

The Implementation of Central Bank Policy during the Economic Crisis in Lebanon

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Abstract

During the last four years Lebanon has been facing a severe crisis that have no way out. It has challenged all the potential of the authorities dealing with financial, social and economic sector circumstances. Recently this economic crisis is still going up in higher frequency and more effectively on the Lebanese people. During this crisis central bank of Lebanon implemented its own monetary policy that is represented by expansionary monetary policy. The aim of this paper is to detect the impact of central bank implemented monetary policy during the economic crisis in Lebanon using money supply and open market operations tools in both short and long run on coincident index and consumer price index. In this consideration we perform monthly data covering the period January 2017 to June 2022 by applying VAR model. The empirical results shows that money supply and open market operation have no impact on coincident index and consumer price index in the long run, in addition they do not cause them in the short run. However the impulse response function show some reactions of coincident index and consumer price index to shocks in money supply and open market operations.

Keywords: Central Bank; Monetary Policy; Economic and Financial Crisis; Coincident Index; Consumer Price Index; Vector Auto Regressive Model.

1. Introduction

What get the Lebanese people into what they are living now, how the government and central bank is responsible for the crisis?

The central bank, Banque Du Liban (BDL) policy has been an attractive discussion especially after the Lebanese civil war that has destroyed the infrastructure and put the monetary authorities in a critical situation in order to face what is destructed and its effect throughout the upcoming years.

Various empirical studies have been conducted into the importance of central bank role during the economic crisis. These studies shows that if central bank didn't act like a lender of last resort than the financial crisis would be more fatigue and destructive (*Shirakawa, 2013*).

After the civil war period in Lebanon we can say that Lebanon is not Lebanon anymore beside the civil war many obstacles faced Lebanon including social, economic, political and financial crisis.

BDL is the central bank of Lebanon, national bank of a country that administer financial and banking services for its government and commercial banks. Its main role is issuing currency and implementing monetary policy to stabilize the economy.

The Lebanese crisis arises since the civil war it accumulated slowly until it explode from 2017 till our days. In this paper we will develop the main problem of central bank reaction to the crisis during the crisis and how it correct the situation.

Throughout this project we will see how the central bank plays its role which is to formulate, implement and monitor the monetary policy in order to maintain the value of the nation currency and ensure price stability, however central bank plays many roles including: bank of issue, credit control, banker to the government, banker of banks, lender of last resort and protector of foreign exchange reserve.

In addition central bank guided the monetary policy which is the process of conducting money supply into the economy, we have three players in the money supply process: the central bank, banks, and depositors. We have two types of monetary policy:

1-Expansionary monetary policy which is the increase in money supply in the economy, we will discuss the consequences of the expansionary monetary policy under Mundel Fleming model in the perfect and imperfect capital mobility with fixed and flexible exchange rate regime.

2-contractionary monetary policy which is the decrease in the money supply, it aim to reduce the monetary expansion in order to fight inflation and keep it at its target which is 2%.

As the most important part we will see how the central bank use its own tools to affect the economy directly and indirectly. CB tools are Open market operations, interest on reserve, reserve requirements and discount rate policy.

One point not too much people really takes their attention is the independence of the central bank ,the questions here is Can CB have an independent monetary policy?

In the coming sections we will develop how is the monetary policy in Lebanon, first will define how the monetary policy is in Lebanon, later how this policy is used in the crisis periods, however we will see what is the origin of these crisis and how we get in here to this situation throughout this years.

The most important part to talk about is the central bank of Lebanon and its financial engineering plan his reaction through the years of crisis to finalize in the Collateral damage.

Some economists argued that monetary policy does not have an effect in the short run, it may take years to be effective, others argued that some tools are efficient in the short run and they became useless in the long run.

If the government expands the money supply in an effort to increase employment, the only result will be inflation, because monetary expansion does nothing to increase the supply of labor willing to work. Monetary policy should thus concern itself solely with the objective of price stability, which is best entrusted to an independent central bank free from political temptation (*Skidelsky, 2021*).

Finally, central bank should study perfectly the policy-implemented impact in the short and long run to reach its target with least adverse consequences.

