter is that provincial government budget makers do indeed tend to respond to unexpected shocks in expenditures and revenues. That is, the bygones be bygones hypothesis does not appear to hold. This conclusion is most strongly seen in the revenue response to revenue shocks, where all of the provinces were found to unfailingly respond to past revenue shocks when budgeting current revenues.

In the next chapter we will again see how provincial government budgets react to budgetary shocks. However, the model will be modified so that revenue and expenditure shocks are broken into their positive and negative components. This will enable the study of whether provincial governments responded differently to positive as opposed to negative revenue and expenditure shocks.

CHAPTER FIVE - MODEL MODIFICATION AND EMPIRICAL RESULTS

New Model Specification

As noted, this chapter will examine how the provincial governments responded to budgetary shocks when these shocks are divided into their positive and negative components. Thus, this will allow for an examination of whether the provinces systematically reacted differently to positive versus negative shocks.

In order to examine this question, the model used previously must be modified slightly. The first step in this modification is to create two dummy variables, RDUM and SDUM, equal to one is fiscal years when revenue shocks (RDUM) and expenditure shocks (SDUM) are positive and zero otherwise. The next step is to use these dummy variables to create new variables which represent data on positive and negative shocks. On the revenue side, for example, this would entail creating $RSHOCK(+)_{t-1} = RDUM * RSHOCK_{t-1}$ to represent positive revenue shocks and $RSHOCK(-)_{t-1} = RSHOCK_{t-1} - RSHOCK(+)_{t-1}$ to represent negative revenue shocks. The same process is followed on the expenditure side to obtain $SSHOCK(+)_{t-1}$ and $SSHOCK(-)_{t-1}$.

With these new variables defined, the equation modeling the government's change in spending is given by equation (5.1).

Equation (5.1)

$$\Delta S_t = \alpha_0 + \alpha_1 * [RSHOCK(+)_{t-1}] + \alpha_2 * [RSHOCK(-)_{t-1}] + \alpha_3 * [SSHOCK(+)_{t-1}] +$$

$$\alpha_4 * [SSHOCK(-)_{t-1}] + \alpha_5 * [E(t-1)GDP_t - GDP_{t-1}] + e_t$$

The equation modeling the government's change in revenue is given by equation (5.2).

Equation (5.2)

$$\Delta R_t = \beta_0 + \beta_1 * [RSHOCK(+)_{t-1}] + \beta_2 * [RSHOCK(-)_{t-1}] + \beta_3 * [SSHOCK(+)_{t-1}] +$$

$$\beta_4 * [SSHOCK(-)_{t-1}] + \beta_5 * [E(t-1)GDP_t - GDP_{t-1}] + \varepsilon_t$$

Note that the variables have the same definitions as applied previously and are all in real per capita terms. Again, e_t and ε_t measure random unobserved changes in planned spending and revenues plus random unexpected changes in current economic conditions (which are assumed to affect spending and revenues on a dollar-for-dollar basis).

Interpretation of the Coefficients

Interpretation of the coefficients of the regression equations (5.1) and (5.2) is almost identical to that applied previously. In equation (5.1), for example, the expected coefficients on the SSHOCK variables, α_3 and α_4, are negative one if governments are letting bygones be bygones and are not responding to shocks. If either variable has a coefficient which is different from negative one, government response to shocks is indicated.

Note, however, that it is now possible to differentiate between government responses to positive and negative shocks. Thus, it might be observed that $\alpha_3 = -1$ while $\alpha_4 \neq -1$ indicating that budget makers in the province did not respond to positive spending shocks but did respond to negative spending shocks.

The interpretation of the other coefficients in equation (5.1) is also fairly standard. If the coefficient on $RSHOCK(+)_{t-1}$, α_1, is positive and significantly different from zero, an unexpected tax and spend policy is indicated. If the coefficient on $RSHOCK(-)_{t-1}$, α_2, is positive and significant, an unexpected deficit fighting policy is indicated (reduced spending in response to lower than expected revenues.) Of course, if budget makers are letting bygones be bygones, both coefficients should be zero.

Once again, the constant indicates how spending has tended to change, *ceteris paribus*, in the province during the study period. The coefficient on the expected change in GDP, α_5, should be similar to the marginal spending rate in the province as estimated by K & M (1998b).

The interpretation for equation (5.2) is virtually identical. A government which let bygones be bygones and did not respond to shocks would result in estimated coefficients on both RSHOCK variables, β_1 and β_2, of negative one. Similarly, the coefficients on both SSHOCK variables, β_3 and β_4, should be equal to zero. Any coefficients which do not take these values are indicative of government response to shocks. Once again, the constant indicates how revenue has tended to change, *ceteris paribus*, during the study period. The coefficient on the expected change in GDP, β_5, should be similar to the marginal taxation rate in the province as estimated by K & M (1998b).

Estimation Procedure

The same methodology as was applied in the previous chapter is applied here. That is, each equation for each province is estimated initially using Ordinary Least Squares (OLS). These equations are then tested for econometric validity using a number of specification, heteroscedasticity, and autocorrelation tests. Again, if heteroscedasticity or autocorrelation are found, they are corrected and the equation estimated again. The result of this process should be twenty well specified equations.

The next step in the process is to estimate these twenty equations simultaneously in a system using the Seemingly Unrelated Regressions (SUR) technique. As before, this is deemed appropriate as all of the provinces are part of the larger Canadian economy. Shocks in one part of the economy are likely to affect other parts, increasing the likelihood of contemporaneous correlation of disturbances in the equations. Again, in this case, the SUR technique will improve the efficiency of the estimated coefficients.

The following pages give the results of the above procedure on a province by province basis. A table giving the results of the OLS estimations for each province is presented. Then the results of the SUR system regression are given and the final form coefficients are interpreted.

Note that in the OLS results tables below, the standard errors of the regression coefficients are in brackets. Asterisks on these standard errors denote rejection of a null hypothesis at the 10% (*) and 5% (**) significance levels on a t-test. The null hypothesis on the coefficient of Revenue Shock (+) and Revenue Shock (-) when ΔR_t is the dependent variable and on Spending Shock (+) and Spending Shock (-) when ΔS_t is the dependent variable is that the coefficient is equal to negative one. On all other coefficients, the null hypothesis is that the coefficient is zero. Asterisks on the specification, heteroscedasticity, and autocorrelation tests denote rejection of the null hypothesis at the 10% (*) and 5% (**) significance levels. An asterisk on the Durbin-Watson *d* indicates autocorrelation.

OLS Results From Modified Model

Table 5.1: Modified OLS Results For Newfoundland

Dependent Variable	ΔS_t (1)	ΔR_t (2)
Constant	-13.83 (244.54)	14.36 (121.02)
Revenue Shock (+)	0.21 (1.24)	0.16 (0.61)*
Revenue Shock (-)	0.96 (0.92)	0.57 (0.45)**
Spending Shock (+)	-0.88 (0.41)	-0.29 (0.20)
Spending Shock (-)	-0.14 (0.59)	-0.13 (0.29)
Expected Change in GDP	0.86 (0.75)	0.57 (0.37)
$\overline{R}^2$	0.09	0.06
RESET(1)	0.196	0.025
RESET(2)	0.239	0.077
RESET(3)	0.168	0.393
ARCH(1)	0.098	0.274
ARCH(2)	0.177	0.660
White	16.430	23.070
BPG	5.515	5.334
LM	0.626	0.058
Durbin-Watson d	2.042	1.856
F test on Zero Restrictions	1.50	1.31

Table 5.2: Modified OLS Results For Prince Edward Island

Dependent Variable	ΔS_t (1)	ΔR_t (2)
Constant	-555.99 (323.08)	2.55 (259.67)
Revenue Shock (+)	0.79 (0.52)	-0.12 (0.36)**
Revenue Shock (-)	0.19 (0.58)	-0.50 (0.35)
Spending Shock (+)	-1.31 (0.44)	-0.70 (0.31)**
Spending Shock (-)	-0.11 (0.55)	0.96 (0.42)**
Expected Change in GDP	2.18 (0.89)**	0.60 (1.90)
$\overline{R}^2$	0.30	0.31
RESET(1)	0.446	0.087
RESET(2)	0.343	0.082
RESET(3)	0.252	0.514
ARCH(1)	1.268	0.024
ARCH(2)	2.125	0.040
White	17.614	21.936
BPG	3.043	6.309
LM	0.624	2.401
Durbin-Watson *d*	1.763	1.413
F test on Zero Restrictions	3.18	3.13

NOTE: Equation (2) represents results after the equation was corrected for autocorrelation using the Cochrane-Orcutt procedure.

