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Research Paper

The Short Run and Long Run Effects of the Key Determinants of Inflation in the Libyan Economy

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Abstract: *This paper examines the key determinants of inflation in the Libyan economy using time series data from 1980 to 2011 by applying the ARDL approach .Taking into account the special characteristics of the Libyan economy and by considering recent empirical studies in the context of inflation, dynamic macroeconomic model has been constructed which emphasis the effect of money supply, real income, expected inflation, imported inflation, exchange rate, and output gap factors along with dummy variables presenting the structural changes in the Libyan economy during the period of study.*

Keywords: *Traditional unit root tests, LM unit root test with one-structural break, LM unit root test with two-structural breaks, ARDL model, and inflation.*

I. INTRODUCTION

Inflation is defined as a sustained or continuous rise in the general price level or, alternatively, as a sustained or continuous fall in the value of money [1]. Two things should be noted about this definition .First, inflation refers to the movement in the general price level. Second, the rise in the price level must be somewhat substantial and continue over a period longer than a day, week, or month

Inflation is mostly measured using index numbers. There are three main price indices, which can be used to measure inflation rate in every economy. First, the gross domestic product (GDP) deflator, which indicates to the index of the average price of the goods and services produced in the economy [2].Second, the wholesale price index (WPI), which measures price changes in the economy at wholesale level [3]. Third, the consumer price index which measures the change in the cost of purchasing a fixed market basket of goods and services representing average consumption patterns during some base period [4].

During the 1970s and early 1980s, Libya experienced drastic increases in oil revenues. As a result of the developing nature of its economy, and the limited availability of other endogenous resources other than oil and gas, the Libyan economy experienced a rapid increase in almost all macroeconomic variables, especially, the general price level. Table 1 shows the movements of consumer price index and gross domestic product deflator in Libyan economy during period from 1980 to 2011.It indicates that the general rate of inflation in the Libyan economy measured by gross domestic product deflator moved in the range of -24.093 percent in 2009 to 36.786 percent in 2002, with the period average of 8.38 percent during (1980-2011). In contrast, consumer price index ranged from -9.863 percent in 2002 to 13.806 percent in 1982 with the period average of 5 percent.

An analysis of the historical record of annual data of consumer price index and gross domestic product deflator indicates that the inflation is still a serious problem in Libya. Thus, there is a need to determine the main factors influencing on inflationary pressure in the Libyan economy in order to minimize the adverse its effects on economic growth and development in the local economy.

Table 1: Consumer price index and gross domestic deflator in Libya (1980-2011)

Year	Consumer price index	Growth rate of consumer price index	Gross domestic product deflator	Growth rate of product deflator
1980	33.320	_	23.771	_
1981	37.716	13.193	25.682	8.039
1982	42.923	13.806	25.223	-1.787
1983	47.434	10.510	25.224	0.003
1984	53.335	12.440	25.760	2.124
1985	58.195	9.112	25.185	-2.232
1986	60.162	3.380	24.629	-2.207

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1987	62.823	4.423	25.303	2.736
1988	64.789	3.130	25.466	0.644
1989	67.682	4.465	26.396	3.651
1990	68.170	0.677	27.704	4.955
1991	76.146	11.705	26.235	-5.302
1992	83.341	9.449	28.617	9.079
1993	89.571	7.475	29.184	1.981
1994	99.129	10.671	30.582	4.790
1995	107.399	8.343	37.530	22.719
1996	111.690	3.995	41.732	11.196
1997	115.695	3.586	45.418	8.832
1998	119.999	3.720	45.826	0.898
1999	123.087	2.573	54.378	18.661
2000	119.509	-2.907	61.596	13.273
2001	108.945	-8.839	67.800	10.072
2002	98.200	-9.863	92.741	36.786
2003	96.178	-2.059	100.00	7.827
2004	97.182	1.044	122.648	22.648
2005	100.00	2.890	152.186	24.083
2006	101.536	1.536	173.504	14.007
2007	107.728	6.098	195.194	12.501
2008	118.932	10.400	245.572	25.809
2009	122.293	2.826	186.404	-24.093
2010	127.796	4.500	196.446	5.387
2011	139.384	9.068	241.453	22.911

Source: 1. International Monetary Fund, yearbooks, 2005.2008, and 2011.
2. The Central Bank of Libya, economic bulletin, various issues.

II. Empirical Survey On Causes Of Inflation

In this section an attempt is made to survey the vast empirical literature on the determinants of inflation in variety countries, paying special attention to the ones conducted on developing economies, including countries from the Arabic region, in order for proper decision making in choosing explanatory variables that are believed to have contributed to high inflation rates in the Libyan economy.

Darrat (1981) used the monetarist approach to inflation to analyze the causes of inflationary phenomenon in the Saudi economy during the period from 1963 to 197. The author found out that among the various explanatory variables, there are three variables exert strong effects on Saudi inflation, namely the rate of growth in the money supply, rate of growth in real income, and world inflation. In other words, the empirical findings of this study provided a strong support for the monetarist approach in analyzing the Saudi inflationary process.

Zahra (1984) examined the effect of foreign inflation on the general price level in the Libyan economy during the period from 1962 until 1978. In this study, the researcher estimated equation of inflation in the Libyan economy, using Ordinary Least Squares (OLS).The author found out that among the various explanatory variables, the foreign inflation (imports price) played important role in determination the general price level in the Libyan economy.

Qayyum (2006) investigated the linkage between the excess money supply growth and inflation in Pakistan and tested the validity of the monetarist stance that inflation is a monetary phenomenon .To achieve this purpose, the researcher estimated the relationship between the rate of inflation, money growth, growth in real income, and growth in velocity of money in Pakistan during the period from 1960 to 2005 by employing Autoregressive Distributed Lagged (ARDL) approach. The results indicated that in the long run there is a one to one relationship between the rate of inflation and growth in money supply, growth in real income and growth in velocity of money. In addition, the important finding from this study is that the excess money supply growth has been an important contributor to the rise in inflation in Pakistan during the study period ,it contributed 90 percent to the explanatory power ,i.e., the money supply is the key factor that affected the inflation in Pakistan.

