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Balanced growth hypothesis: Evidence from Canada

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Abstract

This study examined the balanced growth hypothesis in Canada by employing the unit root test as well as the cointegration test. The methodology employed in this study is Johansen cointegration methodology with the VAR models being estimated as well. Time series data have been used for this analysis which were collected on variables such as consumption, investment, GDP, population, export and import. The study found no empirical evidence supporting the balanced-growth hypothesis in Canada. One of the fundamental hypotheses of the neoclassical growth literature is the balanced growth hypothesis, which envisages that output, consumption, and investment grow at the same rate. This entails that the ratios of consumption to output and investment to output must be unit root free. Empirically, it implies that consumption and investment must be cointegrated with output. The general findings of this study suggest that the data for Canada is inconsistent with the theoretical implications of the balanced growth hypothesis. Although one of the great ratios was stationary, there was no enough evidence in support of the balanced growth in Canada.

Keywords: balanced growth, hypothesis, unit root test, cointegration, vector auto regression, Canada

Introduction

Investigating the existence or otherwise of the balanced-growth hypothesis in a country such as Canada will contribute immensely to the existing body of research and knowledge. Many studies revealed that Balanced- Growth Hypothesis (BGH) is often being rejected in most developed countries such as the United States, the UK, and Canada etc. the concept of balanced-growth is rooted in the classes of equilibrium-growth paths including the development strategy adopted by countries in their development process. It is a central concept in macroeconomic policy and analysis. It defines the path of an equilibrium in which major aggregates and ratios exhibit constant growth. Constancy of ratios of macroeconomic variables such as the ratios of consumption and investment to output is one of the major features of the balanced-growth path and these great ratios are expected to be stationary.

This study is aimed at investigating the applicability of the Balanced-Growth hypothesis to the development of Canadian economy from 1950 to 2011. The study also considers the balanced growth in an open economy where international trade is now included in the analysis. The Balanced Growth hypothesis is a theoretical consequence of the neoclassical growth model. This hypothesis proposes that some major macroeconomic quantities, namely output (GDP), consumption (C) and investment (I) will exhibit constant growth. More technically, the series will "share a common stochastic trend;" and the ratios of consumption (C) to output (GDP) and investment (I) to output (GDP) should be stationary i.e. I(0).

The neoclassical growth model envisages a balanced growth path alongside which per-capita output, consumption and investment grow at the equal constant rate while the investment/output and consumption/output ratios are also constant. This hypothesis has not been consistently supported by empirical investigation using data from developed countries, (Li & Daly, 2009) [20]. This study is therefore aimed at testing the balanced-growth hypothesis using data on Canada.

It has been observed that despite the existing literature and empirical studies on the balanced growth hypothesis, most of the studies are cross country studies with few country specific studies. The fact that balanced growth hypothesis is not valid for most developed countries (Li & Daly, 2009) [20], no study to the knowledge of the researchers that has examined the validity of this hypothesis specifically in Canada. This study therefor contributes to the existing body of knowledge by revealing the existence or otherwise of the balanced growth hypothesis in Canada.

This study used raw data on Gross Domestic Product (GDP), consumption expenditure, investment expenditure, exports, imports and population between 1950 and 2011, for Canada extracted from the PENN WORLD TABLES (PWT).

The variables used in this study are the logarithm of per capita GDP, logarithm of consumption and logarithm of investment. These variables have been created by dividing the raw data by the population and subsequently converting the series to logarithms. If these series are individually I (1), then they have a common stochastic trend and their cointegrating rank should be N-1. This can be tested by Johansen's tests for cointegrating rank. The stationarity of consumption/output and investment/output ratios can be tested using unit root tests on these ratios or by testing whether or not the cointegrating relationships satisfy some relevant parameter restrictions.

Following this introduction, the paper is organised into section II; literature review, section III; methodology, section IV; results and discussion and section V; conclusion.

