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CRISIS AND CURE: COMPARATIVE POLICY RESPONSE TO ECONOMIC FLUCTUATIONS IN ADVANCED SELECTED ECONOMIES

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Abstract
Economic fluctuations can hinder the economic growth of any country while making an economy vulnerable. This paper attempts to analyse the economic fluctuations in four major developed countries of the world including Canada, France, United Kingdom and United States of America. Augmented Dickey Fuller (ADF) test was applied to check the stationarity of GDP series for all the four economies. All the GDP series were found to be integrated of order one. Cyclical components of each GDP series were separated and recovered by using Hodrick- Prescott (HP) filter while showing downturn and recoveries in these economies. As HP filter also soothes out the series so all the cyclical components turn stationary. In order to understand the interaction between USA and Canadian economy Granger Causality test was applied. USA GDP is important to forecast Canadian GDP with all 1, 2 and 3 lags. While Canadian GDP was useful to forecast USA GDP only in case of lag 1. Regarding growth evolution of these four countries during various recessions Canada and France experienced relatively fewer recessions as compared to UK and USA while it seems that UK experienced longest recession and suffered most from the recession. Role of monetary and fiscal policies as crisis response is also discussed for these economies. It is found that USA and Canada have almost fully recovered from the recession but UK and France had to face longer recovery periods. These different recovery patterns might be attributed to different policy responses.
Key Words: *Economic Fluctuations, Stationarity, GDP, Hodrick- Prescott (HP) Filter*

1. Introduction

Business cycles refer to the regular pattern of fluctuations in economic activity that occur over time, including periods of expansion (increased economic growth) and contraction (decreased economic growth). These cycles are typically measured using changes in real Gross Domestic Product (GDP). During period of expansion GDP increases while during recessions GDP decreases. However, business cycles can be unpredictable and difficult to forecast accurately. This is because there are many different factors that can influence economic activity, including changes in consumer and business confidence, shifts in government policies and global economic trends. As a result, business and policymakers need to carefully monitor economic data and indicators in order to anticipate changes in the business cycle and adjust their strategies accordingly.

There has been an important evolution in economic theory history in recent years where the focus has shifted from studying "business cycles" to more general economic fluctuations. This is because the term "business cycle" suggest a regular, cycle pattern of ups and downs while economic fluctuations can be more unpredictable and irregular. Milton Friedman, a prominent economist, believed that most business declines were caused by monetary factors, rather than being part of a regular cycle. He argued that fluctuations in the money supply, interest rates, and other monetary variables were key drivers of economic activity.

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In contrast, Keynesian economics emphasizes the role of aggregate demand in shaping economic activity. According to this theory, fluctuations in demand can cause the economy to deviate from its full employment level of output, leading to periods of growth and contraction. While Keynesian models do not necessarily imply regular cycles, they do suggest that initial shocks can trigger cyclical responses due to the interaction of the Keynesian multiplier and accelerator. Overall, while there is ongoing debate among economists about the underlying causes of economic fluctuations, it is clear that understanding and managing these fluctuations is critical for businesses and policymakers alike.

Real business cycle (RBC) models and Keynesian economics are two different approaches to explaining economic fluctuations. While RBC models attribute fluctuations to technological shocks, Keynesian economics argues that fluctuations can stem from a variety of sources, including monetary policy, fiscal policy, and other external factors. RBC models were developed by economists Finn Kydland and Edward Prescott, and have been associated with the Chicago School of Economics. The basic premise of RBC models is that fluctuations in economic activity are driven by changes in technology that lead to changes in productivity. According to RBC models, technological shocks cause fluctuations in output, employment, and other macroeconomic variables.

Critics of RBC models, particularly Keynesian economists, argue that they are too narrow in their focus and fail to account for the role of monetary policy and other factors in economic fluctuations. They argue that monetary policy can have a significant impact on economic activity, particularly during times of recession or financial crisis. Paul Krugman, a prominent Keynesian economist, has been critical of RBC models and their emphasis on technology shocks. He argues that RBC models are overly simplistic and fail to capture the complexities of modern economies. Krugman also points out that RBC models are unable to explain why some countries experience more severe economic downturns than others, even when they experience similar technology shocks. Thus, RBC models provide a useful framework for understanding the role of technology in economic fluctuations, they have been criticized by some economists for being too narrow in their focus and failing to account for the impact of monetary policy and other external factors.

The real business cycle (RBC) theory, which challenges the Keynesian view that economic fluctuations are primarily driven by changes in aggregate demand. RBC theory suggests that fluctuations in economic activity are due to changes in technology or other external factors, rather than monetary factors. The RBC theory is associated with the Chicago school of economics and economists like Kydland and Prescott. They argue that economic crises and fluctuations cannot stem from a monetary shock, only from external shocks like innovations. RBC models assume that people are rational and that markets always clear, so that any changes in economic activity are driven by real factors such as productivity, rather than by changes in demand.

However, this view has been challenged by mainstream economists in the Keynesian tradition, such as Summers and Krugman. They argue that RBC theory is unrealistic because it assumes that all markets are efficient and that economic agents always act rationally. They also argue that RBC models cannot explain the persistence of recessions or the role of government policies in stabilizing the economy. Overall, while RBC theory has provided an important perspective on the causes of economic fluctuations, it is not widely accepted within mainstream economics, and there is ongoing debate about the relative importance of real and monetary factors in shaping the economy.