Grauwe and Polan (2005) used the quantity theory model to test empirically the relationship between money and inflation by using a sample which covered most countries in the world during from 1969 until 1999 .They began their research by analyzing the full sample of countries, The estimated results of full sample showed that a strong positive relation between the long-run growth rate of money and inflation namely the correlation between average inflation and average of narrow money supply growth was 0.877, and 0.89 for the correlation with domestic liquidity. Then, the authors divided these countries into two sets, low inflation countries (on average less than 10% per year over 30 years) and high inflation countries to detect whether the relation between money supply growth and the inflation rate may vary between subsamples. They started with a sample consisting of countries with inflation and money growth below 10%. Then, they progressively expanded

the sample by adding the observations of the next classes, i.e., 10% to 20%, 20% to 30% and so on. Their findings suggested that strong link between inflation and money growth is almost wholly due to the presence of hyperinflation countries in the sample. On the other hand, the relation between inflation and money growth for low-inflation countries is weak.

Mohamed and Abdelhak (2004) examined empirically the causality issue between money and prices in the Maghreb countries namely Algeria, Morocco and Tunisia, during the period from 1975 to 2003. In this study, the researchers used two measures of money supply for Maghreb countries namely narrow money (M1) and broad money (M2). M1 included currency held by non-bank public and demand deposit held at the monetary sector. M2 consisted of M1 and time deposits held at commercial banks. Both the measures of money supply were used to see their influences on prices by using Granger causality test The causality test between the price level and narrow money in Tunisia and Morocco showed that, the causation is from money (i.e, M1) to prices without significant feedback namely this result support the quantity theorist's view that the causal relation between money and prices is from the former to the latter. In the other hand, the causality tests are made between broad money and consumer price index, for the case of Morocco and Tunisia indicated that. First, there is no causation between board money and the price level in Morocco. Second, there is positive relationship between liquidity and inflation at the 10 % confidence level for the case of Tunisia. Besides, the Granger causality test for Algeria case showed that there is no relation between money (M1, M2) and general price level .Overall, this study found out that there is unidirectional causation from money to prices in the case of Morocco and Tunisia is in line with the monetarist's view that money causes inflation. In addition, the results showed that the apparent absence of causality between money and prices in the case of Algeria.

Tang (2010) empirically re-investigated the relationship between money and prices in the Malaysian economy over the period of 1971:01 to 2008:03, employing the cointegration and causality techniques. The estimated results showed that a unidirectional causal relationship runs from money supply (M2) to aggregate prices, meaning that the monetarist's view exist in the Malaysian economy .But this relationship between money supply and general level of prices is not stable over the analysis period namely inflation is not always a monetary phenomenon in Malaysia. Therefore, the contractionary monetary policy may not be an effective instrument in managing inflationary behavior in Malaysia.

Alomar (2007) examined the main determinants of inflation in Kuwait during the period 1972 to 2004. The researcher used three independent variables believed to influence the behavior of inflation in the Kuwaiti economy namely money supply, real gross domestic product and import inflation. The study was estimated by using Granger causality test which indicated that domestic inflation is influenced mainly by the development of domestic liquidity which overwhelmed the theoretically expected effect of imported inflation. According to the researcher, these results might be caused by two main factors; the first is the economic and political developments during the period of study, and the second is the difference in constructing each measure of inflation. These factors might be responsible for distorting the expected relationship between domestic and imported inflation.

Mosayeb and Mohammad (2009) examined the major determinants of inflation in Iran, using annual time series data (1971 to 2006). In this study, the authors took into their account the effects of structural change in Iran's economy, especially during eight year period of Iran/Iraq war, an econometric model was constructed and estimated using the ARDL approach. The empirical results indicated that one per cent increase in the expected inflation rate leads to 0.34 per cent increase in inflation, one per cent increase in imported inflation leads to 0.17 per cent rise in inflation, one per cent increase in the exchange rate leads to 0.16 per cent rise in the inflation rate and one percent increase in liquidity leads to 0.11% point increase in the inflation rate. In addition, the results of study showed that the eight years period of the Iran/Iraqi war has had a positive effect on inflation increasing the trend dummy, the coefficient of which has the positive value of 0.033, which is statistically significant.

Gungor & Berk (2006) estimated the relationship degree between money supply and inflation in Turkish economy during the period from 1996:2 to 2006:1. In this research, the authors used a simple neural network model to forecast the monthly inflation rate for the Turkish economy. According to the model, broad money supply of the previous month, an inflation rate of the previous month, the seasonal factors and time trend variable were used as input variables and the monthly growth of rate whole price index (rate of inflation) was used as output variable of the model. The results of this study showed that the model predicts the level of inflation with a reasonably good degree of accuracy .Specifically, one percent increase in the growth rate of previous monthly of board money supply results into 0.11 percent rise in the rate of inflation, the monthly growth of rate whole price index would roughly increase by .032 with every one percent rise in inflation rate in the current month. In addition, the results indicated that there is inverse relationship between seasonal dummy variable and inflation rate namely seasonal dummy variable increases while inflation rate decrease from autumn to summer, according to the authors, the main factor for this result must be due to the decrease in agricultural

product prices from autumn to summer season in Turkey. Another important finding of this study, the time trend has the least and very small impact on inflation rate compared to other variables.