This paper is divided into many sections. The first section presents a description of Central bank and monetary policy in Lebanon. Section2 presents literature review on the central bank relation with economic growth and its role during the crisis. Section3 is the Empirical Research Methodology. Section4 shows the results & Discussion and finally chapter section5 provide conclusion and Recommendations

2. Study Aim and Objective of the Thesis

This study aims to fulfill the role of central bank and its monetary policy during rough periods. Emphasizing this role during the period of Lebanese crisis and focusing on the recent periods rather than the origin of this crisis since somehow its blur for some to know what really happened in Lebanon during this period and what brings them to this situation by taking case study Lebanon from 2017 to 2022.

Problematic of the Thesis

The questions that are going to be answered in this thesis are:

1. How the central bank reacts to crisis using OMO?
2. Does the expansionary monetary policy tools have effect on the economic growth?

Theoretical and Empirical analysis are used to provide conclusions about the central bank appropriate implemented monetary policy during the economic crisis. At the end, this study will show that open market operations and money supply has no effect on Consumer price index and coincident index, moreover the expansionary monetary policy will deteriorate the economy in the long run.

Hypothesis

The hypothesis used to show how central bank react to crisis and the impact of monetary policy on the economic growth are:

(H1:0): Monetary policy have no effect on coincident index.

(H1:1): Monetary policy has an effect on coincident index.

(H2:0): Monetary policy have no effect on consumer price index.

(H2:1): Monetary policy has an effect on consumer price index.

Methodology

To examine the effect of monetary policy on economic growth, the study uses monthly times series data for the period from June 2017 to June 2022.

We will use E-Views regressing by multiple regression ,VAR model to determine the effect of expansionary monetary policy tools on the economic growth and impact of open market operations on CPI and Coincident Index with significant level equals to 5% ($\alpha=5\%$).

3. Literature Review on the Central Bank Relation with Economic Growth and its Role during the Crisis.

Central bank role has been always a subject to debate specifically during the crisis time it became a point in question to the economists, policy makers and governments. Many articles, literatures, speeches, conferences and books take this course as an essential point for economic growth and price stability for an economy since central banks apply the monetary price that its priority is to stabilize the prices and in some countries to decrease unemployment rate thus prospering the macroeconomic environment in a certain country. In contrast some researches argues that monetary policy has an adverse effect in the long run. In this section we will review some of the literature that talks about and section provide some theoretical and empirical literature concerning this points respectively starting from providing literature about effect of monetary policy on economic growth, how monetary policy contributed in inflation and price stabilization, relation between monetary policy and exchange rate, impact of open market operation as a monetary policy tool to finalize with evidence from some countries on crisis that happened and how central bank manage it with some lessons to learn.

One of the empirical studies on the effect of fiscal and monetary policy on economic growth is (AMANI and BOUYACOUB, 2022) it spot the light on how the monetary and fiscal policy work on economic growth by applying empirical model using ARDL analysis from 1990 to 2020 in Romania. The outcome shows economic growth in short and long run are influenced by fiscal policy. In contrast monetary policy they are affected by the monetary policy only in the short run. In addition there an adverse result of inflation in both terms. (Srithilat, et al., 2020) conducted study to show how the economic growth is affected by the monetary policy in Lao PDR, by using empirical evidence and dynamic analysis approach based on quarterly time series data for the period of 1995-2018 and the Vector Autoregressive Model. The empirical results view that in Lao PDR the monetary policy has a distinguished influence on the economy and ascending in prices and total credit is due to lowering interest rate. As a conclusion expanded monetary policy has an adverse effect on the economy. Empirically (Okezie et al., 2021) inspected the household consumption relativity to expansionary monetary policy in Nigeria using yearly data covering the period 1981 to 2018 by applying several econometric tests. As a results inflation has an unfavorable link with the household consumption in its two lags, In contrast monetary policy has a positive link with household consumption. Moreover using VECM Granger causality exposed that inflation and money supply does not cause household consumption. By using the impulse response function the indications said that there is an effect of monetary policy on the

household consumption in the short and long run. (OHIOMU, 2020) tested how the economic growth changed due to liberalism of interest rate and monetary policy in Nigeria by relying on ECM, structural break and ARDL tests were applied over the period from 1970-2018. The results admit that freedom of interest rate enhanced the economic growth, in contrast it has an adverse effect on the performance of the monetary policy.