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Almost every economy faces economic fluctuations. The most known examples are the Great Depression of 1930s and now recently the Great Financial crisis of 2008. There might be different reasons and factors behind an economic downturn for each economy but due to high level of interdependence among various economies, economic conditions in one economy soon start affecting the others as well. Here we can quote the example of USA and Canada.

Present study aims at investigating economic fluctuation in four major economies Canada, France, UK and USA. It is divided into two parts. Part I is related to the isolation of business cycles. We have taken Quarterly data of Gross Domestic Product (GDP) for Canada, France, UK and USA. Every data series is transformed into logarithm and tested for stationarity by applying Augmented Dickey Fuller (ADF) test. Then, the first difference of each series is also tested for unit root by applying ADF test. Cyclical and trend component in each time series are separated by using Hodrick- Prescott (HP) filter. And then cyclical component of each series is also tested for stationarity. Lastly, in part I granger causality test is applied to check the interdependence among Canadian and USA economy.

Part II focuses on historical trends in GDP of the four countries in question. This part also provides a comparative analysis of the evolution of the log of GDP following the financial crisis of 2008 in the four countries. In this regard policy responses to the crisis in the form of monetary and fiscal policy are also outlined and compared.

2. Literature Review

Francis (2009) investigated the sources of historical fluctuations in annual labor productivity and employment data of United Kingdom and rejected real business cycle driven by technology for UK by applying long run identifying restrictions to divide shocks into technological and other shocks. While the short run effect of technological shocks on labor productivity was negative irrespective of the defined data generating process.

Barrios et al (2003) analyzed the determinants and patterns of business cycles among six Euro Zone and 11 United Kingdom regions by applying generalized method of moments covering the time period from 1966 to 1997 and found trend towards lower correlations. Fluctuations in output were persistently out of phase for UK regions while minor cyclical heterogeneity was detected. Sectorial specialization led towards output fluctuation among UK regions and Euro zone countries but these specialties were not significantly decreasing output correlations.

Lumsdaine and Prasad (2003) found business cycle fluctuations more closely linked with industrial economies when time varying weights were used to develop common particulars of macroeconomic fluctuations. Economic shocks were dynamically adjusted and treated as a whole while some specific components were witnessed for European economic fluctuations.

Beaudry and Portier (2006) advocated that fluctuations in stock prices were caused by technological shocks which in turn generate fluctuations in consumption, investment and output. Thus, stock prices were the cause of almost 50 percent economic fluctuations. Christiano et al (2010) developed a standard monetary DSGE model to find out the influence of financial factors on the economic fluctuations in Euro Area and US. The results indicated that financial factors including financial contracts, liquidity constraints and market risk were the key determinants of converting short run economic fluctuations into persistent long run fluctuations.

Kose et al (2003) after adjusting similitudes and distinctions across seven regions, sixty countries and aggregates of output, consumption and investment analyzed common dynamic properties of business cycles by applying Bayesian dynamic latent factor model. The results

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indicated that regional specific factors played minor role in business cycles while a common world factor was the key determinant of economic fluctuations.

Kose et al (2008) applied the Bayesian dynamic latent factor model on G-7 countries to find out the country specific and common factors of economic aggregates (output, consumption and investment) fluctuations by using data from 1960 to 2003. They developed three different time periods based on the available data as the Bretton Woods period, Common shocks period and the globalization period. The analysis declared that economic fluctuations were wore during globalization period as compare to the other periods.

Alesina and Sachs (1986) developed a political business cycle theory based on an organized variation between the monetary policies of two parties in a model with labor contracts that was different from the traditional political business cycle theory by Nordhaus. The difference in money growth under the leadership of both the parties was different which resulted in output fluctuations.

The traditional view of business cycle declared that fluctuations in output were a result of deviation of output from the natural rate of output. Thus, indicating that any unexpected change in output should not change output forecast. This traditional view was questioned when quarterly postwar data of USA was analyzed which suggested that an unexpected change in real GNP of 1 percent should change output forecast by over 1 percent for a longer time period (Campbell & Mankiw, 1987).

Campbell and Mankiw (1988) examined the persistence of economic fluctuations internationally by using post war data of seven countries including Canada, France, Germany, Italy, Japan, United Kingdom and United States. The results indicate that out of seven countries six that a one percent shock to output should change the long run univariate anticipation of output by over one percent. Lower order ARM models also supported the same results when applied on this data while the estimates were compared with the Monte Carlo results.

Sheffrin (1988) challenged the common belief that severity of economic fluctuations decreased after Second World War examining the reduction of severe economic fluctuations among six European countries. He found UK to be more sensitive to economic fluctuations than any other studied European country. Calomiris and Hubbard (1989) concluded that disturbances to availability of credit led towards price shocks which resulted in economic fluctuations in USA for pre-World War 1 period

Taylor (1989) compared economic fluctuations in USA and Japan by applying vector auto regressions with their moving average with data from 1972 to 1986 and found Japan to be less sensitive to economic fluctuations than USA while the dynamics of inflation and real output were determined by a combination of wage adjustment and monetary factors.

Norrbin and Schlagenhauf (1990) decomposed sources of industrial output fluctuations in three main categories namely national shocks, specific group industry shocks and distinctive factors for separate data of inter war and post war periods for USA. Engle Watson dynamic MIMIC model was applied and the results suggested that the relative importance of each component was determined based on the considered analysis period while Single Index cycle theory found to be more significant for inter war period.