Almounsor (2010) studied the underlying determinants of inflation dynamics in Yemen using three different approaches namely a single equation model, a Structural Vector Autoregression Model, and a Vector Error Correction Model. In this study, the author used quarterly data to cover the period from 1995 to 2007. The outcomes of the single equation model showed that Yemen's inflation is driven mostly by international prices and exchange rate depreciation. Empirically, a 1 percent increase in the World CPI amplifies domestic prices by about 10–13 percent, and one percent appreciation of the nominal exchange rate yields between 0.31 and 0.44 percent decline in Yemen's inflation. Besides, the results indicated that the impact of domestic demand on inflation is less than that of external factors namely one percent increase in non-oil GDP adds 0.29 percent to inflation. Overall, the results of estimated models showed that the impact of international prices and exchange rate depreciation indicate a significant pass-through of import prices. In the short run, external shocks of international prices and the exchange rate account for most variations in inflation, but domestic shocks to money supply and domestic demand explain larger variations in the medium term.

Cheung and Yuen (2002) investigated effects of U.S. inflation on Hong Kong and Singapore by using monthly observations of Hong Kong, Singapore, and U.S. consumer price indexes (CPIs), covered the period from January 1984 to June 1997. In this research, the authors used the generalized impulse response and forecast error variance decomposition techniques to examine the effects of a U.S. price shock on the CPIs of Hong Kong and Singapore. The United States was taken as the large world economy and the other two were interpreted as small open economies operating under different exchange rate regimes. The results of the generalized impulse response functions of the Hong Kong consumer price index and the United States showed that the U.S price shock has a sizable and sustained impact on the Hong Kong consumer price index. Its effect steadily increases over time and stays at a relatively high level. On the other hand, the results explained that price shocks from the United States exert a more powerful influence on the Singapore consumer price index than shocks from Singapore itself. Overall, the empirical results indicated that, under both fixed and flexible exchange rate arrangements, a large economy has significant influence on a small open economy.

Khan and Gill (2010) investigated the primary determinants of inflation in Pakistan during the period 1970 to 2007. In this study, the researchers used four price indicators as dependant variables namely consumer price index (CPI), wholesale price index (WPI), sensitive price index (SPI), and gross domestic product deflator (GDPD), and seven independent variables such as the budget deficit (BD), exchange rate (ER),wheat support price (WSP), interest rate (IR), value of imports (IMP), support prices of sugar, cotton, rice and wheat (SP), and money supply (M2), to explain the variation in CPI, WPI, SPI and GDP deflator respectively. The estimated results of the first model showed that 10 percent increase in exchange rate lead to rise consumer price index by 3.2 percent, 10 percent increase in interest rate would lead to decrease CPI by 2.1 percent, 10 percent increase in the value of imports would increase the consumer price index by 1.5 percent, 10 percent increase in the support prices would result into increase in consumer price index by 1.7 percent, in addition to that the model showed money supply in the long-run did not affect consumer price index. In the second model, the estimates found out that the wholesale price index would increase by 3.4 percent with every 10 percent increase in exchange rate, the wholesale price index would come down by 4.2 percent with a 10 percent increase in interest rate ,10 percent increase in the value of imports would increase the wholesale price index by 2.4 percent, 10 percent increase in support prices lead to rise wholesale price index by 2.2 percent, besides, supply money had no role to play in explaining wholesale price index. The third model implied that 10 percent increase in exchange rate would increase sensitive price index by 3.2 percent, the sensitive price index would increase by 1.3 percent with 10 percent increase in the value of imports, 10 percent increase in support prices lead to rise in sensitive price index by 1.4 percent, in contrast the effect money supply and interest rate on sensitive price index was insignificant in the long-run .

The last model estimated that 10 percent increase in exchange rate would result into 6 percent increase in gross domestic product deflator, 10 percent increase in interest rate result into 2.3 percent decrease in gross domestic product deflator, gross domestic product deflator would increase by 2 percent with a 10 percent increase in the value of imports, a 10 percent increase in wheat support price leads to 1.8 percent increase in GDP deflator, the effect money supply on gross domestic product deflator like consumer price index, and sensitive price index was insignificant in the long-run. In general, the results of study explained that depreciation of exchange rate and increase in the value of imports contributed positively towards consumer price index, wholesale price index, sensitive price index, and gross domestic product deflator. Besides, the support prices of sugar-cane, rice, wheat, and cotton affected collectively all the indicators positively. In addition to that the study showed that the budget deficit did not play any role in boosting all the four indicators of inflation in Pakistan in the long run.

Helmy (2010) analyzed the dynamics of inflation in Egypt by investigating the importance of the different sources of inflation over the past thirty years. The researcher used Granger causality tests, a variance

autoregressive (VAR) model, impulse response functions (IRF) and variance error decomposition (VDC) analyses to test for the sources and dynamics of inflation in Egypt .Results of this study proved that inflation in Egypt is primarily affected by the rate of growth of money supply. On the other hand, interest rate has a weaker impact on inflation as current inflation is affected by changes in interest rates only one and five years earlier. Changes in the exchange rate has even a milder impact as present inflation is affected by changes in the exchange rate only one year earlier .The results also showed that, the trade deficit do not have any impact on the inflation rate even after a time lag. Overall, estimated results indicated that, the strongest and most magnified impact on inflation came from changes in money supply, which remained in effect for ten years namely the inflation in Egypt was a monetary phenomenon during the period in question.

Yping et al. (2010) examined the main determinants of inflation in China by using a set of time series data from January 1998 to July 2009, including consumer price index, excess liquidity, output gap, housing prices, and stock prices. The researchers posed four hypotheses in their study namely large excess liquidity lifts inflation rate, narrow output gap adds to inflation pressure, strong asset markets push up inflation, and house price increases go up inflation in the Chinese economy. To this end, they conducted their analyses with both year-on-year and month-on-month growth data .the findings of this study found out that one percent increase in the growth of excess liquidity, house price, stock price and output gap would respectively increase rate of inflation by 0.35 percent, 0.22 percent, 0.04 percent and 0.13 percent. In addition, according to the estimated short-run equilibrium relation based on month-on-month, excess liquidity and output gap are the two most important factors to explain the variance of inflation rate which on average ,account for 22.24 percent and 33.1 percent whereas housing price and stock price, on average account for 0.06 percent and 1.38 percent of inflation rate.