Literature Review

In a study by Attfield and Temple (2006) [2], it was explained that analysis of the long-term fluctuations in the great ratios is usually founded on the neoclassical growth model. In this model if technical progress is strictly supplemented by labour and occurs at a constant rate, there will generally be a balanced-growth path along which output (GDP) and consumption as well as capital and investment tend to grow at the equal rate. It therefore means that the great ratios of consumption (C) to output (GDP), and investment (I) to output (GDP), are constant in the equilibrium.

Certain relevant long-run forecasts are products of economic growth models. Standard models bring about balanced-growth path with a zero-trend real interest rate and a constant capital-output ratio regardless of whether growth is seen as exogenous or endogenous variable. Economies are therefore regarded as converging towards equilibrium paths where capital and output (GDP) grow at the equal rate. The "great ratios" of investment (I) to output (GDP) and consumption (C) to output (GDP), will also be constant along the path balanced growth (Attfield and Temple, 2006) [2]. Meanwhile, because the equilibrium great ratios hinge on structural parameters, it is obvious that ratios of the variables may possibly exhibit mean shifts over time. Put it differently, great ratios stationarity tests are eventually considered as testing for joint hypothesis whereby it is not only convergence towards the path balanced growth but also the supporting the hypothesis of parameter constancy.

Balanced growth hypothesis is an essential portion of growth models. Balanced growth is being considered by Temple (2005) [34] to be an essential property of growth models. The publications by Solow (1956) [32] gave an insight to economists into how a balanced growth model could arise from relatively interesting assumptions. The main intuition is that a stable equilibrium path necessitates the likelihood of substitution between capital and labour.

The major concepts of the balanced growth hypothesis had been much more formalised in a much revered article by Murphy, Shleifer and Vishny (1989) [23]. In their multi-sector model, firms in each sector of the economy use constant returns to scale technologies but one firm in each sector also has access to an increasing return to scale technology. This technology will only be profitable to operate given a sufficiently large market. The structure of the model, with a competitive fringe of small-scale producers, ensures that wages are independent of labour demand in the industrializing sectors.

As cited by Li and Daly (2009) [20], the analysis of the macroeconomic aggregates of the USA by Kuznets (1942) [19] through the country's age of industrialisation led him to theorize a long-term constancy in the percentage of savings to income. Meanwhile Klein and Kosobud (1961) [17] used more formal trend fitting techniques to Kuznets' data and resolved that some of the percentages were constant but others, including percentage of savings income, essentially possessed a small trend. In the same vein, Kaldor (1961) [13] postulated a number of constancies, however not including the savings/income ratio, as stylized facts of the growth process. These empirical observations facilitated in promoting what has been called then "balanced growth" literature as considered in a study of King *et al*. (1991) [16].

Ngai and Pissarides (2004) [25], in their study 'balanced growth with structural change', have shown that balanced growth requires some quantitative parameter restrictions. The most imperative of which should be a logarithmic inter-temporal utility function. Forecasted change in each sector that is consistent with the facts requires in addition low substitutability between the final goods produced by each sector. Using data on the US and the UK, they have also revealed that underlying the balanced aggregate growth there is a shift of employment away from sectors with high rate of technological progress towards sectors with low growth, and eventually, in the limit, only two sectors survive, the sector producing capital goods and the sector with the lowest rate of productivity growth.

Evans (2000) [7] using data on the US discovers that net investment ratio is stationary. However the gross investment ratio is only trend stationary which reflect trends in depreciation. Other Researchers have considered countries other than the US, and found that stationarity of the great ratios is frequently being rejected. Sometimes non-stationarity status of the great ratios is being used as evidence against models of exogenous growth, as in the work of Serletis (1994, 1996) [31-30] using data from Canada, Serletis and Krichel (1995) [20] for ten OECD countries.