Table 5.3: Modified OLS Results For Nova Scotia

Dependent Variable	ΔS_t (1)	ΔR_t (2)
Constant	340.01 (128)**	86.38 (76.02)
Revenue Shock (+)	1.63 (0.87)*	-0.22 (0.53)
Revenue Shock (-)	-0.38 (0.65)	-0.43 (0.39)
Spending Shock (+)	-1.40 (0.30)	-0.45 (0.18)**
Spending Shock (-)	0.87 (0.46)**	0.16 (0.27)
Expected Change in GDP	-0.22 (0.23)	0.25 (0.14)*
$\overline{R}^2$	0.41	0.34
RESET(1)	0.669	0.168
RESET(2)	2.279	0.821
RESET(3)	2.480*	0.638
ARCH(1)	0.324	0.353
ARCH(2)	1.638	0.827
White	23.603	22.568
BPG	6.287	17.922**
LM	1.983	0.847
Durbin-Watson *d*	2.274	1.972
F test on Zero Restrictions	4.41	3.62

Table 5.4: Modified OLS Results For New Brunswick

Dependent Variable	ΔS_t (1)	ΔR_t (2)
Constant	14.15 (186.69)	156.86 (178.95)
Revenue Shock (+)	-0.72 (0.64)	-1.20 (0.62)
Revenue Shock (-)	0.03 (0.46)	0.14 (0.45)**
Spending Shock (+)	-0.44 (0.34)	0.17 (0.33)
Spending Shock (-)	-0.53 (0.51)	-0.45 (0.49)
Expected Change in GDP	0.41 (0.42)	0.04 (0.40)
$\overline{R}^2$	0.10	0.04
RESET(1)	0.001	0.210
RESET(2)	0.335	0.165
RESET(3)	0.607	1.011
ARCH(1)	0.412	0.114
ARCH(2)	2.419	0.197
White	13.922	14.537
BPG	4.624	4.462
LM	1.287	0.578
Durbin-Watson d	2.128	1.858
F test on Zero Restrictions	1.59	1.20

Table 5.5: Modified OLS Results For Quebec

Dependent Variable	ΔS_t (1)	ΔR_t (2)
Constant	3.48 (53.31)	-24.15 (50.24)
Revenue Shock (+)	0.69 (0.39)	-0.18 (0.37)**
Revenue Shock (-)	-1.39 (0.54)**	-0.87 (0.51)
Spending Shock (+)	0.25 (0.40)**	0.70 (0.37)*
Spending Shock (-)	0.06 (0.51)*	-0.38 (0.48)
Expected Change in GDP	0.15 (0.06)**	0.22 (0.06)**
$\bar{R}^2$	0.25	0.46
RESET(1)	0.794	1.376
RESET(2)	0.750	1.232
RESET(3)	1.549	1.009
ARCH(1)	0.082	0.235
ARCH(2)	0.506	1.388
White	17.209	22.095
BPG	5.357	8.227
LM	0.168	1.219
Durbin-Watson *d*	2.094	2.253
F test on Zero Restrictions	2.70	5.36

Table 5.6: Modified OLS Results For Ontario

Dependent Variable	ΔS_t (1)	ΔR_t (2)
Constant	171.03 (91.5)*	19.14 (65.65)
Revenue Shock (+)	-0.05 (0.76)	-0.11 (0.55)
Revenue Shock (-)	0.61 (0.60)	-0.33 (0.43)
Spending Shock (+)	-0.13 (0.39)**	-0.12 (0.28)
Spending Shock (-)	0.48 (0.71)**	0.10 (0.51)
Expected Change in GDP	0.05 (0.08)	0.26 (0.06)**
$\bar{R}^2$	-0.07	0.43
RESET(1)	2.033	2.177
RESET(2)	1.727	4.751**
RESET(3)	1.123	4.279**
ARCH(1)	0.635	1.118
ARCH(2)	0.700	3.000
White	19.725	12.104
BPG	10.541*	5.150
LM	1.254	0.051
Durbin-Watson *d*	1.776	1.986
F test on Zero Restrictions	0.64	5.00

NOTE: Due to the failures of the Ramsey RESET test in equation (2), no final form of this equation will be included for Ontario in the system.

Table 5.7: Modified OLS Results For Manitoba

Dependent Variable	ΔS_t (1)	ΔR_t (2)
Constant	61.14 (61.41)	33.24 (62.69)
Revenue Shock (+)	-0.06 (0.42)	-0.25 (0.41)*
Revenue Shock (-)	0.64 (0.53)	-0.73 (0.53)
Spending Shock (+)	-0.88 (0.38)	-0.11 (0.37)
Spending Shock (-)	-0.83 (0.35)	-0.21 (0.34)
Expected Change in GDP	0.12 (0.42)	0.23 (0.30)
$\bar{R}^2$	0.33	0.06
RESET(1)	5.469**	0.0004
RESET(2)	4.148**	0.042
RESET(3)	2.773*	0.207
ARCH(1)	0.066	0.435
ARCH(2)	0.521	0.567
White	23.596	23.807
BPG	6.939	2.461
LM	0.135	1.175
Durbin-Watson *d*	1.698	1.684
F test on Zero Restrictions	3.61	1.36

NOTE: Equations (1) and (2) represent results after the equations were corrected for autocorrelation using the Cochrane-Orcutt procedure. Due to the failure of the Ramsey RESET tests, no final form of equation (1) for Manitoba will be included.

Table 5.8: Modified OLS Results For Saskatchewan

Dependent Variable	ΔS_t (1)	ΔR_t (3)
Constant	425.69 (135)**	-5.19 (105.26)
Revenue Shock (+)	0.37 (0.36)	-0.27 (0.39)*
Revenue Shock (-)	1.16 (0.42)**	-0.99 (0.50)
Spending Shock (+)	-0.95 (0.28)	0.13 (0.27)
Spending Shock (-)	0.76 (0.59)**	0.08 (0.63)
Expected Change in GDP	0.03 (0.12)	0.27 (0.17)
$\overline{R}^2$	0.55	0.18
RESET(1)	0.058	0.051
RESET(2)	1.411	0.588
RESET(3)	0.910	0.448
ARCH(1)	0.701	0.003
ARCH(2)	1.720	0.681
White	23.954	23.871
BPG	2.555	5.580
LM	0.015	2.103
Durbin-Watson *d*	1.746	1.683
F test on Zero Restrictions	7.30	2.13

NOTE: Equation (2) represents results after the equation was corrected for autocorrelation using the Cochrane-Orcutt iterative procedure.

