The Effects of Fiscal and Monetary Policy on Inflation in Lebanon

Mahmoud Hachem

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Mahmoud hachem
EasyChair
Lebanese International University
mahmoud.hachem@liu.edu.lb

Abstract

The main objective of this research is to study the effects of fiscal and monetary policy on inflation and examine the effectiveness of Lebanese monetary and fiscal policy to control inflation between 1978-2019 using an autoregressive distributed lag (ARDL) cointegration technique (ARDL) developed by Pesaran et al. (2001) as well as Granger no-causality approach developed by Toda and Yamamoto (1995) in a two-variable vector autoregression model to explore the direction of causation among the variables of our model.

Based on the empirical study, we found that:

- Lebanese economy is very dependent on the imported inflation through the channel of imports.
- Lebanese fiscal policy has an inflationary effect, due to the weakness of productive sectors of the Lebanese economy.
- Lebanese Monetary policy needs at least 3 years to achieve an influence on the inflation rate.
- The inflation rate in Lebanon is caused by the money supply passing through the velocity of money; it means that monetary policy is ineffective if it is not accompanied by an acceleration of the velocity of money, which plays mediating role (or transmission channel) between the monetary policy and the real economy.

Based on the results above, we conclude the follwing :

- Inflation is mainly determined by the interaction of monetary and fiscal policies and any conflict between them will produce undesirable results
- If the monetary stimulus is not accompanied by an increase in the velocity of money, the stimulus policy will fail
- The velocity of money strengthens the effect of the stimulus policy. As a result, the velocity of money plays a mediating role (or channel of transmission) between stimulus policy and the economy.

Our research highlights the importance of the velocity of money in the process of inflation and warns against the risks of giving this variable a secondary role (assumed constant according to the quantitative theory of money) as in most macroeconomic models.

Key words: Inflation, public expenditure, money supply, consumer price index, velocity of money, monetary policy, fiscal policy, Quantitative Easing policy

1. Introduction

One of the most important economic problems facing the economy is the price instability. This problem can take form of a sharp rise in the general level of prices (according to the economic literature, we call this phenomenon "inflation") or a significant decline in the general level of prices (or deflation). Each of these phenomena poses many problems, as too much inflation has an economic cost, permanently low inflation is harmful for the economy.

For this reason, central banks around the world seek to achieve high and sustainable economic growth with low and stable inflation rate using fiscal and monetary policy. Most central banks in advanced countries aim at price stability, which is generally defined as an inflation rate around 2 percent, for example the European Central Bank (ECB), the Federal Reserve of the United States of America (fed), and the Bank of Japan (BoJ) aim for inflation close to 2% (Haan J. et al., 2016).

In the same context, "The ultimate goal of the central bank is to control inflation." This objective is very clear in the euro zone: "the main objective of the Euro-system is to maintain price stability".[1]

Like most central banks, the main task of the Lebanese Central Bank (BDL) is to preserve price stability. To achieve this objective, the BDL takes the appropriate measures to ensure stability of the exchange rate of the national currency against the americain dollar (LBP/$), in particular by intervention on the foreign exchange market by buying or selling foreign currencies.[2]

In fact, high inflation and chronic deflation represent a great challenge to monetary authorities and threat the monetary system, economic growth, and also cause an increase in the unemployment rate and therefore a deterioration of social welfare.

For this reason, the monetary authorities (i.e. the central banks) must contain the inflationary or deflationary pressures that threat economic stability. Hence, the stability of the price level is the primary and ultimate goal of central banks in order to maintain consumers' purchasing power, stimulate economic activity, create jobs and ultimately achieve social well-being.

2. Research Problem

The classic economic literature focuses on the impact of monetary policy on inflation through the link between changes in the money supply and prices. The existence of a positive relationship between money and prices is well recognized in the classical economic literature.

For monetarists, « *Inflation is always and everywhere a monetary phenomenon*» (FRIEDMAN Milton and SCHWARTZ Anna, 1963). Hence, inflation is a monetary phenomenon can be explained by the quantitative theory of money. Then, the fluctuations of the general price level can then be explained based only by the variations of the money supply.

In modern times, countries have resorted to conventional and unconventional expansionary monetary policies (also known as quantitative easing) to deal with chronic deflation, but inflation has not increased.

Understanding this problem is important and necessary in order to find appropriate combination of fiscal and monetary policy, and to determine the optimal use of these two policies to control the inflation.

Based on many empirical studies, the phenomenon of inflation remains ambiguous. The great contradiction between the empirical studies and the experiences of the countries that have confronted chronic inflation or chronic deflation shows that the phenomenon of inflation, and its relations with monetary and fiscal policy, require more analysis and research.

[1] European Central Bank (2009), « The Euro-system: The European System of Central Banks », Retrieved from: http://www.ecb.int/pub/pdf/other/escb_fr.pdf, p. 20.

[2] « Bank of Lebanon: roles and functions», Retrieved from: http://www.bdl.gov.lb/pages/index/1/137/Role-and-Functions.html

Theoretically, based on the quantitative theory of money, monetarists believe that inflation is a purely monetary phenomenon, arguing that the continued rise in inflation is caused by the excessive rate of monetary expansion. Moreover, in the absence of persistent and excessive money growth, we will not experience persistent inflation. On the other hand, no inflation has ever been halted without bringing monetary growth back to the relevant reference level (BORDO Michael and ORPHANIDES Athanasios , 2008).

In fact, there is growing evidence that the inflation process has been changing. Inflation is now much lower and much more stable around the world, and its sensitivity to the measures of the economic slack and increases in input costs appears to have declined in many industrialized countries (BORIO and FILARDO, 2007).

Empirically, there is a causality going from the money supply to the general price level, as the following empirical studies confirm: Lucas (1980), Altimari (2001), Neumann M. and Greiber C. (2004), Wesche K. and al. (2007), McCandless, G. T. and Weber, W. E. (1995), Vogel (1974), DIAZ-GIMENEZ Javier and KIRKBY Robert (2013), Katrin Assenmacher-Wesche and Stefan Gerlach (2007), De Grauwe P. and Polan M. (2005), Benati (2009), DE SANTIS Roberto (2012), JARIYAPAN Prapatchon (2012), Dwyer and Hafer (1988), Dwyer and Hafer (1999), Rolnick and Weber (1995), Bakare A.S. (2011), Zulkhibri A. (2007), Islam R. and al. (2017), and Tang C. F. et Ozturk I. (2017). Thus, the monetary policy will be an effective tool to affect or boost the rate of inflation according to monetarists view.

