دراسة مدي استقرار المتغيرات الآقتصادية الرئيسية في الآقتصاد الليبي

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ملخص البحث:

يدرس البحث مدي استقرار المتغيرات الاقتصادية الرئيسية في الاقتصاد الليبي خلال الفترة من 1980الي 2011م , بالإضافة إلي تحديد الفواصل الهيكلية المهمة في البيانات الاقتصادية الليبية باستخدام بيانات السلاسل الزمنية التاريخية. وتشمل السلاسل الزمنية متغيرات الاقتصاد الكلي الرئيسية وهي عرض النقود , الدخل الحقيقي , مستوي الأسعار المحلية ,سعر الصرف, التضخم المستورد , التضخم المتوقع , وكذلك فجوة الناتج . وقد أظهرت نتائج اختبار جذر الوحدة (LM) مع أثنين من الفواصل الهيكلية وجود دليل إضافي ضد فرضية العدم لجذر الوحدة مقارنة بنتائج اختبارات جذور الوحدة التقليدية (ADF test and PP test) . بشكل أكثر تحديد , أشارت نتائج اختبار جذر الوحدة (LM) مع فاصل ثنائي المنشأ إلي أن متغيرات الاقتصاد الكلي الرئيسية وهي مستوي الأسعار المحلية , سعر الصرف, التضخم المستورد, والتضخم المتوقع تكون مستقرة الاتجاه عند دراسة الفاصل الهيكلي تحت فرضيتي العدم والبديل في وقت غير معلوم. علي العكس تماما , أشار تطبيق اختبار جذر الوحدة (LM) مع أثنين من الفواصل الهيكلية بشكل واضح الي أن باقي المتغيرات وهي عرض النقود والدخل الحقيقي غير مستقرة خلال فترة الدراسة.

Examining the Stationarity of Main Economic Variables in the Libyan Economy

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Abstract: This research tests the stationarity of main economic variables using historical time series data, as well as to determine the significant structural breaks in Libyan economic data during the period from 1980-2011. The time series includes money supply, real income, domestic price level, exchange rate, imported inflation, expected inflation, and output gap. The results of the LM unit root test with two structural breaks showed that there is additional evidence against the null hypothesis of unit root compared to the results of traditional unit root tests. More specifically, results of the endogenous two-break LM unit root test indicated that domestic price level, exchange rate, imported inflation, and expected inflation are trend stationary when the structural break is considered under both the null and alterative hypotheses at un-known time in trend function. On the contrary, applying the LM unit root test with two structural breaks apparently indicated that the following two variables: i.e. money supply and real income are non-stationary during the period of study.

Keywords: ADF test, PP test, LM unit root test with one-structural break, and LM unit root test with two-structural breaks.

I. Introduction

Any regression result with non-stationary time series provides spurious relationships between variables and therefore, provides misleading implication of the relationship. On the other hand, the presence of a deterministic trend indicates that the series has no unit root process and it is a required condition to provide valid economic implication of the empirical results generated from statistical estimation techniques (Elbeydi, and Hamuda, 2011;Akhtaruzzaman, 2005; Tehranchian, and Behravesh,2011). Thereby, it is necessary, before starting to perform any empirical estimations of the model, to analyze the time series data as to whether they are stationary or non-stationary.

Stationary data refers to the condition in which the means, variances and of these variables remain the same over the length of the series; that is, they are time invariant. Variables whose means and variances change over time are known as non-stationary or unit root variables (Glynn, Perera, and Verma, 2007).

A non-stationary time series can be transferred into a stationary time series by differencing. Accordingly, if the time y_t has to be differenced one time to make it stationary, then y_t is said to be integrated of order 1, denoted by $y_t \sim I$ (1). Similarly, if y_t has to be differenced d times, then the time series y_t is said to be integrated of order d, denoted by $y_t \sim I$ (d). However, if the time series y_t does not require any differencing (i.e. it is stationary), then it is said to be integrated of order zero, denoted by $y_t \sim I$ (0) (Ali, 2011).