As for the effect of monetary growth on inflation rate and growth, some argues that monetary policy is the only thing that creates inflation in the long run and the authorities should pay attention for its side effects in the future.

The theoretical study of (Agarwal & Shah, 2019) declared how the targets of monetary policy changed over time eventually it goes back to the era when it was inflation controller under gold standard by using coefficient integration for the periods of gold standards, WW two and 1950s and 1960s in developing countries. as a conclusion decline in inflation, minimized of external debt and enhancement of the economic growth were noticed in the countries who imply inflation targeting policy. Qayyum (2008) in his paper focused on how the inflation is controlled under the monetary policy framework of state in Pakistan by using literature review approach. He concludes that when monetary policy succeed in controlling the quantity of money in the economy it followed up by succession in defeating inflation. Monetary policy responses are efficient and there should be an applicable measure for M2 and connection between fiscal and monetary authorities. Moreover empirically Houcine et., (2020) article that targeted to figure out how the expected inflation is affected by the unconventional monetary policy tools by using quarterly time series analysis in USA economy during the period from 2003 to 2018 based on VAR analysis. The interpretation shows that there is no relation between expected inflation rates and credit volume change and this is due to unconventional monetary policy tools since it targeted financial market stability and not raising inflation. Moreover the expected inflation rate was promoted by the zero-interest rate in USA markets.

Regarding the relation of monetary policy and exchange rate we can say that exchange rate is a transmission channel of monetary policy and its effect depends on the implemented monetary policy whether it is expansionary or contractionary.

In their study AL Jwejatee and Al Hadidi (2021) pointed the effect of monetary policy and the tools on accomplishing the exchange rate stability and to clarify the role played by monetary policy through its tools (quantitative and new ones) to influence the determination of exchange rates in Iraq during the study period (1990-2019) by using theoretical approach and ARDL model. The results shows that there is long run equilibrium integrated relation between the exchange rate and the monetary policy tools, moreover there is a causal relation moves in same direction between the reserves and exchange rate. The research paper of Dilmaghani and Tehranchian (2015) projected to emphasize the influence of monetary policy on exchange rate based on GMM model for the developing countries from 2001-2010. The outcome presented confirm that the exchange rate is influenced positively and significantly by the lag of the monetary policy. Plus the liquidity coefficient is an important indicator of the monetary policy. In addition, inflation has a positive effect on the exchange rate whereas GDP and exports of goods and services has an adverse effect on exchange rate. (Amato et al., 2005) paper aims to see different models taken considering impact of monetary policy on exchange rate in countries that contributed in the Autumn Meeting of Central Bank Economists on "Exchange rates and monetary policy", which the BIS hosted on 28–29 October 2004 by using theoretical and empirical evidence. The paper shows that monetary policy has a small effect on the exchange rate mainly larger in the short term than in long term.

One of the most influential tool that central bank apply is the open market operations where central bank buy and sell government bonds mainly T-bills in order to affect the liquidity in the economy. Many researches discuss this topic to see its effect on the economy.

Empirically, Awan and Yaqoob (2021) published a paper to determine how the economic stability affected by the OMO applied by state bank of Pakistan using correlation, multiple regression and ADF-test for the analysis of the data covering the period from 1998-2018. The results shows that GDP is significantly impressed by inflation, unemployment, money supply and interest rate. (Grigolashvili, 2019) aim to see

how the open market operations helps in the economy to defeat the inflation rates by using example from Georgia based on literature review. The author concludes that OMO trigger the progress of financial markets and in turn this progress assure the benefit of OMO, moreover it triggers the quantity of money at commercial bank. This tool can lead to an economic growth because it is flexible and it can manage the short term money resources. (J.U.J et al., 2012) work desire to see if the OMO influence stability of prices in Nigeria by adoption of OLS regression model from 1993-2007. The statistics confirmed that positive correlation between consumer stability of prices and OMO exists, plus inflation rates in Nigeria suggest that open market operations have an insignificant positive effect on consumer price stability. Finally the study of Adelowokan et al., (2019) emphasizes the influence of open market operations and money supply on inflation rate in Nigeria during the period of 1981-2016 based on VAR model. The outcomes shows that T-bills, money supply and government bonds have significant and positive relation with inflation. In contrast, interest rate, value of money market instruments and income per capita had significant negatively impact on inflation in Nigeria. The author concludes that during influencing the quantity of money OMO had significant impact on price stability in the long run in Nigeria.