Whereas, the fundamental cause of inflation lies in the structural imbalances of the economy as the following studies confirm: Wachter (1979), Bilquees (1988), Ndanshau (2010), and Ndanshau (2012).

In recent years, the money supply has grown rapidly using unconventional monetary policy after the failure of traditional stimulus policies, and economic policymakers thought that this increase would quickly translate into inflation in order to break out of a vicious circle of deflation, but inflation has not increased, as the following studies confirm: Vuslat Us (2004), Tang C.F. and Lean H.H. (2007), Cheng and Tan (2002), Olubusoye O. E. and Oyaromade R. (2008), Sargent and Surico (2011), TELES Pedro and UHLIG Harald (2010), Inam U.S. (2014), Amassoma D., and al. (2018), Adenuga I. and al. (2012), Kimura T. and al. (2003), SUDO Nao (2011), Yoshino N. and Hesary F. T. (2014), Schenkelberg and Watzka (2013), Fujiwara I. (2006) and Berkmen S. (2012), Moses K. Tule and al. (2015), Tong Cao (2015), Diermeier M. and Goecke H. (2016), Wang X. (2017), and Caraballo J. (2018).

Then, the related studies between inflation and its determinants have not helped to clarify the reasons for the failure of monetary stimulus policies. On the other hand, most empirical studies examining the relationship between inflation and its determinants are contradictory. For this reason, inflation remains a controversial topic in theoretical and empirical debates.

According to the above reason, it is important to study the effects of fiscal and monetary policy on inflation in Lebanon in order to determine the main causes of inflationary pressures in Lebanon.

To solve the contemporary problem of inflation, we ask the following questions:

What are the effects of fiscal and monetary policy on inflation in Lebanon? Is inflation in Lebanon a fiscal, or monetary or structural phenomenon? Are fiscal and monetary policies effective in containing inflationary pressures in Lebanon? What are the main determinants of inflationary pressures in Lebanon?

3. Research Hypotheses

H1: Fiscal policies and monetary policy are inflationary because of the weak production capacity of the Lebanese economy

H2: Inflation is strongly linked to the prices of imported goods in Lebanon

H3: Inflationary expectations play an important role in the Lebanese economy

H4: Structural imbalances play a major role in the general price fluctuations in Lebanon

4. Purpose of the Research

The main purpose of our research is to study and analyze the effects of fiscal and monetary policy on inflation in Lebanon. In a specific way, this study aims to:

- Study the effectiveness of Lebanese monetary and fiscal policy in the context of stabilizing the general price level in Lebanon

- Determine empirically the main determinants of price fluctuations in Lebanon

5. Importance of Research

Our study provides a more detailed analysis and additional explanation for theories of inflation. In addition, this research provides a better understanding of the challenges and obstacles to monetary and fiscal policy in the context of maintaining price stability.

6. Theoretical Background

The theoretical framework focuses on the factors responsible for inflation. According to the monetarists, it is the money supply that determines the general level of prices in the economy. Secondly, the price level is directly linked to the money supply and has an opposite impact on the real value of money (i.e. the purchasing power).

On the other hand, according to the Keynesian approach, inflation is due to the increase in the aggregate demand. If the aggregate demand in the economy rises above full employment level, it drives up the price level.

Two other approaches give us another explanation for the variation in the price level. They say that inflation is due to rising in the production costs and to the structural imbalances on the macroeconomic level.

The following sections present various theories and models that can explain the inflation process.

6.1. The quantitative theory of money

We use quantitative theory of money to formulate an empirical model of inflation in Lebanon.

The quantitative theory of money could be written as follows:

$$M.V + M'.V' = P.T \qquad (1)$$

Where M is the quantity of money in circulation, V is the velocity of M, M': the demand deposits in banks, V' the velocity of M', P is the average price level and T is the volume of transactions of Goods and services (MALEKI Taher, 2015).

The effect on the price level can be easily captured by the GDP version of the quantitative theory of money with the time indices (GRAFF Michael, 2008).

$$M_t.V_t = P_t.Y_t \qquad (2)$$

The quantitative theory of money indicates that there is a relationship between money supply (M), velocity of money (V), prices (P) and real GDP (Y).

The money supply is assumed to be exogenous (controlled by central banks), the velocity of money is independent of other variables. According to these hypotheses, the equation (2) can be rewritten in order to determine the general level of prices (QAYYUM Abdul, 2006).

In this case, equation (2) can be written as follows:

$$P_t = M_t.V_t/Y_t \qquad (3)$$

By taking the log of the equation, we obtain:

$\text{Log}(P_t) = \log(M_t) + \log(V_t) - \log(Y_t)$ (4)

By differentiating equation 4 with respect to time "t", we obtain the inflation equation as follows:

$$\frac{1}{P}\frac{dP}{dt} = \frac{1}{M}\frac{dM}{dt} + \frac{1}{V}\frac{dV}{dt} - \frac{1}{Y}\frac{dY}{dt} \qquad (5)$$

Then, equation (5) can be written as follows:

gp = gm + gv – gy (6)

Where g (X) represents the growth rate of the variable X.

Equation 6 shows that the rise in the general level of prices (i.e. the rate of inflation) is determined by growth in money supply, growth in velocity of money and growth in real GDP.

In the simple version of quantitative theory, it is assumed that real GDP and the money velocity are constant (gm = 0 and gv = 0). In this case, inflation is determined solely by the change in the money supply ⇒ P = *f* (M) (FAROOQ Omer and al., 2015).

6.2. Cagan's model

Cagan's model illustrates the role of expected inflation in real cash balance. Cagan's explanation for inflation is based on the function of demand for real cash using the following formula (LUCAS Robert and SARGENT Thomas, 1981):

$$\log m = -\alpha\pi^e \qquad (7)$$

Where m is the real cash balance, α: elasticity and π^e is the expected rate of inflation.
The expected inflation rate is derived from the difference between the current rate of inflation and the expected rate (BARBOSA Fernando, 2016):

$$\pi^e = \beta(\pi - \pi^e) \qquad (8)$$

β: is a parameter that determines the speed of adjustment of expected rates to current inflation rates.

