

**A Study on Canadian Provincial Business Cycles**

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## **Part I: Introduction and historic background\***

The purpose of this study is to examine Canadian regional business cycles and to compare them with Canada as a whole and with the United States. Canada has been faced throughout its history with difficulties to generate sustained internal growth mainly because of large geographical distances between agglomerations as one base goes, as well as its obvious dispersion from west to east. This lack of grouped large population have forced producers to build plants close to their markets in order to reduce their cost of transportation. "In particular, we know that the prospects for formation of a core-periphery pattern depend negatively on transportation costs, positively on the share of "footloose" demand, and positively on the importance of economies of scale."<sup>1</sup> (footloose demand i.e., not tied directly to natural resources) Given the importance of United States demand it would have been more logical to have producers exchange goods and services from north to south instead of developing an economy based on west to east.

The regional growth patterns have created a diversity within Canada. As stated by Coulombe (1999b, p. 3), population have adjusted to the regional environment to develop. British Columbia has about 85 percent of its population concentrated in urban areas of Vancouver. The other areas of the province are not viable for large urban development due to the mountainous geography. In Alberta, Ontario and Quebec, approximately three dwellers out of four live in urban settings. The majority of the Canadian population resides in Ontario and Quebec, these are also the provinces with the most manufacturing, representing about 71 percent of Canada's total manufacturing sector. Ontario is also part of the golden

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triangle with the United States. In eastern Canada, the population tends to live in rural areas and the cities are comparatively small. In Newfoundland, the majority of the population resides in rural areas.

To understand better the current economic structure of Canada, one has to look at its past. In the period immediately preceding the National Policy of 1879, maritimers discovered that many goods produced by Central Canada were of better quality and that their prices were also about 25 percent cheaper than what they paid for manufactured goods purchased south of the border. By the same token, Central Canada did not take much time in realizing the Maritime market. With the end of the reciprocal agreement in 1866, the colonies had no choice but to find new markets to trade their produces. The National Policy attracted new capital investment and human resources to the economy of Nova Scotia. Proportionately, industries grew faster in Nova Scotia than in Central Canada in the following decade.

In Krugman (1991, p. 91), it is argued that in 1879, the government of Canada adopted the National Policy intended to encourage the development of the Canadian manufacturing sector by imposing a tariff wall on imports according to the degree of manufacturing value added, and to develop a national railway with the prime objective to boost transportation from East to West. Some of the railway was already built in Eastern Canada. The national railway was needed to link Western Canada with the rest of Canada. The evolution of the National policy resulted in a concentration of industries in the regions with higher population.

Canada is one of the largest countries on the globe in terms of land area and the least populated country of the G8. In Coulombe (1999a, p. 7), the use of the land varies considerably from west to east. The early economic

development was concentrated around bodies of water because of the need for water in everyday life but also because it was a good and efficient transportation mode. Many factors influence the level of concentration of industries. As Krugman mentions (1991, p. 38), the concentration of industries is the result of the need to have a knowledge base in the same area. McCallum (1995) adds that the level of geographical development is also largely the result of history. This earlier historical development is followed by further development which is linked primarily to increasing returns to scale faced by corporations that continue the industrial growth.

Consequently, the grouping of industries due to the demographic concentration of expertise in certain localities has helped in increasing return to scale in producing goods with common production processes, and reducing the transportation costs of carrying the goods to the market place. Similarly, provinces with close proximity and similarities in their industrial mix would have greater chance to react the same way to changes in macroeconomic activities. An investigation as to whether geographic location has a direct effect on the economic behavior over time is made in the first part of the study. To verify the validity of such statement, this study will analyze the influence of the industrial composite of provincial economies and their economic integration by using the real Gross Domestic Product (GDP) as an indicator of economic activity.

The real growth rate of GDP can be decomposed into two distinct parts: The trend component and the business cycle component. The component of interest for this study is the cyclical component and it is measured using three different methods that are explained in greater details in Part IV. The cyclical component is an indicator showing how far away an economy is from its trend. "Certainly this view is implicit in the standard explanation of the business cycle: the natural rate of output grows at a more or less constant rate, while the output

fluctuations represent temporary deviations.”<sup>2</sup>

In effect, this study investigates whether this conventional view is realistic. To do this, the study will concentrate on analyzing estimates of the cyclical component. The relationship between the different time-series will be established by analyzing the correlation of the real regional GDP growth rates over a period of 37 years. The level of correlation is also an indicator of the degree of economic integration between the Canadian regional economies, Canada and the United States. Furthermore, the highly positive correlated Canadian regional business cycles will react in the same direction during economic upswing as well as when the economy dampens. A low positive correlation shows that the economies are rarely moving in the same fashion. Finally, a negative correlation shows that the comparative economies are reacting to economic fluctuations in opposite directions. An analysis of the correlation of the business cycle components in terms of geographical proximity and industrial mix is investigated in Part V.

In Part VI, the study concentrates on the methodology used to estimate the persistence of Canadian regional business cycles. It is important to analyze the persistence of Canadian regional business cycles in relation to economic shocks in order to determine if the regional cyclical components are temporary as believed by the conventional view or if shocks have a long term effect. “If fluctuations in output are dominated by temporary deviations from the natural rate, then an innovation in output should not substantially change one’s forecast of output in, say, five or ten years. Over a long horizon, the economy should return to its natural rate; the time series for output should be trend-reverting.”<sup>3</sup>

In essence Part VI of the study will reproduce the findings on the degree of persistence to output fluctuations estimated by Campbell and Mankiw

(1989). Table VI.1 compares both results obtained and show their closeness. By replicating the same methodology, estimates are made for Canada, the provinces and the United States.

It is important to be able to reproduce their findings for two reasons. First, it will serve in the analysis to demonstrate whether the structural modifications that occurred in the 1990s in Canada and the United States have changed as they relate to regional economic deviations from the trend. A quicker regional economic adaptation for Canada as a whole should be reflected in faster regional economic adaptability to output fluctuations. Secondly, the same method as used for Canada and United States can be applied on the provincial front to estimate the regional persistence of shocks. As well, it is expected that two economies showing a high degree of economic integration have also a comparable level of persistence to external shocks.

To my knowledge, regional estimates of business cycles with respect to the persistence of shocks was not done in the past, this study offers a new perspective on the provincial economies. In addition, a comparison between persistence at the regional versus national level will be included at the end of Part VII.

An analysis of the findings with an interpretation of the results is provided in Part VII. The results obtained from the estimates on the persistence provide guidelines on the adjustment period required to recover from an external economic shock.

The objective of Part I to V of the study is to acquire a good knowledge of the economic relationships at the regional and national levels. The objective of Parts VI and VII is to assess the validity of the conventional view that external shocks have a temporary effect on the economy. Fundamentally, the

effect of persistence in the economy is a long lasting debate.

“Many traditional theories of the business cycles maintain two fundamental premises. First, fluctuations in output are assumed to be driven primarily by shocks to aggregate demand, such as monetary policy, fiscal policy, or animal spirits. Second, shocks to aggregate demand are assumed to have only a temporary effect on output; in the long run the economy returns to the natural rate. These two premises underlie many monetarist and neo-Keynesian theories.

“If output fluctuations are highly persistent, both of these premises cannot be maintained. It is not clear, however, which of these two premises should be called into questions.

“Nelson and Plosser argue that the first premise, that fluctuations are driven by aggregate demand (in particular, monetary disturbances) should be abandoned. They advocate models in which fluctuations are attributable to changes in aggregate supply, such as shifts in the available production technology.”<sup>4</sup>

Part II provides a description of the data while Part III deals with the stationarity of the time-series. Part IV explains the methodology to estimate Canadian regional business cycles using real GDP measures.

## **Part II: Description of the data**

### **Section II.0: Introduction**

Part II explains the data used with the length of the period covered and it provides a chart displaying the data graphically. Quarterly data are chosen because they allow to see better the fluctuations occurring in the economy. Annual data reduce the level of noise in the time-series thereby limiting the variations. In this study, three types of data are compared. They are: the real GDP for Canada, the real GDP for the United States and the real Provincial GDP. The data for the real provincial GDP are explained in more details in section II.1. The provincial time-series are derived from estimates of the real GDP for Canada. The data are calculated by the Conference Board of Canada from the time-series for Canada. Section II.2 compares the provincial data and the data for the two countries using graphical illustrations.

### **Section II.1: Estimation of the data**

The data are at factor cost reflecting the cost of production, and in 1986 constant dollars to eliminate the fluctuations due to the rate of inflation. The data are also smoothed to eliminate the seasonal market fluctuations. The real regional provincial GDP are calculated by the Conference Board of Canada based on CANSIM provincial annual time-series. The numbers are then transformed into quarterly series by attributing quarterly pattern to each of the components of GDP (both nominal and real) and adding them up to obtain a quarterly aggregate series. The Conference Board's data system ensures that all quarterly provincial series are consistent with (add up to) their national counterparts. Having derived both real and nominal concepts of GDP, quarterly provincial GDP deflators are derived implicitly, that is by dividing nominal GDP at factor cost by real GDP at factor cost. The time-series obtained by this calculation are consistent with the national and provincial

GDP estimates generated by Statistics Canada. The Canadian real GDP data are available from the CANSIM database. The data for the United States have been taken from the Bureau of Economic Analysis. Graphs II.1, II.2 and II.3 show the provincial real GDP using a logarithmic scaling. In graph II.4, the Real GDP for Canada and the United States are illustrated.

In the work undertaken by Campbell and Mankiw (1987a, 1987b and 1989), the data used are real quarterly GNP. According to Campbell and Mankiw (1987), the use of GNP or GDP data does not affect the results of the study. Campbell and Mankiw (1989) use 119 observations whereas in this study 150 observations are used. The period covered by the data is 1961:1 to 1998:2. This study increases the degree of freedom but it is not its primary objective. In the past, research was undertaken to evaluate the level of persistence of Canada and United States using real quarterly data, so this is not new except for the longer period studied. The new aspect of this study is to investigate the persistence at the regional level and that is the primary interest of the study. Section II.2 provides a descriptive comparison of the data as well as graphs to illustrate the comparative growth in real GDP.

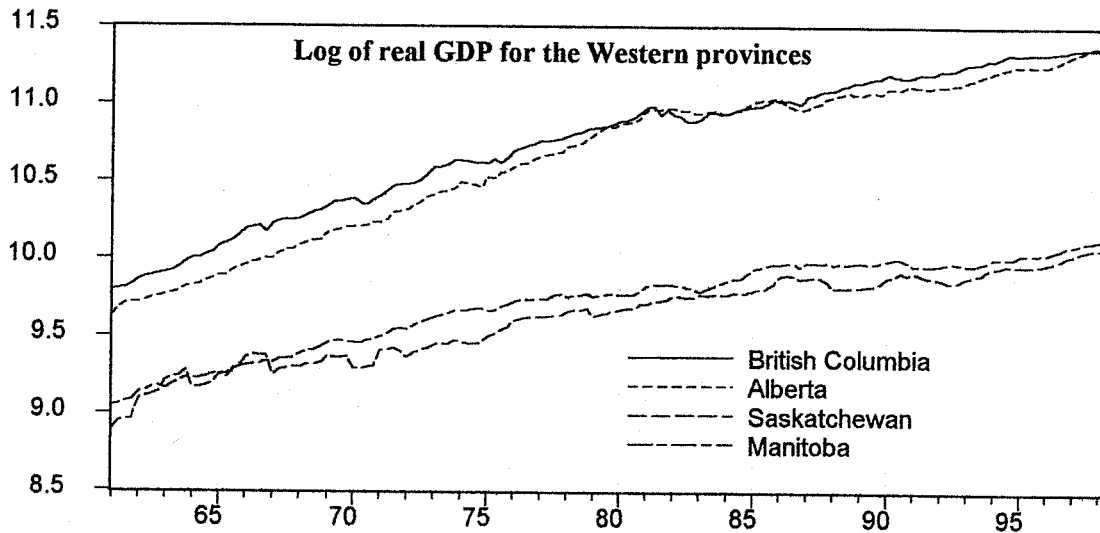
## **Section II.2: Comparison of the data**

The Canadian economy contains a high manufacturing base in Central Canada and the outskirts are providing the commodities needed for their production. Changes in commodity prices directly affect the regions with relatively less manufacturing. In theory, one would expect an increase in output production for the regions intensively producing primary goods and a lowering of the economies using these primary products as input to manufacture their products. In the case when commodity prices increase, it has a direct positive effect on the provincial GDP of the primary goods producers. To illustrate this factor, one has to think of the increase in the price of cod in the early 1970s, the GDP for Newfoundland increased sharply until the commodity prices went down in the following years. This is

illustrated in Graph II.3.

Graph II.1 shows the log of real GDP for the Western provinces. The

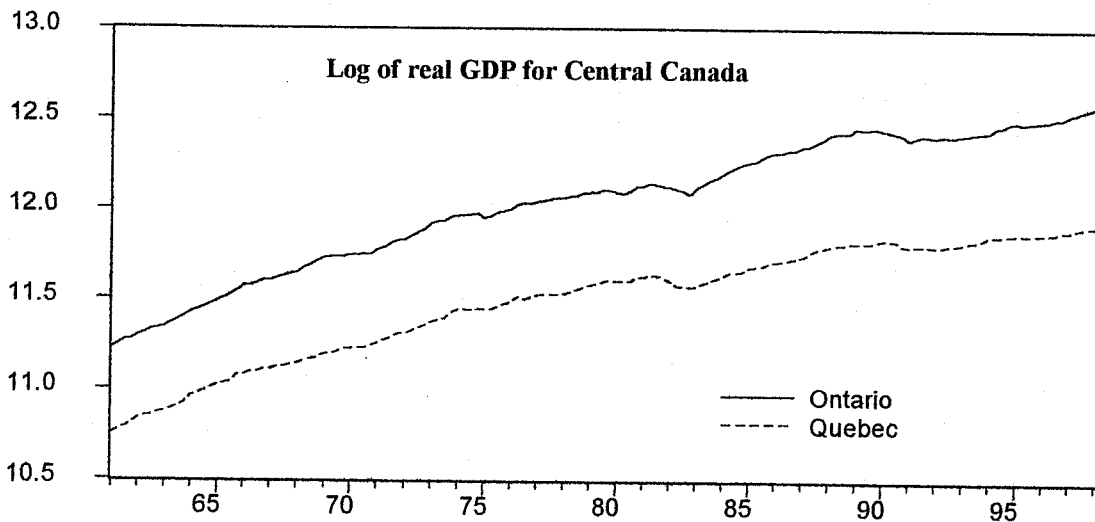
**Graph II.1:**



two largest western provinces are British Columbia and Alberta. Their log of real GDP have crossed three times since 1980. Lefebvre and Poloz (1996) state that in the case of British Columbia's relative GDP (to Ontario), the increase is greater during the 1978-80 shock, in part because of strong increases in the prices for natural gas, gold and silver. Also, the strong growth experienced by British Columbia in the mid-1980s is mainly due to the increase in the commodity prices of mining products such as aluminum, copper, pulp and zinc. British Columbia shows more variance in the log of real GDP than does Alberta. The economy in Alberta behaves independently from the other provinces since its industrial composition is unique. In the last few years, the log of real GDP has been stronger in Alberta than in British Columbia.

The economies of Saskatchewan and Manitoba resemble more closely one another. Both provinces have similar industrial structure with the primary agricultural production. From about 1985 to 1994, the log of real GDP in Manitoba was almost flat. Saskatchewan suffered the worst decline in its GDP around 1987 to 1990. Since 1994, their log of real GDP has grown almost parallel.

**Graph II.2:**



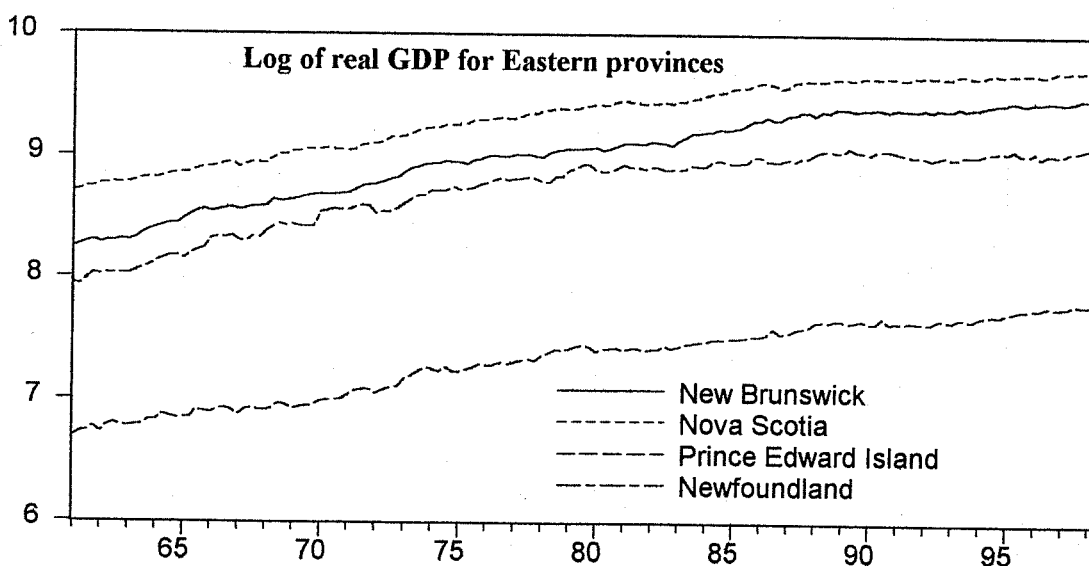
Graph II.2 shows the two largest provinces, Ontario and Quebec. The economic influence of Ontario is predominant. As Ontario's GDP increases so does that of Quebec. The positive slope from the Ontario curve is generally steeper showing stronger growth in log of real GDP than for Quebec. This is more pronounced in the growth of Ontario's economy during the mid-1980s.