II. Research Problem

During the last four decades, the Libyan economy has faced several severe business cycles, marked by periods of expansion and periods of recession. These business cycles resulted into structural changes in most of the economic variables, which are attributed to several events. These events include the oil boom and oil post boom periods, and other important events which took place during the 1980s and 1990s such as the embargo and sanctions imposed by the United States and United Nations. Thereby, it is necessary, before starting to perform any empirical estimation of Libyan models, to analyze the time series data as to whether they are integrated of order I(0) or I (1) , and not integrated of I(2).

III. Research Objective

This research has a very limited objective, i.e. to investigate Libyan economic time series during the period from 1980 to 2011. The aim is to empirically identify whether the time series used in this study is stationary or non-stationary, as well as to determine the major structural breaks of Libyan data.

IV. Literature Review

The stationarity 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 structural breaks, unit root test that takes into account one structural break, and unit root testing that takes into account multiple structural breaks. These tests are briefly discussed below.

4.1 Traditional Unit Root Tests

The most popular and widely used tests in empirical economic studies to examine the stationarity of a time series, in absence of a structural break, are the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979, 1981), and Phillips and Perron (PP) test (1988). 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. The ADF test has three possible types of models, based on the following regression forms:

With constant

$$\Delta y_t = \mu + \propto y_{t-1} + \sum_{i=1}^{n} \delta_i \Delta y_{t-1} + \in_t \qquad (1)$$

With constant and trend

$$\Delta y_t = \mu + \beta_t + \propto y_{t-1} + \sum_{i=1}^{n} \delta_i \Delta y_{t-1} + \in_t \qquad (2)$$

Without constant and trend

$$\Delta y_t = \propto y_{t-1} + \sum_{i=1}^{n} \delta_i \Delta y_{t-1} + \in_t \qquad (3)$$

Where Δ denotes the first difference operator, y is a time series, t is a linear time trend,μ is a constant,n is the number of lags which are included in the model to ensure that the error term$\in_t$ is serially uncorrelated, hence obtaining an unbiased estimate of $\propto$ (i.e. $\in_t$ is white noise with zero mean and constant variance). The null hypothesis of the ADF test is $\propto = 0$ (non-stationary series) against the alternative hypothesis of $\propto < 0$ (stationary series), where $\propto = p - 1$. Non-rejection of the null hypothesis implies that the time series y_t is non-stationary, and in this case the usual t-statistic can not be used, hence the ADF statistic is used. On the other hand, rejection of the null hypothesis signifies the time series is stationary.

The PP statistic is just modifications of the ADF statistic, which takes into account the less restrictive nature of the error process. Therefore, the ADF test corrects the serial correlation by including lagged differenced terms, while the PP test corrects the t-statistic of the coefficient ρ from the AR (1) model to account for the serial correlation in error terms (Elboiashi, 2011). The general form of PP test is estimated by the following regression:

$$\Delta y_t = \mu + \rho y_{t-1} + u_t \qquad (4)$$

Where Δ denotes the first difference, μ is an intercept, u is an error tern with zero mean and constant variance, and t is the time trend variable. The null hypothesis of the PP test is $\rho = 0$ (non-stationary series) against the alternative hypothesis of $\rho < 0$ (stationary series). Rejection of the null hypothesis implies that the time series y_t is stationary. On the other hand, non-rejection of the null hypothesis signifies the time series is non-stationary.

4.2 Unit Root Tests in the Presence of Structural Break

The traditional view held that current shocks only have a temporary effect and that the long-run movement in the series is unaltered by such shocks. Nelson and Plosser (1982) challenged this view and argued, using statistical techniques developed by Dickey and Fuller, that the current shocks in the United States have permanent effects on the long-run level of most macroeconomic variables by using long historical time series. The time series included money stock, velocity, Bond yield, common stock prices, real wages, wages, consumer price, GNP deflator, unemployment rate, employment, industrial production, real per capital GNP, nominal GNP, and real GNP. Nelson and Plosser could not reject the hypothesis that these series are non-stationary stochastic processes with no tendency to return to a trend .More specifically, they found evidence in favor of the unit root hypothesis (non-stationary) for 13 out of 14 macroeconomic aggregate. The results of Nelson and Plosser were challenged by Perron (1989), who argued that most macroeconomic time series are not characterized by the presence of a unit root and fluctuations are indeed stationary around a deterministic trend function. According to Perron the only exogenous shocks which have had persistent effects are the Great Crash in 1929 and the oil price shock in 1973.