Cagan also assumes that the rate of growth of money is exogenous:

$$\mu_t = \frac{d\log M}{dt} \qquad (9)$$

To solve this model, we take the money demand derivative and use the expected inflation rate to get:

$$\mu - \pi = -\alpha\pi^e = -\alpha\beta(\pi - \pi^e) \qquad (10)$$

This equation can be rewritten as follows:

$$\mu - \alpha\beta\pi^e = (1-\alpha\beta)\pi \qquad (10a)$$

By using money demand equation above to substitute the expected rate of inflation into this equation produces the following result:

$$\mu + \beta\log m = (1-\alpha\beta)\pi \qquad (11)$$

By taking the derivative on both sides of this equation, we get:

$$\Delta\mu + \beta(\mu - \pi) = (1 - \alpha\beta)\Delta\pi \quad (12)$$

By rearranging this expression, we reduce Cagan's model to a relation between the rate of inflation and the rate of money growth:

$$\Delta\pi = \frac{\beta}{1-\alpha\beta}(\mu - \pi) + \frac{1}{1-\alpha\beta}\Delta\mu\,; \quad (13) \quad \alpha\beta \neq 1$$

From this equation, we can see that the rate of change in inflation depends on:

1- The gap between the rate of monetary growth and the rate in inflation
2- The acceleration of the rate of money growth (BARBOSA Fernando, 2016).

6.3. Cagan’s model with the government deficit

According to Cagan's model, the constant value of the real deficit of the government is financed by the expansion of the monetary base:

$$d = \frac{G_t - T_t}{P_t} = \frac{B_t - B_{t-1}}{P_t} \quad (14)$$

Where G_t: public expenditure; T_t: taxes; B_T = monetary base; P_t: Price index; d: real public deficit. (BARBOSA Fernando, 2016)

6.4. The expanded Cagan’s model

Cagan model dealt with the previous models on the basis that real output (real GDP) in the economy is constant. This assumption is not adequate. To solve this problem, we use the equilibrium of money and goods and services markets which can be represented by the aggregate demand equation in the following way (BARBOSA Fernando, 2016):

$$Y_t = k + \alpha \log b_t + \beta\pi^e_{t+1} + \gamma f_t \quad (15)$$

Where Y_t is the log of real GDP; k, α, β and γ are parameters; π^e_{t+1} is the expected inflation rate; b_t is the real value of the monetary base; *f* is a variable of fiscal policy.

For simplicity, we assume that the expectations are static:

$$\pi^e_{t+1} = \pi_t \quad (16)$$

With this assumption, the aggregate demand equation transforms to:

$$Y_t = k + \alpha \log b_t + \beta\pi_t + \gamma f_t \quad (17)$$

Using the aggregate demand equation above, we can get the inflation model as follows:

$$\pi_t = k + \alpha \log b_t + \beta Y_t + \gamma f_t \quad (18)$$

Given the possible relationship between import prices (IP) and the inflation rate, the previous model is augmented to include import prices (see, for example, NORMAN David and RICHARDS Anthony, 2010).

$$\pi_t = k + \alpha \log b_t + \beta Y_t + \gamma f_t + \omega IP_t \quad (19)$$

By replacing the monetary base in the Cagan model with the money supply presented in the quantitative theory of money, we obtain:

$$\pi_t = k + \alpha \log M_t + \beta Y_t + \gamma f_t + \omega IP_t \quad (20)$$

Based on the assumption that the velocity of money (V) is not constant (or stable) even in the short term (R. De Santis, 2012). This variable is included into the model.

In this case, our empirical model will be as follows:

$$\pi_t = k + \alpha \log M_t + \beta Y_t + \gamma f_t + \omega IP_t + \psi V_t \quad (21)$$

For the fiscal policy variable f, we will use public expenditure (or government spending) (PE) as the representative variable of Lebanese fiscal policy.

By adding an error term to capture the effect of other variables, we can modify the above equation to get our empirical model of inflation as follows:

$$INF_t = \partial_0 + \partial_1 IP_t + \partial_2 PE_t + \partial_3 MM_t + \partial_4 RGDP_t + \partial_5 VM_t + e_t \quad (22)$$

Where ∂ is the coefficient that measures the effect of the independent variable on the dependent variable, e_t is the error term.

The variables of our model are the inflation rate (INF) which is the dependent variable. The other variables are independent such as import prices (IP), public expenditure (PE), money supply (MM), real GDP (RGDP) and the velocity of money (VM).

The novelty of our thesis is that we jointly model the quantitative theory of money with the augmented Cagan model. In this regard, the proposed model is a new specification of the policy mix model.

The choice of dependent and independent variables is mainly guided by economic theories and by the availability of data or time series concerning the Lebanese economy.

7. Previous Studies

Lucas (1980) obtained a strong positive correlation between inflation and growth in money supply (M1) in the United States between 1953-1977.

Batini N. and Nelson E. (2001) used British and American data for the period 1953-2001 to study the relation between monetary growth rates, inflation and interest rates in these countries. They found that it took one year before monetary policy measures had an effect on inflation.

Altimari (2001) obtained a positive relationship between money supply and inflation in the euro area between 1980-1997. The results support the idea that monetary aggregates provide important information to explain future price changes in the euro area.

Neumann M. and Greiber C. (2004) used quarterly data for the period 1980-2004 in the euro area. The estimation results indicate that inflation and money supply growth are closely linked showing a long-term relationship between them.

Wesche K. et al. (2007) studied monetary factors and inflation in Japan between 1970 and 2005 to assess the determinants of inflation. They found that inflation is linked to growth in money supply and growth in real output. They got a one-way causal link from money supply and real GDP to inflation.

McCandless, G. T. and Weber, W. E. (1995) studied the correlation between money supply and inflation using time series data from 1960 to 1990 for 110 countries. They found strong relationship between inflation and money supply.

Vogel (1974) also found a strong positive correlation between the growth rate of the money supply and the rate of inflation in the countries of Latin America between 1950-1969.

Katrin Assenmacher-Wesche and Stefan Gerlach (2007) also show that, for the euro zone, Japan, the United Kingdom and the United States, there is a strong relationship between money supply growth and inflation between 1970 and 2003.

De Grauwe P. and Polan M. (2005) tested the relationship between money supply (M1 and M2) and inflation using a sample of 160 countries between 1969 and 1999. They found a strong positive long-term relationship between inflation and money supply in countries with high inflation where the correlation between M1 and inflation, and M2 and inflation was 0.877 and 0.89 respectively.

Roberto De Santis (2012) has shown that there is a strong correlation between money supply growth and inflation in the euro area and the United States between 1980 and 2010.

In contrast to previous results, WANG Xi (2017) examined the relationship between money supply growth and inflation in the United States between 1980 and 2007. He claims that the period 1955-1980 was the only period in which quantitative theory fully explained the relationship between inflation and the money supply. This relationship begins to weaken when we go beyond this period.