Mellander et al (1992) presented the case of a small open economy (Sweden) and found permanent supply shocks to be the major causes of fluctuations in Gross domestic product(GDP) both in the short run and in the long run by using a restricted Vector Auto regressions with annual data of Swedish economy from 1875 to 1986.

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Beaudry and Koop (1993) analyzed the persistency of positive and negative economic shocks and found negative shocks to be less persistent when impulse responses to output were more hetrogenous. The prediction of output after a recession was less reliable after eight to twelve quarters as positive economic shocks were long lasting. Backus (1992) declared consumption variations among different countries to be the sole cause of economic fluctuations rather than the output fluctuations.

Movements in US investment were strongly linked with fluctuations in productivity and investment among G7 countries while having minor impact on current account balances when dynamic factor analysis and Kalman filtering were applied to find out the common economic fluctuations among G7 countries. These findings were closely associated with the forecast of multi country dynamic model (George & Head, 1999). Apel and Jansson (1999) presented a new approach to estimate potential output and NAIRU by using Okun's law and a Phillips curve with the data of Canada, UK and USA

Bayoumi and Prasad (1997) analyzed labor market adjustment mechanisms, degree of industrial diversification and output fluctuations in eight US regions and eight European countries by using one digit sectorial data. The results suggested that both of these economies were subject to similar causes of economic fluctuations. However, the interregional labor mobility was the key reason for labor market adjustment in United States because it has a more integrated market than the European Union.

Canova and Marrinan (1998) presented sources and propagation of international output fluctuations by a multi country model that was based on two major sources of disturbances in output including technological and government expenditures disturbances. In their developed model they assumed interlinked consumption and production and found technological disturbances more accurate in replicating actual data.

3. Data Description and Methodology

3.1. Data

Data for the analysis is taken from the following sources:

- For Canada, data on quarterly (seasonally adjusted) real gross domestic product is taken from the CANSIM II database website. We combined the two time series V1992067 (1961Q1 to 2013Q10) and V62306896 (1981Q1 to 2013Q4) and used the rule of tree to construct the series from 1981Q1 to 2013Q4.
- For France data is provided by Prof. Serge Columbe.
- For UK data for the real GDP (seasonally adjusted) for the 1955Q1 to 2013Q3 is taken from http://www.guardian.co.uk/news/datablog/2009/nov/25/gdp-uk-1948-growth-economy#data.
- For USA data on GDP in billions of chained 2009 dollars from 1947Q1 to 2014Q1 is taken from http://www.bea.gov/national/index.htm#gdp.

3.2. Stationary Testing

All the four time series containing quarterly (seasonally adjusted) real gross domestic product for Canada[1] France, UK and USA were transformed into logarithms and were tested for stationarity at level by using Augmented Dickey Fuller (ADF) test. For convenience these series were denoted by lry_ca, lry_fr, lry_uk and lry_us in figures and tables. As the four series have a clear upward trend direction so we include a constant and a deterministic trend in the ADF test equation. The results of the ADF test are summarized in the following table.

[1] Data on Canadian GDP was available only till fourth quarter of 2012. Data for various quarters of 2013 was generated by making use of series V62306896 from CANSIM II.

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Table 3.1: ***ADF Test Results (Log GDP)***

Series	ADF-Statistic	Critical values (5%)	Decision
Lry_can	-2.40244(0.3772)*	-3.43126	Not-stationary
Lry_fr	-0.72807 (0.9693)	-3.42740	Not-stationary
Lry_uk	-1.03972 (0.9353)	-3.42914	Not-stationary
Lry_us	-1.42718 (0.8510)	-3.42674	Not-stationary

***p-values in the brackets**

In ADF test unit root exits with null hypothesis. Column 2 in above table provides test statistic and critical values are provided in column 3. If ADF test statistic is greater than the critical value null hypothesis is accepted. We can also look at the p-value (provided in brackets) in column 2. P-value has to be less than 0.05 to reject the null hypothesis. As it is clear that in the entire above four cases ADF test statistic is greater than the critical value and p-value is much higher than 0.05 so the null hypothesis of unit root could not be rejected. Column 4 provides the decision, all the four time series of quarterly GDP have a unit root or in other words they are not stationary.

Stationarity is a crucial property of time series data in economics, finance, and other fields that rely on statistical analysis. A stationary time series is one in which the statistical properties of the series, such as its mean and variance, do not change over time. This means that the series exhibits no long-term trend or systematic patterns, and that its fluctuations around the mean are random. One way to test for stationarity is to look at the autocorrelation function (ACF) and partial autocorrelation function (PACF) of the time series. If the ACF and PACF exhibit a rapid decay to zero, then the time series is likely stationary. On the other hand, if the ACF and PACF exhibit a slow decay or a trend, then the time series is likely non-stationary.

Unit roots are a key factor in determining whether a time series is stationary or non-stationary. A unit root is a characteristic of a time series that indicates that it has a stochastic trend, meaning that its statistical properties change over time. If a time series has a unit root, it is non-stationary. One way to test for the presence of unit roots is to use the Augmented Dickey-Fuller (ADF) test. The ADF test compares the actual time series to a null hypothesis of a unit root process. If the ADF test rejects the null hypothesis, it suggests that the time series is stationary.