Armesh et al. (2011) examined the factors that explain and help forecast inflation in Iran. A simple inflation model included liquidity (M2), real GDP and import prices, as well as the wheat support price as a monetarist approach. The authors used multivariate and univariate co integration analyses and error correction model (ECM) to determine the effect of liquidity (M2) and other variables on inflation. Quantitative estimates based on the time series annual data from 1961 to 2007, indicated that the coefficients of all the regressors have the hypothesized signs and are statistically significant at the 5 % level. The results of error correction model showed that one unit increase in real income leads to -0.15 units reduce in inflation, and one unit increase in broad money result into 0.13 units increase in inflation, and inflation would increase by 4.1 percent with one percent increase in the import prices.

Samimi and Jamshidbaygi (2011) analyzed the relationship between budget deficit and inflation in Iran using the seasonal data covering the period 1990-2008. In addition to that He analyzed the robustness or fragility of this relationship regarding the definitions of inflation and supply money by using the simultaneous equation model, including four structural equations for budget deficit, monetary base, money supply and inflation. Findings of this study indicated that there is a positive and significant impact of the budget deficit on monetary variables and as result on inflation. As well as, this study found a positive and significant impact of price index on budget deficit in the Iranian economy.

The above empirical studies have tended to suggest that the following variables are mostly responsible for the inflationary process: import prices; interest rates; exchange rates; money supply; output gap, trade deficit, real income, stock prices and budget deficit. However, it is not necessary that all variables mentioned in these empirical studies are the real determinants of inflation in the Libyan economy, due mainly to that the Libyan economy is a surplus economy, especially for the balance of trade.

III. THE MODEL AND DATA

3.1 The Theoretical Model

The theoretical framework of model has its foundation in the contributions of Darrat (1986), Khalid (1999), Kim (2001); and more recently and importantly Mosayeb and Mohammad (2009), Kandil and Morsy (2009), Almounsor (2010), and Dizaji (2011).

The model explicitly incorporates the fundamental features of the Libyan economy and emphasizes the effects of domestic and foreign factors on inflation rate in the Libyan economy, through a number of channels such as money supply, real income, expected inflation, imported inflation, exchange rate, and output gap. It also takes into account the effects of structural changes in the local economy with the objective of capturing the effects of other factors upon the rate of inflation in the economy via one or two endogenous breaks. Therefore, the equation of inflation in the Libyan economy could be formulated as follows:

$$\Delta \text{ Log } P_t = a_0 + a_1 \Delta \text{Log } M_t^s - a_2 \Delta \text{ Log} Y_t + a_3 \Delta \text{ Log} e_t + a_4 \Delta \text{ Log } P_t^f + a_5 \Delta \text{ Log } E_t + \text{g} + D_1 + D_2 + \mu \quad (1)$$

Where:

P_t = the domestic price level (GDPD, 1980 = 100).

M_t^s = Money supply.

Y_t = Real income (GDP at constant market prices).
e_t = Expected rate of inflation.
P_t^f = Average rate of inflation in trading partners.
E_t = Exchange rate.
g= output gap
D_1 =dummy variable
D_2 = dummy variable
Δ = the first difference.
μ = Disturbance (error) term.
Log = the logarithm.

3.2 Secondary Data

The study covers the period from 1980 to 2011.The gross domestic product deflator ,consumer price index, and rates of inflation in trading partners were obtained from International Financial Statistics (IFS) of International Monetary Fund .Raw figures on money supply and exchange rate were obtained from Central Bank of Libya ,while real income and output gap were calculated by author. All variables, except exchange rate, were transformed to logarithmic.

IV. METHODOLOGY

In order to fully grasp the influence tested variables on inflation, this study employs a number of tests or merely sheds further light on the dynamics of inflation.

4.1 Determining the Stationarity of the Data

The stationary properties of a time series are scrutinized by carrying out the unit root test to avoid spurious or nonsense regressions. There are a number of tests available for conducting a unit root namely conventional unit root test, which does not take into account multiple structural breaks, and unit root test that takes into account multiple structural breaks. These tests are briefly discussed below.

4.1.1 Traditional Unit Root Tests

The most popular and widely used tests in empirical economic studies to examine the stationary of a time series, in absence of a structural break, are the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979, 1981). These tests are used to investigate the null hypothesis that all the variables have a unit roots, against that they do not, in the level of variables as well as in their first differences

4.1.2 Lagrange Multiplier Unit Root Test

Lee and Strazicich (2003, 2004) proposed LM unit root tests with one and two structural breaks. They considered two models of structural change. "Model A" is known as the "crash" model, and allows for a change in intercept, as well as 'Model C" allows for a shift in intercept and change in trend slope. In this study, we consider Model (C) for one and two breaks tests, because it performs better than Model (A) (Sen, 2003; Tang, 2008).

4.2 The ARDL Approach

In the light of literature review on determinants of inflation in various countries around the world, we found out several statistical techniques which were used to estimate determinants of inflation in those countries such as VAR granger causality test, ARDL approach, VEC model, and Ordinary least squares. In this study, the Auto-regression Distributed Lag (ARDL) Model developed by Pesaran et al. (2001) will be used to examine the long-run relationship between variables which are included in the behavioral equation 1, as well as to estimate the short-run and long-run elasticities. The ARDL Model has main advantage over the other common procedures to co integration analysis, mainly the Engle and Granger two-step approach and the Johansen maximum likelihood framework. This advantage stems from the fact that the other methods focused on the estimation of long-run relationships among I (1) variables, which inevitably involves a certain degree of pre-testing and thus introduces a further degree of uncertainty into the analysis of relationships between levels (DaCosta and Greenidge, 2009; Pesaran et al., 2001).