Table 5.9: Modified OLS Results For Alberta

Dependent Variable	ΔS_t (1)	ΔR_t (2)
Constant	262.59 (244.39)	-177.03 (309.79)
Revenue Shock (+)	-0.005 (0.32)	-0.18 (0.41)*
Revenue Shock (-)	0.31 (0.37)	-0.74 (0.47)
Spending Shock (+)	-0.64 (0.56)	-0.10 (0.71)
Spending Shock (-)	0.13 (0.65)*	-0.53 (0.82)
Expected Change in GDP	0.04 (0.13)	0.34 (0.17)*
$\overline{R}^2$	-0.03	0.08
RESET(1)	0.002	0.006
RESET(2)	0.259	0.413
RESET(3)	0.356	1.587
ARCH(1)	0.079	0.416
ARCH(2)	2.166	0.696
White	23.309	23.076
BPG	4.685	3.574
LM	1.023	1.024
Durbin-Watson *d*	2.278	1.867
F test on Zero Restrictions	0.85	1.47

Table 5.10: Modified OLS Results For British Columbia

Dependent Variable	ΔS_t (1)	ΔR_t (2)
Constant	115.68 (70.73)	60.62 (77.55)
Revenue Shock (+)	0.38 (0.84)	-0.56 (0.71)
Revenue Shock (-)	0.68 (0.53)	-0.22 (0.46)
Spending Shock (+)	-0.22 (0.44)*	0.21 (0.33)
Spending Shock (-)	-0.13 (0.62)	-0.55 (0.54)
Expected Change in GDP	0.005 (0.12)	0.17 (0.07)**
$\overline{R}^2$	0.03	0.08
RESET(1)	0.327	1.203
RESET(2)	0.156	0.712
RESET(3)	0.098	0.501
ARCH(1)	1.327	0.026
ARCH(2)	2.247	0.373
White	19.919	18.151
BPG	9.360*	9.059
LM	1.815	0.177
Durbin-Watson *d*	1.750	1.953
F test on Zero Restrictions	1.14	1.46

NOTE: Equation (1) represents results after the equation was corrected for autocorrelation using the Cochrane-Orcutt procedure.

SUR System Results and Interpretation by Province

The tables below give the regression results obtained when the eighteen well specified provincial equations were estimated as a SUR system with a total of 479 observations. Again, the system results are given in an individual table for each province, however, it is important to note that these results are part of a larger system made up of regression equations for every province. Following each table is an economic interpretation of these coefficients for each province.

Note that in these tables the standard errors of the estimated coefficients are in brackets. Asterisks beside the brackets indicate rejection of a null hypothesis at the 10% (*) and 5% (**) levels of significance. The null hypothesis on the coefficient of Revenue Shock (+) and Revenue Shock (-) when ΔR_t is the dependent variable and on Spending Shock (+) and Spending Shock (-) when ΔS_t is the dependent variable is that the coefficient is equal to negative one. On all other coefficients, the null hypothesis is that the coefficient is zero.

Newfoundland

The SUR results for Newfoundland are given table 5.11 below.

Table 5.11: Modified SUR Results For Newfoundland

Dependent Variable	Constant	Revenue Shock (+)	Revenue Shock (-)	Spending Shock (+)	Spending Shock (-)	Expected Change in GDP
ΔS_t	243.43 (177.62)	-0.35 (0.76)	1.18 (0.58)**	-1.02 (0.25)	-0.01 (0.36)**	0.29 (0.53)
ΔR_t	12.58 (86.85)	-0.03 (0.35)**	0.56 (0.27)**	-0.36 (0.11)**	-0.01 (0.18)	0.67 (0.25)**

Examination of both the ΔS_t and ΔR_t equations reveals insignificant constants in each. Again, this indicates that governments in Newfoundland over the study period have tended, *ceteris paribus*, to hold real per capita expenditures and revenues constant. This concurs with the result obtained in the previous chapter.

The coefficient on positive revenue shocks in the ΔS_t equation is not significantly different from zero, the value expected if the bygones be bygones hypothesis holds. The coefficient on negative revenue shocks, however, is significantly different from zero with a value of 1.18. This means that in response to a \$1.00 unexpected decrease in revenues the previous fiscal year, governments in Newfoundland tended to reduce spending by \$1.18 in the current fiscal year.

Turning to the coefficients on the Spending Shock variables we see that positive spending shocks appear to have been ignored. Negative spending shocks, however, appear to have been viewed as being permanent. The estimated coefficient of -0.01 indicates that roughly 100% of unexpected decreases in spending were built into subsequent budgets.

K & M (1998b) estimated the marginal spending rate in Newfoundland to be -0.04. The estimate obtained here is 0.29 with a large standard error of 0.53. Given this large standard error, the coefficients were judged to be reasonably similar. Again, this suggests that governments in Newfoundland seemed to trust GDP forecasts when making expenditure decisions. This concurs with the conclusion reached in the previous chapter.

Turning to the ΔR_t equation, we see that both coefficients on Revenue Shock are significantly different from negative one. This indicates that revenue shocks were responded to as if they were viewed as being permanent by governments in

Newfoundland. The coefficients indicate that a positive revenue shock of $1.00 in the previous period caused the government to anticipate nearly an additional $1.00 in revenue this period. A negative revenue shock of $1.00 in the previous period caused the government to anticipate a drop in revenue of about $1.56 this period.

The coefficient on positive expenditure shocks is significantly different from zero at -0.36. This indicates that governments in Newfoundland decreased revenues in response to unexpected increases in spending. This is a very unusual response, however, this result was also found in the previous chapter. In contrast, negative spending shocks appear to have been ignored.

K & M (1998b) estimated Newfoundland's marginal tax rate to be 0.03. The estimate obtained here is 0.67 with a standard error of 0.25. As such, these estimates seem fairly far apart. Thus, this result suggests that GDP estimates were viewed as being incorrect when revenues were being budgeted. This conclusion is in agreement with that obtained in Chapter Four.

Prince Edward Island

The SUR results for Prince Edward Island are given in table 5.12 below.

Table 5.12: Modified SUR Results For Prince Edward Island

Dependent Variable	Constant	Revenue Shock (+)	Revenue Shock (-)	Spending Shock (+)	Spending Shock (-)	Expected Change in GDP
ΔS_t	-630.99 (255)**	0.52 (0.37)	0.27 (0.43)	-1.31 (0.31)	0.05 (0.39)**	2.48 (0.70)**
ΔR_t	-196.32 (176.49)	-0.04 (0.21)**	-0.45 (0.21)**	-0.77 (0.18)**	0.87 (0.24)**	2.07 (1.28)

Examination of the ΔS_t equation reveals that the constant is negative and significantly different from zero at the 5% level. Recall that the coefficient estimate obtained in the previous chapter was significant at -555.82 with a standard error of 244. The estimate obtained here is -631 with a standard error of 255. Thus, these two estimates seem reasonably similar.

The constant in the ΔR_t equation is not significantly different from zero with a value of -196.32 and a standard error of 176.49. The coefficient estimate obtained in the previous chapter was significantly different from zero at -337.67 with a standard error of 197.7. These estimates do not, however, seem qualitatively different.

Turning to the ΔS_t equation we see that neither of the estimated coefficients on Revenue Shock are significantly different from zero. This is what is expected if the bygones be bygones hypothesis holds. As well, the coefficient on positive expenditure shocks is not significantly different from negative one. Thus, governments in PEI appear to have treated unexpected spending increases as temporary. Negative expenditure shocks, on the other hand, seem to be viewed as being permanent. The estimated coefficient on Spending Shock (-) of 0.05 indicates that a $1.00 decrease in spending in the previous fiscal year caused the government to anticipate spending to decrease by about $1.05 in the current fiscal year.

K & M (1998b) estimated Prince Edward Island's marginal spending rate to be 0.11. The estimate obtained here is 2.48 with a standard error of 0.70. Again, there is a large discrepancy between the two estimates. Governments in PEI therefore appear to have viewed GDP estimates as highly inaccurate when making their spending decisions. This result concurs with that obtained in the previous chapter.

As was noted in the last chapter, however, PEI is a very small province and data collected from it may be subject to measurement error. This may explain some of the extreme coefficients estimated for the province. The SUR system was estimated without the equations for PEI with little difference in the other estimated coefficients or their standard errors. Thus, the system does not appear overly sensitive to the inclusion of PEI and it was therefore included.

Examination of the ΔR_t equation reveals universal rejection of the bygones be bygones hypothesis. Both of the estimated coefficients on Revenue Shock are significantly different from negative one, indicating that both positive and negative shocks were viewed as being permanent. The estimated coefficient on Revenue Shock (+) of -0.04 indicates that an unexpected increase in revenues last period caused the government to anticipate an additional $0.96 increase in revenues this period. The estimated coefficient on Revenue Shock (-) of -0.45 indicates that an unexpected decrease in revenues last period caused the government to anticipate an additional $0.55 decrease in revenues this period.