Caraballo J. (2018) empirically tested the validity of the monetarist theory as an inflation theory between 1959 to 2011 in the United States. He found that the monetarist theory does not fit the data, given the lack of a strong relationship between money growth and inflation in the US.

Kapounek S. and Lacina L. (2007) examined the relationship between money supply growth and inflation in the euro area between 1995 and 2005. His empirical study has revealed a statistical and significant correlation between growth of money supply and inflation in three member countries of the euro area (Germany, Ireland and the Netherlands). In other countries (Belgium, Spain, France and Austria), a statistically significant correlation has also been identified. However, 1 to 2 months lag between the time series does not fully match the expected impact of money supply growth on inflation. The correlation was found with different lags in different countries.

Diermeier M. and Goecke H. (2016) found that the growth in money supply does not translate into an increase in the price level in the countries of the European Union because of the lack of correlation between money supply growth and prices in these countries.

Globan T. et al. (2014) studied the determinants of inflation between 2001 and 2013 in the euro area. The results indicate that the external shocks are an important factor in explaining the dynamics of inflation in the medium term, while the dynamics of inflation in the short term are mainly influenced by internal shocks.

Kimura T. et al. (2003), Fujiwara I. (2006) and Berkmen S. (2012) found only minor positive effects on economic growth and inflation resulting from quantitative easing, while these effects tend to be statistically not significant.

Schenkelberg and Watzka (2013) found that the quantitative easing led to a significant drop in long-term interest rates and a significant increase in output, albeit temporarily and with considerable delay. However, the objective of increasing inflation was not achieved.

Tong Cao (2015) observed that, before 1990, the relationship between money supply and inflation was positively correlated. However, from 1990, the United States and other developed countries experienced a new era in which huge monetary growth and low inflation coexisted.

Ndanshau (2010) found that there is no relationship between monetary aggregates (M0, M1 and M2) and inflation in Tanzania between 1967 and 2005.

Vuslat Us (2004) also found that inflation in Turkey over the past 30 years is not a monetary phenomenon but a result of political corruption, in other words, misuse of the public power (political misconduct).

Thus, because of this contradiction and this ambiguity between inflation and its determinants, our research based on the Lebanese experience aims to fill this gap and complete the literature with several methodological and empirical contributions.

8. Methodical Study

Our empirical study adopted the following:

8.1. Research Methodology

In order to study and analyze empirically the effects of fiscal and monetary policy on inflation in Lebanon, an Autoregressive Distributed Lag model (ARDL model) (PESARAN M.H., SHIN Y. and SMITH R.J., 2001) was used to estimate the short and long run relationship between the variables of our model.

In order to study the causality, we will use the Toda-Yamamoto causality test (1995) to determine the direction of causality between the variables of our model (DRITSAKI Chaido, 2017), (ALIMI S. and OFONYELU C., 2013).

8.2. Data Sources

The data in our model are annual, in real values, in Lebanese pound, and in logarithmic form covering the period 1978-2019, they are compiled from the World Bank, bank of Lebanon and United Nations Statistics Division. The program used to do this study is version 9 of Eviews.

8.3. Research Variables

The model combines the inflation rate (INF), import prices (IP), public expenditure (or government spending) (PE), money supply (MM), real GDP (RGDP), and the velocity of money (VM).

8.4. Econometric Model

The functional form of the model:

$$INF = f(IP, PE, MM, RGDP, VM)$$

Our model is written as follows:

$$INF_t = \partial_0 + \partial_1 IP_t + \partial_2 PE_t + \partial_3 MM_t + \partial_4 RGDP_t + \partial_5 VM_t + e_t$$

Where ∂ is the coefficient that measures the effect of the independent variable on the dependent variable.

In order to examine the short-run and long-run effects of the above explanatory variables on the inflation rate in Lebanon, the ARDL representation will be:

$$\Delta INF_t = a_0 + \sum_{i=1}^{p} a_{1i} \Delta INF_{t-i} + \sum_{i=0}^{q} a_{2i} \Delta IP_{t-i} + \sum_{i=0}^{q} a_{3i} \Delta PE_{t-i} + \sum_{i=0}^{q} a_{4i} \Delta MM_{t-i} + \sum_{i=0}^{q} a_{5i} \Delta RGDP_{t-i}$$

$$+ \sum_{i=0}^{q} a_{6i} \Delta VM_{t-i} + \theta_1 INF_{t-1} + \theta_2 IP_{t-1} + \theta_3 PE_{t-1} + \theta_4 MM_{t-1} + \theta_5 RGDP_{t-1} + \theta_6 VM_{t-1} + e_t$$

Where Δ : first difference operator ; a_0 constant ; $a_1 \ldots a_6$: Short-run effects ;

$\theta_1 \ldots \theta_6$: Long run effects ; e_t : error term (white noise).

Through the procedure of Pesaran et al. (2001), an error correction model used to study the existence of cointegration between the variables (PESARAN M. H., 2015).

This model will have the following form within the framework of our study:

$$\Delta INF_t = a_0 + \sum_{i=1}^{p} a_{1i} \Delta INF_{t-i} + \sum_{i=0}^{q} a_{2i} \Delta IP_{t-i} + \sum_{i=0}^{q} a_{3i} \Delta PE_{t-i} + \sum_{i=0}^{q} a_{4i} \Delta MM_{t-i}$$
$$+ \sum_{i=0}^{q} a_{5i} \Delta RGDP_{t-i} + \sum_{i=0}^{q} a_{6i} \Delta VM_{t-i} + \psi u_{t-1} + e_t$$

Where: ψ is the error correction term. The cointegration hypothesis is confirmed if the coefficient ψ is negative and significant.

8.5. Empirical Results

8.5.1. Unit root tests

In this section, we test for order of integration of the time series.

Most time series are non-stationary in level and the estimations based on these variables cause a fallacious estimation.

For this reason, the first step of all econometric studies is to carry out the stationary test to solve the problem of the choice of the estimation method.

A time series is then stationary if it performs a stationary process. This implies that the series has no trend or seasonality and more generally no factor changes over time. Unit Root Test tests detect the existence of non-stationarity and determine the correct method for stationarizing the series.

We will apply the Augmented Dickey Fuller Test (ADF) and Phillips-Perron test on each series. This helps us to determine the order of integration of each variable.

The results are presented on the table below.