The Microfit 5 package (Pesaran and Pesaran, 2009) will be used in this study to estimate the behavioral equation of the model. However, before the equation of inflation for the Libyan economy is estimated, it is necessary to define whether the main macroeconomic variables in the behavioral equation contain a trend or not, and whether the trend is deterministic or stochastic. In the other words, it is essential to check each time series for stationary. Furthermore, it is crucial to accurately identify structural breaks in the data for any economy. The importance of this is; firstly, to avoid misspecification of the model considered; secondly,

to obtain unbiased coefficients. In the context of the Libyan economy , it has faced several severe business cycles , marked by period of expansion and periods of recession .These business cycles reflect structural changes in the Libyan economy , which are attributed to several events .These events include rise of oil prices in the early 1980s ; the collapse of oil prices during the mid 1980s to the 1990s ; the economic reforms in the early 1990s and the beginning of this century in which the restrictions on private sector were alleviated; the UN sanctions in the early 1990s; the lifting of sanction in 2003, the change of the official exchange rate in 1999;the unification of the exchange rate in 2002;amongst others.

Since non-stationary time series variables $I(1)$ can lead to spurious results, this study will test for the stationary of the variables before attempting to conduct utilizing the ARDL co integration.

V. CONTRIBUTION TO THE LITERATURE

There is extensive literature devoted to analyzing the effects of domestic factors upon the rate of inflation in developing and developed economies over the short and long terms. This literature places attention on how local factors affects inflation rate**,** specifically during the long-run**,** through a number of channels such as money supply, interest rate, expected inflation, output gap, and real income (for example, Darrat , 1986; Grauwe and Polan., 2005; Qayyum, 2006; and Tang, 2010)**.**

On the other hand, other literature has placed emphasis on effects arising from foreign shocks, through a number of channels including foreign inflation (imported inflation), and exchange rate effects (see, Zahri, 1984; Cheung and Yuen, 2002; Almounsor, 2010). Furthermore, this literature has also taken into account the effects of structural changes in the economy with the objective of capturing the role of other factors such as institutions, political process and culture in the creation or acceleration process of inflation via known or exogenous dummy variable (for example, Gungor & Berk ,2006; Mosayeb and Mohammad.,2009).

However, no model in the relevant literature identified important structural breaks and their effects upon the rate of inflation in the economy via one or two endogenous breaks. Also, in this sense, recent studies for the case of Libya cannot be found. Thus, this study has emphasized both domestic and foreign factors identified above but also extended the existing relevant literature via using a program called Gauss designed for testing unit root with one and two structural break(s), to analyze whether the variables used in this study are stationary or non-stationary, as well as to determine the main structural breaks in the Libyan economy.

VI. EMPIICAL RESULTS

6.1 Empirical Results for Traditional Unit Root Tests

The regression results of the ADF and PP unit root tests applied to Libyan data used in this study, with an intercept term and a linear trend, are revealed in Table **2.** The findings show that both the ADF and PP tests reject only the null hypothesis of a unit root for output gap (g). This can be seen by comparing the observed values (in absolute terms) of both the ADF and PP test statistics with the critical values (also in absolute terms) of the test statistics at the 5% level of significance.

Generally speaking, results from the ADF and PP model are able to reject only 1 out of the 7, representing almost 14 percent of the variables of interest. These results may be biased towards the non-rejection of the unit root test, and the observed unit root behavior, as Perron (1989) suggested, resulting from failure to account for a structural break in the data. Perron (1989) argues that the traditional unit root hypothesis tests may not be reliable in the presence of structural breaks. Hence ignoring structural break(s) in the trend function leads to considerable power reduction of traditional unit root tests. Thereby, applying traditional unit root tests in the absence of structural changes is insufficient, since significant structural breaks are very likely to have occurred in the Libyan economy time series. Thus, we will perform the LM unit root tests with one and two structural break(s) to affirm the order of integration.

Table 2: Traditional Unit Root Tests for stationarity (Includes an Intercept and a Linear Trend

Variables	*I* (0)	*I (1)*	*I* (0)	*I (1)*	Decision
	ADF Test Statistics	ADF Test Statistics	PP Test Statistics	PP Test Statistics	
Narrow money supply (M^S)	-0.286395 [0]	-6.368664 [0]	-0.286395	-6.329874	*I* (1)
Real income (Y)	-2.727454 [0]	-6.664560 [0]	. -2.729671	-6.648633	*I (1)*
Domestic price level (P)	-1.611620 [0]	-5.490258 [0]	-1.598359	-5.490512	*I (1)*
Exchange rate (EX)	-1.704518 [0]	-4.249853 [0]	-1.836334	-4.231622	*I (1)*
Imported inflation (p^f)	-2.976146 [0]	-6.815383 [0]	-2.809607	-10.85428	*I (1)*
Expected inflation (e)	-1.995309 [0]	-5.988912 [0]	-2.002951	-6.027707	*I* (1)

Output gap (g)	-4.129314 [1]		-4.410725		I (0)

(1) All variables in the Table are in log form, with the exception of exchange rate. (2) Critical value of I (0) at the 5 percent level is -3.536601, whereas critical value of I (1) at the 5 percent level is -3.540328.The critical values are obtained directly from the empirical results generated by Eviews 5 package. (3) Figures in square brackets besides each ADF test represent optimum lags, selected automatically using Schwarz Bayesian Criterion (SBC). (4) The ADF and PP tests are based on the null hypothesis of unit roots.