The estimated coefficients on Spending Shock also reveal response to unexpected shocks. In response to an unexpected $1.00 increase in spending last fiscal year, the government appears to have decreased revenues by $0.77 this fiscal year. Again, this is a curious result and may be due to the possible data problems for PEI discussed above. In response to an unexpected $1.00 decrease in spending last period, the government appears to have followed the more sensible policy of decreasing revenues this year. Nevertheless, both coefficients provide evidence against the bygones be bygones hypothesis.

K & M (1998b) estimated the marginal tax rate to be 0.01. The estimate obtained here is 2.07 with a standard error of 1.28. Again, the two estimates are quite different and mistrust of GDP forecasts is indicated.

Nova Scotia

The SUR results for Nova Scotia are given in table 5.13 below.

Table 5.13: Modified SUR Results For Nova Scotia

Dependent Variable	Constant	Revenue Shock (+)	Revenue Shock (-)	Spending Shock (+)	Spending Shock (-)	Expected Change in GDP
ΔS_t	276.09 (93.8)**	2.07 (0.62)**	-0.30 (0.47)	-1.35 (0.22)	0.56 (0.33)*	-0.18 (0.17)
ΔR_t	56.84 (42.34)	0.05 (0.25)**	-0.53 (0.19)**	-0.43 (0.09)**	0.05 (0.13)	0.24 (0.07)**

Examining the equations for Nova Scotia we see that the constant is significantly different from zero in the ΔS_t equation but not in the ΔR_t equation. The conclusion from this is that governments in Nova Scotia have been inclined to increase real per capita spending by about $276 per year while holding revenues constant.

The coefficient on Revenue Shock (+) in the ΔS_t equation is significantly different from zero at 2.07. This provides evidence of a fairly extreme unexpected tax and spend policy. The coefficient on Revenue Shock (-), however, is not significantly different from zero and thus supports the bygones be bygones hypothesis.

Looking at the Spending Shock coefficients in this equation we see that positive expenditure shocks were ignored while negative expenditure shocks were treated as permanent. The coefficient on Spending Shock (-) of 0.56 indicates that an unexpected decrease in expenditures of $1.00 last period caused the government to expect a further decrease of $1.56 this period.

K & M (1998b) estimated the marginal spending rate in Nova Scotia to be 0.20. This contrasts with the estimate here of -0.18 with a standard error of 0.17. Thus, GDP forecasts were not trusted when making expenditure decisions.

Turning to the ΔR_t equation we see that both Revenue Shock coefficients are significantly different from negative one, indicating that shocks were treated as permanent. The coefficients suggest that an unexpected increase in revenue of $1.00 last period caused the government to anticipate an additional $1.05 increase in revenue this fiscal year. An unexpected decrease in revenues of $1.00 last period caused the government to anticipate an additional $0.47 decrease this period.

The Spending Shock coefficients indicate that an unexpected increase in expenditures last period, as with Newfoundland and Prince Edward Island, caused the unusual reaction of reducing revenues this period. On the other hand, negative expenditure shocks were ignored.

K & M (1998b) estimated the marginal tax rate in Nova Scotia to be 0.06, while the estimate obtained here is 0.24 with a standard error of 0.07. Thus, again, GDP forecasts were not trusted.

New Brunswick

The SUR results for New Brunswick are given in table 5.14 below.

Table 5.14: Modified SUR Results For New Brunswick

Dependent Variable	Constant	Revenue Shock (+)	Revenue Shock (-)	Spending Shock (+)	Spending Shock (-)	Expected Change in GDP
ΔS_t	136.37 (107.80)	-0.53 (0.31)*	-0.06 (0.24)	-0.42 (0.17)**	-0.83 (0.24)	0.03 (0.25)
ΔR_t	34.44 (114.72)	-0.84 (0.35)	-0.21 (0.25)**	0.13 (0.18)	-0.55 (0.26)**	0.25 (0.26)

As can be seen, neither constant in the two equations above is significantly different from zero. This result concurs with that obtained in the last chapter. Again, the conclusion is that, *ceteris paribus*, governments in New Brunswick have tended to hold per capita expenditures and revenues constant.

Analysis of the ΔS_t equation shows that Revenue Shock (+) is significantly different from zero at -0.53. This suggests that governments in the province reduced expenditures in response to unexpected revenue increases. The coefficient on Revenue Shock (-) is not significantly different from zero and thus supports the bygones be bygones hypothesis.

The coefficient on Spending Shock (+) of -0.42 is significantly different from negative one. Its value indicates that an unexpected expenditure increase of $1.00 last period caused the government to anticipate additional spending of about $0.58 this period. The coefficient on Spending Shock (-) is not significantly different from negative one. Thus, unexpected increases in spending were viewed as permanent while unexpected decreases in spending were viewed as temporary.

K & M (1998b) estimated the marginal spending rate in New Brunswick to be -0.14. The estimate obtained here seems reasonably close to this and faith in GDP forecasts is therefore indicated.

Turning to the ΔR_t equation we see that the estimated coefficient on Revenue Shock (+) is not significantly different from negative one. Again, this indicates that unexpected revenue gains were assumed to be temporary. The coefficient on Revenue Shock (-), however, indicates that unexpected decreases in revenue were viewed to be permanent. The coefficient value of -0.21 indicates that an unexpected revenue loss of \$1.00 last period caused the government to anticipate and additional loss of \$0.79 this period.

The coefficient on Spending Shock (+) is insignificant. This supports the bygones be bygones hypothesis. The coefficient on Spending Shock (-) is significantly different from zero at -0.55. This coefficient indicates a curious policy of increasing revenues in response to an unexpected decrease in spending.

Finally, K & M (1998b) estimated the marginal tax rate in New Brunswick to be 0.01. The estimate obtained here was not significantly different from zero. As above, faith in GDP forecasts is indicated.

Quebec

The SUR results for Quebec are given in table 5.15 below.

Table 5.15: Modified SUR Results For Quebec

Dependent Variable	Constant	Revenue Shock (+)	Revenue Shock (-)	Spending Shock (+)	Spending Shock (-)	Expected Change in GDP
ΔS_t	-19.51 (34.21)	0.73 (0.21)**	-1.46 (0.29)**	0.34 (0.21)**	-0.05 (0.27)**	0.17 (0.04)**
ΔR_t	-22.22 (28.61)	-0.27 (0.16)**	-0.82 (0.22)	0.80 (0.15)**	-0.47 (0.21)**	0.20 (0.03)**

Examining both equations above we see that neither constant is significantly different from zero. This contrasts with the results from the previous chapter where both constants were positive and significant. Furthermore, neither of the constants from above can be said to be reasonably close to the respective constants from Chapter Four. The constants estimated here imply that, *ceteris paribus*, governments in Quebec have tended to keep per capita revenues and expenditures relatively constant.

Turning to the ΔS_t equation we see total rejection of the bygones be bygones hypothesis. The coefficient on Revenue Shock (+) is significantly different from zero at 0.73, implying an unexpected tax and spend policy. The coefficient on Revenue Shock (-) is significantly different from zero at -1.46. This suggests that unexpected decreases in revenue led to increased spending on the part of Quebec governments.

The estimated Spending Shock coefficients also reveal government response to shocks. The coefficient on Spending Shock (+) is significantly different from negative one at 0.34. This means that an unexpected expenditure increase of $1.00 in the previous fiscal year caused the government to anticipate an additional spending increase of $1.34

in the current fiscal year. The coefficient on Spending Shock (-) is significantly different from negative one at -0.05. Again, this implies that an unexpected decrease in revenues of $1.00 the previous period caused governments to anticipate a further decrease of about $0.95 this period.

K & M (1998b) estimated the marginal spending rate in Quebec to be zero. Since the estimated coefficient on Expected Change in GDP is significantly different from zero at 0.17, government distrust of GDP forecasts is indicated. This concurs with the conclusion from the previous chapter.

The ΔR_t equation also reveals government response to shocks. The estimated coefficient on positive revenue shocks is significantly different from negative one at -0.27. The standard interpretation of this applies. The coefficient on Revenue Shock (-) is not, however, different from negative one. Thus, governments in Quebec seem to have viewed positive revenue shocks as permanent but negative revenue shocks as temporary.