Commodity prices were relatively high in the first few years of the 1980s and they dropped substantially in the following years until the early portion of 1986. In the same period as the decline in commodity prices, the value of the Canadian dollars declined significantly. The net effect of these changes was to render the Canadian manufactured products more competitive internationally. The high international

demand for Canadian goods brought about an increase in the production of Central Canada as seen in Graph II.2. Ontario has enjoyed a strong growth from about mid-1980s to the beginning of 1990. Quebec's growth was very strong as well but less than the growth in Ontario. It is important to notice that when the economy in Ontario takes a downturn, Quebec follows almost immediately the same pattern. In Part V, I show the high economic integration between the two provinces as well as the importance of the economy of Ontario for the rest of the country.

Graph II.3 shows the log of real GDP for the Eastern provinces. The province of Prince Edward Island is far behind the other eastern provinces in terms of

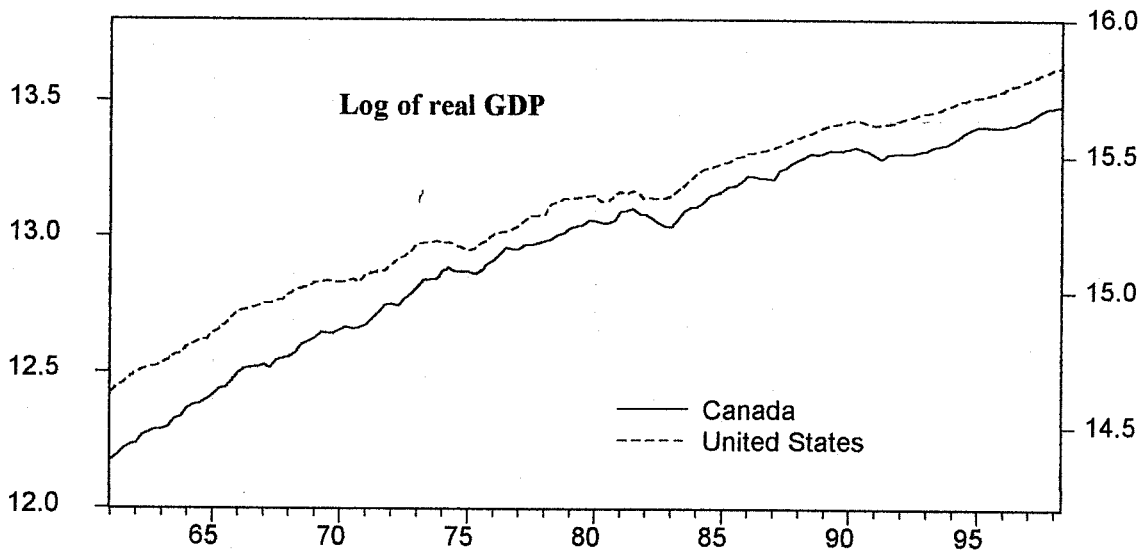
**Graph II.3:**



economic size. In Newfoundland, the log of real GDP is almost horizontal since the end of the 1980s while it has increased for the other provinces. This is due to the federal restriction on the northern cod fishing. The impact of such policy was to slow down its economic activity.

Graph II.4 shows a comparison of the log of real GDP for Canada and the United States. At first sight, the real GDP for Canada has a greater variance. The American economy is more stable with a more constant growth in real GDP than Canada. The graph also shows that the United States' economy leads the Canadian economy. A decline in the American economy is shortly followed by a

**Graph II.4:**



slow down in the Canadian economy. The downturn in the Canadian economy is occurring at a greater rate and the reduction is also deeper. The pattern of growth between the two countries is also different. In periods of growth, Canada has more fluctuations and the level of growth is more volatile. In general, the economies of Canada and the United States are growing at about the same pace. Canada's growth has been export-led by the strong demand emanating from the United States during most of the last twenty years. The variations in the international commodity prices added to the resurgence of the American economy required a stronger production from Canadian manufacturers as well as greater supply of primary goods.

Appendix A provide some comparisons of the real Quarterly Growth rate

while the graphs in appendix B compare the real Annual Growth rate for some Canadian time-series. For a more complete picture of the data for each of the time-series, appendix C contains some charts of the real GDP with the trend and the Hodrick-Prescott (HP) gap. These graphs show quite clearly the level of fluctuations of the Canadian regions, Canada as well as the United States. In Appendix D, some graphs show a comparison for some Canadian regions with respect to the HP gap estimation.

In Part III, I show the procedures to verify if the time-series need to be corrected for autocorrelation. It is important to do tests in order to determine which estimation method is preferable to isolate the Canadian regional business cycles from the trend. The test employed is the Augmented Dickey Fuller (ADF) unit root test.

## **Part III: Stationarity of the time-series**

### **Section III.0: Introduction**

In this part, the ADF unit-root test is used to test whether the time-series contain a deterministic time trend. It is important to test the data to determine the best approaches to estimate the output gap. The procedures to perform the tests as well as the results are explained.

### **Section III.1: Testing for unit root**

The tests done are the ADF unit root test on the log of the real quarterly GDP for each of the time-series. The null hypothesis is to verify whether the time series are integrated of order 1. If it is possible to reject the null hypothesis in most of the cases, then it will be possible to affirm that the time-series are trend deterministic. The specifications for the ADF are that the unit root test is done in levels, and it includes a trend and an intercept. I use the real quarterly data for the 1961:1-1998:2 sample.

The preliminary procedure is to determine the number of  $k$  to account for autocorrelation. I have adopted the following procedure first proposed by Perron (1989) to determine the number of  $k$  for lagged difference. The ADF test statistic is ran until the last lag difference is significant. Starting with 8 lag difference, I run the ADF test statistic and I verify if the last lag difference is significant. If it is not significant, I continue using 7 lag difference and I check the significance of the lag difference. I continue the procedure until the last lag difference is significant at 5%. The null hypotheses is rejected when the value of the ADF test statistic is greater in absolute value than the critical value of the t-statistic. The ADF test statistic and the number of  $k$  are depicted in Table III.1.

The United States is the only time-series which can be rejected at the 10% critical value. Based on the ADF unit root tests, it can be affirmed that the null hypothesis can not be rejected and as a consequence, the time-series are not trend deterministic. This explains why the Hodrick-Prescott Filter (HP) estimation method and the two difference methods are chosen to estimate the cyclical component of the regional business cycles.

**Table III.1**

<b>Provinces</b>	<b>ADF Test</b>	<b>Lag</b>
	<b>Statistic</b>	
	<b>log (GDP)</b>	
<b>BC</b>	-1.56	0
<b>AL</b>	-1.19	0
<b>SA</b>	-3.10	4
<b>MA</b>	-2.26	0
<b>ON</b>	-2.21	1
<b>QU</b>	-2.26	1
<b>NB</b>	-1.25	0
<b>NS</b>	-0.57	2
<b>PE</b>	-1.36	2
<b>NF</b>	-1.83	8
<b>CA</b>	-2.31	8
<b>US</b>	-3.20	1

NOTE:

1% Critical Value	-4.0224
5% Critical Value	-3.4407
10% Critical Value	-3.1446

In Part IV, the method used to estimate the cyclical component of the data is explained. The real quarterly GDP is comprised of two components, the trend and the cyclical component. The component of interest for this study is the cyclical component. In the next part, the methods used to extract the cyclical component are explained in detail.

## Part IV: Estimation of the business cycle

### Section IV.0: Introduction

In part IV, the estimation methods used in calculating the cyclical component are explained. The first method is the HP gap which is the difference between the real GDP and the estimated long term trend. The second method is the first difference and it is calculated from the variation in real GDP. The last method is the fourth difference which is a subtraction between the real GDP in one period minus the real GDP four periods preceding it. The last two calculations are also the change in the growth rate of the real GDP. The first difference being the real quarterly growth rate\*\* and the fourth difference is the real annual growth rate.

The three methods are used to estimate the cyclical component. The HP gap is explained in section IV.1, and the first and fourth differences are demonstrated in section IV.2. The deterministic time-trend method was not chosen because the ADF unit root tests showed that the time-series are integrated of order one. It is important to use more than one method to estimate the cyclical component because it is not possible to determine which of the methods would provide the most accurate estimation. By having estimators from more than one method, it allows us to compare the results and provides a more robust estimation of the cyclical component. Using only two methods may be misleading especially if the estimation results are not close to one another. In such case, it would be difficult to determine which of the estimators are better. Section IV.1 shows the calculation made to estimate the HP gap. Section IV.2 explains the methodology to calculate the first and fourth difference. In section IV.3, I provide a comparative analysis of the estimation methods.

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\*\* Appendix A contains some charts of Canadian regional real quarterly growth rate and Appendix B shows some charts of the Canadian regional real annual growth rates.

### **Section IV.1: The HP gap**

The estimation of the HP gap is based on the decomposition of real GDP. The real GDP is the sum of a trend and a deviation from the trend. The deviation from the trend is in effect the cyclical component of the real GDP. In the following equation, the cyclical component (cc) is measured as the difference between the real GDP and the HP estimate of the trend component

$$cc(\ln(y_t)) = \ln(y_t) - hp(\ln y_t)$$

The HP gap is a measure taken at some point in time and it is based on the long term estimation of the trend. The trend growth rate is allowed to change over time with the HP smoothing procedure.

### **Section IV.2: The first difference and the fourth difference**

In this section, I define and explain the other two methods used to estimate the cyclical component. Both methods are calculated directly from the log of real GDP. The main difference between the two methods is in the period of time used in the calculation of the deviation in the log of real GDP. The first difference estimates the fluctuations at each consequent period. It is an estimate of the cyclical component in the very short term. The first difference is estimated from the subtraction of the real GDP from one period minus the period immediately preceding it. In effect, it is the real quarterly growth rate which is measured as

$$100 * (\ln Y_t - \ln Y_{t-1})$$

The last method to estimate the cyclical component is the fourth difference. It is a longer measure of the fluctuations in the log of real GDP because it comes from the difference between the GDP in one period minus the GDP four periods preceding it. The fluctuations for the cyclical component using this method

tend to be less variable which is a sign of the low frequency of external shocks in the time-series. The standard deviation is also less important. The fourth difference is also known to be the real annual growth rate. In section IV.3, I explain the differences in greater detail and I compare the three estimation methods for Ontario. The fourth difference method is calculated as follow

$$100*(\ln Y_t - \ln Y_{t-4})$$

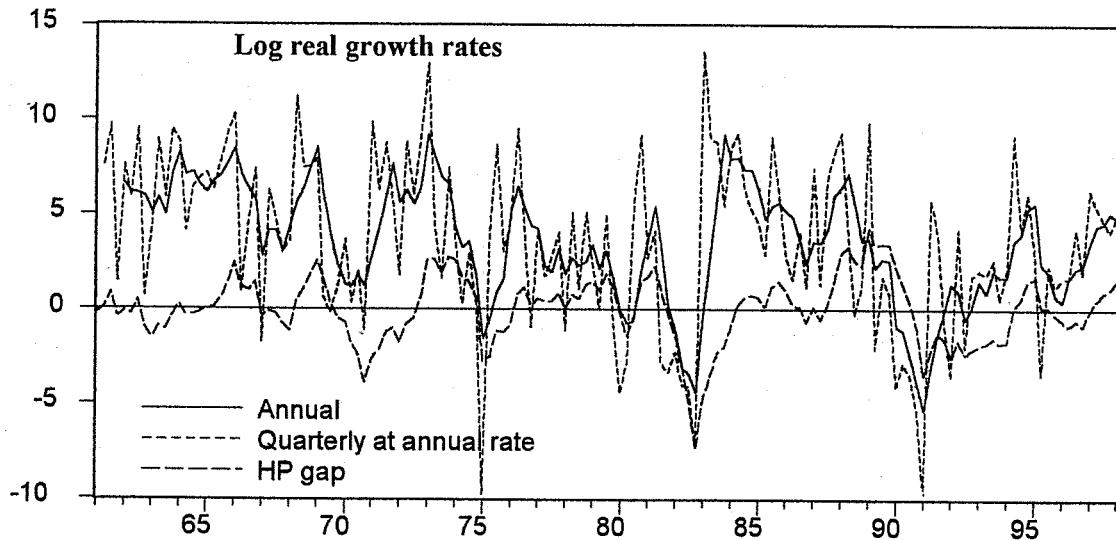
### **Section IV.3: Comparative analysis of the three estimation methods**

This section is intended to provide a comparison of the estimation methods used to isolate the real Canadian regional business cycles. In graph IV.1, the case of Ontario is analyzed. The log of real quarterly GDP is multiplied by 4 in order to be compared with the other estimation methods. The HP gap curve tends to be at the lower limit of the curves for the entire period studied except on occasions when the decline in the log of real GDP is very important. The correlation between the real annual growth rate and the HP gap is 0.51. This level of synchronization between these two measures are not surprising since the HP gap reacts to every nominal fluctuations of the GDP, whereas the real annual growth rate is not influenced by very short term movements (less than 9 months). Furthermore, by definition, the HP gap estimates the difference in the output fluctuations that are away from the long term trend curve. For this reason, the mean corresponding to the HP gap is 0. That is, on average the growth of the economy is on the HP trend.

As for the level of correlation between the real annual and the quarterly growth rates, it stands at 0.67. The explanation of the high level of correlation between the two estimation methods requires further investigation. The real quarterly growth rate reacts to all GDP fluctuations. Fluctuations in the GDP will affect both estimations either right away, in the case of the real quarterly growth rate or in a few periods for the real annual growth rate. On the graph, although the log of real

quarterly growth rate fluctuates more than the log of real annual growth rate, and it follows the underlying pattern of the annual growth rate. To this effect, the

**Graph IV.1: Comparison of estimation methods for Ontario**



mean for the quarterly growth rate at an annual rate is 3.64% whereas the mean for the annual growth rate is 3.6%. As for the correlation between the real quarterly growth rate and the HP gap, it is less important at 0.25. The graph shows very little similarities in the fluctuations between the two curves. The real quarterly growth rate has a lot of noise while the HP gap is an estimate of the difference between the actual real GDP and the potential GDP.

The three estimation methods have different business cycles as seen in the graph IV.1 although they have some similarities in their behaviors. They generally fluctuate in the same direction especially when the movements are steep in nature. In Part V, I investigate the level of correlation between these estimation methods.

## **Part V: Correlations in the Canadian regional economies**

### **Section V.0: Introduction**

It is important to analyze and determine the degree of correlation in the Canadian regional business cycles for the following reasons. First, provinces with a high degree of synchronization have a higher degree of economic integration amongst themselves. Their industrial structure is most likely closer to one another.

Furthermore, provinces with a high level of integration as well as similarities in their structural mix will tend to react with comparable magnitude to external economic disturbances.

Second, the level of economic and structural integration is also important for national policy makers as they develop economic policies. As stated in Antia, Djoudad and St-Amant (1999), the Canadian economic structure is fairly well integrated. They found that external shocks to provincial economies are absorbed at about 64% of the total fluctuation from the trend by market mechanisms like the capital market and credit market. The market mechanisms are split between capital market smoothing estimated at 37% and 27% of the shocks being absorbed by credit market smoothing. Federal tax-transfers such as the employment insurance system and the social benefits program absorbs at an estimated 27 percent of the total deviation from the trend. They are automatic stabilizers built-in the economy to smooth external shocks.

It is important to learn more about the degree of synchronization of the United States economy with the Canadian regional business cycles because Canada sends more than 80% of its exports there. Also, the United States remains the largest producer in the world and their close proximity renders Canada liable to direct economic impact due to economic fluctuations south of the border. In fact, an increase in the United States demand usually triggers a higher level of economic

Table V.1: Correlations of Canadian regional economies using HP gap, first and fourth

	BC				AL				SA				MA	
	HPGap	InYt-1	InYt-4	InYt-4	HPGap	InYt-1	InYt-4	InYt-4	HPGap	InYt-1	InYt-4	InYt-4	HPGap	InYt-1
BC	1.00	1.00	1.00	1.00	0.58	0.28	0.58	0.58	0.12	0.13	0.26	0.26	0.41	0.26
AL	0.58	0.28	0.58	1.00	1.00	1.00	1.00	1.00	0.05	0.20	0.17	0.17	0.38	0.24
SA	0.12	0.13	0.26	0.05	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.44	0.36
MA	0.41	0.26	0.53	0.38	0.24	0.24	0.47	0.46	0.44	0.36	0.46	1.00	1.00	1.00
ON	0.64	0.32	0.68	0.41	0.17	0.40	0.40	0.18	0.03	0.15	0.18	0.58	0.51	0.51
QU	0.67	0.34	0.73	0.48	0.28	0.51	0.51	0.19	0.03	0.16	0.19	0.50	0.44	0.44
NB	0.49	0.27	0.57	0.21	0.17	0.27	0.27	0.12	-0.00	0.09	0.12	0.31	0.29	0.29
NS	0.37	0.04	0.50	0.38	0.32	0.48	0.48	0.24	0.15	0.31	0.24	0.50	0.37	0.37
PE	0.24	-0.04	0.32	0.07	0.01	0.18	0.18	0.07	-0.06	0.07	0.07	0.13	0.13	0.13
NF	0.20	0.11	0.34	0.26	0.19	0.37	0.37	0.06	-0.08	-0.08	0.06	0.10	0.10	0.17
CDN	0.69	0.27	0.71	0.57	0.32	0.56	0.56	0.20	0.06	-0.07	0.20	0.57	0.21	0.21
US	0.60	0.32	0.62	0.34	0.13	0.35	0.35	0.25	0.08	0.16	0.25	0.48	0.48	0.39

	NB				NS				PE				NF	
	HPGap	InYt-1	InYt-4	InYt-4	HPGap	InYt-1	InYt-4	InYt-4	HPGap	InYt-1	InYt-4	InYt-4	HPGap	InYt-1
BC	0.49	0.27	0.57	0.57	0.37	0.04	0.50	0.50	0.24	-0.04	0.32	0.32	0.20	0.11
AL	0.21	0.17	0.27	0.38	0.38	0.32	0.48	0.48	0.07	0.01	0.18	0.18	0.26	0.19
SA	-0.00	0.09	0.12	0.15	0.31	0.31	0.24	0.07	-0.06	0.07	0.07	0.07	-0.08	-0.08
MA	0.31	0.29	0.46	0.50	0.37	0.55	0.55	0.24	0.13	0.13	0.24	0.10	0.10	0.17
ON	0.60	0.33	0.68	0.57	0.31	0.63	0.63	0.43	0.47	0.27	0.43	0.36	0.36	0.33
QU	0.58	0.36	0.67	0.48	0.26	0.59	0.59	0.46	0.45	0.22	0.46	0.40	0.40	0.25
NB	1.00	1.00	1.00	0.47	0.35	0.55	0.55	0.48	0.49	0.29	0.48	0.35	0.35	0.29
NS	0.47	0.35	0.55	1.00	1.00	1.00	1.00	0.32	0.28	0.27	0.32	0.22	0.22	0.18
PE	0.49	0.29	0.48	0.28	0.27	0.32	0.32	0.07	1.00	1.00	1.00	0.40	0.40	0.26
NF	0.35	0.29	0.48	0.22	0.18	0.35	0.35	0.51	0.40	0.26	0.51	1.00	1.00	1.00
CDN	0.55	0.26	0.62	0.57	0.29	0.63	0.63	0.41	0.40	0.11	0.41	0.46	0.46	0.40
US	0.47	0.34	0.53	0.48	0.21	0.51	0.51	0.41	0.44	0.08	0.41	0.20	0.20	0.17

activity in Canada due to the strong Canadian export sector. In the Monetary Policy Report (1999) produced by the Bank of Canada, it mentions that there is a risk of inflation in the United States because of excess demand for labor, as well as because of the increase in the world commodity prices and a declining US dollars. The Bank will have to follow closely the evolution of inflation in the United States to maintain the inflation within the target established.