As we mentioned above central bank role importance shows up during the recession periods. Some economists blame central banks for not overcoming the crisis, others blame the government but the question is can we really blame central bank or the government or both of them.

(Brinke, 2013) article highlighted the primary characteristics of the Mexican debt crisis from the side of its causes to debt restructuring and reforms by using theoretical approach over the Mexican economy from 1982 to 1988. In August 1982 Mexico announced incapability of paying its external debt obligations. The debt payments accelerated strongly and many models of debt reestablishment were executed like the baker plan and the Brady plan, the latter included US banks handled the Mexican debt losses. The IMF backed with financial support that come along by formational improve. (ARIFF & ABUBAKAR, 1999) The aim of their article is to focus on the impression of the Asian crisis on Malaysian economy and the problems it faces during the recovery plan by using theoretical approach over Malaysia from 1997-1999. In May 1997 Malaysia's crisis characterized by decline in crediting and borrowing, deterioration of the banking sector, inflation, depreciation of the ringgit, and much more. Tighten policies were applied but this was not enough so MOF formed (NEAC) in January 1998 to face the crisis, it expanded monetary and fiscal policy by lowering capital cost, interest cap and cut SRR rate, the government supplied RM 7 billion funds as well as applying specific control acts by so the economy is restructured.(Hoshi & Kashyap, 2004) scoped of the study is to picture that the obstacles of financial system of Japan cannot be analyzed only by the macro economic variables and what risk the Japanese banks have by using theoretical approach over japan in 1990's. The economy collapsed in 1992, low macroeconomic surroundings, GDP decrease, drop in land prices, banking suffer, zombie borrowers and fall of jobs. The government applied Fiscal expand, reduce interest rate to attain zero and fund of ¥10 trillion in the banking system. This subsidy created the zombie borrower and decreased the ongoing businesses. Offices are created to assist banks but nothing can help because they did not focus on the restructuring strategy, by this the government fails.

Ever wondered how central banks faces the crisis? What tools they use? Which type of monetary policy? Is it expansionary or contractionary? Here are some studies to clear your thoughts about this idea.

(Lars Heikensten, 1998) intended in this seminar is to illustrate the Sweden crisis, causes, management and comparison with Asia by using theoretical approach over Sweden in 1980's. Expanded capital inflow due to fixed exchange rate and huge interest rate, local financial market liberalism, 40 %public debt-to-GDP ratio, low-inflation system adaptation and more. To overcome the crisis the government promised an endless assurance for all borrowers and investors, action to categories banks between rebuild and convert, harsh assessment regulations, over use of AMCs and creation of new consultant to back up the policy needed far from politics but under government attention. (Paduszyńska, 2018) targeted to view the shock of the Financial Crisis on Monetary Policy and How to Cope with Its Adverse Effects in the United Kingdom by using theoretical approach over the UK economy from 2008-2011. UK witnessed a financial crisis that characterized by low and negative GDP, high CPI and falling of European Union. BOE decreases the interest rate to 0.5% to encourage to trigger the economic activities. By using the money of England central bank the monetary policy committee of England declared a program to purchase a large number of asset from the public and private sector, this is known by quantitative easing. By this BOE targeted the 2% CPI.