The importance of stationarity in economic forecasting is that it allows for the use of statistical models that assume stationary data. Non-stationary time series can lead to spurious regression results, where two non-stationary time series appear to be highly correlated but have no real causal relationship. By ensuring that time series data is stationary, researchers can avoid such spurious results and make more accurate forecasts.

A time series with a unit root is non-stationary and follows a random walk. The term "random walk" refers to the idea that the series moves randomly in response to shocks, with no tendency to return to a long-run path. This means that shocks to the series have permanent effects, rather than dissipating over time as they do in stationary series. As a result, non-stationary series can be more difficult to model and forecast accurately than stationary series.

The study by Nelson and Plosser (1982) is indeed an important contribution to macroeconomics and econometrics. In their paper, Nelson and Plosser analyzed a large set of macroeconomic time series and found evidence of unit roots in many of them. This

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challenged the prevailing view at the time that macroeconomic variables were stationary and led to a renewed focus on the importance of stationarity in economic analysis.
Since Nelson and Plosser's paper, there has been a large literature on the topic of stationarity in economics. Researchers have developed a range of methods for testing for stationarity and for dealing with non-stationary data in economic models. These methods have improved our ability to analyze and forecast economic variables, and have contributed to our understanding of how the economy works.

3.3. Difference Operator

In the above table 3.1 all the four time series were found non stationary in level form. So we can use the difference operator here. The first difference of a time series is the series of changes from one period to the next. If Y(t) denotes the value of the time series Y at period t, then the first difference of Y at period t is equal to Y(t)-Y(t-1). If a time series is seasonally adjusted we can remove the trend in mean by taking first/ second difference of the series.

The graphs of first difference of GDP for all the four countries revealed that the first differenced series in each case that it is neither increasing nor decreasing. Therefore we conduct unit root test with intercept only. Table 3.2 below summarizes the results of ADF test after taking first difference of each GDP series.

Table 3.2. ***ADF Test Results (First-difference of log GDP)***

Series	**ADF-Statistic**	**Critical values (5%)**	**Decision**
dLry_can	-9.90947 (0.0000)*	-2.8750	stationary
dLry_fr	-5.37290 (0.0000)	-2.8725	stationary
dLry_uk	-14.1630 (0.0000)	-2.8737	stationary
dLry_us	-10.9755 (0.0000)	-2.8716	stationary

***p-values in the brackets**

As it is evident from the results summarized in TABLE 1.2, all the four GDP time series are found to be stationary in first-differenced form. In all the four cases the computed ADF statistic is less than the critical value (for Canada –9.90947< -2.8750, for France -5.37290< -2.8725, for UK -14.1630< -2.8737 and for US -10.9755< -2.8716) and p-value is < 0.05. It implies rejection of null hypothesis that the series contains a unit root leading to the conclusion that all the series are integrated of order one or stationary after the transformation.

3.4. Extracting the Cyclical Component by Hodrick and Prescott Filter (HP)

The Hodrick-Prescott filter is a widely used method to decompose a time series into a trend component (also known as the growth component) and a cyclical component. The idea behind the filter is to minimize the fluctuations in the trend component while still allowing it to capture the general movement of the time series. This is done by minimizing a penalty function that measures the deviation of the observed time series from its trend component, subject to a constraint on the curvature of the trend.
In practice, the Hodrick-Prescott filter is often applied to a time series that has already been seasonally adjusted, as you mentioned. This is because seasonal components can have a strong cyclical pattern that could interfere with the detection of the underlying business cycle. By removing the seasonal component beforehand, the filter is better able to isolate the cyclical component of the time series. Hence in their conceptual framework a given (previously seasonally adjusted) time series is the sum of a growth (or trend) component *gi* and a cyclical component *ci*

$$y_i = g_i + c_i \qquad for\ i = 1, \ldots, T \tag{1}$$

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Their measure of the smoothness of the $\{gi\}$ path is the sum of the squares of its second difference. The *ci* are deviations from *gi* and their conceptual framework is that over long time periods, their average is near zero. These considerations lead to the following programming problem for determining the growth components:

$$\min_{g_t^T_{t=-1}} \{\sum_{t=1}^{T} c_t^2 + \lambda \sum_{t=1}^{T} [(g_t - g_{t-1}) - (g_{t-1} - g_{t-2})]^2\} \quad (2)$$

In this formulation, the parameter λ is a positive number that penalizes variability in the growth component series. The larger the value of λ, the smoother the solution series is. Based on ad-hoc arguments Hodrick and Prescott arrive at a 'consensus' value that is extensively used when analyzing quarterly data (the frequency most often used for business cycle analysis): the value of =1600. This parameter tunes the smoothness of the trend, and depends on the periodicity of the data and on the length of the main cycle that is of interest. It has been pointed out that this parameter does not have an intuitive interpretation.

Here we have used HP filter twice, firstly on each time series in level form and secondly on each time series in first difference form. The motivation comes from Harvey & Jaegar (1994) and Cogley and Nason (1995). Harvey & Jaegar (1994) assert that applying HP filter to time series with stochastic trend may extract cyclical movements which are entirely spurious. Similarly, Cogley and Nason (1995) are of the view that that the filter can generate business cycle and co movement even if none is present in the original data. Applying the standard HP filter to a random walk (which is a special case of unit root) produces de trended observations which have the characteristic of a business cycle for quarterly observations. Such cyclical behavior is spurious. It is shown that HP filter operates like a high-pass filter when applied to stationary time series.