Using US data from 1948 to 2000, Fisher *et al*. (2003) [8], find evidence of two cointegrating vectors even though the controlled coefficients on output depart slightly from unity. D'Adda and Scorcu (2003) [5] examine the stationarity of the capital-output ratio over long time spans for selected developed countries where they discover that the capital-output ratio is stationary for the US but it is not for Japan. As for the UK, there was evidence for stationarity over the period 1870-1948, but not over the longer period 1870-1992.

Ji and Park (2011) [8] evaluate the balanced growth hypothesis for Australia where they tested its estimates for the existence of great ratios using standard unit root test and cointegration test. The general findings of the study revealed that the Australian data is inconsistent with the balanced growth hypothesis.

Methodology

Model specification

Basically, this study employs the Vector Autoregressive (VAR) methodology in determining the existence of the balanced growth hypothesis in Canada. The VAR model to be estimated is specified thus:

$$lpcgdp_t = \gamma_1 + \gamma_2 lpcgdp_{t-i} + \gamma_3 lpccs_{t-i} + \gamma_4 lpci_{t-i} + \varepsilon_{1t} \quad -(1)$$
$$lpccs_t = \varphi_1 + \varphi_2 lpcgdp_{t-i} + \varphi_3 lpccs_{t-i} + \varphi_4 lpci_{t-i} + \varepsilon_{2t} \quad -(2)$$
$$lpci_t = \vartheta_1 + \vartheta_2 lpcgdp_{t-i} + \vartheta_3 lpccs_{t-i} + \vartheta_4 lpci_{t-i} + \varepsilon_{3t} \quad -(3)$$

Where:

lpcgdp is the log of per capita GDP which is given as the ratio of GDP to population.

lpccs is the log of per capita consumption expenditure which is given as the ratio of consumption expenditure to population.

lpci is the log of per capita investment which is given as the ratio of investment to population.

γ, φ, and ϑ are parameters to be estimated.

$\varepsilon's$ represent the stochastic disturbance terms also known as the impulses or innovations or shocks in the language of VAR.

Unit Root Test

Most time series observed in practice are non-stationary and it necessary to transform them to be stationary before they are analysed. A stationary series is one that has all its moments such as mean, variance and covariance to be constant. Most economic data in their original forms exhibit non-stationary behaviour and hence they need to be made stationary to avoid spurious regression. Furthermore, most economic time series are expected to be I(1). The variables used in this study namely log of per capita income, log of investment, log of consumption are equally expected to follow the economic theory by indicating I(1) behaviour which can be verified using unit root tests. Testing for stationarity implies testing for unit root. If the unit root is rejected, then the variables can be said to be stationary. There are many econometric techniques that can be used to test for a series stationarity. This study employed the most commonly used unit root test which is the Augmented Dickey-Fuller (ADF) test. The Augmented Dickey-Fuller (ADF) is basically applied when the error term is correlated and it is performed by adding the lagged values of the dependent variable. The Augmented Dickey-Fuller (ADF) test has been reported to have good size. The ADF test representations of the variables in this study including trend and intercept are given in equations 4, 5 and 6 below.

$$\Delta lpcgdp_t = \beta_{11} + \beta_{12}t + \beta_{13}lpcgdp_{t-1} + \sum \beta_{14}\Delta lpcgdp_{t-i} + \varepsilon_t \quad -(4)$$

$$\Delta lpccs_t = \beta_{21} + \beta_{22}t + \beta_{23}lpccs_{t-1} + \sum \beta_{24}\Delta lpccs_{t-i} + \varepsilon_t \quad -(5)$$

$$\Delta lpci_t = \beta_{31} + \beta_{32}t + \beta_{33}lpci_{t-1} + \sum \beta_{34}\Delta lpci_{t-i} + \varepsilon_t \quad -(6)$$

Where Δ is the difference operator, β_{11}, β_{21}, β_{31} are the intercepts, while β_{12}, β_{22}, and β_{32} are the trend coefficients. The lag values of the dependent variables are included in the ADF to eliminate serial correlation.