(Bech et al., 2012) paper detected the importance of monetary policy is recession by using regression based on a sample of 24 developed countries. The results implies that when a collapse occur and it is linked to a financial crisis the achievement of appropriate monetary policy are harder than normal times. Moreover during collapse the decrease of total financial leverage of private sector assist in well return. Even if the governmental regulation change, fluctuations of exchange rate and improvement in the global environment these results doesn't change. As a conclusion, during financial crisis a weakness in the transmission mechanism could happen thus leading to less power of the monetary policy. (Mohanty, 2009) speech is to focuses on question of why India involved in the crisis? How did they get out of it and how this change the balance sheet of Indian central bank balance sheet based on theoretical and empirical data discussion and description for the macroeconomic variables? The repo, repo reserve and cash reserve ratio rates were declined. As a conclusion central bank of India succeeded in recovery. (Mező & Bagi, 2012) research explains how the global financial crisis of 2008-09 affected the macroeconomic environment of the Baltic region by stating the needed data based on information from Eurostat over the Baltic region economy from 1997 to 2010. The results show that decline in wages, social expenses and government expenditures in the public sector and increases in many tax rates affected the economy and helped to recover, in addition to help from the external resources. The author concluded that the success of the recovery plan taken by the Baltic can be examples for other countries. (Kohn, 2010)The aim of his speech is to highlight the new methods used by Fed to overcome the global crisis and what to do in the future based on the speaker position he announced that many conventional and unconventional methods has been take including: yield liquidity to non-bank financial institutions, decline of interest rate to zero, buying huge quantity of long-term securities, discount window credit, innovating a field of emergency liquidity facilities like asset-backed securities (ABS) and formation of TALF. As result USA succeeded in beating the crisis.in their research (Uppal & Mangla, 2010) aimed to criticize how Islamic banks affected by the global financial crisis during 2007-09 based on theoretical and empirical evidence by studying six indicators for these banks relative to the overall banking sector using regression model. The results shows that Islamic banks are affected by the crisis more than the conventional banks because they are impressed indirectly after the crisis not during it. There is a decline in the reserves for losses comparing to the other banks and the liquidity level of these banks is damaged. As a conclusion Islamic banks did get touched by the crisis like other banks.

Finally (O'CARROLL, 2017) derived the lessons learned from the global financial crisis in 2007-09 in all the countries by analyzing what happened through observations. The results shows three lesson to learn from the crisis. The first one is that's it's important to distinguish between the diagnoses and the disease. The second one is that if things are going well now that doesn't mean it will continue in the same way in the future and last lesson is that don't assume anything without testing it all surrounding. As a conclusion those lessons wont block the crisis but it will help diminish the damages.

4. Methodology and Empirical Research

This study aims to fulfill the role of central bank and its monetary policy during rough periods. Emphasizing this role during the period of Lebanese crisis from June 2017 to June 2022 and focusing on the recent periods rather than the origin of this crisis since somehow its blur for the Lebanese to know what really happened in Lebanon during this period and what brings them to this situation.

The study intended to answer how the central bank reacted to crisis by using open market operations (OMO) and Money supply (M2) and how they influence the coincident index (COIN_INDEX) and consumer price index (CPI) by relying on econometrics methods to examine the validity of the hypothesis in Lebanon within framework of Vector Auto Regression (VAR) covering the monthly period from 2017 to 2022 (66 observation) using E-Views statistical software version 12. The data used for this study was secondary data source obtained from a variety of sources such as the Banque du Liban, Brite indicators and trends and central administration of statistics in Lebanon. The reasons of selecting data during this period is that Lebanon suffered from a severe crisis including financial and economic crisis like depreciation, default of the Lebanese government, poverty, Covid 19, etc.

4.1 Model Specification

This study make use of time series econometrics, which are presented by Vector Auto Regression (VAR) model. This model can show the relationship between the dependent and independent variables while dealing with the variables as exogenous and endogenous at the same time. The advantage of VAR model is easy to apply and analyze.

The selection of the VAR model among the other models is that after detecting the stationarity of the variables using the ADF test we saw that they are all integrated on the same level I (1), moreover after detecting the cointegration test using Johansen-cointegration test between the variables the results show that there are no cointegration equation links them and thus we can't use VECM so we are using the VAR model.

4.2 Variable Specification

4.2.1 The Dependent Variables

4.2.1.1 Coincident Index

In 1994, BDL approved a compounded index that allow to approximate the GDP, it is called Banque du Liban Coincident Index. This index is monthly weighted average that it's linked to business cycle and it compute the economic activity. It includes 7 indicators that show the present economic performance of the Lebanese economy. The indicators are electricity production (with a weight of 18.6% in the index), oil derivative imports (with a weight of 18.2%), cement deliveries (with a weight of 16.5%), passenger flows (with a weight of 11.0%), foreign trade (imports and exports) (with a weight of 11.8%), cleared checks (with a weight of 12.0%), and money stocks (M3) (with a weight of 12.0%).