By knowing the level of correlation between the Canadian regional economies and that of the United States, the Bank is well aware that if it reacts by tightening monetary policy to prevent the importing of inflation born in the United States and to slow down the inflationary pressures, the Canadian monetary policy would be counter-cyclical in regions that are closely correlated with the United States business cycles but not with the other provincial economies. The economies of Central Canada are the most integrated with the United States and since 60% of the Canadian economy is concentrated in these regions, the Central Canadian regions are the initial carriers of inflationary pressures from the United States. The Bank can use the inflationary pressures from the United States as an early indicator of inflationary pressures in Canada but has to be conscious that interventions using monetary policy might be appropriate for Central Canada but not for Saskatchewan, Alberta and Prince Edward Island whose effects would be pro-cyclical.

Mansell and Copithorne (1986) mention factors influencing how an economy is affected by an economic downturn. Some industries are more sensitive to cyclical fluctuations. For instance, industries involved in the production of primary goods are impacted by changes in commodity prices or durable manufactured goods have a tendency to be more sensitive to change in the demand. As a consequence, the proportion of sensitive-type industries in the economy of a region will affect the way it is able to sustain economic growth in periods of slow down. The second factor of importance is the size and the level of skills of the workers. The smaller the firm and the lower the level of skills required, the more liable the firm is to economic turmoil.

The last factor to consider is the proportion of head offices in a region versus the level of branches. In periods of slow down, there is a tendency for firms to reduce the productivity of the branches prior to the activities of the head office. It is important for provincial economies to be well diversified in their industrial mix.

The list of reasons mentioned above is not exhaustive but it exemplifies why it is important to understand the relationships between the Canadian regional economies and its closest economic allies. In part V, an analysis of the correlations using the different estimation methods is done. The results are shown in Table V.1 on page 21, interpretations of the results are also provided in section V.1 showing the similarities and the differences. Section V.2 analyzes the geographical pattern and a graph shows the combined correlations of Ontario and Quebec in relation to the rest of Canada. In section V.3, I compare the results for Central Canada with the Canadian regional economies. In section V.4, an investigation of the regional factors are raised. In the last section V.5, a comparison of the correlations between Canada and the United States is done.

### **Section V.1: Synthesis of the results**

Table V.1 shows three different approaches to compare the level of correlations. The table is divided by provinces and within each province, there are three columns providing a different type of measurement for the correlation. In the first column, the HP gap shows the level of the fluctuations away from the trend. The second column shows the real Quarterly Growth rate and the last column for each region is the real Annual Growth rate.

The lower results obtained from the real Quarterly Growth rate suggests that there is much more noise in the data when using the first difference. Among the potential explanations for the increased noise in the data is an error in the data measured. Another plausible reason for this high level of noise is the sensitivity

of this measure to regional shocks. The estimates found using the real quarterly growth rate are less interesting since the results are not as easily comparable. In the following synthesis of results, we will see the resemblances between the results obtained using the HP gap and the real annual growth rate.

In general, the results for the HP gap and the real annual growth rate are of the same magnitude. In all cases, when a province has the highest correlation, it is for both estimations. Also, the majority of the provinces have a high level of correlation with Central Canada. The provinces with high correlations with Central Canada are British Columbia, Manitoba, New Brunswick, Nova Scotia, and Newfoundland. These results are the consequences of the great economic influence of Central Canada where about 60 % of the Canadian economic activity occurs. The exceptions to this pattern are Alberta, Saskatchewan and Prince Edward Island.

In Alberta, the highest correlations for the HP gap and the real Quarterly Growth rate are with BC. Both provinces rely heavily on exports of commodities. Specifically, the fluctuations in the prices for the energy sector affects both provinces but with a different economic weight. British Columbia produces natural gas but its economy is well diversified into other primary goods. Alberta's economy is heavily weighted in the production of oil and natural gas. Hence an excess supply leading to a reduction in oil prices would affect more directly Alberta than British Columbia. Furthermore, being producers of primary commodities, they are both dependent on the valuation of the exchange rate as well as the levels of world commodity prices.

In Saskatchewan, the highest level of correlations are with Manitoba. Two reasons can explain the high correlation between Saskatchewan and Manitoba. First, their industrial composition has a lot in common. Their economies are based on the production of primary goods such as agriculture. Second, their close proximity tends to link them economically for reasons such as the increased return to

scale and the cheaper transportation costs.

In Prince Edward Island, the three highest measures of correlation are with New Brunswick which is at very close proximity to one another. New Brunswick is a central province for the Atlantic region since one must pass through this province to attain Central Canada and the United States. You will find in Table V.1 the measures of correlation. The next section analyzes the correlation from the point of view of their geographical pattern. In essence, I evaluate the peripheral effect between two economies that are at close proximity.

### **Section V.2: The geographical pattern**

Intuitively, I expect that adjoining provinces would have high correlations. "So it is the interaction of increasing returns to scale and uncertainty that makes sense of Marshall's labor pooling argument for localization."<sup>5</sup> The development of production in a country is intimately linked with the concentration of firms producing the same type of goods. As McCallum states: "Other things equal, province-to-province trade is now six times greater than province-to-state for British Columbia, eight times greater for Newfoundland, and 25 times greater for the other eight provinces. It is perhaps natural that the east-west trade bias should be weakest for Newfoundland and British Columbia, the provinces on the two extremities of the country."<sup>6</sup> In fact, these two provinces have very little in common except that both economies are dependent on their natural resources. Both economies are involved in the fishing industry but Newfoundland relies on it much more than does British Columbia.

An analysis of the neighboring provincial correlations shows that Central Canadian regions with their manufacturing sector, have strong correlations with one another but, as we move towards the west, the correlations of provinces adjacent to each other diminish. British Columbia, for example, is more correlated

with Central Canada than Alberta. British Columbia received the exclusive right to develop its natural resources at the moment of joining the Confederation in 1871. The development of its resource base in the production of forestry products and hydro electricity export have created similarities with Central Canada. This explains the high correlation between the three provinces.

In the east, the three Atlantic provinces are more correlated between each other. New Brunswick has generally a greater degree of synchronization with all the Atlantic provinces. Further to the East, Newfoundland is more correlated with Central Canada due to the important transfer payments that it receives from the latter.

As a whole, the results are somewhat surprising. Although the manufacturing sector has been decreasing in importance for the last few years relative to the service industries, it remains the engine of the Canadian regional economies. Provinces at close proximity tend to have strong correlations but they are not always the highest. This result was also found by Boothe and Davidson (1996). "In sum, we see that there is clear evidence that some of the regional economies in Canada and the U.S. experience fluctuations around trend output which are very different from their neighbours or from the averages calculated for the national economies. These differences are especially pronounced for Alberta in Canada and Texas in the U.S."<sup>7</sup> The geographical importance of Central Canada is emphasized in the graph V.1 and an analysis is provided in Section V.3.

### **Section V.3: Central Canada and the Canadian regional economies**

This section will look at the importance and influence of the Ontario and Quebec economies in the context of the Canadian regional economies. In the Graph V.1, the data for Ontario and Quebec has been pooled to illustrate better the importance of Central Canada. The pooling procedure is explained as follows. First, the two provincial time-series are added to create a time-series so that,

$$\ln(\text{GDP}_{\text{ONQU}}) = \ln(\text{GDP}_{\text{ON}} + \text{GDP}_{\text{QU}})$$

The HP method is used to estimate the trend using the new time-series. The difference between the real  $\text{GDP}_{\text{ONQU}}$  and the trend obtained gives us the HP gap. The measures of correlation are then taken from the Canadian regional HP gap in relation to the Central Canada HP gap.

From graph V.1, it is possible to see that as we move towards the east from Central Canada, the correlations decrease regularly as the distances increase. In the west, the situation is totally different since Saskatchewan's economy is almost entirely based on the production of agricultural goods. This is a major contrast with the industrial composite of Central Canada and this result is also predominant in Graph V.1. As discussed earlier, British Columbia is more correlated with Central Canada than Alberta.

In Alberta, the concentration of economic activities on oil, natural gas, and mines render that region unique in Canada. As a consequence, the correlation with Central Canada is not very high due to the differences in their industrial mix. The industrial composite of Central Canada is mainly in the manufacturing sector whereas Alberta's economy is dependent on the world commodity price fluctuations of its natural resources. Increases in energy prices have a negative impact on the economy of Central Canada since it raises the cost of doing business for the manufacturing sector. Similarly, the same change in the commodity prices for energy will benefit the economy in Alberta which is well endowed in the production of oil. In Table V.2, I look at the relationships between Central Canada, the rest of Canada without Central Canada, and the United States.

The data for the rest of Canada is found by subtracting the real GDP for Canada with the sum of the real GDP of Ontario and Quebec. The calculation is as follow,

United States which stands at 0.77 for HP gap and 0.80 for the fourth difference. These results confirm that the economies of Central Canada are the first affected by fluctuations in the United States but also that the Canadian economy is dependent on the economic conjuncture in Central Canada.

**Table V.2: Correlations of the rest of Canada, Ont.-Que. and the United States**

	RESTCA			ONQU			US		
	HPGap	lnYt-1	lnYt-4	HPGap	lnYt-1	lnYt-4	HPGap	lnYt-1	lnYt-4
RESTCA	1.00	1.00	1.00	0.51	-0.05	0.53	0.43	0.10	0.46
ONQU	0.51	-0.05	0.53	1.00	1.00	1.00	0.77	0.59	0.80
US	0.43	0.10	0.46	0.77	0.59	0.80	1.00	1.00	1.00

The differences in the measure of correlation can be explained by the historical background of trade between the two countries. “In Canada, as in most other industrialized countries, protection has trended downward since the early 1960's, while international trade shares have trended upward beginning around the same time. Indeed, the simple correlation coefficient between our measures of tariff protection and trade shares over the period 1950-1993 is -0.91.”<sup>8</sup> Trade barriers have been reduced drastically in Canada and United States since the implementation of the Free Trade Agreement in 1988. As Coulombe states: “...despite the relative decline of the manufacturing sector, there has been a notable increase in goods and services trade between Ontario and the United States in recent years, particularly of vehicles, auto parts, and manufactured products. Indeed, both Ontario and Alberta have experienced a real boom in exports over the past decade.”<sup>9</sup> The sustained growth in exports is mainly due to the strong economic activities south of the border but also to the decline in the exchange rate making our products more competitive internationally. Section V.4 deals with regional specificity.

## **Section V.4: Regional factors**

The fact that some provinces produce a unique set of goods and services as compared to other provinces, it is expected that their level of economic integration and their degree of synchronization will be much lower. This section deals with regional economies that have a strong level of concentration in a few sectors of the economy.

The province of Saskatchewan has low correlation with all the provinces. Their economy is largely concentrated on the production of agricultural products. A bad crop one year may be followed by a good one the next. The business cycles are much more volatile. Alberta's economy has some similarities with Saskatchewan in the sense that the economy is highly concentrated on a few sectors.

The concentration level in Alberta is in sectors such as oil, natural gas and mines. The production cycles in those sectors are much longer than for agriculture but both provinces are dependent on global commodity price fluctuations and on the exchange rate. The extraction process for oil is relatively short but it takes a number of years for the exploration of new fields and it requires a lot of capital investment.

In the east, the situation is different than in Alberta and Saskatchewan. Prince Edward Island and Newfoundland have low correlation with most of the regional economies except for Central Canada. They both are fairly poor provinces and they benefit from the fiscal redistribution. Newfoundland is the highest beneficiary of transfer payments from the Canadian government. The high correlation of Newfoundland with Central Canada is almost like a domino effect whereby the transfer payments emanate from the federal government, and since Canada is highly correlated with Central Canada, it is not a surprise that Newfoundland is highly synchronized with Central Canada. On the other hand, Prince Edward Island is a very

small economy and for that reason, they tend to be more affected by economic turbulence. The primary sectors of activity in that province are agriculture, fishing, logging and mining. All of these sectors are sensitive to the world commodity price fluctuation. As well Prince Edward Island is a very small player in the world production of these goods.

In this section, the results show that a low level of synchronization between some regions is largely due to a low level of economic integration and weak commonality in the industrial composite. In section V.5, an analysis of the level of correlation between the Canadian regional economies with Canada and the United States is done.

### **Section V.5: Correlations with Canada and the United States**

In this section, it is important to be careful in interpreting the results obtained from the correlation Table V.1. The reason for this is that the real GDP for Canada contains the real provincial GDP as well and the degree of synchronization are probably strong in relation to their actual value. For example, a province producing the vast majority of Canadian goods and services has a higher correlation with Canada than a province producing a small amount since that province has a greater portion of its production in the national GDP. At the end of this section, a discussion comparing the results obtained by a paper written by Antia, Djoudad and St-Amant (1999) and the results estimated from this study is done. The methodology and the objectives of their paper is also discussed.

First, let's analyze the correlation results between the Canadian regional economies and Canada. The provinces with the highest degree of synchronization with Canada are the four largest provinces. Their measures of correlation are also ranked in the same order as their national economic size. The economic activities in Central Canada account for about 60 % of Canadian output and Ontario (HP gap:0.85;

In  $Y_{t-4}$  :0.87) and Quebec (HP gap:0.82; In  $Y_{t-4}$  :0.85) have the highest measures of correlation with Canada. British Columbia and Alberta have the second highest correlation. The next grouping of provinces with a high level of synchronization with Canada are the provinces closest to the provinces in Central Canada. The province of Manitoba with an HP gap of 0.57 and a fourth difference of 0.69 are very close to the correlation of Alberta. New Brunswick with its close proximity to Central Canada has almost the same level of correlation as Manitoba.

The correlations with the United States show a distinct relationships with different Canadian regions according to their specific industrial composition. The highest correlations are with the four provinces closest to the golden triangle with higher values for Ontario (HP gap: 0.79, In  $Y_{t-4}$ : 0.80) and Quebec (HP gap: 0.64, In  $Y_{t-4}$ : 0.70). In the west, British Columbia's degree of synchronization with United States is 0.60 for the HP gap and 0.62 for the fourth difference which is explained by the large exports of wood pulp. The correlation is comparable with the level of synchronization obtained by Quebec. This is explained by the similarities between the two provinces. Both are large exporters of goods and services south of the border. In the east, the Atlantic provinces have comparable correlations. Saskatchewan, Newfoundland and Alberta have the lowest level of economic synchronization with the United States. In section V.6, a comparison is made with a paper by Antia, Djoudad and St-Amant (1999) on the Canadian regional economic integration.

### **Section V.6: Some results on the Canadian regional economic integration**

In a paper written by Antia, Djoudad and St-Amant (1999), they investigate smoothing mechanisms of regional economic shocks. To do this, they analyze the level of correlations of the Canadian regional economies in conjunction with the role of risk-sharing mechanisms in the context of a monetary union. Their study is different than our current study as it is not specifically investigating economic integration for the purpose of monetary union but, instead, it is using the measures of

correlation to better understand the Canadian regional economies.

The paper by Antia, Djoudad and St-Amant is interested in smoothing mechanisms because one of the argument for having a fluctuating nominal exchange rate is that it serves as an adjustment mechanism when the Canadian regional economies are faced with external shocks. They want to verify whether there exists comparable smoothing mechanisms between Canada and the United States. The interesting part for this study deals with a comparison of correlations for output, income and consumption to identify the existing mechanisms in the Canadian regional economies.

They calculated the average correlations of the Canadian regional economies using annual per-capita provincial GDP as one of their measurement indicators. The methods used are the first difference (on an annual basis) and the HP filtered series. For these reasons, our comparison will only take into account the values obtained from the measure of correlation based on the real Annual Growth rate and the HP gap.

Using the same method, I estimate the average interprovincial correlation for the Canadian regional economies with Canada to be 0.55 for the HP gap and 0.61 for the real Annual growth rate. Their results are lower with 0.49 and 0.50 respectively. In this study, the results are very close to Antia et al. especially when considering that our longitudinal series is longer and that I use real quarterly data versus real annual per-capita data for Antia, Djoudad and St-Amant. The results of the average interprovincial correlations with the United States is 0.45 using the HP gap, and 0.51 for the real annual growth rate.

One of the main conclusion drawn by Antia, Djoudad and St-Amant is that Canada is benefitting largely from federal transfers such the unemployment insurance system when country specific shocks occur. The United States has no such

$$\ln(\text{GDP}_{\text{ONQU}}) = \ln (\text{GDP}_{\text{ON}} + \text{GDP}_{\text{QU}})$$

The HP method is used to estimate the trend using the new time-series. The difference between the real  $\text{GDP}_{\text{ONQU}}$  and the trend obtained gives us the HP gap. The measures of correlation are then taken from the Canadian regional HP gap in relation to the Central Canada HP gap.