6.2 Empirical Results of the Lee and Strazicich Unit Root Test with One Structural break.

The LM unit root test with one-structural break is applied to Libyan data to analyze whether the time series is stationary or non-stationary. The regression results for the LM unit root test with one-structural break are presented in Table 3. The results indicate that there is additional evidence against the null hypothesis of unit root compared to the results of traditional unit root tests, namely ADF and PP unit root tests. In other words, while the traditional ADF and PP unit root tests suggest that P , EX , and e are non-stationary, results from the LM unit root test with one-structural break suggest that these time series are trend stationary when the structural break is considered under both the null and alterative hypotheses at un-known time in trend function. However, we have to perform an endogenous two-break Lagrange multiplier unit root test that allows for breaks under both the null and alternative hypotheses. Thereby, rejection of the null unambiguously implies trend stationary.

Table 3: Results of One-Break Minimum LM Unit Root Test, Model C: Break in Intercept and Slope

Variable	t-statistic	T_B	k	Result
Narrow money supply (M^S)	-3.3958	2004	0	Unit Root
Real income (Y)	-3.8093	1995	3	Unit Root
Domestic price level (P)	-5.6217*	1999	3	Stationary
Exchange rate (EX)	-7.7313*	2000	4	Stationary
Imported inflation (p^f)	-3.7753	2001	1	Unit Root
Expected inflation (e)	-4.8022*	1998	4	Stationary
Output gap (g)	-5.4798*	1986	0	Stationary

Note: (1) The asterisks $*$ denotes statistically significant at 5-percent level. (2) The critical values at the five percent significance level are as follows for P, e is λ= (0.4)= -4.50, for EX is λ= (0.3) = -4.45, and for g is λ= (0.2) = -4.47.

6.3 Empirical Results of the Lee and Strazicich Unit Root Test with Two Endogenous Structural Breaks.

In this sub-section the two-break minimum LM unit root test is applied to Libyan data to analyze whether the time series is stationary or non-stationary ,as well as to determine the major structural breaks that can be used in the regression of the behavioral equation. The regression results for the two-break LM unit root test are reported in Table 4. The LM unit root test with two-structural breaks indicates that there is no additional evidence against the null hypothesis of unit root compared to the result of LM unit root test with one-structural break, except p^f . Results of the endogenous two-break LM unit root test for model C (two changes in the level and trend) show that the variable imported inflation (p^f) is trend stationary when the structural break is considered under both the null and alterative hypotheses at un-known time in trend function.

Regarding the stationary series the break dates were consistent with increasing oil prices during the period of the early 1980s ; collapse of oil prices during the mid 1980s until 1990s ;the economic reforms in the early 1990s and the beginning of this century in which the restrictions upon the private sector were alleviated; the United Nation sanctions in the early 1990s; the depreciation of the official exchange rate in 1999; the lifting of sanctions imposed by UN in 2003; and the unification of the exchange rate in 2002.

Table 4: Results of Two-Break Minimum LM Unit Root Test, Model C: Breaks in Intercept and Slope

Variable	T-statistic	T_{B1}	T_{B2}	k	Result
Narrow money supply (M^S)	-4.5024	1988	2003	0	Unit Root
Real income (Y)	-4.9039	1988	2001	3	Unit Root
Domestic price level (P)	-6.0393*	1987	1999	3	Stationary
Exchange rate (EX)	-6.1139*	1999	2002	0	Stationary
Imported inflation (p^f)	-5.7927*	1987	1995	3	Stationary
Expected inflation (e)	-6.5385*	1989	1999	4	Stationary
Output gap (g)	-7.8602*	1987	2004	1	Stationary

Note: (1) The asterisk $*$ denotes statistically significant at 5-percent. (2) The critical values at the five percent significance level are as follows for P, p^f is λ= (0.2, 0.6) = -5.74. for EX is λ= (0.6 ,0.8) = -5.73, for e is λ= (0.4, 0.6)= - 5.67,and for g is λ= (0.2 , 0,8) = -5.71 .

6.4 Empirical Results of the Equation of Inflation in the Libyan Economy Based on the ARDL Model

As has been shown by the unit root tests, especially the results derived from the LM unit root test with two structural breaks. The time series of the behavioral equation in this study is a combination of stationary and non-stationary variables, i.e., the variables consist of a mix of *I (0)* and *I (1)* series with structural breaks. For this reason, and the advantages mentioned above, the ARDL co-integration approach is utilized in this study to analyze the long run relationships and dynamic interactions between the variables in our equation.

Furthermore, the trend term will be included in the behavioral equation (1) as this coincides with the LM unit root test of Lee and Strazicich (2003), which captured two structural breaks in the intercept and trend. Thereby, in line with Pesaran et al. (2001), and without having any prior knowledge about the direction of the relationship among the variables, our ARDL model could be reformulated as follows:

$$\Delta LogP_t = a_0 + \sum_{i}^{n} a_{1i}\,\Delta \text{Log}\, M^s_{t-i} - \sum_{i}^{n} a_{2i}\Delta\, \text{Log} Y_{t-i} + \sum_{i}^{n} a_{3i}\Delta\, \text{Log} e_{t-i} + \sum_{i}^{n} a_{4i}\,\Delta\, \text{Log}\, P^f_{t-1} + \sum_{i}^{n} a_{5i}\,\Delta\, \text{Log}\, EX_{t-1} + \sum_{i}^{n} a_{6i}\,\Delta\, \text{Log}\, g_{t-1} + a_7\, D_{1987} + a_8\, D_{1999} + B_1 \text{Log}\, M^s_{t-i} - B_2 \text{Log} Y_{t-i} + B_3 \text{Log} e_{t-i} + B_4 \text{Log}\, P^f_{t-1} + B_5\, \text{Log}\, EX_{t-1} + B_6\, \text{Log}\, g_{t-1} + B_7\, D_{1987} + B_8\, D_{1999} + e_t \qquad (2)$$

The first part of the equation with a_1 ,a_2. $a_3, a_4, a_5, a_6, a_7,$ *and* a_8 represents the short-run dynamics of the model whereas the parameters B_1 ,B_2. B_3, B_4, B_5, B_6,$B_7,$ *and* B_8 represents the long-run dynamic coefficients of the underlying ARDL model.