The results of HP filter are presented in Appendix. (See graphs 9-25).We have separate graphs showing cyclical component in each GDP series. Here we have used λ= 1600 as suggested by Hodrick and Prescott (1980). The green line represents the residual of the filtered line from the actual value line which is represented by blue line. The zero line highlights positive and negative GDP gap. Or in other words there is a positive GDP gap (actual value is above the potential) above zero line and vice versa. For Canadian economy we can see that economy entered a deep recession at 5.1% below the trend in 1982Q4. After that the economy recovered from shock and has a positive GDP in 1989Q2 at 2.7%. Similarly the graph on cyclical component clearly indicates economic downturn in various time periods in i.e. 1984, 1993 and 2008.

The results of HP filter applied to other three economies are also provided in the appendix. Separate graphs for cyclical component are also provided showing cyclical variation in all the economies. An important thing to be noticed is that all the economies experience recession one after the other showing interdependence among economies. Here we can take the example of 2008 economic downturn. The results of HP filter when applied to first difference are also provided in Appendix and are showing results quite similar to the results when it is applied to series in log level form.

3.5. Stationarity of Cyclical Components

HP filter has been applied to separate trend and cyclical component from the GDP time series of all the four countries. The filter is applied twice firstly on log levels of these series and then on first difference of the series. To test the stationarity of cyclical component we have applied the ADF test to cyclical component in each series separated by HP filter. Results are summarized in table below.

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Table 3.3. ***ADF Test Results (Cyclical component when HP filter is applied to log levels)***

Series	ADF-Statistic	Critical values (5%)	Decision
cyc_can	-5.37520(0.0000)*	-1.94233	stationary
cyc_fr	-7.37730 (0.0000)	-1.94206	stationary
cyc_uk	-5.01612(0.0000)	-1.94218	stationary
cyc_us	-7.47281(0.0000)	-1.94202	stationary

***p-values in the brackets**

Following table summarizes the results of ADF test when ADF test is applied to cyclical component separated by HP filter from first differenced GDP series for all the four countries.

Table 3.4. ***ADF Test Results (Cyclical component when HP filter is applied to first difference series)***

Series	ADF-statistic	Critical values (5%)	Decision
dcyc_can	-11.93213(0.0000)*	-1.94233	stationary
dcyc_fr	-19.41782(0.0000)	-1.94205	stationary
dcyc_uk	-16.18587 (0.0000)	-1.94219	stationary
dcyc_us	-12.19921 (0.0000)	-1.94201	stationary

***p-values in the brackets**

It can be seen that in all the cases null hypothesis of unit root is rejected for all the four cyclical components. In both cases, cyclical component for all the four countries Canada, France, UK and USA are found to be stationary. It might be attributed to the fact that a time series with cyclic behavior (but no trend or seasonality) is stationary. This is because the cycles are not of a fixed length so before we observe the series we cannot be sure where the peaks or troughs of the cycle will be. In general a stationary time series will have no predictable patterns in the long-term. Time plots of a stationary time series show that it will be roughly horizontal (although some cyclical behavior is possible) with constant variance. In the long-run, the timing of cycle is not predictable so the time series is stationary. It also implies that that any of the cyclical series with infinite smoothing is effectively stationary.

3.6. Granger Causality Test

The Granger causality test is commonly used in econometrics to determine the direction of causality between two time series variables. If both variables are stationary, the test can be performed on their levels. However, if one or both variables are non-stationary, then the test must be conducted on the first differences of the variables, since non-stationary series may exhibit spurious correlation, meaning that their apparent correlation may be a result of both variables being influenced by the same underlying trend rather than any actual causal relationship. The first differences transform the variables to stationary series, allowing for a valid test of causality. We have used granger causality test to check causality among GDP of Canada and USA. Lags including 1, 2 and 3 have been used to test the causality correspondently. The results of granger causality test are summarized in the following table

Table 3.5. ***Results of Granger Causality Test***

Null Hypothesis	No. of lags	Computed value	Decision
Dlry_us does not granger cause Dlry_ca	1	47.3405(0.0000)	Ho rejected
Dlry_ca does not granger cause Dlry_us	1	4.8458(0.0288)	Ho rejected
Dlry_us does not granger cause Dlry_ca	2	23.7270 (0.0000)	Ho rejected
Dlry_ca does not granger cause Dlry_us	2	0.81707(0.4432)	Ho accepted
Dlry_us does not granger cause Dlry_ca	3	15.1101(0.0000)	Ho rejected

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Dlry_ca does not granger cause Dlry_us	3	0.60454(0.6128)	Ho accepted

As it is clear from the above table that in all three cases lag 1,2 and 3 the null hypothesis "dlry_us does not granger cause dlry-ca" is rejected implying that USA GDP is important in predicting Canadian GDP. It is rational due to heavy dependence of Canadian economy on USA economy. The other hypothesis " dlry_ca does not granger cause dlry_us" is rejected only in case of 1 lag implying that in short run (for a quarter or so) Canadian GDP is important in forecasting USA GDP. However this hypothesis is rejected when we use 2 and 3 lags. It can be interpreted as Canadian GDP is not useful in forecasting USA GDP when number of lags is more than 1.

4. Historical Evidences, the Great Recession and Policy Responses

In order to pertain four tables were constructed to post war recessions in Canada, France, UK and USA. There are three columns in each table. The first column provides information about period of peak in each recession. Second column summarizes the duration of each recession which is defined as two consecutive quarters with negative real GDP growth. Third columns summarize the degree of growth rate drop from peak to trough.