From graph V.1, it is possible to see that as we move towards the east from Central Canada, the correlations decrease regularly as the distances increase. In the west, the situation is totally different since Saskatchewan's economy is almost entirely based on the production of agricultural goods. This is a major contrast with the industrial composite of Central Canada and this result is also predominant in Graph V.1. As discussed earlier, British Columbia is more correlated with Central Canada than Alberta.

In Alberta, the concentration of economic activities on oil, natural gas, and mines render that region unique in Canada. As a consequence, the correlation with Central Canada is not very high due to the differences in their industrial mix. The industrial composite of Central Canada is mainly in the manufacturing sector whereas Alberta's economy is dependent on the world commodity price fluctuations of its natural resources. Increases in energy prices have a negative impact on the economy of Central Canada since it raises the cost of doing business for the manufacturing sector. Similarly, the same change in the commodity prices for energy will benefit the economy in Alberta which is well endowed in the production of oil. In Table V.2, I look at the relationships between Central Canada, the rest of Canada without Central Canada, and the United States.

The data for the rest of Canada is found by subtracting the real GDP for Canada with the sum of the real GDP of Ontario and Quebec. The calculation is as follow,

$$\ln(\text{GDP}_{\text{RESTCA}}) = \ln(\text{GDP}_{\text{CA}} - \text{GDP}_{\text{ON}} - \text{GDP}_{\text{QU}})$$

**Graph V.1: Correlations with combined Ontario-Quebec  
(1961:1;1998:2)**

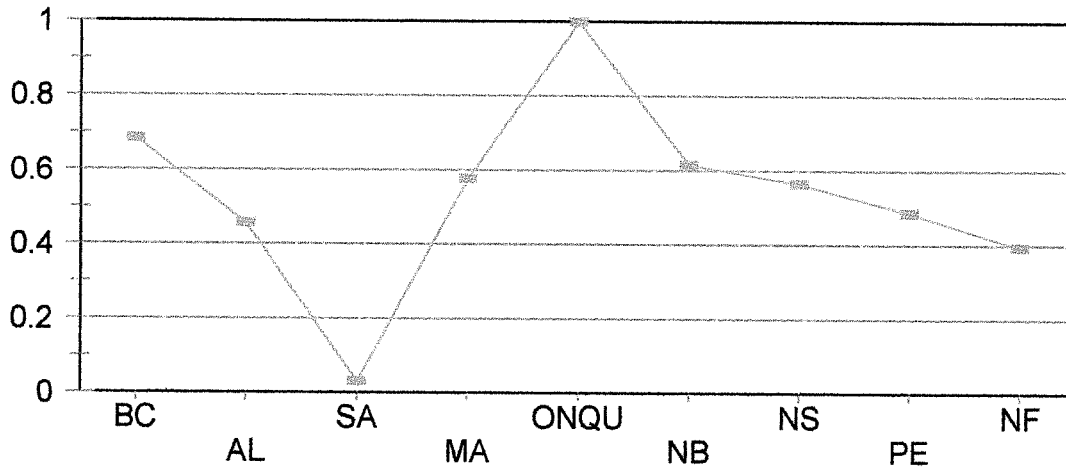


Table V.2 provides interesting information regarding the relationships between the rest of Canada, Central Canada and the United States. The table shows that the rest of Canada has a degree of synchronization slightly higher with Central Canada (HP gap:0.51;  $\ln Y_{t-4}$  :0.53) than with the United States (HP gap:0.43;  $\ln Y_{t-4}$  :0.45). The results obtained from the correlation is expected based on the earlier discussion on the need for Central Canada to have inputs from the peripheral regions.

The higher measures of correlation between Ontario-Quebec and the United States than with the rest of Canada are somewhat surprising. In effect, the level of the correlations between Central Canada and the United States is greater than the correlations of Canada with the United States as shown in Table V.1. The level of the correlations between Canada and the United States (HP gap:0.70;  $\ln Y_{t-4}$  :0.73) is lower than the degree of synchronization between Central Canada and the

United States which stands at 0.77 for HP gap and 0.80 for the fourth difference.

These results confirm that the economies of Central Canada are the first affected by fluctuations in the United States but also that the Canadian economy is dependent on the economic conjuncture in Central Canada.

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ONQU	0.51	-0.05	0.53	1.00	1.00	1.00	0.77	0.59	0.80
US	0.43	0.10	0.46	0.77	0.59	0.80	1.00	1.00	1.00

The differences in the measure of correlation can be explained by the historical background of trade between the two countries. "In Canada, as in most other industrialized countries, protection has trended downward since the early 1960's, while international trade shares have trended upward beginning around the same time. Indeed, the simple correlation coefficient between our measures of tariff protection and trade shares over the period 1950-1993 is -0.91."<sup>8</sup> Trade barriers have been reduced drastically in Canada and United States since the implementation of the Free Trade Agreement in 1988. As Coulombe states: "...despite the relative decline of the manufacturing sector, there has been a notable increase in goods and services trade between Ontario and the United States in recent years, particularly of vehicles, auto parts, and manufactured products. Indeed, both Ontario and Alberta have experienced a real boom in exports over the past decade."<sup>9</sup> The sustained growth in exports is mainly due to the strong economic activities south of the border but also to the decline in the exchange rate making our products more competitive internationally. Section V.4 deals with regional specificity.

#### **Section V.4: Regional factors**

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small economy and for that reason, they tend to be more affected by economic turbulence. The primary sectors of activity in that province are agriculture, fishing, logging and mining. All of these sectors are sensitive to the world commodity price fluctuation. As well Prince Edward Island is a very small player in the world production of these goods.

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In this section, it is important to be careful in interpreting the results obtained from the correlation Table V.1. The reason for this is that the real GDP for Canada contains the real provincial GDP as well and the degree of synchronization are probably strong in relation to their actual value. For example, a province producing the vast majority of Canadian goods and services has a higher correlation with Canada than a province producing a small amount since that province has a greater portion of its production in the national GDP. At the end of this section, a discussion comparing the results obtained by a paper written by Antia, Djoudad and St-Amant (1999) and the results estimated from this study is done. The methodology and the objectives of their paper is also discussed.

First, let's analyze the correlation results between the Canadian regional economies and Canada. The provinces with the highest degree of synchronization with Canada are the four largest provinces. Their measures of correlation are also ranked in the same order as their national economic size. The economic activities in Central Canada account for about 60 % of Canadian output and Ontario (HP gap:0.85;

In  $Y_{t-4}$  :0.87) and Quebec (HP gap:0.82; In  $Y_{t-4}$  :0.85) have the highest measures of correlation with Canada. British Columbia and Alberta have the second highest correlation. The next grouping of provinces with a high level of synchronization with Canada are the provinces closest to the provinces in Central Canada. The province of Manitoba with an HP gap of 0.57 and a fourth difference of 0.69 are very close to the correlation of Alberta. New Brunswick with its close proximity to Central Canada has almost the same level of correlation as Manitoba.

The correlations with the United States show a distinct relationships with different Canadian regions according to their specific industrial composition. The highest correlations are with the four provinces closest to the golden triangle with higher values for Ontario (HP gap: 0.79, In  $Y_{t-4}$  : 0.80) and Quebec (HP gap: 0.64, In  $Y_{t-4}$  : 0.70). In the west, British Columbia's degree of synchronization with United States is 0.60 for the HP gap and 0.62 for the fourth difference which is explained by the large exports of wood pulp. The correlation is comparable with the level of synchronization obtained by Quebec. This is explained by the similarities between the two provinces. Both are large exporters of goods and services south of the border. In the east, the Atlantic provinces have comparable correlations. Saskatchewan, Newfoundland and Alberta have the lowest level of economic synchronization with the United States. In section V.6, a comparison is made with a paper by Antia, Djoudad and St-Amant (1999) on the Canadian regional economic integration.

### **Section V.6: Some results on the Canadian regional economic integration**

In a paper written by Antia, Djoudad and St-Amant (1999), they investigate smoothing mechanisms of regional economic shocks. To do this, they analyze the level of correlations of the Canadian regional economies in conjunction with the role of risk-sharing mechanisms in the context of a monetary union. Their study is different than our current study as it is not specifically investigating economic integration for the purpose of monetary union but, instead, it is using the measures of

correlation to better understand the Canadian regional economies.

The paper by Antia, Djoudad and St-Amant is interested in smoothing mechanisms because one of the argument for having a fluctuating nominal exchange rate is that it serves as an adjustment mechanism when the Canadian regional economies are faced with external shocks. They want to verify whether there exists comparable smoothing mechanisms between Canada and the United States. The interesting part for this study deals with a comparison of correlations for output, income and consumption to identify the existing mechanisms in the Canadian regional economies.

They calculated the average correlations of the Canadian regional economies using annual per-capita provincial GDP as one of their measurement indicators. The methods used are the first difference (on an annual basis) and the HP filtered series. For these reasons, our comparison will only take into account the values obtained from the measure of correlation based on the real Annual Growth rate and the HP gap.

Using the same method, I estimate the average interprovincial correlation for the Canadian regional economies with Canada to be 0.55 for the HP gap and 0.61 for the real Annual growth rate. Their results are lower with 0.49 and 0.50 respectively. In this study, the results are very close to Antia et al. especially when considering that our longitudinal series is longer and that I use real quarterly data versus real annual per-capita data for Antia, Djoudad and St-Amant. The results of the average interprovincial correlations with the United States is 0.45 using the HP gap, and 0.51 for the real annual growth rate.

One of the main conclusion drawn by Antia, Djoudad and St-Amant is that Canada is benefitting largely from federal transfers such the unemployment insurance system when country specific shocks occur. The United States has no such

mechanism and, more importantly, there are no cross-country smoothing mechanisms to reduce the effect of external country specific shocks. They also conclude that without "deep structural reforms, a Canada-U.S. monetary union would encounter more difficulties than would the existing Canadian monetary union."<sup>10</sup>

Antia, Djoudad and St-Amant argue that Canada is not prepared to have a currency fixed on the US dollar mainly because of the lack of cross-country smoothing mechanism. The end of this section deals with another point of view suggesting that a common currency in North America would be beneficial.

In a well discussed commentary by Courchene and Harris (1999), they evaluate the available currency options for Canada in relation to the North American economic integration since the Free Trade Agreement with the United States and then with Mexico. The commentary deals at first with the historical advantages for maintaining flexible exchange rates and then it makes a case to show the benefits of having exchange rate fixity with our largest trading partners. This commentary is by no means directly related to the work done in my study but since most of the arguments on the needs to review the exchange rate policy is based on the increasing North American economic integration, I felt it was important to discuss it as this study shows the high degree of economic integration between some provinces and United States.

One of the main arguments for maintaining the flexibility in the exchange rate is that the dollar fluctuations play the role of buffer in the event of external shocks. It is argued by Courchene and Harris that the difficulty with such adjustment to external shock is that it is not possible to know if the currency fluctuations are the result of a misalignment of the currency or if it is a temporary or permanent change in the value of the dollar. Furthermore, it is extremely difficult to pin point the exact reasons for the fluctuations in the currency whether it is a behavior shift by investors, bad monetary or economic policies, or a change in the terms of trade. In effect, there are a

large number of reasons potentially able to explain shifts in the value of the dollar. As well, the commentary raises important issue as to the importance of economic integration.

The commentary states on page 12 that Canada is viewed more as a series of regional economies trading mostly North-South than the interprovincial economies with high levels of trade from west to east. The results obtained from this study tends to confirm this view. Courchene and Harris also argue that a common currency would put Canadian firms in better position to face external shocks as they will react in the same way as their direct competitors in the United States. Hence an oil shock would affect in the same manner the producer in Alberta and in Texas. Courchene and Harris are claiming that a review of the exchange rate policy is needed in light of the European Monetary Union and the increasing economic integration in North America.

Over 60% of the Canadian production emanates from these two provinces, this finding adds an argument in favor of a unique monetary system in North America. Canada has about 80% of its trade with the United States, a "...monetary union brings both benefits (reduced transaction costs in international trades, greater credibility and stability of monetary policy) and costs (greater difficulty in adjusting to country-specific shocks). The usual argument is that the greater the trade between two nations, the larger the gains from a common currency and the less the value of the freedom to adjust exchange rates."<sup>11</sup>The information resulting from the study of correlation is also important for the analysis of Part VI which looks at the concept of persistence. The work done in this study is only partial in determining the benefits or the disadvantages in having a common currency with the United States. Nonetheless, the results on the economic integration are interesting in understanding the behavior of the regional economies when they are faced with an external shock.

In Part VI, I focus on the persistence of external shocks in relation to the Canadian regional economies. This new measure provides further information on the

nature and effects of external shocks on the Canadian regional economies. Part VI replicates the work done by Campbell and Mankiw (1989) and a comparison of the level of persistence is made using a new set of time-series for Canada, the United States and the Canadian regional economies. The study on the level of the persistence between the two countries is not new but the measures of persistence for the Canadian regional economies are new and they are the important measures for this part.

## **Part VI: Persistence of shocks in the Canadian regional economies**

### **Section VI.0: Introduction**

Part V showed findings on the degree of synchronization between the Canadian regional economies. One of the main results is that the provinces have correlation levels close to one another when considering their specific characteristics such as the economic integration, the industrial composite or even their proximity. In this Part, I demonstrate that external shocks affect differently Canadian regions according to their specific characteristics. By the same token, external shocks are different and they trigger different reactions from Canadian regional economies according to these same characteristics. Not all provinces are affected by a given external shock. For example, a shock will not have the same impact on the profitability of producing oil in Alberta as it would on the production of Saskatchewan wheat. As a consequence, I expect that the measures of persistence for the Canadian regional business cycles are by nature different thereby providing an explanation of the differences in the degree of synchronization found in Part V. Provinces with roughly the same level of synchronization also have comparable measures of persistence. Part VI shows a relationship between the correlation and the measure of persistence.

A considerable amount of work has been done on the subject of persistence of output changes to external shocks but very little work on the level of GDP in the Canadian regional economies was undertaken. This section studies whether persistence of shocks remain at the same level as studied in 1989 in a paper by Campbell and Mankiw. To estimate the level of persistence, a simple but proven method is used. An external shock is a disturbance in the economy creating output fluctuations. "We take persistence as meaning 'continuing for a long time into the future'."<sup>12</sup> So if external shocks can have a lasting effect on the Canadian regional economies, then it is important to measure its level.

The methodology of the calculation and the persistence indicators are explained in section VI.1. In order to estimate a measure of persistence, a replication of the results obtained by Campbell and Mankiw (1989) was undertaken. At first, the same period (1957:1, 1986:1) is used by applying one of the methods explained in their paper. Then, the measure of persistence is calculated using a longer sample size (1961:1, 1998:2). In the section VI.2, the results of the estimates for persistence of provincial and overall Canadian economic fluctuations as well as United States' persistence are shown with the equation used. A table of findings showing a comparison of the results obtained by Campbell and Mankiw (1989) and the findings I have for the calculation of persistence are presented. In Part VII, I compare the results obtained by Campbell and Mankiw in 1989 in section VII.1 and I show the new findings after using longer time-series. More importantly, in section VII.2, I analyze the interprovincial results on the measures of persistence.

### **Section VI.1: The approach to measure the persistence**

“One is tempted to interpret the permanent component as the natural rate of output and the temporary component as the deviation of output from the natural rate.”<sup>13</sup> It is important to determine the measures of persistence because if a shock is considered to be transitory, the effects will dissipate rapidly over the periods following the external shock. On the contrary, if the shock is permanent, its effects will have lasting repercussions on output fluctuations for a number of periods. On the other hand, “one cannot reject that some fraction of an innovation in the series is permanent.”<sup>14</sup> This section will not attempt to determine the ratio of each portion. Instead, the focus will be on estimating a measure of persistence. “Intuitively, this measure is the answer to the question: If output is 1 percent higher this period than expected, by what percent should I change my forecast of output in the distant future?”<sup>15</sup> Understandably, policy makers seek to know whether disturbances will disappear in a short period of time such as three months, or will

they drag and impede the growth of the economy by creating undesired output fluctuations for years to come. These interrogations are investigated in the following sections. Hence, one of the main objectives of this section is to investigate the outcome of shocks on output.

Real-business-cycle models are based primarily on the need to have technological innovation in order to have fluctuations in the level of output. Logically, a technological innovation today may not hinder any innovation in the future but it will permanently have increased the expected level of technology. On the contrary, traditional Keynesian models believe that "output movements are largely the result of monetary and other aggregate demand disturbances coupled with sluggish adjustment of nominal prices or wages"<sup>16</sup> In their models, there is a gradual adjustment in prices and wages which implies that there is no permanent effects in the level of output and therefore, output can only fluctuate in the neighborhood of a deterministic trend path. This issue raised a lot of controversy and discussion on the persistence of output movements. As stated by Campbell and Mankiw (1989), "if a stochastic process reverts to a deterministic time trend, then one would expect unusually low growth rates (recessions) to be followed by unusually high growth rates (recoveries)."<sup>17</sup>

Campbell and Mankiw have devoted a number of articles on the topic of persistence of external shocks on various industrialized countries including Canada and the United States. They have found that in Canada, for the period of their studies, 1957:1 to 1986:2, shocks would tend to have a permanent effect of up to 10 years before it is completely dissipated. As explained earlier, part of the external shock will revert shortly to the natural rate of output and the residual output gap will take much more time to return to its natural state. Campbell and Mankiw (1987b) have compared three approaches to estimate the measure of persistence and they found that the results were roughly the same by using either of the methods to estimate the persistence  $V^*$ .

The approach favored in this study for the calculation of the estimate is the method first used by Cochrane in 1988. The method is described by himself as the variance of the change in the random walk component divided by the variance of the total change in output. The ratio of variance can be expressed as the following:

$$V^k \equiv \frac{1}{k+1} \frac{\text{var}(Y_{t+k+1} - Y_t)}{\text{var}(Y_{t+1} - Y_t)}$$

This method was used to estimate the measure of persistence for the same periods as used by Campbell and Mankiw. The equations based on the ratio of variances and the results obtained from the replication of the Campbell and Mankiw studies are presented in table VI.1. In section VI.2, I compare the results obtained by Campbell and Mankiw with my findings.