The ARDL model requires two steps for estimating long run relationships. The first step is to investigate the existence of long relationship among all variables in the equation under estimating. This can be done by using the F-test. Once a long-run co-integration relationship is found to exist the second step is to estimate the long-run and short-run elasticities. The empirical results for our model are now presented.

5.4.1Testing for the Existence of a Long Relationship among the Variables

The first step is to test for presence of the long-run relationship through the bounds testing approach. The result of the ARDL bounds test with regard to Libya is reported in Table 5.This result implies that the computed F-statistic statistic is greater than the upper bound critical value. Hence, we have strong evidence to reject the null hypothesis of no co-integration at 5 percent significance level. It shows that the variables of interest are bound together in a long run relationship

Table 5: F-test for a Co-integration Relationship

Equation	95% Lower bound	95% Upper bound	90% Lower bound	90% Upper bound	The computed F-statistic
$F(p / M^S, Y, e, p^f, E, g, D_{1987}, D_{1999})$	2.6039	3.7458	2.2897	3.3826	9.9442

Note: The Critical bounds are obtained directly from the empirical results generated by Mirofit 5.

The following step is to estimate the long run parameters using the ARDL approach, and then the short run parameters using an ECM. The two significant and relevant structural breaks determined endogenously by the LM method will be taken into account by inclusion of break data dummy variables in the ARDL model. The break points for p are 1987 and 1999. The empirical results of the long run and the short run coefficients of the behavioral equation are reported in the next sub-sections.

6.4.2 Empirical Results of the Long-run Relationship between Inflation Rate and its Determinants in the Libyan Economy.

The empirical results in Table 6 reveal that in long-run the money supply, expected inflation rate, imported inflation, exchange rate and output gap have a positive effect upon rate of inflation in Libya ,and are statistically significant at 5%,1%,1%,1%,10% level respectively. Specifically, the results show that one percent increase in money supply leads to 0.38 percent a rise in inflation and one percent increase in expected inflation results in an increase 0.02 percent in rate of inflation. Similarly, one percent increase in imported inflation brings about an increase in rate of inflation by 0.29 percent and one percent increase in exchange rate leads to 0.18 point increase in the inflation rate. On contrast, a 1 percent increase in real income will result in a decrease in the rate of inflation by 0.42 percent.

It must be also mentioned that the structural break for 1987 has had a negative effect on inflation increasing, the coefficient of which, according to the results in Table 6, has the negative value of 0.08, which is statistically significant at 10 percent level. The structural change of 1987 is consistent with the introduction of Law No.15 in the early 1980s, when wages were frozen. Similarly, the structural change of 1999 is also

significant. The dummy variable for 1999 has a positive sign indicating that it has a positive long-run impact upon the rate of inflation in the Libyan economy. The structural change for 1999 coincided with the depreciation of the official exchange rate.

Table 6: Estimated Long-run Coefficients Using the ARDL Approach

Regressor	Coefficient	Standard Error	T-Ratio	[Prob]
M^S	0.38062**	0.13718	2.7746	[.011]
Y	-0.42470***	0.21329	-1.9912	[.058]
e	0.02147*	0.00752	2.8550	[.009]
p^f	0.29816*	0.06715	4.4402	[.000]
E	0.18390*	0.04022	4.5723	[.000]
g	0.09723***	0.05190	1.8734	[.073]
D_{1987}	-0.08305***	0.04120	-2.0158	[.055]
D_{1999}	0.17793*	0.05356	3.3221	[.002]
INPT	0.22847**	0.10923	2.0916	[.047]
Trend	-0.56471**	0.25108	-2.2491	[.034]
R^2= 0.83721	$R^{\backslash 2}$= 0.72230			

Note: (1) The results obtained by using the Microfit 5 package. (2) Dependent variable is p and ARDL model (1, 1, 1, 0, 0, 0, and 0) is selected based on Schwartz Bayesian Criteria (SBC). (3) The asterisks ∗,∗∗ and ∗∗∗ denotes statistically significant at 1-percent, 5-percent and 10-percents level respectively.

6.4.3 Empirical Results of the Short-run Relationship between Inflation Rate and its Determinants in the Libyan Economy.

Table 7 reports the short-run coefficients estimates obtained from the ECM version of the ARDL model. The empirical results show that the coefficient of money supply (0.26) indicates that one percent increase in money supply results in an increase in the rate of inflation by 0.26 percent in the Libya economy, and one percent increase in imported inflation brings about an increase in the rate of inflation by 0.13 percent. Similarly, one percent increase in exchange rate results in an increase in the rate of inflation by about 0.08 percent in the Libyan economy, one percent increase in output gap brings about an increase in rate of inflation by 0.04 percent, and one percent increase in expected inflation result in an increase 0.009 percent in rate of inflation in the Libyan economy. On contrast, the short-run estimated coefficient of real income (- 0.31) reveals that one percent increase in real income results in a decrease in the rate of inflation by 0.31 percent in the Libyan economy.

Finally, the result for the error correction term for rate of inflation indicates that the estimated coefficient of the ECM (-0.45) has the correct sign and is statistically significant at the one percent level and is moderately large, showing a strong and significant tendency for inflation rate to return back to long-run equilibrium when shocks occurred in the short-run. The result specifically states that deviation from the long-term rate of inflation is corrected by 45 percent in the next period.