Table 4.1. ***The behavior of Real GDP in Canada (Recessions in Canada)***

Quarter	No of quarters	Change in GDP (Peak to trough %)
1979q3	2	-0.02567
1981q1	6	-3.09981
1989q4	4	-1.18159
2008q4	3	-2.60197

Recessions in Canada is summarized in Table 4.1. Column 1 is showing the peak period and last column is showing the change in GDP. In spite of the fact that Canadian GDP can be forecasted on the basis of USA GDP, the number of recessions in Canadian economy is much smaller as compared to Canadian economy. In case of Canada we find just four major downturns where the longest is the one which occurred in 1981 and in this case loss in GDP is at its maximum i.e. 3.0998%.

Table 4.2. ***The behavior of Real GDP in France (Recessions in France)***

Quarter	No of quarters	Change in GDP (Peak to trough %)
1974q2	3	-1.45981
1990q2	2	-0.29705
1991q4	4	-0.40032
2007q4	5	-3.42456

Table 4.2 summarizes behavior of real GDP in France during various recessions. As compared to USA the number of recessions seems much smaller. There are four major downturns as compared to 9 in case of USA. The fall in GDP ranges from 0.297in 1990 to 3.424 at the end of 2007.The time between the end of one recession and beginning of the other ranges from 6 quarters in 1990-1991 to almost 16 years. The worst recession seems to be that of 2007-08 where output declined by almost 3.424%.

Table 4.3.***The behavior of Real GDP in United Kingdom (Recessions in UK)***

Quarter	No of quarters	Change in GDP (Peak to trough %)
1955q4	2	-0.31143
1961q2	2	-0.53394

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1973q2	3	-0.40143
1974q4	2	-1.26966
1979q3	5	-2.99194
1990q1	5	-1.78147
2008q1	5	-6.78453
2011q3	3	-0.61345

Real GDP behavior of UK during various post war recessions is summarized in Table 19. There are 7 major downturns as compared to just four in France. The fall in GDP ranges from 0.314% in 1956 to 6.7845% in 2008-09. The time between the end of one recession and beginning of the other ranges from 3 years from 2009-2012 to almost 11 years from 1980 to 1991. As compared to USA and France UK seems to be worst hit by the recent recession of 2008 as decline in output is highest in case of UK.

Table 4.4. ***The behavior of Real GDP in United States of America (Recessions in USA)***

Quarter	No of quarters	Change in GDP (Peak to trough %)
1948q3	2	-1.23092
1953q1	3	-1.32244
1957q2	2	-0.07027
1969q2	2	-0.19140
1974q1	3	-1.10885
1979q4	2	-1.70848
1981q2	2	-0.03039
1990q2	2	-0.82478
2008q1	4	-3.51124

Lastly, table 4.4 summarizes the behavior of real GDP during various recessions in USA. There were several relatively deep recessions which lasted for more than 2 quarters. The output declines very considerably in size and spacing. The fall in GDP ranges from 0.03% in 1981 to 3.5% in 2008. The time between the end of one recession and beginning of the other ranges from 5 quarters in 1979-1981 to almost 18 years from 1990 to 2008.The most serious post war recession is that of 2008 when output declined by about 3.5%.

5. The financial crisis of 2008 and the role of fiscal and monetary policy responses to the crisis

The global financial crisis 2008 which had its epicenter in the American subprime market has been greater in magnitude than the crash in 1929, but its "real" effects have been relatively lower. In contrast to the governments behavior during the "Great Depression" this time central banks reacted aggressively and quickly as lender of last resort. The nationalizations of the Northern Rock in UK and the Freddie Mac and Fannie Mae in United States are some examples of the policymaker's reaction to the financial bankruptcy. However, the institutional strategies to stabilize the financial sector were different in the four countries analyzed: while in United States and UK the financial assistance was faced by his respective central banks (the US Federal Reserve (Fed) and the Bank of England), in Canada was faced mainly by the Canada Mortgage and Housing Corporation (but also by the Bank of Canada and even by the Fed) (Macdonald, 2012). As France is part of the Eurozone, it has had some particularities that will be analyses then. However most recovery plans set by these countries seem to be in line with Keynesian Economics which involves rise in government spending

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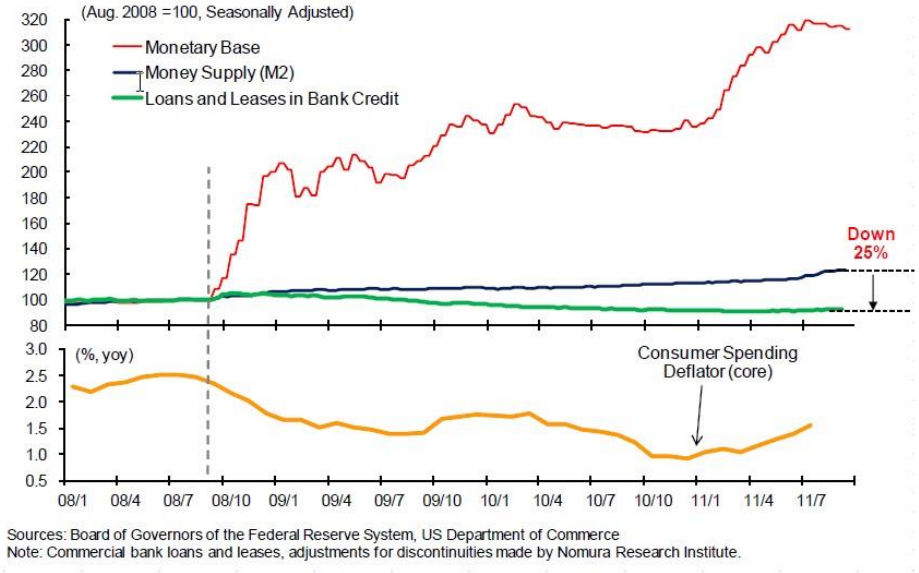
and focus on aggregate demand. We also find that all the four economies introduced fiscal stimulus to come out of recession.