It is important to compare and replicate the work done by Campbell and Mankiw to assure the estimate method is an accurate reflection of their work. As well, it will be possible to compare if a change occurred with a different time period. I re-estimate the Campbell and Mankiw's findings by using the same period to verify the exactitude of the estimation equations. Table VI.1 contains three columns. The first column shows the estimation of the ratio of variance,  $V$ . The second column is the ratio of variance adjusted for the downward bias. It is important to correct the estimate of  $V^k$  for the following reasons. To have a better estimate of  $V$ , it is preferable that  $k$  be as large as possible but as  $k$  gets closer to the sample size  $T$ , the value of  $V^k$  equals zero since  $k = T - 1$ . Consequently, the value of  $k$  must be as large as possible without being too close to  $T$ . The difficulty is that it is not possible to know what value  $k$  should take. For this reason  $k$  takes on three values and the bias-corrected is used to eliminate the downward bias. As mentioned in Campbell and Mankiw (1989), the estimator  $V^k$  has a mean value of

about  $(T-k)/T$  instead of the normal value of 1. That is why the bias-corrected for the estimate of  $V^k$  is  $T/(T-k)$ . The last column gives the results found by Campbell and Mankiw in their 1989 paper.

For the United States, my results obtained are astonishingly close to the estimates of Campbell and Mankiw (1989). Their results were between 1.32 to 1.48 and the results of this study range from 1.34 to 1.42. The results for Canada are slightly different but the discrepancy could be the consequences of using a different data source or adjustments made to the data over time to improve the level of accuracy. The results found for Canada by Campbell and Mankiw are between 1.35 and 1.76 while the estimates for this study are between 1.57 and 1.92.

In the 1989 paper by Campbell and Mankiw, they use data originating from the International Monetary Funds International Financial Statistics where as discussed earlier I use data from the CANSIM database. The other potential explanation for the discrepancy between the results is the adjustments made to the data over the years. It is quite common to correct the data in order to improve their accuracy and their quality. It is therefore normal that the Canadian data is more accurate through the work of Statistics Canada than the data taken from an International agency. In this study, the period of study have been extended greatly when compared with the period of time used in the work of Campbell and Mankiw.

Romer (1996, p. 178) suggests the statistical difficulty of making an accurate estimate of output fluctuations using data from a limited period. To alleviate the statistical problem raised by Romer, the time-series in this study are much longer. The articles by Campbell and Mankiw used a time period of 118 observations for Canada and 119 observations for the United States. In this study I use 150 observations. As mentioned, it is hard to determine what is the appropriate

**Table VI.1: Estimation using the same period as Campbell and Mankiw (CM)**

		$\sqrt{\phantom{x}}$	Bias- correc.	CM
<b>REAL UNITED STATES GDP (119 observations)</b>				
t=1				
k=20	$\text{var}(\ln Y_{us}) = (1/21) * (\text{var}(\ln Y_{us}(22)) - \text{var}(\ln Y_{us}(1))) / (\text{var}(\ln Y_{us}(2)) - \text{var}(\ln Y_{us}(1)))$	1.10	1.32	1.34
k=40	$\text{var}(\ln Y_{us}) = (1/41) * (\text{var}(\ln Y_{us}(42)) - \text{var}(\ln Y_{us}(1))) / (\text{var}(\ln Y_{us}(2)) - \text{var}(\ln Y_{us}(1)))$	0.91	1.36	1.35
k=60	$\text{var}(\ln Y_{us}) = (1/61) * (\text{var}(\ln Y_{us}(62)) - \text{var}(\ln Y_{us}(1))) / (\text{var}(\ln Y_{us}(2)) - \text{var}(\ln Y_{us}(1)))$	0.73	1.48	1.42
<b>REAL CANADA GDP (118 observations)</b>				
k=20	$\text{var}(\ln Y_{can}) = (1/21) * (\text{var}(\ln Y_{can}(22)) - \text{var}(\ln Y_{can}(1))) / (\text{var}(\ln Y_{can}(2)) - \text{var}(\ln Y_{can}(1)))$	1.12	1.35	1.57
k=40	$\text{var}(\ln Y_{can}) = (1/41) * (\text{var}(\ln Y_{can}(42)) - \text{var}(\ln Y_{can}(1))) / (\text{var}(\ln Y_{can}(2)) - \text{var}(\ln Y_{can}(1)))$	1.00	1.51	1.88
k=60	$\text{var}(\ln Y_{can}) = (1/61) * (\text{var}(\ln Y_{can}(62)) - \text{var}(\ln Y_{can}(1))) / (\text{var}(\ln Y_{can}(2)) - \text{var}(\ln Y_{can}(1)))$	0.87	1.76	1.92

Note: The same period was used to replicate the results found by CM except that the author uses GDP instead of GNP.

time span but a longer period should provide better estimators of persistence. One should keep in mind that it is unlikely that the measure of persistence can be used to

evaluate the long term effects of a shock on the level of GDP since innovations may occur only once or many times skewing the long term forecasts. Hence, the values obtained for the persistence are only valid for a short period of time.

Another difference between the work of Campbell and Mankiw and this study concerns the type of data used. Campbell and Mankiw estimated the measure of persistence using real Gross National Product (GNP) and in this study, we use real GDP. Campbell and Mankiw in their 1989 paper investigated whether using real GNP or real GDP would alter their findings. They found that the difference between the two types of data was minimal. This is probably why they use interchangeably the GNP and the GDP for different countries depending on the availability of the time-series.<sup>18</sup> Based on this fact, I choose to use real GDP.

In Part VI, I explained the methodology to measure the level of persistence using the ratio of variances as developed by Cochrane and subsequently used by Campbell and Mankiw. I demonstrated the accuracy to the estimation method by replicating the findings of Campbell and Mankiw. In Part VII, I look at the results and findings in Canada and in the United States in light of the results obtained by Campbell and Mankiw, then I analyze the results for the Canadian regional economies.

## Part VII: Results and findings

### Section VII.0: Introduction

Many factors influence the effects of external shocks on the Canadian regional economies. Engerman raised some interesting arguments in his 1965 paper concerning the factors influencing the regional economies following an external shock. The mixture of industrial composite will affect the way a region reacts to external shocks. The level of trade diversification modifies the level of sensitivity of a region to specific external shocks. Two regions may have a different mixture of industrial composite and a different degree of trade diversification and even if they are side by side, they react in a different way to external shocks. To this effect, in this section an explanation based on the industrial composite will be provided but in less details than in Part V.

The first interpretation on the persistence estimator should be with Canada and the United States since we can compare our results with the findings of Campbell and Mankiw (1989). It is important to mention again that the period covered by Campbell and Mankiw is not the same as the period covered in this study. Nonetheless, it is interesting to compare the findings of both studies and to evaluate whether there has been a change in the speed of adjustment of the two economies when faced with external shocks. You may recall that the estimators obtained for Canada were 1.57, 1.88 and 1.92 for  $k$  ranging from 20 to 60. In this study, the average of the estimators is 0.91 for the three measures of persistence. It is a significant reduction in the estimator of persistence showing the structural evolution that has happened in Canada since the beginning of the 1990s.

A quick historical review of major events since the end of the 1980s provides for some of the explanations regarding this drastic change in the estimators of persistence. The structural modifications in the Canadian economies really

began around 1988 with the ratification of the Free Trade Agreement with the United States. The agreement stated that trade barriers would slowly be eliminated over a period of ten years to allow businesses to adjust to the new environment. Some of the barriers were eliminated in the next few years when both countries felt the markets as well as businesses were ready to compete in a free market environment. As a consequence, businesses in Canada and to some extent in the United States were aware of the added competition and many reorganized their operation to reduce their cost of doing business.

In the early 1990s, the United States was hit by a recession that took them off their long term growth path. This is clearly visible from graph II.4. As Canada is highly correlated with the United States, it did not take very long for Canada to be hit with a very steep recession. The confidence level in Canada was also very low for a number of years and the level of employment decreased due to the efforts by businesses to further reduce their costs of production. Domestic demand went down again following the short recovery in 1994. It took a few years for the domestic demand to get back to sustainable levels. In fact, the recovery was mainly led by strong exports of Canadian goods.

The findings for the United States are better as well. In the results from Campbell and Mankiw, the persistence estimators were between 1.34 and 1.42. Now, they are much lower and they range between 0.83 to 0.88. These changes in the estimators are the results of structural adjustments due to the recession of the early 1980s and the beginning of the 1990s. As well, businesses in the United States invested heavily in past years on technological innovation creating very important efficient gains. The reduction in the measures of persistence for Canada and the United States is a clear demonstration of the industrial adjustments that took place in the North American economies since the implementation of the Free Trade Agreement and the recovery from the past recessions.

Canada is moving more and more towards a service-oriented economy. The economic cycle for the service sector has a much shorter life span and consequently, the speed of adjustment to external shocks will also be faster. Since services are much more localized in the way they are delivered, it is normal that the effects of external shocks are felt within the regional economy where the services are provided. In the United States, the more prevalent focus on the technological changes in the economy has led to important efficiency gains throughout the economy. Canada has followed suit in upgrading its technological equipment in the last few years. As a result, the domestic demand remains very strong, wages are increasing and the cost of doing business is reduced due to the higher efficiency of production. Knowing that the North American economies can adjust faster to external shocks is interesting but now let's turn our attention to the speed of adjustment of the Canadian regional economies.

**Table VII.1: Value of the measure of persistence,  $V^k$**   
(1961:1 - 1998:2)

	<b>k=20</b>	<b>bias- corrected</b>	<b>k=40</b>	<b>bias- corrected</b>	<b>k=60</b>	<b>bias- corrected</b>
<b>BC</b>	0.83	0.95	0.68	0.93	0.56	0.93
<b>AL</b>	0.94	1.08	0.84	1.14	0.72	1.20
<b>SA</b>	0.49	0.56	0.44	0.60	0.41	0.68
<b>MA</b>	0.73	0.85	0.61	0.84	0.48	0.80
<b>ON</b>	0.80	0.92	0.64	0.87	0.51	0.85
<b>QU</b>	0.74	0.86	0.60	0.82	0.48	0.80
<b>NB</b>	0.87	1.00	0.75	1.02	0.61	1.01
<b>NS</b>	0.88	1.01	0.79	1.08	0.68	1.13
<b>PE</b>	0.90	1.04	0.93	1.27	0.79	1.32
<b>NF</b>	0.76	0.87	0.58	0.79	0.45	0.75
<b>CDN</b>	0.80	0.92	0.66	0.91	0.54	0.91
<b>US</b>	0.76	0.88	0.61	0.83	0.52	0.87

## **Section VII.1: Persistence in the Canadian regional economies**

In the Canadian context, Saskatchewan has the lowest estimate of persistence in Canada, its persistence estimator is even lower than the United States. A number of explanations can shed some light to this result. First, Saskatchewan has been benefitting for a few years from the Wheat Board which controls the level of inventory of grains produced by providing advice to farmers and vital information as to the type of crop to grow based on the demand for grain and on the need for diversification of crop production. Second, Saskatchewan farmers are contributing to the federally controlled Agricultural Income Disaster Assistance Program which is in effect a crop insurance program allowing them to limit the extent of their losses in bad times. The insurance has also the effect of reducing the level of profits in good times by the cost of the insurance program. Third, it is common to see the federal government intervene in bad years like last year's flood by subsidizing an amount of money to compensate for the loss of revenues encountered by the farmers.

In Coulombe (1999b), there is also a comment to the effect that Saskatchewan can adjust fast to shocks to the output. One argument to explain this phenomenon is the high level of concentration of its economy on the wheat production and that it is highly influenced by the fluctuating world commodity prices of its resource. As stated by Coulombe, the world fluctuations in the price of wheat is much more volatile than the fluctuations in the Consumer Price Index. As the price of resources stabilizes, the economy in Saskatchewan becomes less volatile and the effect of a decline in the world price is limited by the crop insurance program. In fact, agricultural shocks may only have a temporary effect on the Saskatchewan economy since the cost of seeding for a new crop in the following year is relatively cheap as compared to the replacement of heavy machinery used in the manufacturing sectors. As such, one bad crop may be

followed by a good crop balancing out the crop production or a bad year can be followed by a good year. Finally, "sustained growth in agricultural productivity accounts for the decreasing proportion of population remaining in the farming regions, a phenomenon which has been observed in Canada since the 1930s."<sup>19</sup> These factors are specific to Saskatchewan due to their high concentration of economic activity in agricultural production.

Newfoundland is also adjusting fast from external shocks in output with the second lowest persistence estimators. One main explanation for this fast adjustment in Newfoundland is the transfer payment made by the federal government in order to help in the event of shock. One prime example comes from the early 1990s with the dramatic decrease in the stock of northern cod. As Coulombe (1999b) states: "This might be the result of the massive transfers from the federal government to this province in order to offset temporarily the effects of the crisis". Furthermore, Newfoundland's economy is based on seasonal activities and in the slow season, they tend to receive compensation from the government in the form of employment insurance. For most of the year, the Newfoundlanders are receiving transfer payments from the federal government.

In the province of Quebec, the measure of persistence is on average 0.83. The province has a high concentration of manufacturing and it has been in decline in the country for a few decades. The economy is more active in providing services which are more responsive to external shocks. It produces a different mixture of goods than its neighbors which explains the differences in the persistence estimators between Ontario and Quebec.

Manitoba has persistence estimators around 0.83. The industrial composite in Manitoba comprises a lot of agricultural production but not at the same level of concentration as Saskatchewan. This partly explain why the two provinces have different measures of persistence. The economy in Manitoba has some

manufacturing but it has a high concentration of finance and insurance activities.

Quebec and Manitoba have the same level of persistence and they are also highly correlated. This can be explained because both provinces share some characteristics in their industrial composite. Although they produce different goods and services, they have a very comparable relative mixture of industrial composite. They both have a manufacturing sector. They produce agricultural products although they do not produce the same goods. Both provinces are integrated economically even if they produce a different set of goods and services.

The measure of persistence in British Columbia is slightly below the critical value of 1. British Columbia is a province with a lot of natural resources such as mines, lumber and natural gas. It is highly affected by fluctuating commodity prices around the world but it has the advantage to be diversified in manufacturing, financial services and in construction. This diversification explains their relatively low measure of persistence as compared with Alberta. In fact, British Columbia is more integrated economically with Ontario as the level of correlation is higher and their measures of persistence are close.

The estimator for Ontario are below 1 and it shows that Ontario has the ability to adjust to shocks. It is the richest province in Canada with a well diversified production of goods and the largest manufacturer in the country. It also benefitted from the strong automobile industry with the Auto Pact in the mid 1960s. At the time of the Auto Pact agreement, Ontario was the largest producer of automobile in Canada and this agreement reinforced the strength in this industry. In the past years, the auto industry has been growing since many consumers are renewing their vehicles. The measures of persistence for Ontario remain lower than Alberta and the Atlantic provinces. This is not surprising for two reasons. Alberta's economy is dependent on world commodity prices and fluctuating exchange rates. The Atlantic provinces are small economies with little influence on

the economic conjuncture. Also, Ontario being the largest manufacturer, it is normal that the economy takes time to adjust to economic turbulence due to the cost of modifying manufacturing plants.

Four provinces are still showing some signs of persistence. They are in order of importance, the three Atlantic provinces and Alberta. Although the findings are greater than 1, their estimators of persistence are relatively close to the critical level of 1. The only exception to this is Prince Edward Island which has a measure of persistence much higher than one but still lower than the results found by Campbell and Mankiw (1989). The three Atlantic provinces have a high concentration of industries in fishing and fish processing. In the west, Alberta has the highest estimate of persistence of the group. It is understandable since the industrial composite of the province is mainly from production of oil and natural gas. Fluctuations in the world prices of these commodities have a direct effect on the growth rate of the province. This high level of concentration makes them very liable to external shocks especially when they are directly related to oil shocks.

As mentioned by Coulombe (1999), "first, it is particularly difficult to anticipate the relative evolution of the growth pattern of a peripheral economy that is largely based on the exploitation of natural resources. The fortunes of such an economy often depend on changing oil prices of its main resources, such as oil, wheat, or wood pulp. These prices fluctuate much more than those of manufactured products and are often subject to significant sudden movements that are difficult to predict."<sup>20</sup> An economy based on the production of commodity prices is dependent on the goods market fluctuations such that a sharp decline in the demand for goods disrupt businesses inventory. The manufacturing sector is less disrupted by market fluctuations since a lot of the goods are purchased in advance and are purchased on anticipation of sales. This means that the risk for an external shock is shared between the manufacturer and the various sellers of the goods. As a consequence, the level of persistence depends on the industrial composite, the

degree of trade diversification and the level of economic integration with the other regional economies.

In this Part, I demonstrated that the provinces showing a strong economic integration by having a high level of correlation tend also to have comparable measures of persistence. For example, I showed that the provinces such as Manitoba and Quebec have a high level of correlation as well as some similarities in the mixture of the industrial composite. Their measures of persistence confirm the results obtained from the levels of correlation. The two economies are well integrated economically.

Consequently, the measures of persistence is an important tool in understanding the Canadian regional economies. In Part VI, I showed the values of correlation between the provinces, Canada and the United States. In Part VII, I demonstrated that provinces with high levels of correlation also tend to have comparable measures of persistence. Hence, it is possible to affirm that their economies are integrated, their relative mixture of industrial composite are at comparable levels and their levels of trade diversification are close.

## **Part VIII: Conclusion and potential future research**

In this study, I examine the Canadian regional business cycles with Canada and the United States using different methods such as the levels of correlation and the degree of persistence to external shocks. The level of correlation in the real provincial GDP is a good indication of the similarities in the mixture of the industrial composite and the level of economic integration. One of the new elements of the study is to analyze the degree of persistence at the regional level.