Cointegration Test

Once variables have been classified as integrated of order I(1), it is possible to set up models that lead to stationary relations among the variables and where standard inference is possible. The necessary criteria for stationarity among non-stationary variables are called cointegration. Testing for cointegration is a necessary step to checking if the modelling has meaningful empirical relationships. If variables have different trends processes, they cannot stay in fixed long run relation to each other, implying that one cannot model the long run, and there is usually no valid base for inference based on standard distributions. In this study, the model 7 below is supposed to be cointegrated if the linear combination between the variables stationary.

$$lpcgdp_t = \varphi_{11} + \varphi_{12}lpccs_t + \varphi_{13}lpci_t + u_t \quad -(7)$$

The equation 7 is the cointegration regression and the parameters φ_{12} and φ_{13} are the cointegrating parameters. What is needed is to estimate equation 7 and obtain the residuals and in equation 8 below.

$$u_t = lpcgdp_t - \varphi_{11} - \varphi_{12}lpccs_t - \varphi_{13}lpci_t \quad -(8)$$

If after applying ADF test to equation 8, the residual is found to be stationary i.e. I (0), then there is presence of cointegration among the variables otherwise there is not. However, this test provides only one cointegrating equation and where there are more than one cointegrating equations, this approach cannot be valid. This necessitate the use of Johansen cointegration methodology. This approach takes care of the issues identified in the Engle and Granger technique. Hence, this study adopts the traditional Johansen cointegration approach to test for the presence of cointegration among the variables in this study.

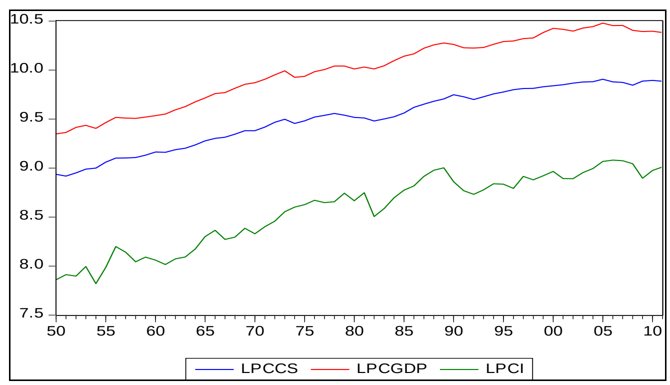
Results and Discussion

The main analyses done are the graphical analysis, the unit root analysis, cointegration analysis as well as the Vector Autoregressive (VAR) analysis. The variables have been subjected to unit root test in order to avoid spurious regression and to determine the order of integration of the series. Cointegration test has also been done to determine the presence of the balanced growth Canada.

The graph of the series under investigation is given in figure 1 to visually inspect and identify the salient features of the series.

Graphical Presentation of the Variables

As a first step in time series analysis in particular and econometrics in general, it is often important to visually identify the features in the data being modelled because this will influence the approach to modelling. The upward trending of these series mean that their means increase over the sample period which is consistent with most of the macroeconomic variables as they grow through time and so are expected to have upward trends.



Source: Author's computation using Eviews 8.0

Fig 1: A plot of log of per capita income, consumption and investment

We study the time series features of the log of the per-capita variables used in this study. The Figure 1 above indicates that over time, the three variables, in logarithms, that is, logpcgdp, logpccs and logpci, have the same slope. The three variables exhibit upward trends which indicate that they appear to share similar trends. This behaviour might suggest a "balanced growth", in the sense that these series tend to grow at the same rate. Nevertheless, a formal test is needed to enable us make decision and conclusion about the presence or otherwise of the balanced growth in Canada.

Below is the test formally for determining whether the series used in this study share a common stochastic trend which is implied in the balanced growth conclusion rooted in neoclassical stochastic growth model. Next is the assessment of the stationarity of the variables by employing the Augmented Dickey-Fuller (ADF) test.