The estimated coefficient on Spending Shock (+) is positive and significantly different from zero. This implies an unexpected spend and tax policy in the province. The estimated coefficient on Spending Shock (-) is negative and significantly different from zero. This implies the unusual policy of increasing revenues in response to unexpected decreases in spending.

K & M (1998b) estimated the marginal tax rate for Quebec to be 0.11. The estimate obtained here is 0.20 with a standard error of 0.03. As such, there appears to be evidence to indicate government mistrust of GDP forecasts. This supports the conclusion reached above and in the previous chapter.

Ontario

The SUR results for Ontario are given in table 5.16 below. Recall that no ΔR_t equation was included due to the inability to obtain a well specified equation.

Table 5.16: Modified SUR Results For Ontario

Dependent Variable	Constant	Revenue Shock (+)	Revenue Shock (-)	Spending Shock (+)	Spending Shock (-)	Expected Change in GDP
ΔS_t	144.59 (59.9)**	-0.10 (0.43)	0.61 (0.35)*	-0.01 (0.23)**	-0.09 (0.40)**	0.04 (0.05)
ΔR_t						

The constant in the ΔS_t equation is significantly different from zero with a value of about 145 and a standard error of about 60. This constant is quite similar to that estimated in the last chapter (118). Thus, *ceteris paribus*, governments in Ontario have tended to increase real per capita spending.

The estimated coefficient on Revenue Shock (+) is not significantly different from zero and therefore supports the bygones be bygones hypothesis. The coefficient on Revenue Shock (-), on the other hand, is significant at 0.61. This implies governments in Ontario have reduced expenditures in response to unexpected decreases in revenues.

Both coefficients on Spending Shock suggest government response to shocks. Both the coefficient on Spending Shock (+) and the coefficient on Spending Shock (-) are significantly different from negative one. The standard interpretation applies.

Finally, K & M (1998b) estimated the marginal spending rate in Ontario to be 0.01. The estimate obtained here is 0.04 with a standard error of 0.05. Thus, faith in GDP forecasts is indicated. This supports the conclusion of the previous chapter.

Manitoba

The SUR results for Manitoba are given in table 5.17 below. Recall that no ΔS_t equation was included due to the inability to obtain a well specified equation.

Table 5.17: Modified SUR Results For Manitoba

Dependent Variable	Constant	Revenue Shock (+)	Revenue Shock (-)	Spending Shock (+)	Spending Shock (-)	Expected Change in GDP
ΔS_t						
ΔR_t	18.77 (47.15)	0.003 (0.25)**	-1.00 (0.33)	-0.25 (0.24)	-0.19 (0.21)	0.25 (0.22)

The constant in the ΔR_t equation above is not significantly different from zero. This was also found to be the case in the previous chapter. Again, the conclusion is that real per capita revenues have been held constant over the study period, everything else being equal.

The estimated coefficient on Revenue Shock (+) is significantly different from negative one and is essentially zero. This means that an unexpected revenue gain of $1.00 last period caused the government to anticipate an additional $1.00 in revenue this period. On the other hand, the coefficient on Revenue Shock (-) is not significantly different from negative one. Thus, governments in Manitoba viewed unexpected revenue gains as permanent but unexpected revenue losses as temporary.

Neither of the Spending Shock coefficients is significantly different from negative one. This result is consistent with the bygones be bygones hypothesis.

K & M (1998b) estimated Manitoba's marginal tax rate to be 0.05. The estimate here of 0.25 seems to indicate that GDP estimates were not trusted.

Saskatchewan

The SUR results for Saskatchewan are given in table 5.18 below.

Table 5.18: Modified SUR Results For Saskatchewan

Dependent Variable	Constant	Revenue Shock (+)	Revenue Shock (-)	Spending Shock (+)	Spending Shock (-)	Expected Change in GDP
ΔS_t	466.34 (81.7)**	0.39 (0.20)*	1.32 (0.24)**	-0.95 (0.16)	0.81 (0.32)**	-0.01 (0.07)
ΔR_t	-2.64 (69.48)	-0.32 (0.21)**	-1.06 (0.27)	0.06 (0.14)	0.12 (0.31)	0.28 (0.09)**

The constant in the ΔS_t equation is significantly different from zero while that in the ΔR_t equation is not. These coefficients mean that, *ceteris paribus*, governments in Saskatchewan have tended to increase real per capita expenditures by about $466 a year while holding revenues constant.

Turning to the ΔS_t equation we see that both Revenue Shock coefficients are significantly different from zero. The coefficient on Revenue Shock (+) indicates an unexpected tax and spend policy. The coefficient on Revenue Shock (-) indicates that expenditures fell in response to unexpected decreases in revenues.

The coefficient on Spending Shock (+) is not significantly different from negative one while that on Spending Shock (-) is. These coefficients indicate that unexpected increases in spending were treated as temporary while unexpected decreases in expenditures were treated as permanent.

K & M (1998b) estimated the marginal spending rate in Saskatchewan to be 0.01. The marginal spending rate estimated here is very close to K & M's. Full faith in GDP forecasts on the part of governments in their expenditure decisions is therefore indicated.

Examination of the ΔR_t equation shows that the coefficient on Revenue Shock (+) is significantly different from negative one while that on Revenue Shock (-) is not. These coefficients suggest that unexpected increases in revenue were treated as permanent while unexpected decreases in revenue were treated as temporary.

Neither Spending Shock (+) nor Spending Shock (-) were found to be significantly different from zero. This is consistent with the bygones be bygones hypothesis.

K & M (1998b) estimated the marginal tax rate for Saskatchewan to be 0.09. The estimate obtained here of 0.28 with a standard error of 0.09 seems significantly different from K & M's estimate. Government distrust of GDP forecasts is therefore indicated, contrasting with the conclusion reached above.

Alberta

The SUR results for Alberta are given in table 5.19 below.

Table 5.19: Modified SUR Results For Alberta

Dependent Variable	Constant	Revenue Shock (+)	Revenue Shock (-)	Spending Shock (+)	Spending Shock (-)	Expected Change in GDP
ΔS_t	426.68 (147.9)**	-0.13 (0.17)	0.64 (0.19)**	-1.03 (0.28)	-0.14 (0.33)**	-0.06 (0.08)
ΔR_t	-89.76 (235.63)	-0.13 (0.30)**	-0.62 (0.35)	-0.30 (0.52)	-0.52 (0.61)	0.24 (0.13)*

Examination of the ΔS_t equation reveals a significant constant with a value of about 427. The constant in the ΔR_t equation is not significantly different from zero. This result contrasts with that obtained in the previous chapter where neither of the constants was significant. The conclusion suggested here is that, *ceteris paribus*, real per capita expenditures tended to be increased and revenues held constant.

In the ΔS_t equation the coefficient on Revenue Shock (+) is not significantly different from zero. This is consistent with the bygones be bygones hypothesis. The coefficient on Revenue Shock (-) is significantly different from zero. This coefficient suggests that expenditures were decreased in response to unexpected decreases in revenue.

Turning to the expenditure variables we see that Spending Shock (+) is not significantly different from negative one. In other words, positive expenditure shocks were treated as temporary. Spending Shock (-) is, however, different from negative one at -0.14. This coefficient indicates that if spending last period was $1.00 lower than expected, the government budgeted an additional $0.86 reduction in spending in the current period. In other words, negative expenditure shocks were treated as permanent.

K & M (1998b) estimated Alberta's marginal spending rate at -0.08 while it was estimated here to be -0.06. Faith in GDP forecasts is indicated, concurring with the conclusion last chapter.

Turning to the ΔR_t equation, we see that the coefficient on Revenue Shock (+) is significantly different from negative one at -0.13. Thus, an unexpected revenue gain of $1.00 last period caused the government to anticipate an additional $0.87 in revenue this period; unexpected increases in revenue were seen to be permanent. In contrast, the coefficient on Revenue Shock (-) is not significantly different from negative one. Thus, unexpected decreases in revenue were seen as being temporary.