This added tool serves to verify and confirm some of the findings found with the analysis of the levels of correlation. In most cases, a high correlation between two economies is reflected by having about the same measures of persistence. To do this investigation, I replicate the work done by Campbell and Mankiw in their paper of 1989. The results were comparable with the findings mentioned in their paper. On this basis, I estimate the degree of persistence for the Canadian regional economies. The results are interesting as Canada and the United States have reduced their measures of persistence since the publication of the paper by Campbell and Mankiw. Furthermore, the provinces are showing a relatively low degree of persistence to external shocks. The provinces with results showing persistence have either a limited trade diversification like Alberta, or are very small economies with the production concentrated on few commodity products such as the Atlantic provinces.

Another striking result from the study is the higher correlation between Central Canada with the United States than with Canada. This shows that Central Canada is more integrated economically with the United States than with Canada. One of the reason for this relationship is the effect of the historical evolution of the economy and the strong influence of the golden triangle in the United States.

“In all the provinces we examined, our evidence suggests that overall

federal policy affected economic conditions in the desired way. Similar evidence for provincial fiscal policy suggests that overall provincial policy also affected regional economic conditions. Thus, both levels of government ran counter-cyclical fiscal policy appropriate for individual regional economies largely because of the automatic stabilizers."<sup>21</sup> This is a sign that the federation is well set to counteract external shocks. The fiscal system has automatic stabilizers to redistribute payments when needed. "Regional disparities put significant pressures on fiscal federalism for the financing of local public goods. In this context economic disparities translate into a differential tax burden per unit of public good across local governments. In Canada the traditional solution to this problem has focussed on geographical redistribution of financial resources operated through the equalization system."<sup>22</sup> The federal government needs to intervene temporarily only in cases when the automatic stabilizers were not fully effective.

At the present time, it is not possible to determine with certainty if the decline in the level of persistence of shocks toward the output fluctuations is really an improvement in the structural composition of the economy or if it is in fact, a consequence of the efficiency gains from rapidly changing technology. At the beginning of the 1990s, businesses have been encouraged to upgrade their capital equipments following structural changes in the Canadian regional economies, and the technological modifications taking place in the United States. In the past couple of years, the government of Canada has added incentives for businesses to upgrade their computer systems for the upcoming turn of the century.

As well, the adoption of the Free Trade Agreement with the United States increased the need for corporations and businesses to become more efficient and to modernize their working habits to better compete. The implementation of the Goods and Services Tax was also important in encouraging the business community to upgrade their cash registers to more performing computers albeit the grants offered by the federal government to do so. Another potential factor which played

a role in the technological changes is the increased global competitive pressure created by more freer markets, the European Economic Community, and greater communication links. All these factors together have modified the way business is being made and it is very important for larger firms to maintain a certain degree of technological innovation in order to sustain their level of competitiveness.

In the period of 1957 to 1986, Campbell and Mankiw have found that shocks had a tendency to be permanent in Canada as well as in United States. In this study, it is clear that when the social and economic factors are assembled, the output fluctuations from shocks are transitory. In other words, the results have changed and there are no signs in the estimated measure of persistence that external shocks have a lasting effect on the Canadian regional economies. This regional study also shows the relationship between regions and the degree of regional economic integration in Canada. This study demonstrates that the Canadian regional economies are in constant change especially during the last decade.

## Endnotes

- 1 Krugman, Paul (1991), pp. 51-52.
- 2 Campbell, John Y. and N.-Gregory Mankiw (1987b), p. 857.
- 3 Ibid p. 857.
- 4 Campbell, John Y. and N.-Gregory Mankiw (1978b), p. 876.
- 5 Krugman, Paul (1991), p. 41.
- 6 McCallum, John (1995), p. 620.
- 7 Boothe, Paul and Michelle Davidson (1996), p. 6.
- 8 McCallum, John (1995), p. 621.
- 9 Coulombe, Serge (1999b), p. 7.
- 10 Antia, Z., Djoudad Ramdane and Pierre St-Amant (1999), p. 18.
- 11 Krugman, Paul (1991), p. 82.
- 12 Campbell,-John-Y. and N.-Gregory Mankiw (1987b), p. 112.
- 13 Ibid, p. 115.
- 14 Campbell,-John-Y. and N.-Gregory Mankiw (1987a), p. 858.
- 15 Romer, David (1996), p. 178.
- 16 Ibid, p. 175.
- 17 Campbell,-John-Y. and N.-Gregory Mankiw (1989), p. 321.
- 18 Campbell,-John-Y. and N.-Gregory Mankiw (1989), p. 326.
- 19 Coulombe, Serge (1999b), p. 5.
- 20 Ibid, p. 19.
- 21 Boothe, Paul and Michelle Davidson (1996), p. 12.
- 22 Coulombe, Serge and F.C. Lee (1995), p. 887.

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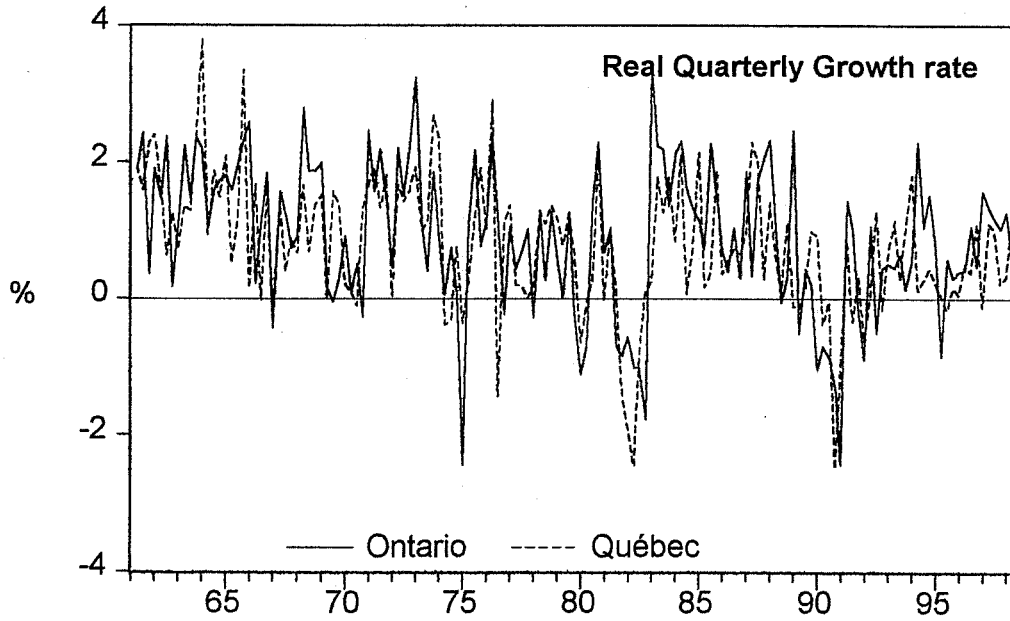
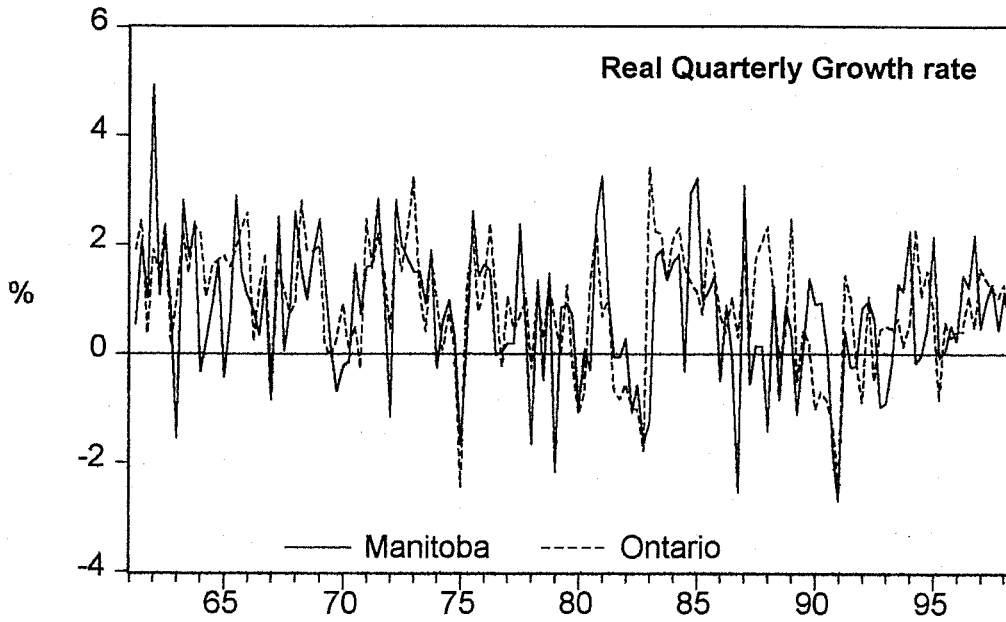
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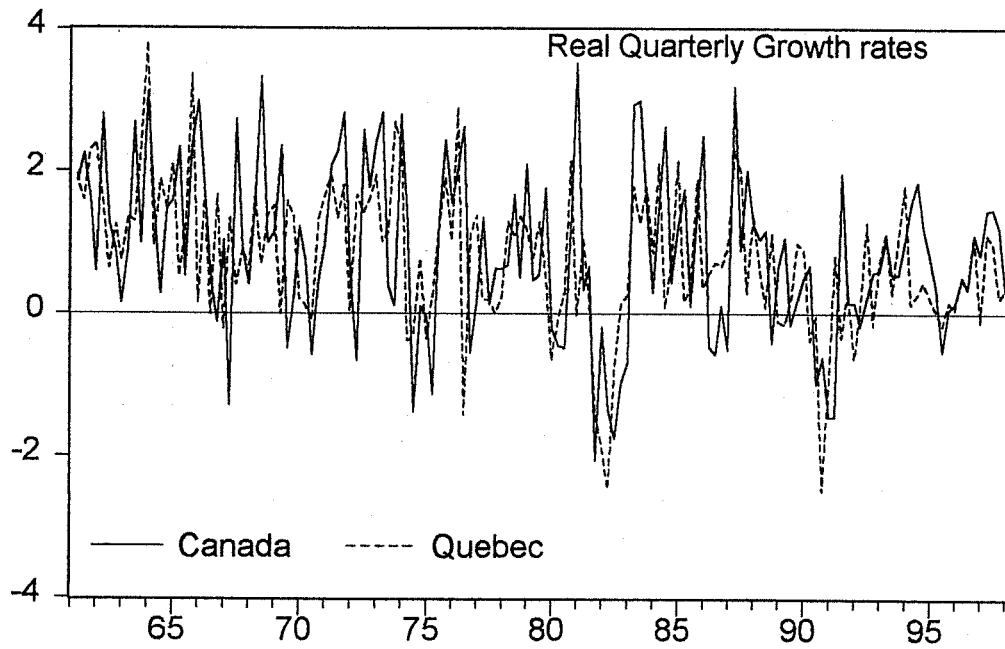
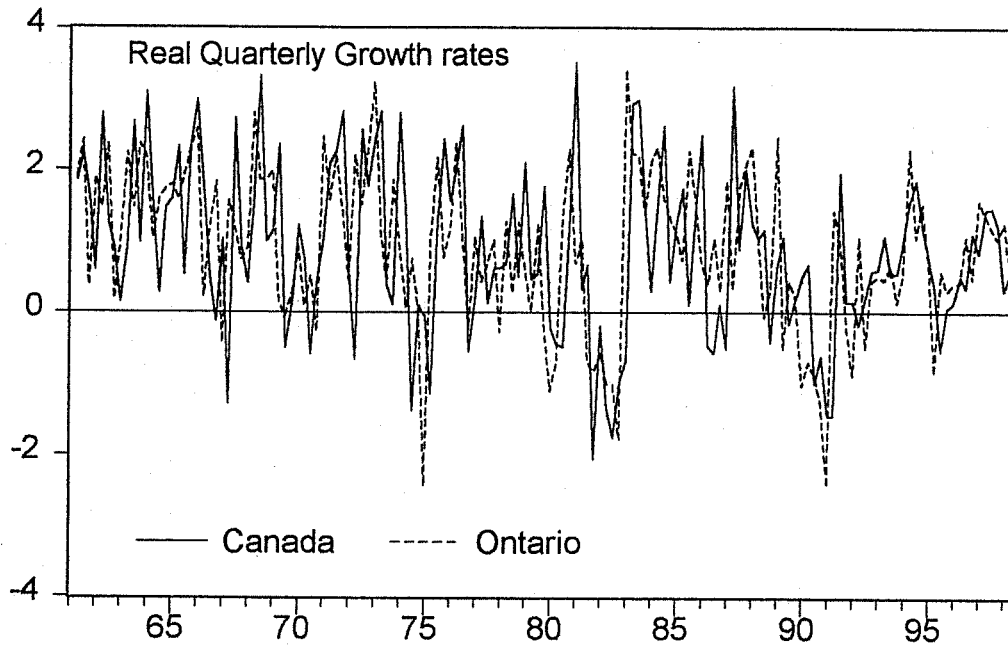
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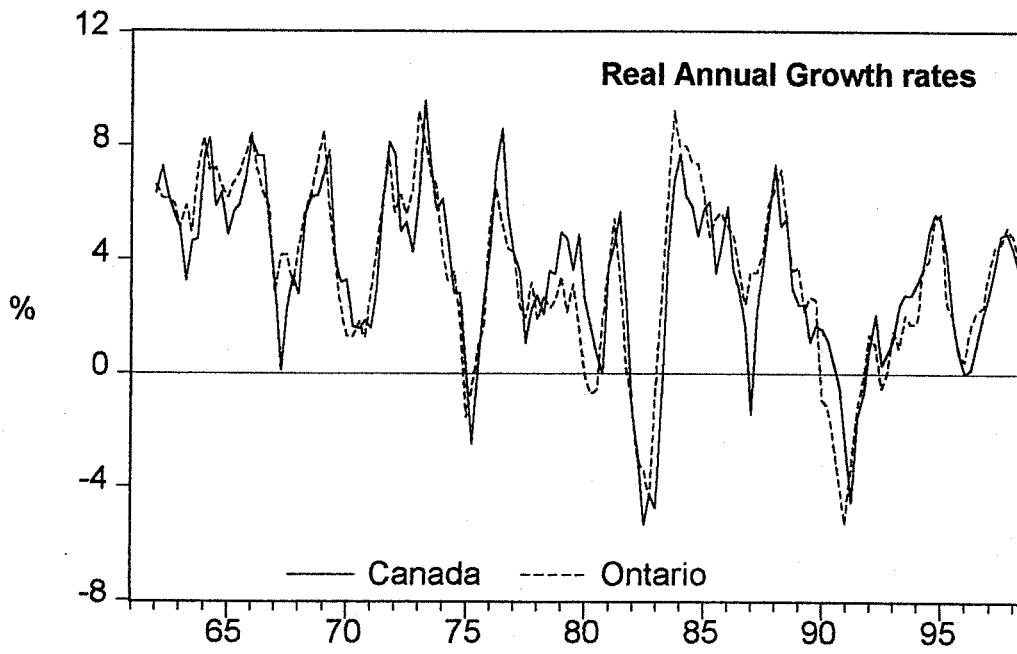
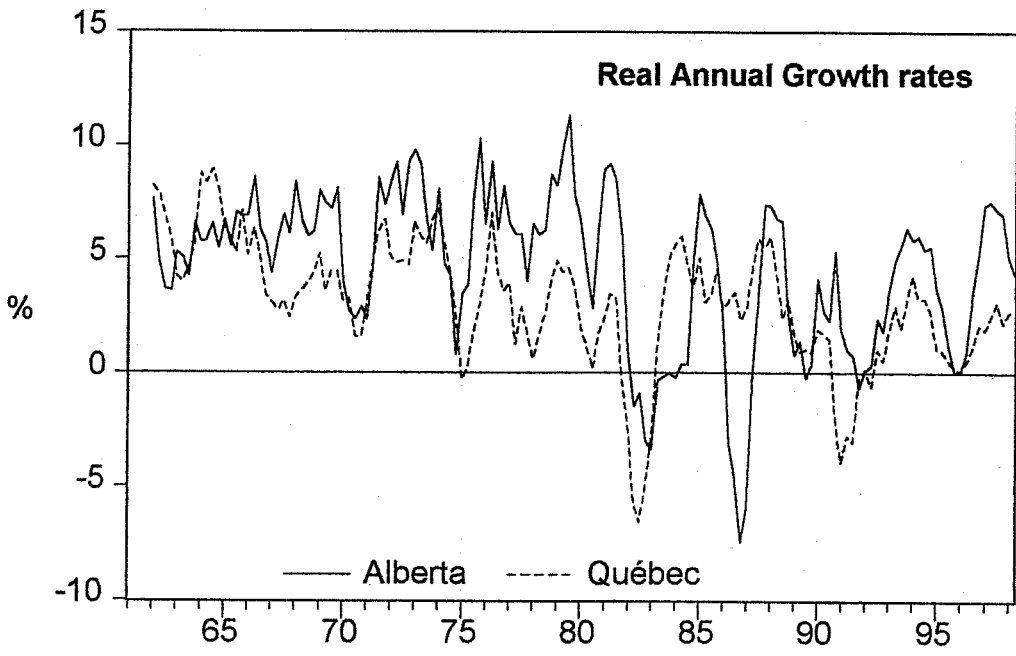
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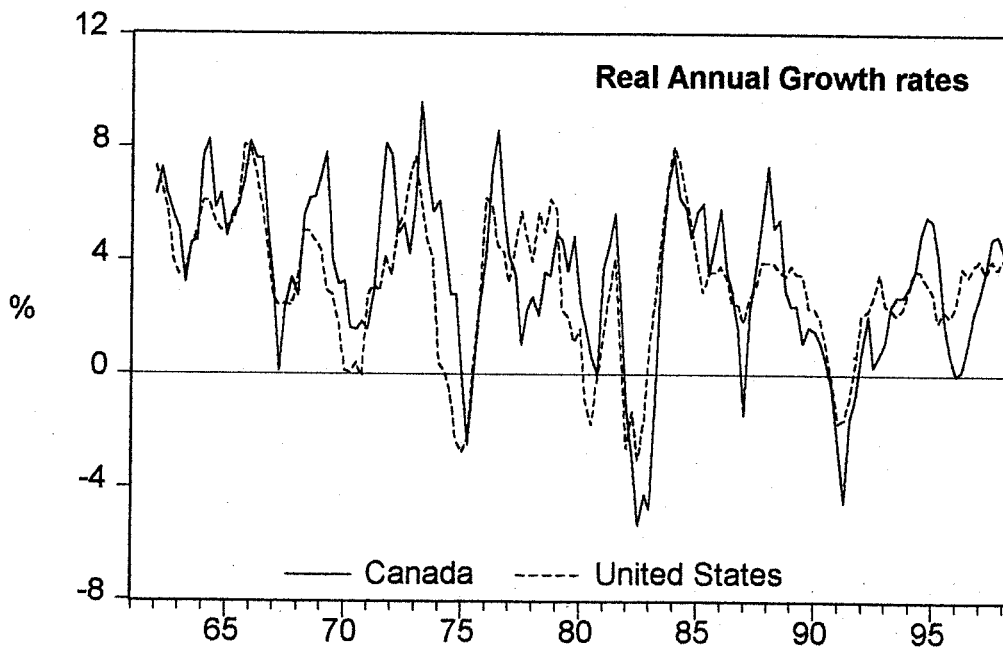
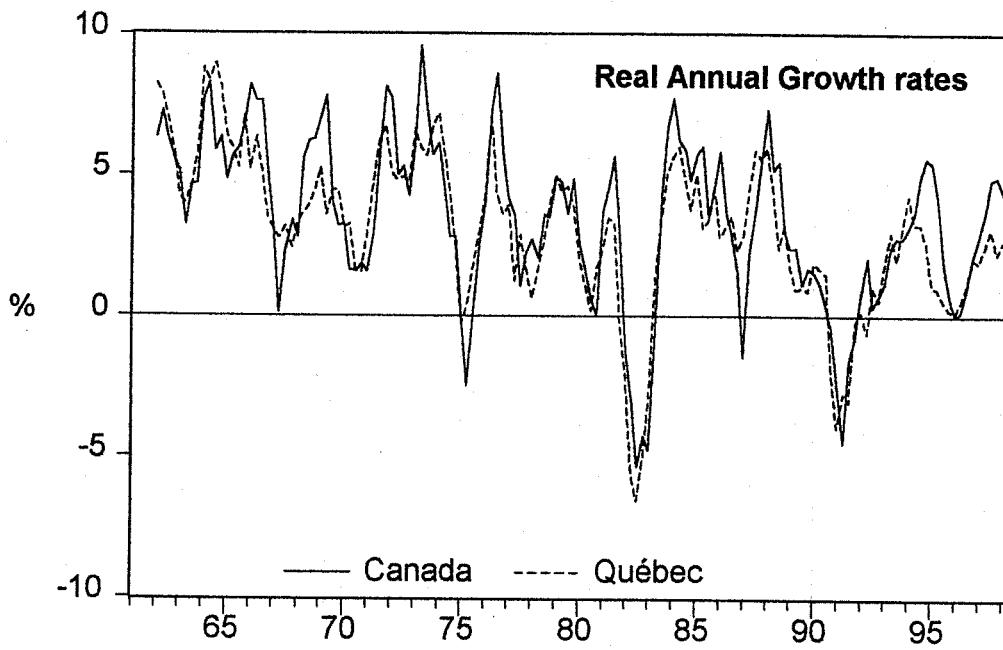
**Appendix A: Charts for the Real Quarterly Growth rates between economies**