There is a very strong correlation between this index and real GDP, it is verified that over the years the index provide systematic evaluation of GDP (*Awdeh, 2019*).

This variable is represented by COIN_INDEX

4.2.1.2 Consumer price index

A country's consumer price index (CPI) is a very important indicator socially and economically since it shows all-around picture about the prices of consumed goods and services by households. Beside it asses in showing the impact of prices on the standards of living of households, individuals, economic and social indicators. It includes 12 divisions according to "The Classification of Individual Consumption by Purpose" as published by UN, they are : Foods and Non-Alcoholic Beverages (with a weight of 20%), Alcoholic Beverages, Tobacco and Narcotics (with a weight of 1.4%), Clothing and Footwear (with a weight of 5.2%), Housing , Water, Electricity, Gas and other Fuels (including rents) (with a weight of 28.4%), Furnishing , Household Equipment & Routine Household Maintenance(with a weight of 3.8%), Health (with a weight of 7.7%), Transport (with a weight of 13.1%), Communication (with a weight of 4.5%), Recreation and Culture (with a weight of 2.4%), Education (with a weight of 6.6%), Restaurants and Hotels(with a weight of 2.8%), and Miscellaneous Goods & Services (with a weight of 4.1%).

CPI consists of 12 time series. They are designed specifically to measure the annual and monthly inflation of prices of all CPI goods purchased by households. CPI is calculated by using the Geometric Laspeyres equation. This equation represents the weighted geometric average for CPI on expenditure division's level (CAS).

This variable is represented by CPI

4.2.2 The Independent Variables

We test the effect of expansionary monetary policy on coincident index and CPI in Lebanon through the Money supply and Open Market Operations.

4.2.2.1 Money supply

Money supply is the total amount of money in circulation existed in a country. Money supply in Lebanon is categorized in 4 categories.

M1: Currency in Circulation + Sight Deposits in LBP

M2: M1+ Time Deposits in LBP

M3: M2+ Deposits in Foreign Currencies + Other Financial Liabilities

M4: M3+ Treasury Bills held by the Non-Banking System

In our case we are going to use M2 as money supply variable because it already includes M1 and also it measure assets that are not cash but they are highly liquid and since this variable can give directions and efficiency of central bank policy. This variable is represented by M2.

4.2.2.2 Open Market Operations

Open market operations is the entry of central bank into the cash market in order to increase or decrease the quantity of money supplied through buying or selling the securities. The effectiveness of this operations is determined by their success in achieving the liquidity or illiquidity of the money market as a whole, the will of central bank alone is not enough to achieve this success, but it depends on many factors such as the nature and size of the money market in terms of capacity and coverage, in addition to availability of sufficient amounts of monetary assets that can be traded in the market and yell clients and finally on agreement of central bank and clients (zaiter,2015)

In this case we will use the number or amount of the holding of BDL from T-Bills since this amount will show if the central bank decreased or increases its holding depending on the economic situation of the economy and since this affects the economy heavily.

This variable is represented by OMO

Throughout the next chapters of empirical findings and results, we will see the impact of money supply (M2) and open market operations (OMO) once on the coincident index (COIN_INDEX) and once on the consumer price index (CPI) through two econometric models. The variables will be transformed into Log base10 variables because log will prevent the regression model from facing a problems in the residuals and because results can be directly interpreted.

The first model is to see the impact of money supply and open market operations on the coincident index.

Coincident index is a function of money supply and open market operations. The relationship can be expressed as.

$$\text{COIN_INDEX} = f(\text{M2}, \text{OMO}) \dots\dots (1)$$

Where:

COIN_INDEX = coincident index; M2 = money supply and OMO = open market operations.

Equation 1 can be written in the econometric model and in their respective log base 10 form as thus:

$$\text{LCOIN_INDEX}_t = \beta_0 + \beta_1 \text{LM2}_t + \beta_2 \text{LOMO}_t + U_t$$

LCOIN_INDEX is the log of coincident index; L M2 is the log of money supply; LOMO is the log of open market operations ,L is logarithm of base 10 ; β_0 is the intercept or autonomous parameter estimate; β_1 β_2 β Is the Parameter estimate associated with the determinants of coincident index in Lebanon and $t \epsilon$ is the stochastic error term.