Table 1: Unit Root Test using Augmented Dickey Fuller Test

Variables	**Constant and Linear Trend**		**Constant**		**None**		**Order of integration**
	ADF Test Statistic	CV	ADF Test Statistic	CV	ADF Test Statistic	CV	
INF	-1.593	-3.526	-1.768	-2.938	-0.605	-1.949	**I (1)**
Δ(INF)	-3.730**	-3.529	-	-	-	-	
IP	-0.813	-3.529	-1.757	-2.938	-0.558	-1.949	**I (1)**
Δ(IP)	-4.177**	-3.529	-	-	-	-	
PE	-2.182	-3.533	-2.172	-2.941	0.547	-1.949	**I (1)**
Δ(PE)	-6.498*	-4.211	-	-	-	-	
MM	-0.810	-3.529	-2.207	-2.936	-0.113	-1.949	**I (1)**
Δ(MM)	-4.303*	-4.219	-	-	-	-	
RGDP	-3.739**	-3.526	-	-	-	-	**I (0)**
Δ(RGDP)	-	-	-	-	-	-	
VM	-2.498	-3.523	-2.548	-2.935	-1.088	-1.949	**I (1)**
Δ(VM)	-5.650*	-4.211	-	-	-	-	

Source: our estimates by Eviews 9
*, **, *** represent the significance levels of 1%, 5% and 10% respectively
Δ means the first difference of the variable

Table 2 : Unit Root Test using Phillips-Perron

Variables	Constant and Linear Trend		Constant		None		Order of integration
	PP Test Statistic	CV	PP Test Statistic	CV	PP Test Statistic	CV	
INF	-0.804	-3.523	-1.648	-2.935	-0.292	-1.949	**I (1)**
Δ(INF)	-2.478	-3.526	-2.549	-2.936	-2.347**	-1.949	
IP	-0.737	-3.523	-1.671	-2.935	-0.338	-1.949	**I (1)**
Δ(IP)	-2.846	-3.526	-2.926***	-2.606	-	-	
PE	-2.667	-3.523	-2.543	-2.935	0.554	-1.949	**I (1)**
Δ(PE)	-7.821*	-4.205	-	-	-	-	
MM	-0.875	-3.523	-1.543	-2.935	-0.167	-1.949	**I (1)**
Δ(MM)	-3.382***	-3.194	-	-	-	-	
RGDP	-5.078*	-4.198	-	-	-	-	**I (0)**
Δ(RGDP)	-	-	-	-	-	-	
VM	-2.392	-3.523	-2.452	-2.935	-0.901	-1.949	**I (1)**
Δ(VM)	-12.949*	-4.205	-	-	-	-	

Source: our estimates by Eviews 9
*, **, *** represent the significance levels of 1%, 5% and 10% respectively
Δ means the first difference of the variable

The results on the table above reveal that our series indicate a different integration order. RGDP is integrated at level I(0) while the other variables are integrated at first order I(1). Therefore, we examine the long run relationship between the variables of our model using Pesaran et al. (2001) methodology i.e. the ARDL model.

All variables are not integrated in order 2, so we can move on to the ARDL model.

8.5.2. Cointegration

The variables are stationary but in a different order of integration, so the next step is to examine the long-term relationship between the variables in the model.

The cointegration test is prior to the estimation of an ARDL model, because for variables which are not cointegrated, it will not be possible to estimate an error correction model, nor to estimate the short run or long run effects.

The cointegration test by Auto Regressive Distributed Lags (ARDL) was applied to our time series over the period 1978-2019. The presence of cointegration suggests that there is a long-term relationship between Inflation rate in Lebanon (INF), import prices (IP), public expenditure (PE), money supply (MM), real GDP (RGDP), and the velocity of money (VM).

The bounds test for examining evidence for a long-run relationship can be conducted using the F-test.

This test is based on the following assumptions:

H0: $\alpha 1 = \alpha 2 = \alpha 3 = \alpha 4 = \alpha 5 = \alpha 6 = 0$ absence of cointegration
H1: $\alpha 1 \neq \alpha 2 \neq \alpha 3 \neq \alpha 4 \neq \alpha 5 \neq \alpha 6 \neq 0$ presence of cointegration

The F-statistic resulting from the regression of the models is compared with the lower and upper bounds (critical values) proposed by Pesaran et al. (2001).

One of the following decision rules must be observed:

If F calculated> upper bound: **Cointegration exists**

If F calculated <lower bound: **Cointegration does not exist**

If lower bound < F calculated <upper bound: **No conclusion** (PESARAN M. H., 2015), (ACIKGOZ Senay and MERT Merter, 2014).

But before determining if the variables are cointegrated, it is necessary to determine the optimal lag length for our model using Akaike information criteria (AIC) and Schwarz information criteria (SIC).

It should be noted that the ARDL-AIC and ARDL-SC estimators have very similar performances on small samples, with performances slightly better for ARDL-SC in the majority of the experiments. This may reflect the fact that the Schwartz criterion is a coherent model selection criterion, unlike Akaike (Pesaran M. and Shin Y., 1997).

The results of these criteria are presented on table 3.

Table 3: number of lags using ARDL-AIC and ARDL-SC

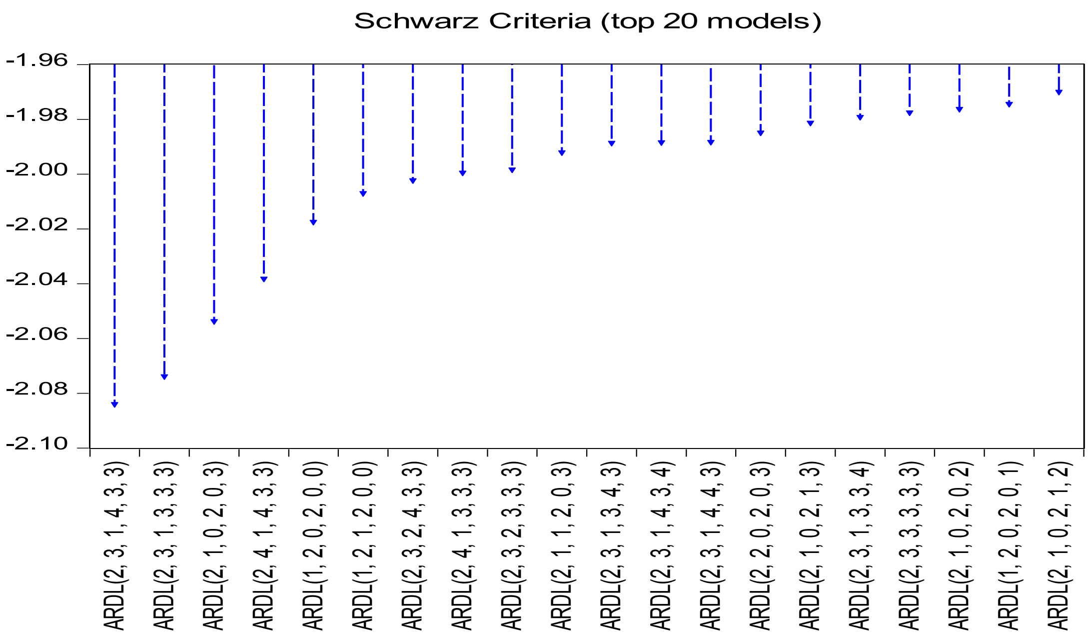
Information Criteria	1 lag	2 lags	3 lags
AIC	-5.332443	-7.040900	-8.170468
SIC	-3.540915	-3.713777	-3.307750