Both Spending Shock (+) and Spending Shock (-) are insignificantly different from zero. This is consistent with the bygones be bygones hypothesis.

K & M (1998b) estimated Alberta's marginal tax rate at 0.19. The estimate obtained here of 0.24 is therefore indicative that governments in Alberta placed full faith in GDP forecasts. This confirms the results above and in the previous chapter.

British Columbia

The SUR results for British Columbia are given in table 5.20 below.

Table 5.20: Modified SUR Results For British Columbia

Dependent Variable	Constant	Revenue Shock (+)	Revenue Shock (-)	Spending Shock (+)	Spending Shock (-)	Expected Change in GDP
ΔS_t	153.90 (53.7)**	1.04 (0.57)*	0.84 (0.37)**	-0.53 (0.30)	0.41 (0.41)**	-0.06 (0.09)
ΔR_t	51.64 (45.30)	-0.62 (0.35)	-0.37 (0.24)**	0.38 (0.16)**	-0.48 (0.26)*	0.14 (0.04)**

Analysis of the ΔS_t equation shows a significant constant of about 154 with a standard error of about 54. This is quite similar to the estimate of 104 obtained in the previous chapter. Again, the interpretation is that governments in British Columbia have tended to increase real per capita spending. The constant in the ΔR_t equation is not significantly different from zero, indicating that real per capita revenues did not tend to change.

The coefficients on both Revenue Shock (+) and Revenue Shock (-) are significantly different from zero in the ΔS_t equation. This suggests an unexpected tax and spend policy and a reduction of expenditures in response to an unexpected decrease in revenues.

The estimated coefficient on Spending Shock (+) is not significantly different from negative one. Again, this implies that unexpected increases in spending were viewed as temporary. The estimated coefficient on Spending Shock (-) is significantly different from negative one and suggests unexpected declines in expenditure were treated as permanent.

K & M (1998b) estimated the marginal spending rate for British Columbia to be -0.08. The marginal spending rate estimated here is -0.06. Government faith in GDP forecasts is therefore indicated.

Turning to the ΔR_t equation, we see that the estimated coefficient on positive revenue shocks is not significantly different from negative one. The coefficient on negative revenue shocks is significantly different from negative one. These two coefficients suggest that governments in British Columbia viewed unexpected increases in revenue as temporary but unexpected decreases as permanent.

The positive coefficient on Spending Shock (+) indicates an unexpected spend and tax policy operational in the province. The negative coefficient on Spending Shock (-) implies the rather strange policy of increasing revenues in response to unexpected decreases in spending.

The marginal tax rate for British Columbia was estimated by K & M (1998b) to be 0.06. The estimate obtained here is 0.14 with a standard error of 0.04. The difference between the two estimates seems large enough to indicate government mistrust of GDP projections. This is contrary to the conclusion reached above.

Results Summary and Conclusions

Table 5.21 summarizes the key empirical results presented in this chapter. In this table, “Ignored” indicates that the null hypothesis cannot be rejected that a shock from last period has no impact on the current period’s budget. On the other hand, “Permanent” indicates that this null hypothesis can be rejected. That is, a shock last period results in a budgetary response this period. Note that the degree of this response is not considered in this table (however it was discussed in the previous sections). Thus, table 5.21 presents qualitative rather than quantitative results.

Table 5.21: Summary of Empirical Results

		Spending Side		Revenue Side	
Province	**Shock Type**	**Revenue Shocks**	**Spending Shocks**	**Revenue Shocks**	**Spending Shocks**
Nfld.	**Positive**	Ignored	Ignored	Permanent	Permanent
	Negative	Permanent	Permanent	Permanent	Ignored
PEI	**Positive**	Ignored	Ignored	Permanent	Permanent
	Negative	Ignored	Permanent	Permanent	Permanent
Nova Scotia	**Positive**	Permanent	Ignored	Permanent	Permanent
	Negative	Ignored	Permanent	Permanent	Ignored
New Brunswick	**Positive**	Permanent	Permanent	Ignored	Ignored
	Negative	Ignored	Ignored	Permanent	Permanent
Quebec	**Positive**	Permanent	Permanent	Permanent	Permanent
	Negative	Permanent	Permanent	Ignored	Permanent
Ontario	**Positive**	Ignored	Permanent	N/A	N/A
	Negative	Permanent	Permanent	N/A	N/A
Manitoba	**Positive**	N/A	N/A	Permanent	Ignored
	Negative	N/A	N/A	Ignored	Ignored
Sask.	**Positive**	Permanent	Ignored	Permanent	Ignored
	Negative	Permanent	Permanent	Ignored	Ignored
Alberta	**Positive**	Ignored	Ignored	Permanent	Ignored
	Negative	Permanent	Permanent	Ignored	Ignored
British Columbia	**Positive**	Permanent	Ignored	Ignored	Permanent
	Negative	Permanent	Permanent	Permanent	Permanent

Recall that a government which lets bygones be bygones would not respond to any shocks. In table 5.21, a province which had "Ignored" in all eight cells would therefore exemplify the bygones be bygones hypothesis. Note that none of the provinces exhibit this pattern, indicating that the bygones be bygones hypothesis does not hold. This was also the conclusion reached in Chapter Four using the other version of the model.

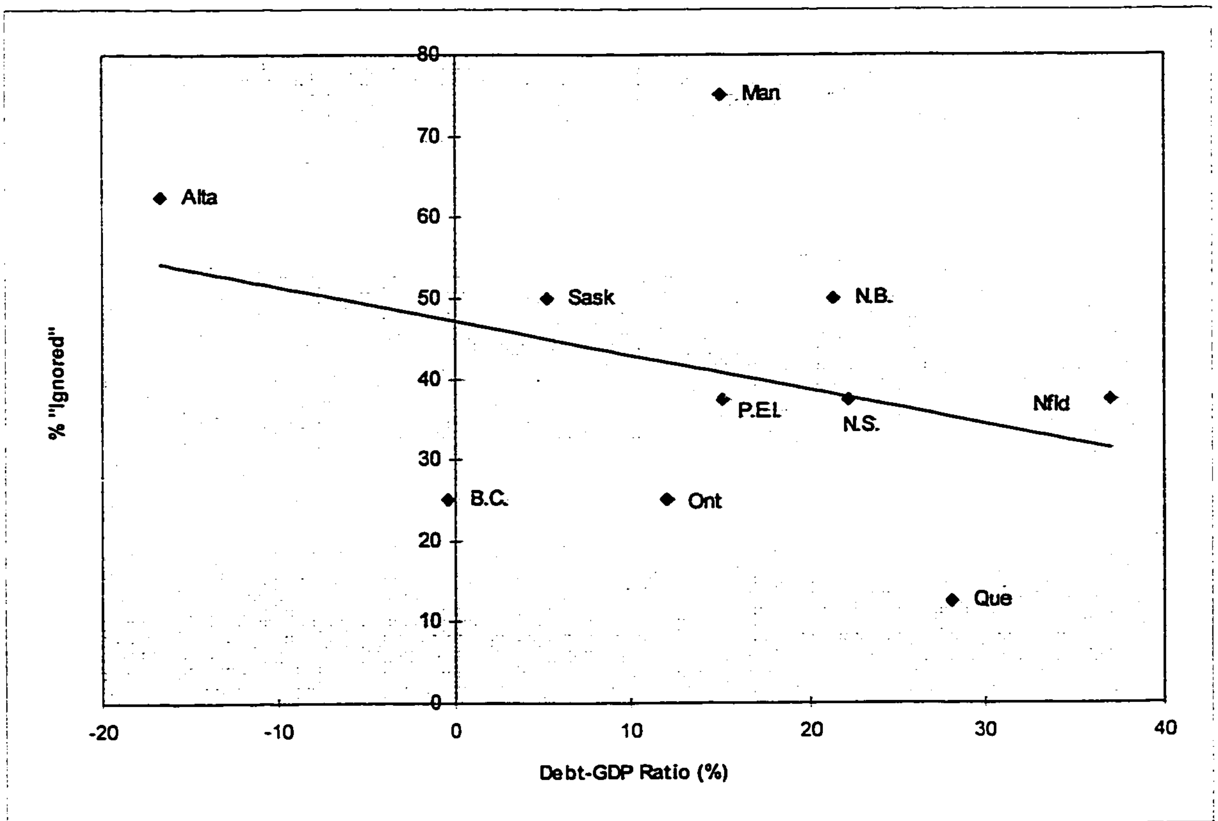
The province for which both equations were estimated which is closest to the bygones be bygones pattern is Alberta with five of eight cells entered with "Ignored". Saskatchewan and New Brunswick come next with four of eight cells entered with "Ignored". As well, Manitoba has "Ignored" in three of the four cases for which answers were derived. Finally, at the other end of the spectrum, Quebec has only one of eight cells entered with "Ignored" and as such was furthest from the bygones be bygones pattern. In other words, Quebec was the province which responded to shocks the most.