Model 2

The second model is to see the impact of money supply and open market operations on consumer price index.

Consumer price index is a function of money supply and open market operations. The relationship can be expressed as.

$$\text{CPI} = f(\text{M2}, \text{OMO}) \dots\dots\dots (1)$$

Where:

CPI = Consumer price index; M2 = money supply and OMO = open market operations

Equation 1 can be written in the econometric model and in their respective log base 10 form as thus:

$$LCPI_t = \beta_0 + \beta_1 LM2_t + \beta_2 LOMO_t + U_t$$

LCPI is the log of consumer price index; LM2 is the log of money supply; LOMO is the log of open market operations, L is logarithm of base 10; β_0 is the intercept or autonomous parameter estimate; β_1 β_2 β_n is the Parameter estimate associated with the determinants of coincident index in Lebanon and U_t is the stochastic error term.

4.3 Technique of Estimation

4.3.1 Descriptive Statistics

The descriptive statistics shows the mean, median, maximum, minimum, Std.Dev, skewness, Kurtosis, Jarque Bera and the number of observations.

4.3.2 Stationarity Test

Time series stationarity is whose aspects does not rely on the time at which the series is detected. Time series that have seasonal effect or trend are not stationary because this will influence the value of the time series over time (*Kwiatkowski et al., 1992*). In other words for a time series to be stationary it should have constant mean and constant variance over time (has no unit root) the two variables should be constant, otherwise the time series said to be non-stationary.

If a time series is not stationary, the behavior of this series will be studied only in the consider time period and thus the result can't be applied to another time periods and that why stationarity is important. And it can be transformed into stationary using the differencing method which is the first difference level, second difference level and so on.

If a series is stationary without any differencing it is designated as I (0), or integrated of order 0. On the other hand, a series that has stationary first differences is designated I (1), or integrated of order one (1) (*Ihugba et al., 2021*)

Augmented Dickey-Fuller test suggested by Dickey & Fuller (1979) and the Phillips-Perron test recommended by Phillips & Perron (1988) have been used to test the stationarity of the variables (to test if unit root exist or no).

4.3.3 Autocorrelation LM-test

The autocorrelation LM- test is used to reports the multivariate LM test statistics for residual serial correlation up to the specified order. The null hypothesis is that there is no serial correlation of any order up to p. Because the test is based on the idea of Lagrange multiplier testing, it is sometimes referred to as an LM test for serial correlation. A similar assessment can be also carried out with the Durbin-Watson test and the Ljung-Box test.

4.3.4 Lag selection Criteria

There are three famous used information criteria to select the optimal lag length of the series, they are the Akaike Information Criterion (AIC), the Schwarz-Bayesian Criterion (SBC) and the Hannan-Quinn Criterion (HQC). We choose the least AIC and SBC value. It's important to select the optimal lag length in order to decrease the residual correlation.

4.3.5 Stability Condition

The stability condition are represented to make sure that there is no root lies outside the unit circle

4.3.6 Granger Causality Test

To detect if a time series can be used in expecting another time series, we use the statistical hypothesis which is the granger, it shows if variables X cause or does not cause the Y variable and vice versa. This test gives us some information between the series.

For example: If variable X has a previous data (taking into consideration all the factors) that can help in giving expectations about the future of the variable Y, then we can say that X is the Granger cause of Y.

H0: $\beta_1 = \beta_2 = \dots = \beta_p = 0$ (Y_t doesn't cause X_t)

H1: $\beta_1 \neq 0$

4.3.7 Impulse-Response Analysis

In vector autoregressive models impulse response analysis is an essential step in the econometrics analysis of the variables. The main objective of this analysis is to see how a variable in a specific model reacts/ responds to some external shock in one or more variables.

4.3.8 Variance decomposition analysis

Variance decomposition is a statistical analysis that detaches the change in one of the endogenous variables into separate shocks that affect all endogenous variables, it indicates the amount of information each variable contributes to the other variables in the autoregression. It is important because it helps in evaluating how shocks pass through each economic variable.