Source: our estimates by Eviews 9

The Schwarz information criterion (SIC) is chosen to select the optimal ARDL model. With a value of -3.713777 (the lowest value), 2 lags are the most suitable for our ARDL model.

In the following sections, we see the estimation results of the optimal ARDL model.

Graph 1: Order of optimal lags (p, q)



Source: our estimates by Eviews 9

As we can see, the ARDL model (2, 3, 1, 4, 3, 3) is the most optimal among the other models presented, because it offers the lowest SIC value. Furthermore, it is necessary to examine the statistical properties of the estimated model. The model was tested for normality, serial correlation, heteroscedasticity and stability. The results, reported in Table 4 and graph 2, suggest that the model is well specified. The diagnostics indicate that the residuals are normally distributed, homoscedastic and serially uncorrelated and the parameters appear to be stable.

Table 4: Results of diagnostic tests of the estimated ARDL model

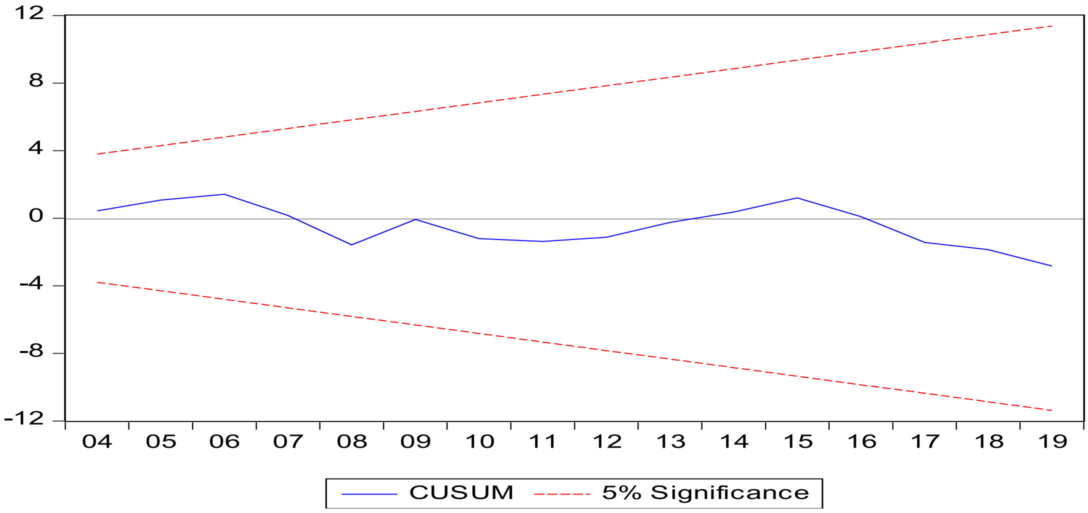
Hypothesis testing	Diagnostic Tests	F-statistics (Probability)
serial correlation	Breusch-Godfrey	0.261057 (0.7739)
heteroskedasticity	Breusch-Pagan-Godfrey ARCH test	0.524218 (0.9173) 0.622751 (0.4353)
normality	Jarque-Bera	0.386920 (0.824103)

Source: our estimates by Eviews 9

Our model is validated statistically. The estimated ARDL model (2, 3, 1, 4, 3, 3) is generally good and can explain the dynamics of the inflation rate in Lebanon between 1978 and 2019.

It is important to check the stability of the coefficients. In order to do this, we will use the "Cumulative Sum of Recursive Residuals" test (CUSUM test). This test makes it possible to study the stability of the coefficients of the estimated model over time.

Graph 2: CUSUM test



Source: our estimates by Eviews 9

The coefficients of the model are stable over time, and there is no structural break, because the statistic on the residuals is contained in the confidence interval defined by α at 5%. This confirms the existence of a long-term relationship between the variables of our model.

Afterwards, we conduct the ARDL bounds testing approach of cointegration according to Pesaran et al. (2001) to examine the existence of a long-term relationship between the variables of our model.

For this reason, an F-statistic test must be performed in order to test the existence of the long-term relationship.The calculated F statistic will be compared to the critical values (which form bounds) as follows in table 5:

Table 5: Results of F bounds test

F-Bounds Test		**Null Hypothesis: No levels relationship**		
Test Statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
F-statistic	9.690526	10%	2.26	3.35
		5%	2.62	3.79
		2.5%	2.96	4.18
		1%	3.41	4.68

Source: our estimates by Eviews 9

Table 5 illustrates the evidence for the existence of the long-term relationship (i.e., the existence of cointegration) between the variables of our model.

8.5.3. Toda-Yamamoto causality test

In order to test the causality between the variables of our models, we will use the Toda and Yamamoto causality test to determine the direction of causality between the variables of our models. The determination of the direction of causality between economic variables is very important for central banks around the world because it adjusts their monetary policy (DRITSAKI Chaido, 2017).

In our study, we adopt the causality test of Toda and Yamamoto (1995) instead of the traditional causality test of Granger because the method of Toda and Yamamoto (1995) of the causality test is relatively more efficient for small samples and it is suitable particularly for time series which the order of integration is not the same (MISHRA P. K., 2014).

While, the Granger causality test has several limitations that affect its effectiveness and can lead to fallacious and fragile results (DRITSAKI Chaido, 2017) (ANGUIBI C., 2015) (ALIMI S. and OFONYELU C., 2013)

Toda and Yamamoto's procedures can also improve the power of Granger's causality test (UTAMI Herni et al., 2017), as well as its effectiveness (AKÇAY S., 2011).