Another interesting result to notice is that the column with the least "Ignored" entries is the revenue shock column on the revenue side. This implies that the provincial governments responded most to past unexpected changes in revenue when making current revenue plans. This concurs with the result obtained in the previous chapter. On the other hand, table 5.21 shows that the provincial governments responded the least to past unexpected changes in expenditures when making current revenue plans.

Given that the bygones be bygones hypothesis does not hold, are there any factors which explain why some provinces, such as Quebec, respond to shocks more than other provinces, such as Alberta? One possible explanation for the dispersion may be the debt level of the province. For example, a province with a high debt level may be more apt to respond to budgetary shocks. This is because such a province will probably have less leeway in terms of the size of deficits it can run. The province may be forced to aggressively respond to shocks in order to preserve its credit rating and borrowing capacity. On the other hand, a province with a lower debt burden will be less concerned about losing its credit rating and therefore may be more inclined to ignore shocks in the budgeting process.

Figure 5.1 below graphs the relationship between a province's debt and its response to shocks. On the vertical axis of this graph is the percentage of cells entered with "Ignored" in table 5.21. On the horizontal axis is the province's average net-debt-to-GDP ratio over the fiscal years 1969-70 to 1992-93 (compiled from Kneebone (1998)).

Figure 5.1: Provincial Debt and Response to Shocks



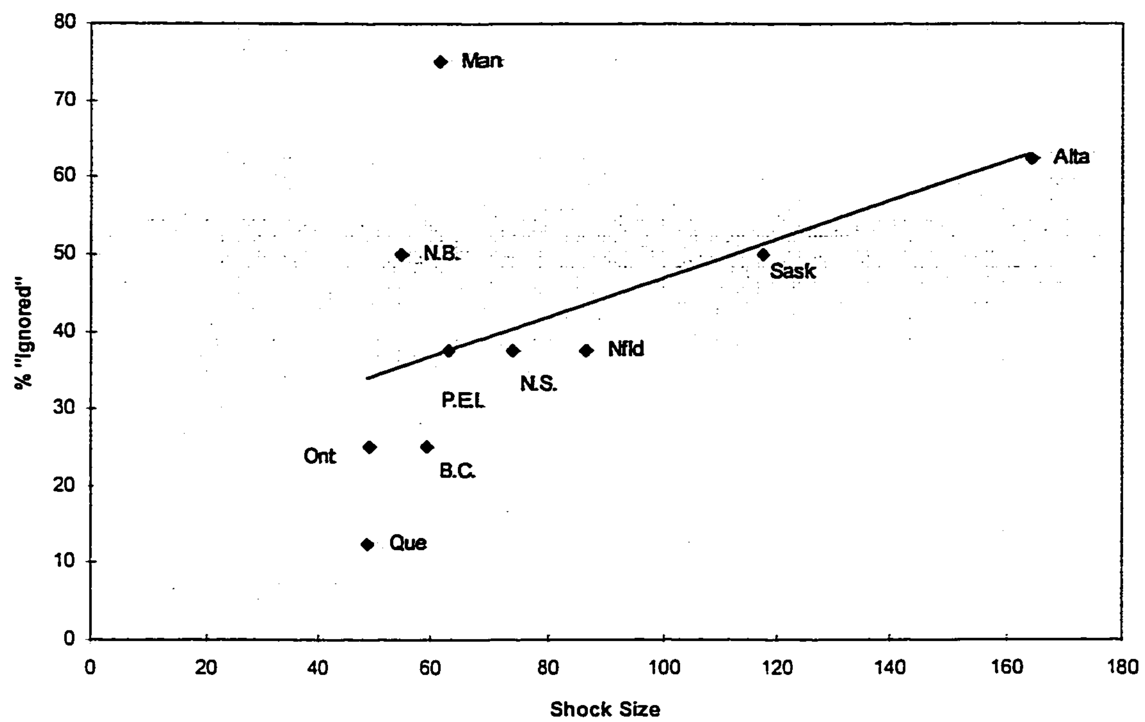
As can be seen from the trend line in figure 5.1, there seems to be a mild relationship between level of debt and response to shocks. Provinces with higher debt appear to respond to shocks more than those with lower debt. For example, as can be seen from the figure, Quebec has a debt-GDP ratio near 30% and ignores shocks only about 10% of the time while Alberta has a debt ratio near -15% and ignores shocks about 60% of the time.

As can also be seen from the figure, the data points are not clustered closely around the trend line, suggesting that the relationship is not particularly strong. Indeed, a simple regression with the percentage of ignored cells as the dependent variable and the debt ratio as the explanatory variable resulted in an adjusted R-square of 0.011. The constant in this regression was 47.19 with a t-statistic of 5.78 while the estimated coefficient on the debt ratio was -0.43 with a t-statistic of -1.05. Thus, while the negative estimated coefficient on debt ratio is consistent with the idea that a higher debt level results in provinces responding to shocks more, the regression indicates that this is a fairly mild relationship. Given this, it is desirable to examine other possible explanations for the different provincial responses.

Another variable which may have an important influence on whether or not a province responds to budgetary shocks is the size of the shocks themselves. For example, a province which typically experiences very large shocks may find it harder to ignore budgetary shocks than a province which experiences smaller shocks.

Figure 5.2 below graphs the relationship between the average size of budgetary shocks in a province and its response to shocks. As before, the vertical axis of this graph is the percentage of cells entered with "Ignored" in table 5.21. The average size of the budgetary shocks is on the horizontal axis. These were calculated by averaging the absolute value of the mean values of the four budgetary shocks (i.e. $RSHOCK(+)_{t-1}$, $RSHOCK(-)_{t-1}$, $SSHOCK(+)_{t-1}$, and $SSHOCK(-)_{t-1}$) for each province. The final average value is in real per capita terms.

<u>Figure 5.2: Average Shock Size and Response to Shocks</u>



As can be seen from the trend line in figure 5.2, there seems to be a fairly strong positive relationship between average shock size and the number of shocks ignored. This relationship appears to be stronger than that involving debt as the data points are distributed more closely to the trend line. As well, a simple regression with the percentage of ignored cells as the dependent variable and the average shock size as the explanatory variable resulted in an adjusted R-square of 0.15. The constant in this regression was 21.59 with a t-statistic of 1.62 while the estimated coefficient on the shock size variable was 0.25 with a t-statistic of 1.62. The positive coefficient on shock size indicates that provinces with larger average shock sizes tend to ignore shocks more than provinces with smaller shock sizes.

This positive relationship is different than what was first expected. Initially it was thought that larger shocks might tend to be more difficult to ignore. This positive relationship, however, is not without an economic explanation. Note that provinces with larger average shock sizes probably have greater unexpected changes in expenditures and revenues due to more volatile economies. In such volatile economies the provincial government may want the budget to play more of an automatic stabilizing role in order to smooth the business cycle. Such an explanation is consistent with the results obtained.