Unit Root Test Result

Broadly speaking, unit root tests are performed to confirm that the data series are likely I(1) variables, so we have to be mindful of the danger of spurious regression result and long-run cointegrating relationships.

Table 1: ADF tests on LOGPCGDP, LOGPCCS and LOGPCI for Canada, 1950-2011

	LPCGDP		**LGPCCS**		**LGPCI**	
	Lag	**ADF**	**Lag**	**ADF**	**Lag**	**ADF**
Series levels	10	-0.300	10	-1.094	10	-2.765
First difference	10	-6.964***	10	-6.445***	10	-8.430***

*, ** and *** indicate rejection of unit root at 10, 5 and 1% significance level respectively.

Source**:** Author's computation using Eviews 8.0

In order to conduct the formal cointegration test within the Johansen framework, we first need to establish that the lpcgdp, lpccs, and lpci are integrated of order one i.e. $I(1)$ series. The use of Augmented Dickey-Fuller (ADF) test is being employed where constant and trend are included in the test equations. The lag length is being determined using downward testing starting with an arbitrarily large number of lags, which are 10 in this case based on Schwarz Information criterion.

The results of the ADF test presented in table 1 above show that the log of income per capita, log of consumption per-capita and log of investment per capita are not stationary at levels but the first difference of the series is stationary and as such they are treated as $I(1)$.

Having identify the fact that we are dealing with variables integrated of order one, i.e. I(1), we can suitably proceed to the Johansen procedure. We first need to estimate our VAR equations and the pre-requisite to that is the lag selection. The choice of the lag order is very essential in the framework of Vector autoregressive (VAR) model, since all inferences in this model depend upon correct model specification. The Johansen procedure requires that the choice of deterministic variables and maximum lag length (k) be such as to prevent serial correlation in the disturbance processes – both within each equation of the VAR and also across equations. Therefore, Table 2 below presents the appropriate lag length for the VAR and which is later used for the cointegration test.

Table 2: Lag Order Selection Criteria for the VAR

VAR Lag Order Selection Criteria						
Endogenous variables: LPCCS LPCGDP LPCI						
Exogenous variables: C						
Sample: 1950 2011						
Included observations: 55						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	176.1664	NA	3.70e-07	-6.296960	-6.187469	-6.254619
1	360.5246	341.9006*	6.29e-10*	-12.67362*	-12.23566*	-12.50426*
2	364.8447	7.540595	7.49e-10	-12.50344	-11.73701	-12.20706
3	365.9187	1.757464	1.01e-09	-12.21523	-11.12032	-11.79181
4	369.9992	6.231990	1.22e-09	-12.03633	-10.61295	-11.48590
5	372.2181	3.146828	1.60e-09	-11.78975	-10.03789	-11.11229
6	380.8217	11.26296	1.69e-09	-11.77534	-9.695008	-10.97086
7	384.8864	4.877600	2.13e-09	-11.59587	-9.187069	-10.66437
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

Source**:** Author's computation using Eviews 8.0

There have been many studies on selection of lag length for a nonstationary VAR model subject to cointegration restrictions. Eviews offers five different lag length selection criteria. The first of these is the Likelihood Ratio (LR) testing the null hypothesis that all the coefficients of the longest lag offered by the user are zero. The other four lag length criteria are all based on the log -likelihood of the fitted model. In this study, we use the Final Prediction Error (FPE) criterion for the following reasons:

FPE and AIC give similar results in large samples, FPE is possibly better in small samples. SC and HQ penalise large models more than AIC/FPE so could be said to risk under-specifying the lag length. This risk, however, is guarded against here by the autocorrelation check that follows in table 3 below. We see in table 2 above that the optimal lag length is 1. All of the five VAR lag order selection criteria including FPE and AIC also conclude on the use of 1 lag.