In order to investigate Granger causality (1961), Toda and Yamamoto (1995) developed a method based on the estimation of augmented VAR model ($k+d_{max}$) where k is the optimal time lag on the first VAR model and d_{max} is the maximum integrated order on system's variables (VAR model) (UTAMI Herni et al., 2017).

The Toda and Yamamoto approach follows the steps below (MISHRA P. K., 2014):

• We find the integration order for each series. If the integration order is different we get the maximum (d_{max}).
• We create a VAR model on series levels regardless of integration order that we found.
• We define the order of VAR model (k) from lag length taken from AIC and SC criteria.
• We test if VAR ($k+d_{max}$) is correctly specified.
• We apply Granger causality test for non-causality using pairwise equations and modified Wald test (MWald) for the significance of parameters on examined equations on number time lags ($k+d_{max}$).
• The modified Wald test (MWald) follows Chi-square (χ^2) distribution asymptotically and the degrees of freedom are equal to the number of time lags (k+dmax).

VAR model of Toda and Yamamoto causality is set up as follows:

$$h_t = a_0 + \sum_{i=1}^{k} a_{1i}h_{t-i} + \sum_{j=k+1}^{k+d_{max}} a_{2j}h_{t-j} + \sum_{i=1}^{k} \alpha_{1i}m_{t-i} + \sum_{j=k+1}^{k+d_{max}} \alpha_{2j}m_{t-j} + u_{1t} \ldots$$

$$m_t = b_0 + \sum_{i=1}^{k} b_{1i}m_{t-i} + \sum_{j=k+1}^{k+d_{max}} b_{2j}m_{t-j} + \sum_{i=1}^{k} \beta_{1i}h_{t-i} + \sum_{j=k+1}^{k+d_{max}} \beta_{2j}h_{t-j} + u_{1t} \ldots$$

We expressed the null hypothesis of no causal relationship against the alternative of presence of causality.

Finally, the null hypothesis of non-causality must be tested using a Wald statistic (MISHRA P. K., 2014). If the null hypothesis (H0) is rejected, then the causality can be confirmed (UTAMI Herni et al., 2017).

The null hypothesis (H0) stipulates the absence of causality between the variables studied (probability X^2> 5%). The following table presents the causal relations between the variables of our model.

Table 6: Results of the Toda-Yamamoto Causality test

k	d_{max}	Dependent variables	Independent variables					
			INF	IP	PE	MM	RGDP	VM
2	1	INF	-	10.4177** (0.0153)	40.4842* (0.0000)	21.9227* (0.0001)	47.0696* (0.0000)	14.6079* (0.0022)
		PE	2.0289 (0.5664)	3.0765 (0.3800)	-	4.4206 (0.2195)	4.3404 (0.2270)	17.9073* (0.0005)
		MM	3.2467 (0.3551)	3.4293 (0.3300)	11.6400* (0.0087)	-	38.5111* (0.0000)	11.9864* (0.0074)
		RGDP	1.6832 (0.6407)	3.4131 (0.3322)	0.5743 (0.9023)	5.8260 (0.1204)	-	12.5174* (0.0058)
		VM	1.0808 (0.7817)	5.8209 (0.1207)	2.5281 (0.4702)	12.2870* (0.0065)	32.1875* (0.0000)	-

Source: our estimates by Eviews 9
*, **, *** represent the significance levels of 1%, 5% and 10% respectively

From this table, it can be seen that the domestic inflation rate is caused directly by the variables of the model.

The inflation rate in Lebanon is caused directly by import prices.

The inflation rate in Lebanon is caused directly by public spending by the government, which indicates that fiscal policy is an important tool to control domestic inflation if it is restrictive.

The inflation rate in Lebanon is caused by the money supply passing through the velocity of money; it means that monetary policy is ineffective if it is not accompanied by an acceleration of the velocity of money, which plays mediating between the central bank and the economy.

The inflation rate in Lebanon is caused directly by real GDP, which indicates that a change in the real economic growth rate has direct effects on the domestic inflation rate.

The rate of inflation in Lebanon is caused directly by the velocity of money which plays a mediating role (or transmission channel) between monetary policy and the rate of domestic inflation.

8.5.4. Short Run Coefficient Estimates

Granger and Lin (1995) have shown that the advantage of using the error correction model is that it can differentiate between long-run and short-run causal relationships (KIRCHGÄSSNER Gebhard and WOLTERS Jürgen, 2008).

In this part, we will present the results of the estimation of our model, the short run estimation of the model, the long run estimation and the analysis of the results obtained.

Table 7: estimation of the short run coefficients of the model

Dependent Variable: INF				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-2.041400	0.240012	-8.505393	0.0000
D(INF(-1))	0.440979*	0.100728	4.377933	0.0005
D(IP)	0.529664*	0.056545	9.367049	0.0000
D(IP(-1))	-0.097286	0.070524	-1.379476	0.1867
D(IP(-2))	-0.254773*	0.072689	-3.504963	0.0029
D(PE)	0.367717*	0.061121	6.016227	0.0000
D(MM)	-0.641596*	0.116552	-5.504783	0.0000
D(MM(-1))	-0.997498*	0.155444	-6.417108	0.0000
D(MM(-2))	-0.375658*	0.107228	-3.503352	0.0029
D(MM(-3))	0.159500**	0.070800	2.252823	0.0387
D(RGDP)	-0.301943*	0.085484	-3.532165	0.0028
D(RGDP (-1))	0.158742	0.102964	1.541727	0.1427
D(RGDP (-2))	0.343873*	0.087753	3.918643	0.0012
D(VM)	0.036711	0.039656	0.925737	0.3683
D(VM (-1))	-0.266558*	0.045395	-5.871974	0.0000
D(VM (-2))	-0.182723*	0.038107	-4.795003	0.0002
CointEq(-1)	-0.478247*	0.054746	-8.735725	0.0000

Source: our estimates by Eviews 9

*, **, *** represent the significance levels of 1%, 5% and 10% respectively

In order to verify the short-term causality of the independent variables to the dependent variables, the Wald test is used.

Table 8: Wald test for the short-run causality

Variable	F-statistic	p-value	Results
IP	21.67262*	0.0000	IP causes INF
PE	21.90635*	0.0000	PE causes INF
MM	11.90873*	0.0001	MM causes INF
RGDP	4.425540**	0.0134	RGDP causes INF
VM	4.505150**	0.0125	VM causes INF

Source: our estimates by Eviews 9
*, **, *** represent the significance levels of 1%, 5% and 10% respectively

The null hypothesis of non-causality between the independent variables and the dependent variable is rejected; the alternative hypothesis of short-run causality between the independent variables and the dependent variable is then accepted. So, all variables in our model cause the domestic inflation rate in the short run.