Table 7: Short-run Error Correction Model (ECM)

Regressor	Coefficient	Standard Error	T-Ratio	[Prob]
dM^S	0.25587**	0.09960	2.5689	[.011]
dY	-0.31052***	0.15699	-1.9780	[.060]
de	0.00963**	0.00379	2.5409	[.021]
dp^f	0.13375*	0.02622	5.1011	[.000]
dE	0.08250*	0.02311	3.5699	[.001]
dg	0.04362***	0.02491	1.7511	[.094]
dD_{1987}	-0.03726	0.02232	-1.6694	[.111]
dD_{1999}	0.07982*	0.02774	2.8774	[.009]
d Trend	-0.25333***	0.12372	-2.0476	[.056]
ECM(-1)	-0.44860*	0.11310	-3.9664	[.001]
R^2= 0.80173	$R^{\backslash 2}$= 0.71676	DW=2.0116		

Note: (1) The results obtained by using the Microfit 5 package. (2) ECM-ARDL model (1, 1, 1, 0, 0, 0, and 0) is selected based on Schwartz Bayesian Criteria (SBC). (3) The asterisks ∗, ∗∗ and ∗∗∗ denotes statistically significant at 1-percent, 5-percent and 10-percents level respectively.

6.5 Stability Analysis

To ascertain the goodness of fit of the ARDL model, the stability tests are conducted. The structure stability of the long-run and short-run relationships of the ARDL model for the entire period is examined by the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMQ) of the recursive residual test which provided by Brown et al (1975). The same procedure has been utilized by Pesaran and Pesaran (1997), Suleiman (2005), and Mohsen et al (2002) to test the stability of the long run coefficients. The CUSUM test is useful for

detecting systematic changes in the regression coefficient and the CUSUMQ test is useful in situation where the departure from the consistency of the regression coefficient is haphazard and sudden. The null hypothesis of these tests is that the regression equation is correctly specified. These two tests are presented in Figure 1. The pair of straight lines in each figure indicates the 5 percent significant level and if the plotted CUSUM and CUSUMQ graphs remain inside the straight lines the null hypothesis of correct specification of the model can be accepted. Otherwise, the null hypothesis is rejected and it can be concluded the regression equation is miss-specified. The two figures reveal that the plots of CUSUM and CUSUMSQ stay within the lines, and therefore, this clearly indicate the absence of any instability of coefficients during the investigated period.

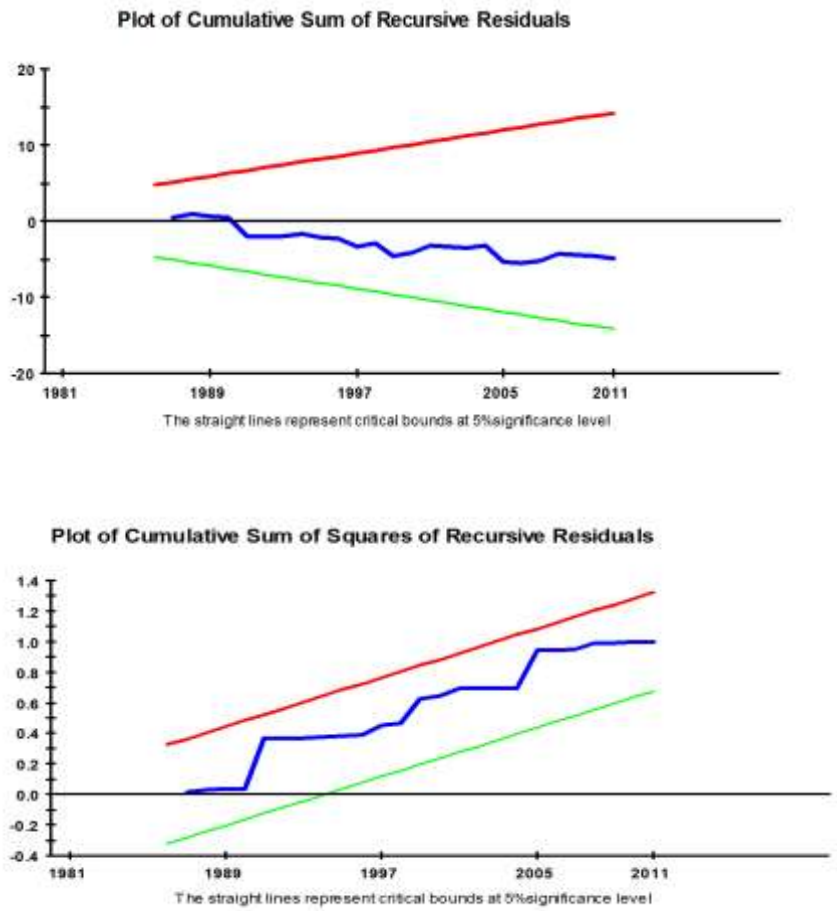

Figure 1: Plots Of Cusum And Cusumq Statistics For Coefficients Stability Tests

VII. CONCLUSION

The empirical results confirm the existence of a co-integration relationship among the variables under study. Based on the results in both the long and short-run, money supply, imported inflation, and real income have the most significant impact on the inflation rate in the Libyan economy. After the above variables, other variables such as exchange rate, output gap, and inflation expectation are the effective factors in inflation rise, respectively. Moreover, freezing of wages in the early eighties had a negative effect on inflation increasing in the Libyan economy. Similarly, the depreciation of the official exchange rate had a positive long-run impact upon the rate of inflation in the Libyan economy. Finally, the error correction term (-0.45) is found to be negative and statistically significant showing a strong and significant tendency for inflation rate to return back to long-run equilibrium when shocks occurred in the short-run.

Regarding the appropriate economic policies, aiming to minimize the adverse impact of both domestic and foreign factors on the inflation rate in the Libyan economy, the major outcomes of this study suggest that a development oriented policy in form of increased government investment on various sectors of the economy, in particular agricultural and gas sector results in an improvement of economic growth which will in turn reduce the inflation rate. It also suggests that policy of imports substitution not only contributes to reduce the Libyan economy's dependence on imports, but also protect itself against changes in its prices, and therefore, reduce the impact of foreign factors on domestic inflation. Moreover, inflation can also be cured by a sufficiently tight

monetary policy through instituting appropriate mechanisms to sterilize foreign exchange injections into the Libyan economy.

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