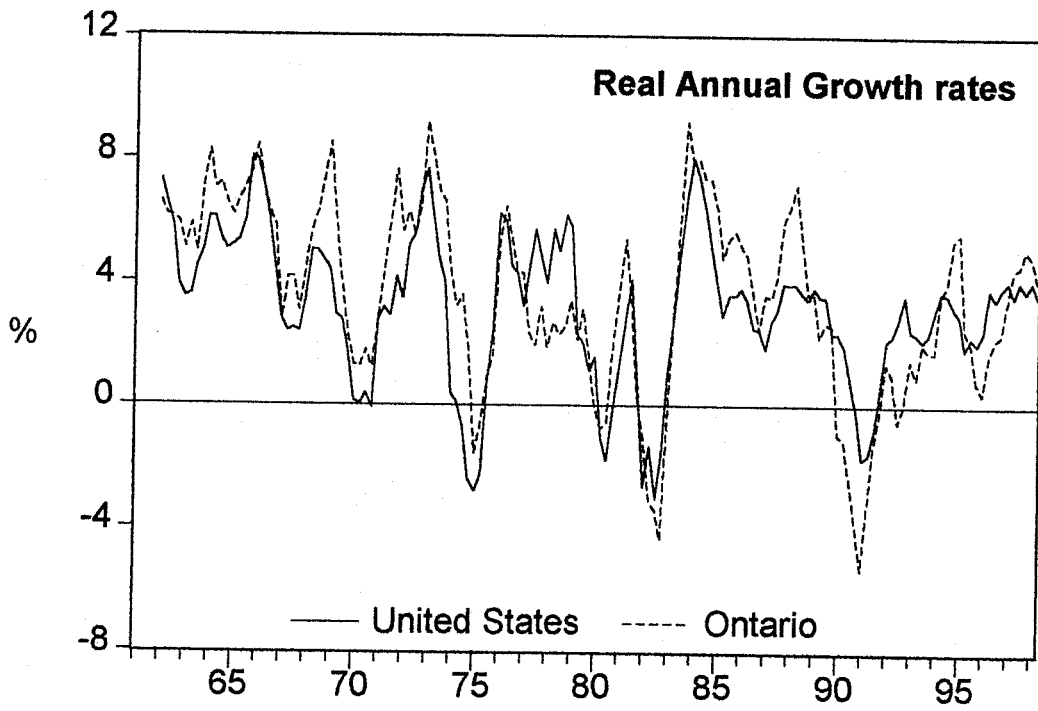




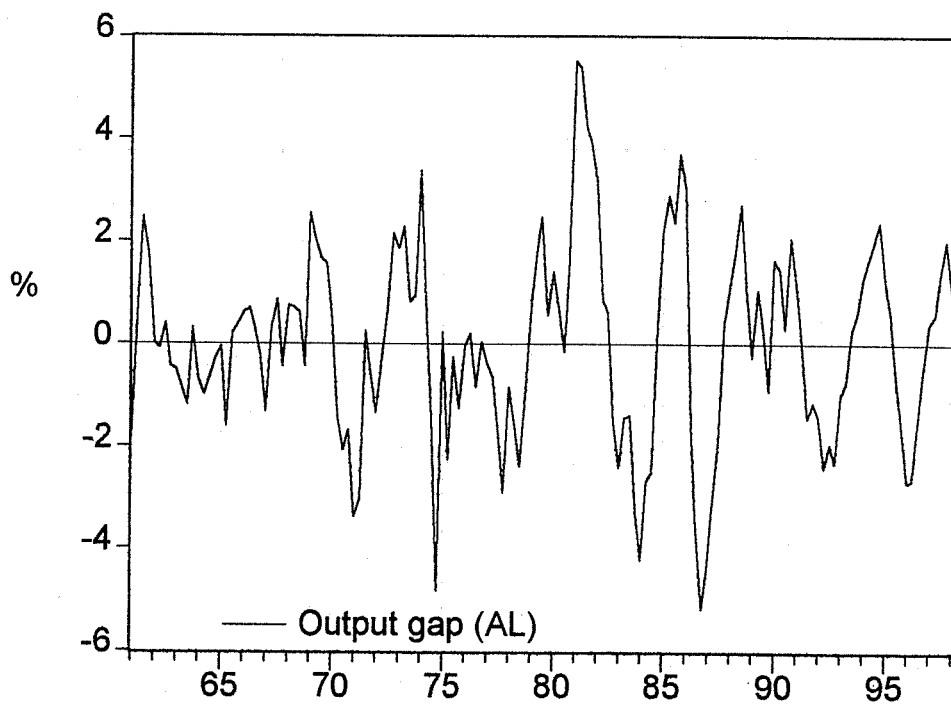
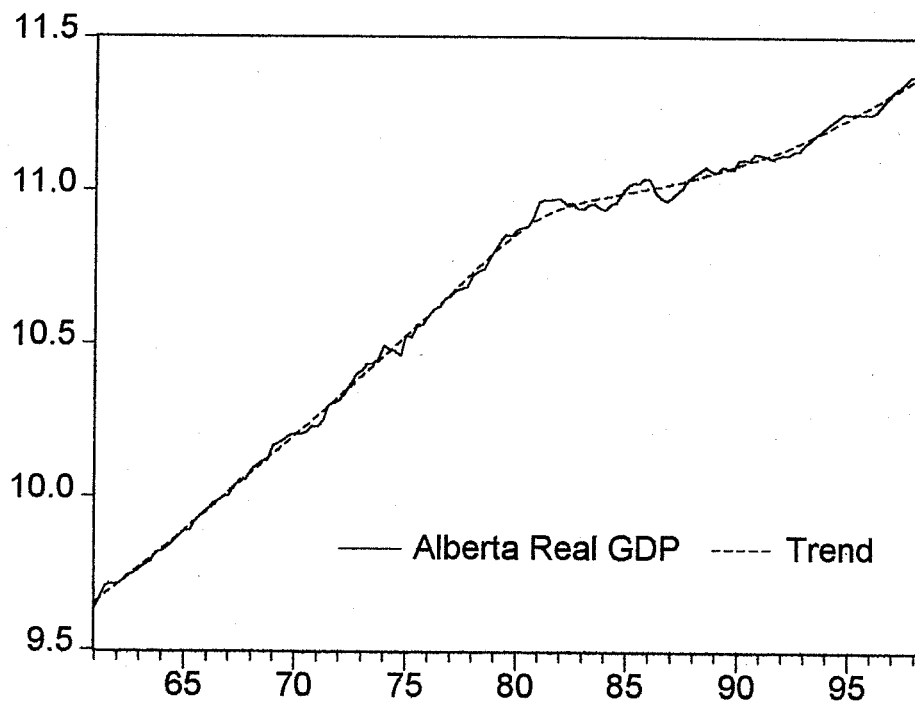
**Appendix B: Charts for the Real Annual Growth rates between economies**

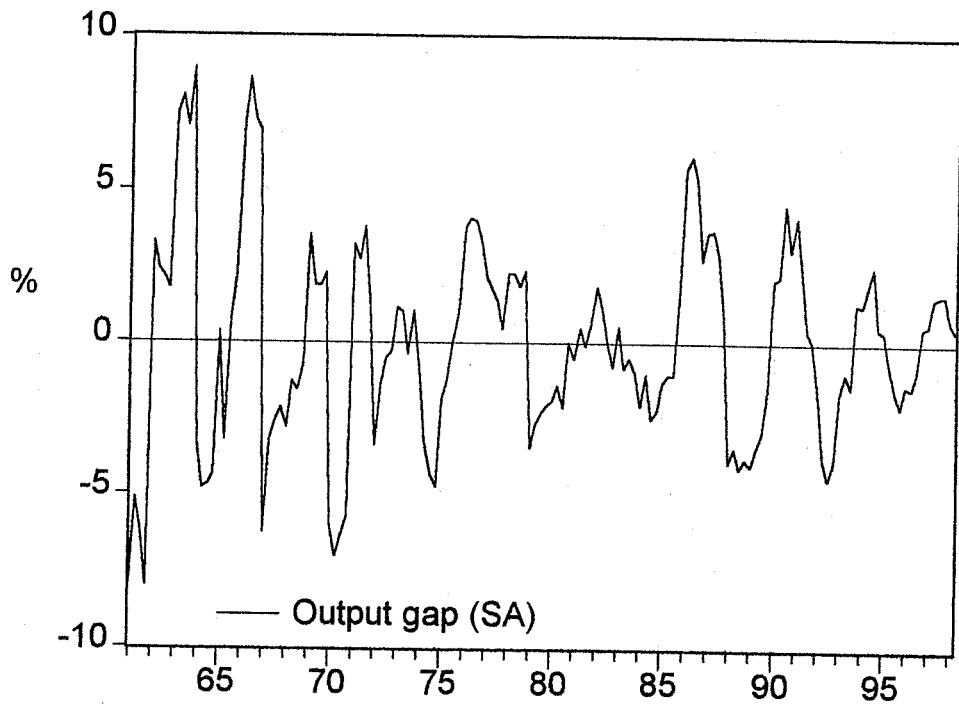
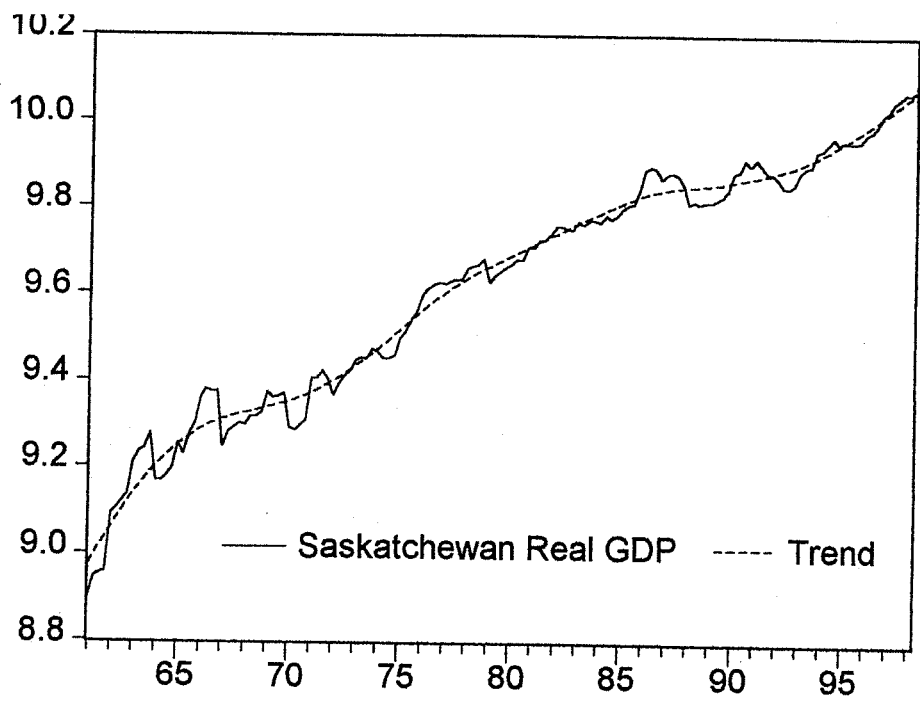


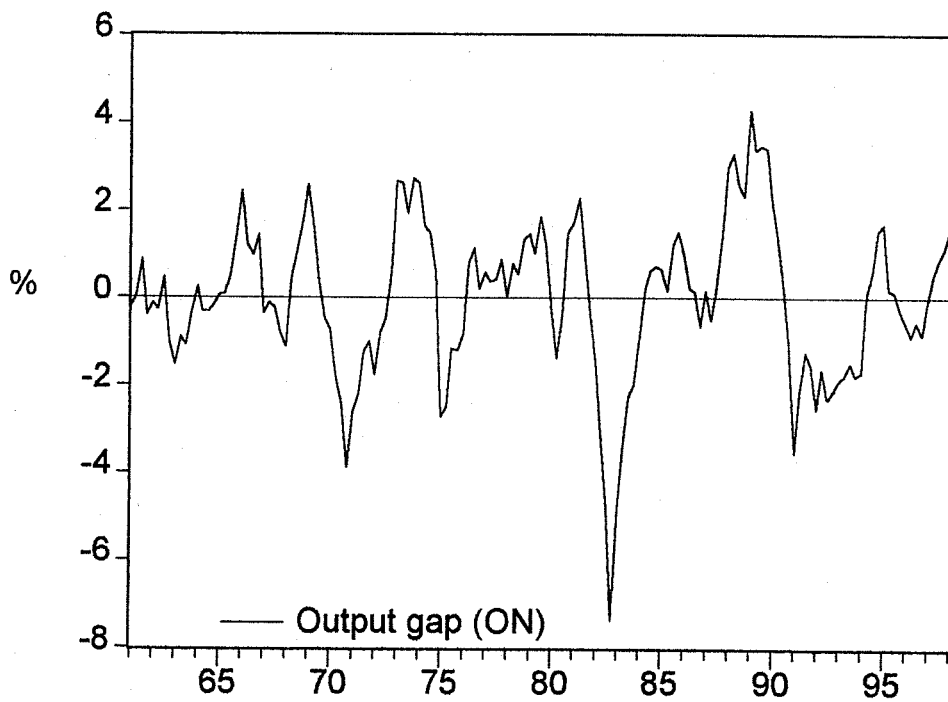
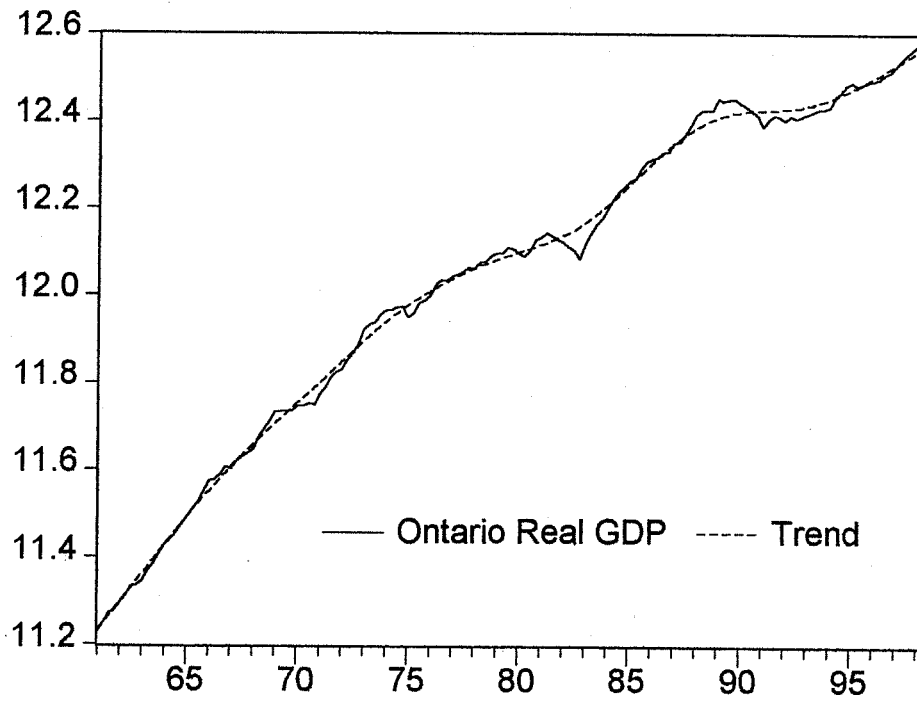