Autocorrelation Test

Table 3: Residual Tests / Autocorrelation LM Test

Autocorrelation Lm Test			Portmanteau TEST				
lag	**LM-Stat**	**Prob.**	**Q-Stat**	**Prob.**	**Adj Q-Stat**	**Prob.**	**df.**
1	8.855	0.451	7.263	NA*	7.3842	NA*	NA*
2	3.303	0.951	10.171	0.337	10.390	0.320	9
3	3.377	0.948	13.611	0.754	14.009	0.729	18
4	1.854	0.994	15.436	0.963	15.962	0.954	27
5	14.441	0.108	28.247	0.818	29.917	0.752	36
6	6.413	0.698	33.728	0.891	35.995	0.829	45
7	4.227	0.896	37.546	0.957	40.308	0.917	54

*The test is valid for lags larger than the VAR lag order.
Source: Author's computation using Eviews 8.0

We see in table 3 above that there is autocorrelation since the null hypothesis of no serial correlation cannot be rejected at any lag within the specified range lag of 7 given by $\sqrt{55} \cong 7$ as tested by the LM test as well as the Portmanteau test. It is obvious therefore that the residuals of these series are not correlated.
Having known that the variables contain stochastic trends, we next consider whether they are idiosyncratic or shared in common stochastic trends where the latter being a necessary condition for the "balanced-growth".

Vector Autoregressive (VAR) Results

The VAR equations 1, 2 and 3 have been estimated using the lag selected by the leg length selection criteria which is one and the result is being reported in table 4 below with the standard errors in parenthesis.

Table 4: Var Representation

REGRESSOR:	$LPCCS_t$	$LPCGDP_t$	$LPCI_t$
REGRESSAND:			
$LPCCS_{t-1}$	0.784	-0.061	-0.158
	(0.101)	(0.123)	(0.342)
$LPCGDP_{t-1}$	0.240	1.145	0.687
	(0.103)	(0.125)	(0.347)
$LPCI_{t-1}$	-0.069	-0.110	0.454
	(0.039)	(0.047)	(0.131)
Intercept	0.257	0.089	-0.663
	0.139	0.170	0.471
Fit Measures:			
$\mathbf{R^2}$	0.995	0.994	0.962
$\bar{R}^2$	0.994	0.994	0.960
S	0.022	0.027	0.074

Source: Author's computation using Eviews

Table 4 above presents the Vector Auto regression Estimates for the three series. We see that the log of per capita consumption and the log of per capita income in the preceding period have statistically significant impact on the log of per capita consumption in the current period because the t-ratios exceed the two tailed critical value of 2. However, the log of per capita investment in the preceding period does not have statistically significant impact on the current log of per capita consumption since the t-ratio is less than the two tailed critical value of 2.
The lagged values of the lpcgdp and lpci also have statistically significant influence on the log of current per capita GDP whereas the lagged value of the log of consumption is not significant. We also see that, for the log of per capita current investment, only the lagged value of the logpci is statistically significant.
As seen in the table 4 above, the models have very high fit as indicated by the high coefficient of determination and the adjusted coefficient of determination of about 96% to 99% as well as the low standard errors of the regression of around 2.2% and 7.4%.
Having explore these relationships between the variables, the cointegrating rank of these variables are then estimated below.

Cointegration Test Result

We discuss whether or not the data for lpcgdp, lpccs, lpci are generated with a single common stochastic trend, i.e. by a VECM with cointegrating rank r=2 as a necessary condition for the balanced growth. We have tested the stationarity of the series using the Standard Johansen (1995) maximum likelihood procedure for estimating the cointegrating rank. We give the results in table 5 where we tested for cointegration in models with (i) no intercepts no trends; (ii) intercepts no trends (iii) intercepts no trends(linear); (iv) intercepts plus trends (linear and quadratic). Using the trace statistic, there is evidence for two cointegrating vector at the 5% level under specification (i). For specification (ii) there is only one cointegrating vector. For specification (iii), there is evidence for three cointegrating vectors. For specification (iv), there is no evidence of cointegrating vectors.