The conventional monetary policy was replaced by unconventional monetary policy measures as it was asserted that the single focus on inflation control by central banks was the primary reason we failed to "connect the dots" on what caused the crisis, and more importantly failed to take the necessary, timely, corrective actions to avert, or at least minimize the fallout of, the global financial crisis.(Taylor 2009) Unconventional monetary policy took the form of "Quantitative Easing" (QE) programs in United States, UK and Canada and the "zero interest rate policy" (ZIRP) was oriented to bailout a financial sector that was paralyzed or virtually in default. For this goal, these monetary policies were very pragmatic and effective. The financial crisis showed that a lender of last resort is a systemic need under modern financial markets; or in Minskian terms one could say that a "big government" could be an important stabilizer factor in an unstable economy (Minsky, 1986).

However, in terms of the mainstream macroeconomic approach these "unconventional" monetary policies have generated interesting debates and theoretical discussions. If we think in the Monetarist theory, before that aggressive exogenous increase in the monetary base we should expect an acceleration of inflation in some moment if we assume a vertical long run aggregate supply curve. In other words, if we assume that inflation is always a monetary phenomenon in a long run and if we assume the existence of a stable money multiplier in a banking system, thus, the QE programs should expand the credit supply to the aggregate demand and cause inflation at some moment. However, the empirical evidence suggests that during approximately the last six years since the beginning of the crisis, the credit and inflation did not response to the increase of the monetary base as described in the Figure 5.1 below. For United States (but similar path occurs in UK, Canada and France). As we can see, monetary base increased persistently but the stock of loans fall and inflation decrease in the trend.

Figure 5.1: ***US Banking Sector***



Source: Koo (2011)

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According to recent research by various agencies, like BIS, European Central Bank (ECB), Fed, Bank of England, money creation in the abroad sense is largely determined by credit demand (Borio, 2009; EBC, 2009; Carpenter and Demiralt, 2010; Standard and Poor 2013 and McLeay et al, 2014). It means that the Monetarist money multiplier is not stable and is lower than one, and consequently, do not work as policy instrument (see Moore, 1988; and Lavoie, 1992, for a theoretical discussion about the endogenous money approach). For that reason, as the credit would be largely determined by the GDP growth rate it is reasonable to assume that under recession credit decrease, regardless of the exogenous monetary expansion of the central bank.

But really it is not new. Central bankers know that the quantity of money became difficult to control since the increasing financial innovations at the beginning of the 80s. As pointed out the former Governor of the Bank of Canada Gerald Bouey in 1983: "We did not abandon M1, M1 abandoned us". However, even in a modern New Keynesian model without "LM curve" the theoretical challenges are similar than in a Monetarist case. In theoretical terms, a persistent ZIRP should generate cumulative inflation pressures because the monetary interest rate is been forced to be fixed above the natural rate for long time.

In the Eurozone, particularly in France, the impact and response to the crisis was different. First, the financial markets in the European continent do not linked with the American financial market as in the UK. But regardless the financial integrations the main difference have been related with the nature of the Eurozone. In contrast to the United State, UK and Canada, France (as the rest of the Eurozone countries) does not have the sovereignty to act as lender of last resort because is part of the monetary union without fiscal union.

For that reason, in the Eurozone the monetary policy was less effective than in United States, Canada and UK. The decisions of the ECB in Frankfurt frequently were late and extremely moderate. Thus, as the global financial crisis impacted directly on the sovereign debt markets, especially in the periphery "PIIGS" (Portugal, Ireland, Italy, Greece and Spain), the monetary and fiscal policy in each country was reduced to a narrow zone. Therefore, the paralysis of the economic policy in Europe explains the different path in the GDP growth rate before 2010 between France and North American countries. The Britain case is curios because even with all the instruments available the recovery has been very slow.

In USA and Canada, monetary policy was effective to stop the bankruptcy of the financial system but ineffective to expand the aggregate demand according to the conventional wisdom. For that reason, fiscal policy was oriented to expand output and reduce the unemployment in a Keynesian fashion. UK introduced sales tax cut including a 2.5% temporary cut in value added tax and also made an investment of 3 billion. Besides that a 20 billion small enterprise Loan guarantee scheme was introduced. In United States spending $800 billion federal spending and tax package was introduced covering a variety of expenditures from rebates on taxes to business investment. Here also government increased spending in order to stimulate consumption and investment. Canadian government also introduced fiscal measures to reduce the cost of government and increase spending in meanwhile. Almost $31billion tax cuts were introduced during 2009-10.