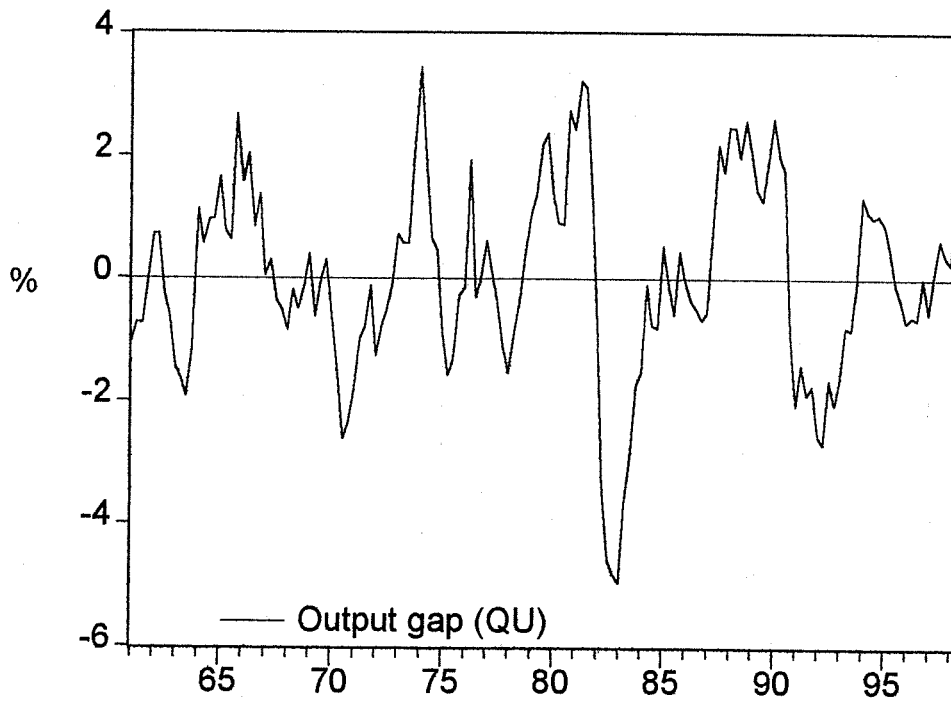
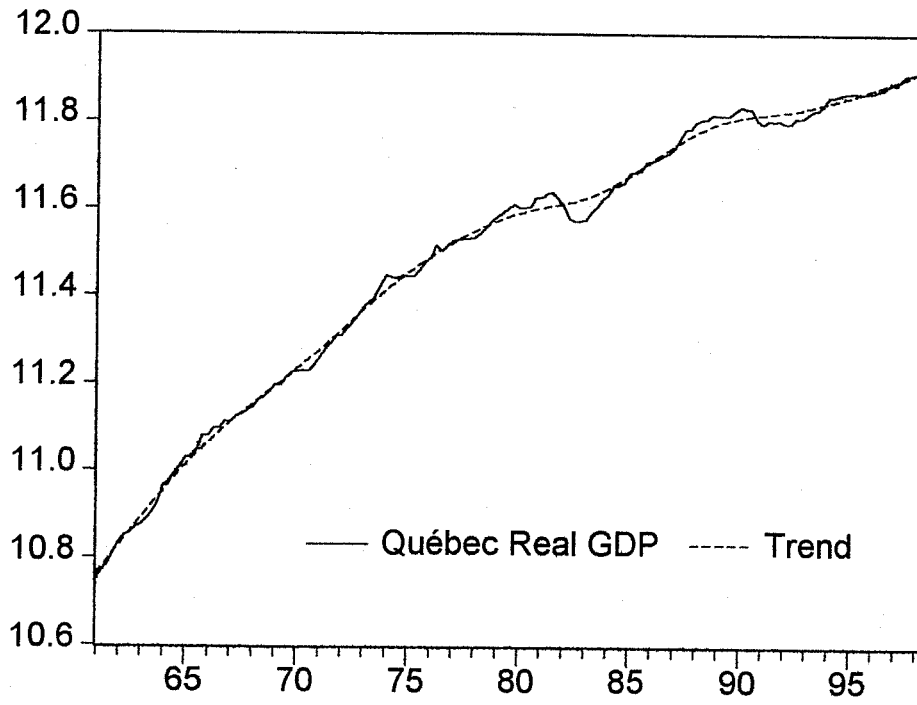


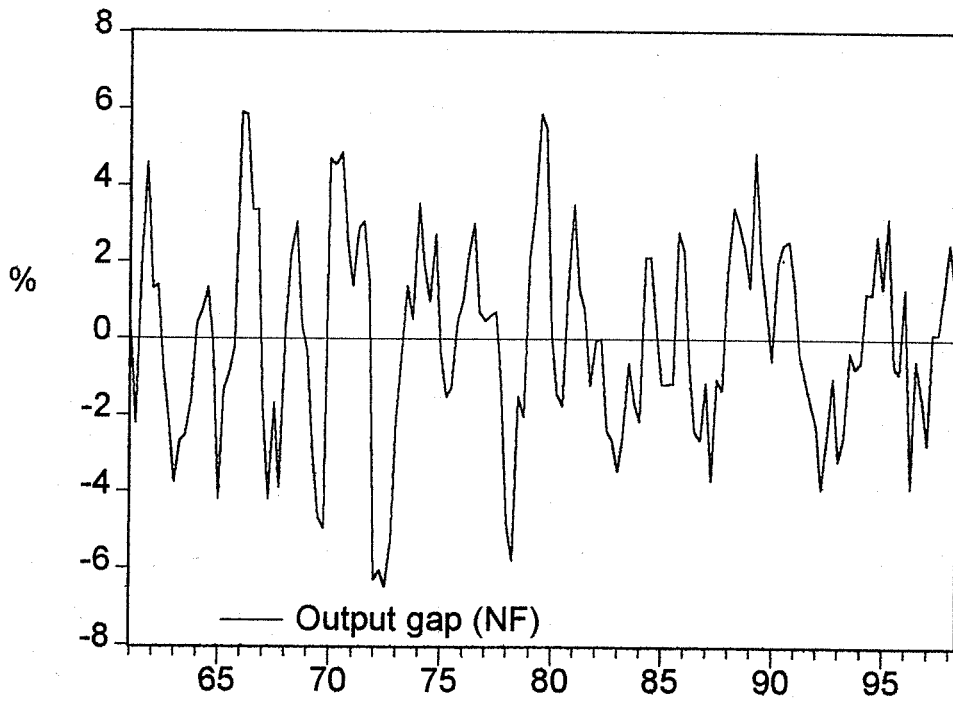
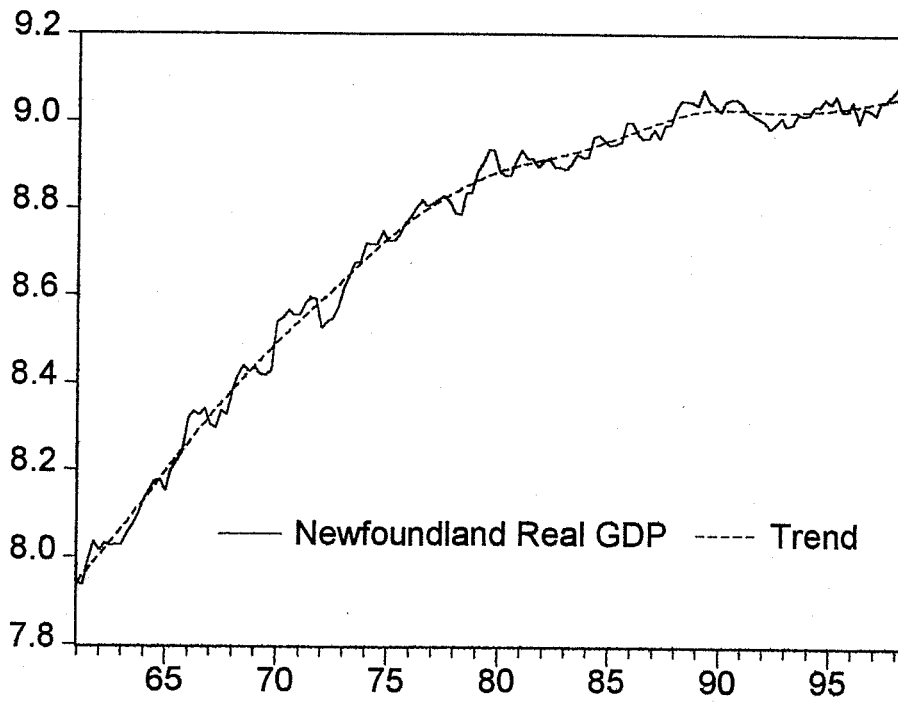
### Appendix C: Canadian regional Real GDP, trend and output gap

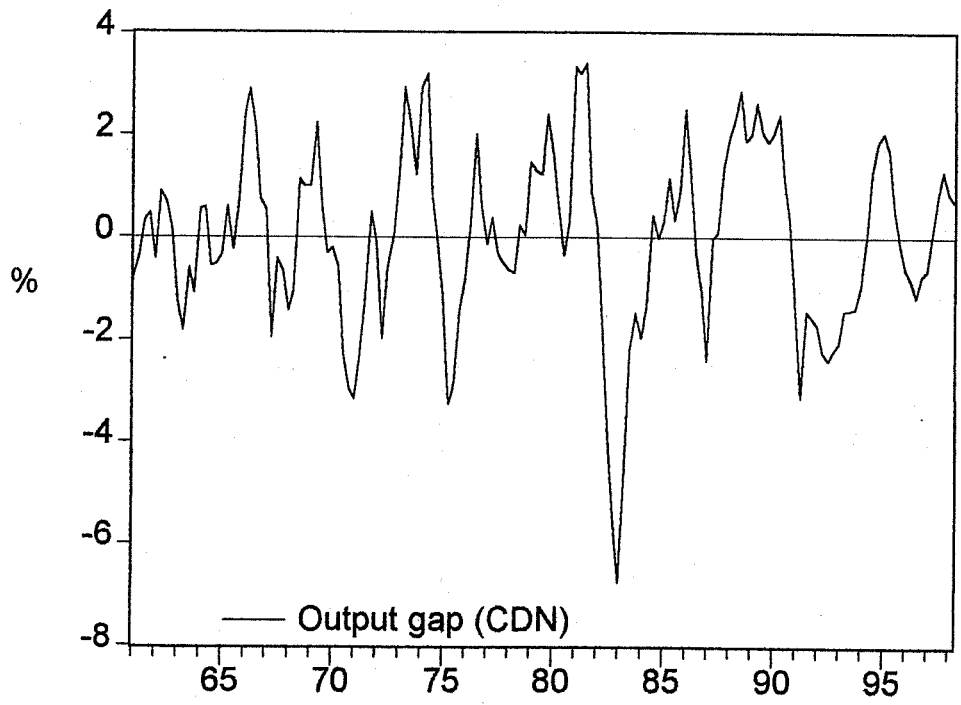
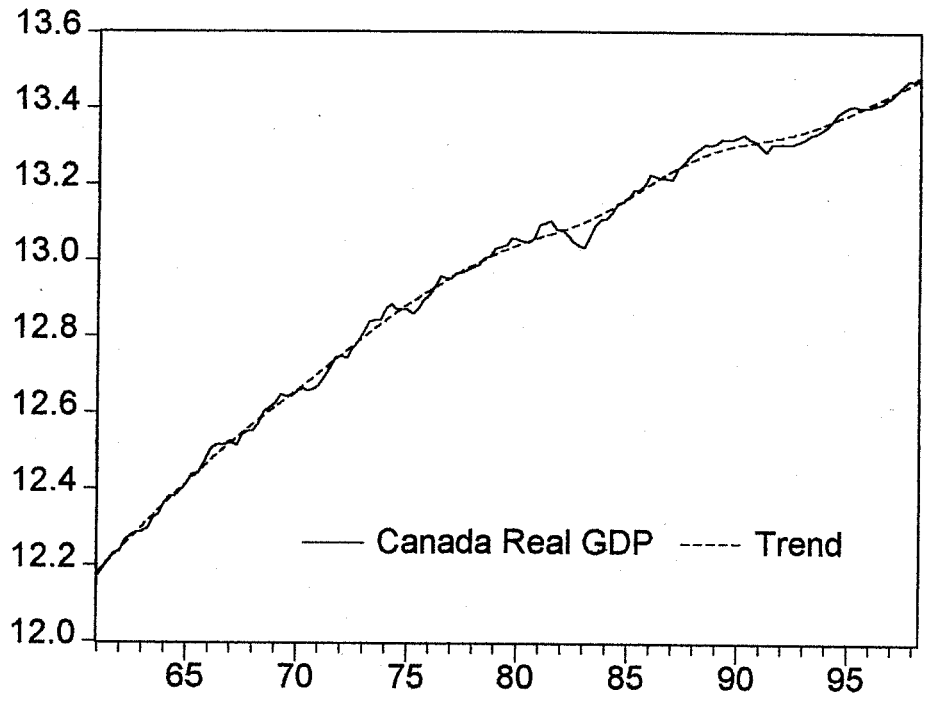


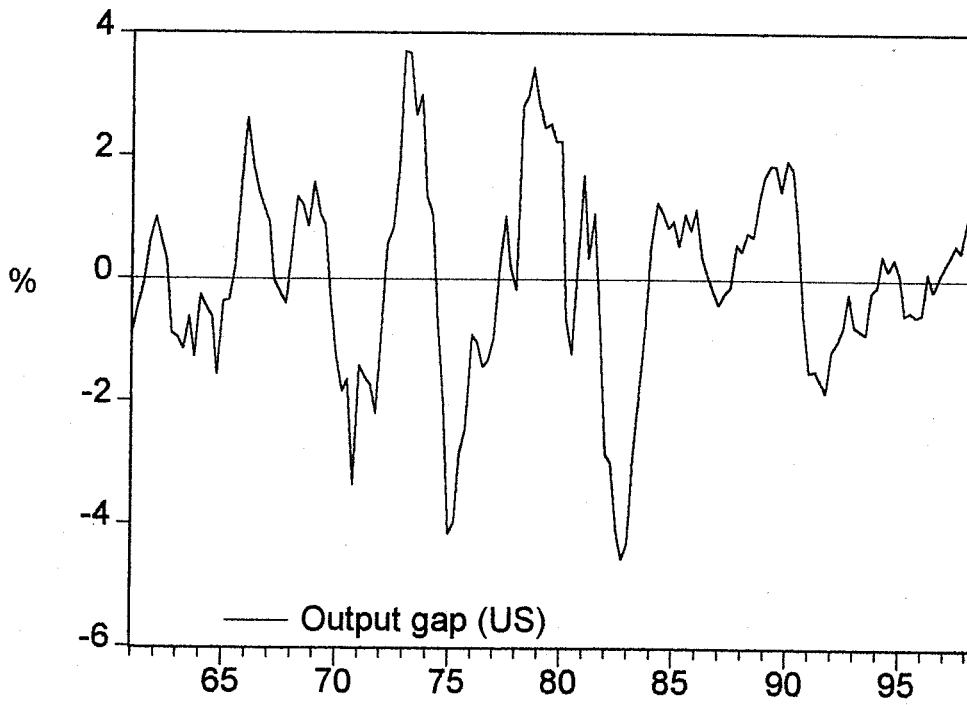
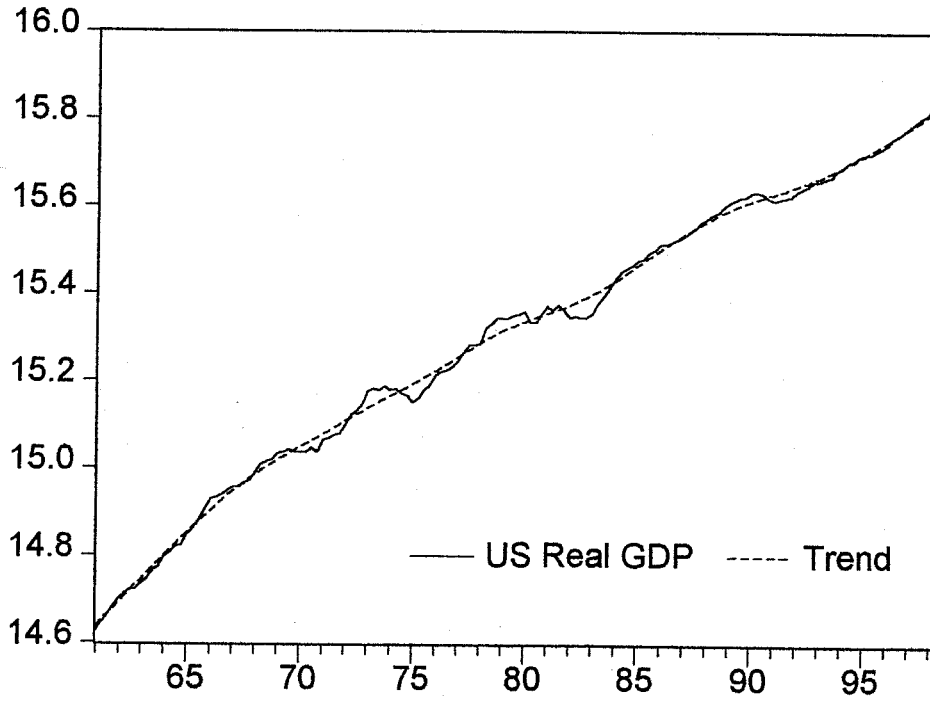












### Appendix D: Charts comparing the HP gap