Table 5: Cointegration Rank

Selected (0.05 level*) Number of Cointegrating Relations by Model					
Data Trend:	**None**	**None**	**Linear**	**Linear**	**Quadratic**
Test Type	**No Intercept**	**Intercept**	**Intercept**	**Intercept**	**Intercept**
	No Trend	**No Trend**	**No Trend**	**Trend**	**Trend**
Trace	2	1	3	0	0
Max-Eig	1	1	0	0	0

Source: Author's computation using Eviews 8.0

The number of lags used in the VAR model that forms the basis of Johansen's estimation is chosen to eliminate serial correlation in the residuals of each equation. The VAR that has been tested for cointegration has 1 lag, as suggested by the lag length selection criteria as seen in table 2. Moreover, the VAR has a very high goodness of fit as indicated by the adjusted coefficient of the determination of about 96% to99% as seen in table 4 above. Hence, this is an adequate model of the data generation process.

The Trace test and the Max-eigenvalue tests do agree with each other in some cases in the sense of suggesting no cointegration relations. However, the results do not show r=2 with believable estimates of the data trend in the sense of matching the series graphs. Moreover, the results do not depict r =2 with intercept or intercept plus trend in the cointegrating vectors which imposes economically implausible restrictions on the behaviour of consumption, investment and income.

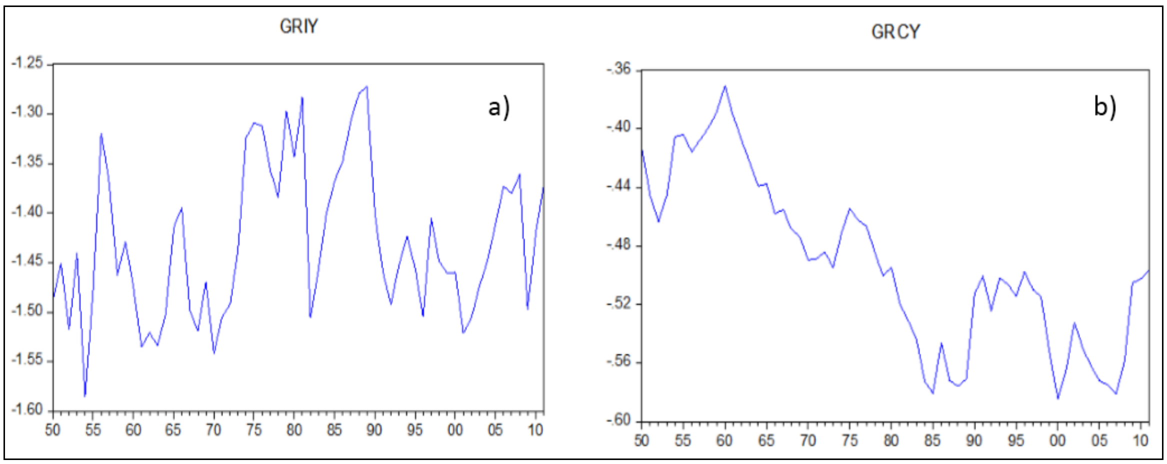
It has been formally established here therefore that the three series namely, log of per capita GDP, log of per capita consumption and log of per capita investment do not share a common stochastic trend and are not cointegrated. Hence, there is no empirical evidence in support of the balanced growth hypothesis in Canada for the sample period 1950 to 2011.

The result of this analysis is consistent with the assertion given by Vince and Hong that "This hypothesis has not been consistently supported by empirical investigation using data from developed countries (Li & Daly, 2009) [20]".

Since conclusions above do not favour a single shared stochastic trend for lpcgdp, lpccs, lpci, then it could be argued that this evidence is against "balanced growth". It should be recognised, however, that the Johansen procedure is not powerful in small samples and cannot be assumed to always offer a correct conclusion. Direct stationarity testing for the Great Ratios can therefore be seen as complementary to the Johansen procedure in this application. We should be interested to see whether the two approaches agree with each other. Hence we proceed by assessing the stationarity of the "Great Ratios" as follows.