As can be seen in Table 8, the adjustment coefficient is statistically significant. It is negative and between zero and one in absolute value, which guarantees an error correction mechanism, therefore the existence of a long-term relationship (cointegration) between the variables of the model. The results indicate that the exit from the long-term trajectory due to a certain shock is adjusted by 47.82% each year.

Also, we note the following results:

• In the short-run, inflation lag-1 period has a positive effect on the current rate of inflation. This indicates that the current inflation rate depends mainly on its past value. So, the domestic inflation is linked to its own past values. In this case, there is an important role of expectations in the inflationary process in Lebanon. From the previous estimate, it can be seen that a 1% increase in past inflation increases the current inflation rate by 0.44% in the short run.

• Import prices have a positive effect on the domestic inflation rate where a 1% increase in import prices causes the domestic inflation rate to rise by 0.53% in the short run, which means that the Lebanese economy is very dependent on the imported inflation through the channel of imports.

• Government spending has a positive effect on the domestic inflation rate where a 1% increase in the government spending causes the domestic inflation rate to rise by 0.37% in the short run. Lebanese fiscal policy is therefore inflationary, due to the weakness of productive sectors of the Lebanese economy.

• Money supply has a negative effect on the domestic inflation rate, which confirms the ineffectiveness of Lebanese monetary policy in slowing the domestic inflation rate. The negative effects of the money supply continue over time. Lebanese Monetary policy needs at least 3 years to achieve an influence on the inflation rate.

• Real GDP has a negative effect on the domestic inflation rate where a 1% increase in real GDP causes the inflation rate to fall by -0.30% in the short run. Real GDP increases the aggregate supply of goods and services and then decreases the inflationary pressures.

• Velocity of money does not have an instantaneous effect on the rate of domestic inflation. But, it needs at least 2 years to have negative effects on the domestic inflation rate. The orientation of the money supply to treasury bills means less money in circulation, this will affect negatively the velocity of money which negatively affects real GDP and then the rate of domestic inflation will increase.

We now turn to the long-term analysis of the estimated model, also based on the Toda-Yamamoto long-term causality test carried out for this purpose.

8.5.5. Long Run Coefficient Estimates

Table 9: Results of estimation of the long run coefficients of the model

Dependent Variable: INF				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
IP	1.102565*	0.054760	20.134481	0.0000
PE	1.457182*	0.231529	6.293737	0.0000
MM	0.290751***	0.153572	1.893259	0.0766
RGDP	-1.126895*	0.282208	-3.993134	0.0010
VM	0.869261*	0.258396	3.364072	0.0039
C	-4.268503	2.648892	-1.611429	0.1266

Source: our estimates by Eviews 9
*, **, *** represent the significance levels of 1%, 5% and 10% respectively

Based on the Toda-Yamamoto causality test, all of the variables in the model cause the inflation rate.

According to the above table, we note the following results:

• As in the short run, the effects of import prices remain positive in the long term and show that: if import prices increase by 1%, the inflation rate will increase by 1.102%. This confirms our economic analysis and indicates that the domestic inflation rate is highly dependent on imported inflation through the price of imports.

• Also, public spending has positive long run, as well as short run, effects on the domestic inflation rate and show that: if public spending increases by 1%, the domestic inflation rate will increase by 1.46%. This indicates that an expansionary fiscal policy will increase the inflation rate. This indicates that Lebanese fiscal policy is extremely inflationary due to the weakness of the productive sectors of the Lebanese economy.

• In addition, contrary to the short run results, the money supply has positive effects on the inflation rate and shows that: if the money supply increases by 1%, the domestic inflation rate will increase by 0.290 %. This indicates that, if the Lebanese central bank increases the money supply, the rate of inflation will increase. However, the impact of the money supply must first affect the velocity of money to have an impact on inflation (based on the causality test). So the velocity of money reinforces the effect of monetary policy.

• As in the short run, the effects of real GDP remain negative significant in the long run and show that: if real GDP increases by 1%, the domestic inflation rate will slow by -1.126%. This indicates that if the Lebanese government implements a structural reform and promotes investment in the productive sectors, this will reduce inflationary pressures by increasing the aggregate supply on one hand, and by reducing the economy's dependence on the prices of imported goods on the other hand.

• Concerning the velocity of money, contrary to the results in the short run, the velocity of money has positive effects on the inflation rate and shows that: if the velocity of money increases by 1%, the domestic inflation rate will increase by 0.869% in the long run. Indeed, the slowdown in the velocity of money observed, in particular after 1993, due to the chronic economic recession, the orientation of the money supply to treasury bills, and the pessimistic expectations of Lebanese economic agents because of the negative economic, political, and social circumstances, explains the permanence of the deflationary pressures of the Lebanese economy.

9. Conclusion and recommendations

Based on the empirical study, we found that:

- Lebanese economy is very dependent on the imported inflation through the channel of imports.
- Lebanese fiscal policy has an inflationary effect, due to the weakness of productive sectors of the Lebanese economy.
- Lebanese Monetary policy needs at least 3 years to achieve an influence on the inflation rate.

- The inflation rate in Lebanon is caused by the money supply passing through the velocity of money; it means that monetary policy is ineffective if it is not accompanied by an acceleration of the velocity of money, which plays mediating role (or transmission channel) between the monetary policy and the real economy.

Based on the results above, we conclude the follwing :

- Inflation is mainly determined by the interaction of monetary and fiscal policies and any conflict between them will produce undesirable results

- If the monetary stimulus is not accompanied by an increase in the velocity of money, the stimulus policy will fail

- The velocity of money strengthens the effect of the stimulus policy. As a result, the velocity of money plays a mediating role (or channel of transmission) between stimulus policy and the economy.

Our research highlights the importance of the velocity of money in the process of inflation and warns against the risks of giving this variable a secondary role (assumed constant according to the quantitative theory of money) as in most macroeconomic models.

We recommand the following :

Since Lebanese monetary and fiscal policy are ineffective in containing inflationnary pressures, with an inflationary influence from fiscal stimulus, structural reform becomes necessary or even crucial in order to resolve the structural imbalance of the Lebanese economy and ensure efficiency of the stimulus policy in Lebanon.

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