Thus, the variability observed in the provinces' responses to budgetary shocks may be due either to differences in provincial debt levels or to differences in average size of budgetary shocks experienced. The evidence presented shows a mild trend towards a higher debt level resulting in a greater tendency toward responding to shocks. Greater support was found for the idea that provinces with larger average shocks respond to shocks less. Again, this may be due to the fact that the automatic stabilizing role of the budget is more important in volatile economies.

Recall that in their examination of the case for Alberta, K & M (1998a) found the basic conclusion that, when making expenditure decisions, governments in Alberta ignored all revenue shocks and positive spending shocks but assumed negative spending shocks to be permanent. When making revenue decisions, governments ignored negative revenue shocks and all spending shocks but assumed positive revenue shocks to be permanent. From this the authors conclude that in Alberta good news in the form of unexpectedly higher revenues and lower expenditures was expected to continue while bad news in the form of unexpectedly lower revenues and higher spending was expected to be temporary. In other words, the government was unduly optimistic.

Evidence that this same basic pattern was found in this study can be seen by returning to table 5.21. In this table ten out of eighteen positive spending shocks were found to be "Ignored" while only six of eighteen negative spending shocks were entered as "Ignored". Thus, as a whole, the provinces tended to treat unexpected spending increases as temporary but unexpected spending decreases as permanent. In other words, the provinces tended to be overly optimistic when looking at spending shocks. On the revenue shock side, evidence for the overly optimistic conclusion is also present but not nearly as strong. Here, six out of eighteen positive revenue shocks were entered as "Ignored" while seven out of eighteen negative revenue shocks were entered as "Ignored". Unexpected increases in revenue (good news) were therefore treated as permanent only slightly more than unexpected decreases in revenue (bad news). As a whole, therefore, the provinces do seem to exhibit a trend toward over optimism in their treatment of budgetary shocks.

On a more specific level, table 5.22 below gives the pattern of "Ignored" and "Permanent" entries that a province would exhibit in table 5.21 if it responded to shocks the way Alberta was found to respond by K & M (1998a). Table 5.23 then examines how closely each province followed this pattern by listing how many of the entries from table 5.21 matched the pattern on the spending and revenue sides and in total.

Table 5.22: Kneebone and McKenzie's (1998a) Result Pattern

	Spending Side		Revenue Side	
Shock Type	**Revenue Shocks**	**Spending Shocks**	**Revenue Shocks**	**Spending Shocks**
Positive	Ignored	Ignored	Permanent	Ignored
Negative	Ignored	Permanent	Ignored	Ignored

Table 5.23: Similarity to Kneebone and McKenzie's (1998a) Result Pattern

Province	Spending Side	Revenue Side	Total
Newfoundland	3/4	2/4	5/8
Prince Edward Island	4/4	1/4	5/8
Nova Scotia	3/4	2/4	5/8
New Brunswick	1/4	1/4	2/8
Quebec	1/4	2/4	3/8
Ontario	2/4	N/A	2/4
Manitoba	N/A	4/4	4/4
Saskatchewan	2/4	4/4	6/8
Alberta	3/4	4/4	7/8
British Columbia	2/4	0/4	2/8

As can be seen from table 5.23, Alberta was found to match K & M's (1998a) result most closely with seven of the eight entries the same. This is encouraging in the sense that it shows that the overall conclusion reached by these authors is also supported here. In other words, the modifications to their model and methodology made in this thesis appear to have had only a minor effect on the overall conclusion for Alberta. The general model therefore seems to be fairly resilient to modification.

The table also reveals that several other provinces were found to behave in a similar manner. Manitoba matched all four entries on the side for which an equation was estimated. Saskatchewan matched six of eight entries while Newfoundland, Prince Edward Island, and Nova Scotia each matched five of eight. On the other hand, British Columbia, Nova Scotia, and Quebec all had less than four matches, indicating that their response to shocks was significantly different from Alberta's. In total, however, six of the ten provinces (including Alberta) exhibited a similar, though not as pronounced, behavioural pattern to that found for Alberta by K & M (1998a). Their conclusions for Alberta seem to apply, more or less, to the majority of the Canadian provinces. That is, it does seem that budget makers in the provincial governments are overly optimistic in the sense that they tend to ignore bad budgetary news while treating good budgetary news as permanent.

We now turn to the last chapter in this thesis which will summarize the main findings and conclusions. As well, this final chapter will include a discussion of some of the weaknesses of this thesis and suggestions for further areas of research that may prove promising.

CHAPTER SIX - SUMMARY AND CONCLUDING REMARKS

Results Summary

The main purpose of this thesis has been to examine how Canadian provincial governments responded to budgetary shocks over the fiscal years 1965/66 through 1994/95. The hypothesis that the provincial governments ignored budgetary shocks and let budgets play an automatic stabilizing role was rejected by both versions of the model estimated. Some provinces, however, were found to be more likely to respond to budgetary shocks than others. Further examination revealed that the level of a province's debt had a mild relationship to the likelihood that the province would respond to budgetary shocks. More specifically, it was found that provinces with lower debt burdens tended to ignore budgetary shocks more than those with higher debt burdens. A stronger relationship was found between the average size of the budgetary shocks experienced by a province and that province's response to shocks. In this case it was exhibited that the larger the average shocks a province experiences, the less likely it is to respond to shocks. This result was rationalized by noting that larger shocks are likely associated with more volatile provincial economies where the automatic stabilizing role of the budget may be more important or desirable.

Another purpose of this project was to test the generality of K & M's (1998a) results for Alberta with respect to the other provinces. On this front the results were quite encouraging. Even with a few important changes in methodology between this thesis and the previous work, the general result for Alberta remained nearly identical. In both studies, budget makers in Alberta were concluded to be overly optimistic by treating unexpected revenue gains and expenditure decreases as permanent and unexpected revenue losses and expenditure increases as temporary. This same basic pattern was revealed to be followed to a lesser extent in five other provinces, meaning that more than half of Canadian provinces seem to follow Alberta's overly optimistic pattern when responding to budgetary shocks.

Weaknesses and Suggestions for Further Research

As mentioned before, one of the weaknesses of the methodology used in this project is that both the forecast equations and the actual regression equations did not include dummy variables which would take account of known events which may have affected discretionary spending and revenues. To the extent that such variables were not included, the shock values estimated here may overstate or understate the actual shocks experienced. Thus, one avenue of promising future research would be to go back through the economic and legislative history of each province in order to identify events likely to affect discretionary spending and revenues which could then be taken into account of in the model. Such a process may lead to more clear cut conclusions as to whether Alberta's pattern of over optimism is an extreme form of a milder pattern or the norm for most provinces.

Recall that for both versions of the model, well specified revenue side equations for Ontario were not obtained. Owing to the SUR system's sensitivity to proper equation specification, revenue side equations for Ontario were therefore not included in the SUR system. Due to the major role that Ontario plays in the Canadian economy, however, it would be very desirable to include it in the SUR system and obtain results for this province. Thus, an important area of future research would be to find well specified equations for Ontario (and the other provinces for which specification was a problem) which could be included in the SUR system.

Another avenue of future research which might prove informative would be to modify the model to allow for the study of how large versus small shocks may have affected budgetary responses within a province. For example, squared values of the revenue and expenditure shock terms might be included as explanatory variables in the regression equations.

It may also be interesting to include political factors such as election years and which political parties are in power as dummy variables into the model. This would allow for the identification of possible election driven budgetary cycles or behavioural consistencies in certain political parties. Of course, the addition of too many variables into the model becomes problematic due to the loss of degrees of freedom caused and the fact that the available sample size is so small.

Another interesting area of future research would be to extend analysis into the international arena by studying the budgetary response to shocks of governments in other jurisdictions which follow the parliamentary form of government. Such research may be able to shed further light onto the question of what factors are responsible for differences between governments in terms of the degree to which shocks are responded to or ignored. Indeed, it may be discovered that governments elsewhere are more likely to ignore (or respond to) shocks than the Canadian provincial governments or that federal governments respond differently than provincial governments. Finally, such research could answer the question of whether an over optimistic response to budgetary shocks, as demonstrated by Alberta, is common the world over.

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IMAGE EVALUATION TEST TARGET (QA-3)

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6″

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