Assessing Great Ratio Stationarity

Balanced growth also requires that some "Great Ratios" – consumption (C) to output (GDP) and investment (I) to output (GDP) are stationary. Figure 2(a) shows that the ratio of investment (I) to output (GRIY) has been relatively stable over time with little fluctuations within a narrow band. Figure 2(b) indicates that the ratio of consumption to output (GRCY) has moved downwards substantially over time and show little apparent tendency for mean-reversion.



Source**:** Author's computation using Eviews 8.0

Fig 2: A plot of the Great Ratios of Investment and Consumption to Output

Some pertinent long-run expectations arise directly from models of economic growth. Economies are regarded as converging towards an equilibrium path in which capital and output grow at the same rate. The "great ratios" of investment to output and consumption to output, will also be constant along the balanced growth path**.**

Table 6 below indicates that the "great ratio" of investment to output (GRIY) is level stationary i.e. $I(0)$ while the first difference of the "great ratio" of consumption to output(GRCY) is stationary i.e. $I(1)$. Even though these great ratios are stationary, the great ratio of consumption to output is trend-stationary whereas the great ratio of investment to output is level-stationary. However, the trend-stationarity of the great ratio of the consumption (C) output (GDP) weakens the evidence for balanced growth since it indicates that the ratio does not have a constant expected value.

Table 6: ADF tests on GRCY and GRIY for Canada, 1950-2011

	GRCY		GRIY	
	Lag	**ADF**	**Lag**	**ADF**
Series levels	10	-1.688	10	-3.151***
First difference	10	-6.395***	10	-8.028***

*, ** and *** denote rejection of the unit root null with significance level at 10, 5 and 1% respectively

Source**:** Author's computation using Eviews 8.0

The results from the test of the null hypothesis indicate that the ratio series for consumption to output contains a unit root. The standard Augmented Dickey-Fuller test indicates that the unit root hypothesis at the conventional level of significance is not rejected for the consumption ratio.

Sufficient empirical studies such as those of (Kunst & Neusser, 1990; Hossain & Chung, 1999; Harvey *et al*., 2003) [6] have examined the great ratios. Notwithstanding the evident theoretical support, however, the empirical findings for a number of industrialised economies have seen little success except for US data (King *et al*., 1991) [16]. The ratios have been found to be nonstationary using unit-root tests as confirmed by most authors (Philip *et al*., 2011). Neusser (1991) suggests that the unique empirical results for the US may be due to the long period of uninterrupted growth which allowed the US to grow on a steady-state path, unlike some European countries that have experienced destructive incidents such as World War II.

However, Canada is not an exception among a majority of the industrialised economies whose great ratios data do not agree with the theoretical predictions. Although the great ratio of investment to output is stationary which might suggest some partial support for the balanced growth, the conclusion here also does not favour a single shared stochastic trend for lpcgdp, lpccs, lpci and it could be argued that there is no enough empirical evidence to believe that there is "Balanced Growth" in Canada over the sample period.

Conclusion and Recommendation

To examine the balanced growth in Canada, unit root tests and cointegration tests have been carried out. The unit root tests suggest that the log of per capita GDP, log of per capita consumption and log of per capita investment are integrated of order one I(1). Cointegration tests revealed that these variables are not cointegrated and as such there is no empirical evidence to support balanced growth in Canada. The validity of the great ratios of Canada is also examined by directly applying the unit root tests where the great ratio for investment is stationary while that of the consumption is not stationary. The stationarity of great ratio of investment to output arguably suggest some partial balanced growth in Canada.

Although, the results of the great ratios suggest some partial support for balanced growth in Canada, in the sense that the great ratio of investment to output has been found to be stationary, we can arguably conclude that there is no enough evidence that there is a balanced growth in Canada.

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