Thus French fiscal policy have not been found wanting in terms of 'fiscal effort' to restore the public finances. Both key aspects of fiscal consolidation - increasing the overall tax take and curtailing public expenditure have been pursued boldly by French government in the aftermath of financial crisis. Although initially certain expansionary measures were introduced but could not be sustained due to lack of political will and rising budget deficits.

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Following table summarizes the fiscal stimulus for all the four countries in response to financial crisis.

Table 5.2. ***Fiscal stimulus of each country***

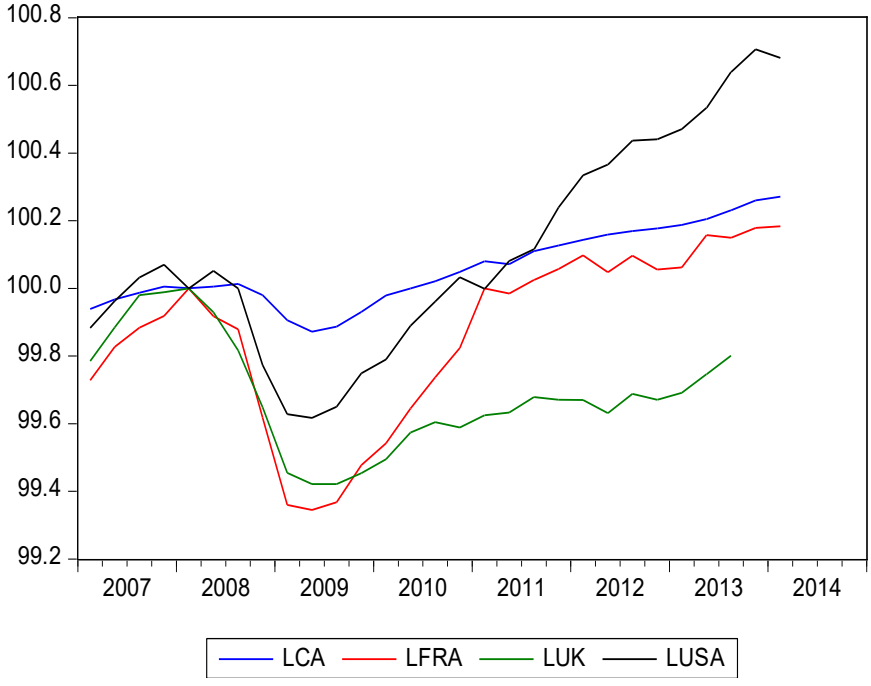
Country	Spending in 2009 as percentage of 2008 GDP	Total size of stimulus as percentage of 2008 GDP
France	0,7	0,7
UK	1,4	1,5
Canada	1,5	2,8
United States	1,9	5,9

Source: ***Prasad and Sorkin (2009)***

If we compare we can say that UK was more conservative in the use of both monetary and fiscal policy. They maintained a certain interest rate due to increased inflation however; USA went for quiet low interest rates and adopting almost a zero interest rate policy. This is in accordance to economic theory which says that low interest rates lead to higher consumption and help economy to come out of recession. Similarly unconventional monetary policy measures like quantitative easing were introduced simultaneously in USA and Canada. UK focused more on fiscal measures and ended up in a deficit of 175 billion pounds and a debt amounting to 80% of its GDP. As discussed above in case of France fiscal effort was not well directed due to fiscal constraints and a well-targeted monetary policy could not be adopted due to lack of independence. So it seems that policies in USA were relatively more effective as compared to UK and France.

Figure 5.3 shows normalized GDP for the four countries. It is clear that USA economy recovered rapidly from recession. It is also worth noting that in case of Canadian economy not only magnitude of downturn is small and recovery much better. But we can also see a slow recovery both in case of UK and France. The recovery path of various economies is shown in figure 5.3 below.

Figure 5.2. ***Log of GDP of each country transformed in an index. 2008 =100***



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On the basis of above discussion it might be concluded that the economies which used a good mix of both polices timely and effectively were able to come out of recession quickly and easily. So it is difficult to conclude that it is monetary policy or fiscal policy alone which was more effective however a careful and right blend of both is needed for an economy to recover. However we still have debates about the long-run impacts of these policies.

5.1. Conclusion:

In the first section of the report we used Augmented Dickey Fuller (ADF) to test the stationarity of GDP series for all the four countries i.e Canada, France, UK and USA. All the GDP series were found to be integrated of order one (first difference stationary). As the next steps cyclical components of each GDP series were separated by using Hodrick- Prescott (HP) filter. Cycle component of GDP of each country was separately recovered and plotted showing downturn and recoveries in these economies. As HP filter also smoothes out the series so all the cyclical components are stationary. In order to understand the interaction between USA and Canadian economy we conducted Granger Causality test. The test provided different results with different number of lags. USA GDP is important to forecast Canadian GDP with all 1, 2 and 3 lags. However it was not true otherwise as Canadian GDP was useful to forecast USA GDP only in case of 1 lag.

Growth evolution of these four countries during various recessions is reported while we found that Canada and France experienced relatively fewer recessions as compared to UK and USA although UK experienced longest recession and suffered most from the recession. Role of monetary and fiscal policies as crisis response is also discussed in these economies and it might be concluded that the economies which used a good mix of both polices timely and effectively were able to come out of recession quickly and easily.. It is found that USA and Canada have almost fully recovered from the recession but UK and France had to face longer recovery periods. These different recovery patterns might be attributed to different policy responses.

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