In accordance to Perron (1989) failure to allow for an existing break leads to a bias that reduces the ability to reject a false unit root null hypothesis. In order to overcome this problem, Perron (1989) used a modified Dickey-Fuller (DF) unit root test that included dummy variables to account for one known, or exogenous structural break. The break point of the trend function is fixed (exogenous) and chosen independently of the data. Using data of Nelson and Plosser (1982), Perron chose the stock market crash of 1929 as a break point that permanently changed the level of series. He found that his result is somewhat different from their result. Perron reversed their conclusion by rejecting the unit root for 11 out of 14 American macroeconomic variables. The results confirmed the view that where there is a structural break, the ADF tests are biased towards the non-rejection of the unit root.

Perron's known assumption of the break date i.e., the timing of break points is known a priori, was criticized because of its tendency to favor the alternative hypothesis. Therefore, subsequent literature, most notably, Zivot and Andrews (1992), Perron and Vogelsang (1992), have incorporated an endogenous single break time into the model specification. More specifically, Zivot and Andrews (1992) developed a unit root testing procedure which utilizes the full sample and uses a different dummy variable for each possible break date. The break date is selected where the t-statistic from the ADF test of unit root is at a minimum. Consequently a break date will be chosen where the evidence is least favorable for the unit root null. The critical values in Zivot and Andrews (1992) are different to the critical values in Perron (1989). The difference is due to that the selecting of the time of the break is treated as the outcome of an estimation procedure, rather than predetermined exogenously.

Zivot and Andrews (1992) re-examine results of Perron (1989) by using data of Nelson and Plosser (1982).They reversed the conclusion of Perron by rejecting the unit root at the five percent significance level for only 3 of 13 series. Thereby, they provided evidence that confirmed findings of Nelson and Plosser, in the sense that the results are mostly in favor of the integrated model. In accordance to Zivot and Andrews this difference is attributed to two reasons. First, the break year defining dummy variables are estimated endogenous instead of being fixed at particular time, such as the Great Crash in 1929 and the oil price shocks in 1973. Second, Zivot and Andrews did not impose a structural break under their null hypothesis.

Unlike, Zivot and Andrews (1992) who re-examined the Nelson and Plosser data for a single endogenous break, Lumsdaine and Papell (1997) re-examined the Nelson and Plosser data for two endogenous breaks. They found more evidence against unit roots than Zivot and Andrews but less than Perron (1989).More specifically, using finite-sample critical values, they rejected the unit root null for five series at the five percent significance level, the three series found by Zivot and Andrews plus employment and capita real GNP.

4.3 Lagrange Multiplier Unit Root Tests

Extensions of the seminal work of Perron (1989) have been made by Perron and Vogelsang (1992), and Zivot and Andrews (1992), through accounting for one endogenous structural break, and by Lumsdaine and Papell (1997), through accounting for two structural breaks .This literature assumes no break(s) is allowed under the null hypothesis and derive their critical values in view of that, except Perron's (1989) exogenous break unit root test which allowed for a break under both the null and alternative hypothesis. However, Nunes, Newbold, and Kuan, 1997; and Lee and Strazicich 2003; indicated that the above unit root tests, based on the ADF test, suffer from spurious rejection in finite samples when a break is present under the null hypothesis.

Lee and Strazicich (2003) continued in this direction and stated that that the rejections of the null hypothesis in the above endogenous unit root tests does not necessarily imply rejection of a unit root hypothesis per se, but may imply rejection of a unit root without breaks. Similarly, the alternative does not necessarily imply trend stationary with breaks, but may indicate a unit root with breaks.

Lee and Strazicich (2003) expanded the LM test procedure of Schmidt and Phillips (1992) and provided a remedy to the limitations noted in the above tests, assuming a break (s) under the null and alternative hypothesis. Applying the LM unit root test suggested by Lee and Strazicich has at least five advantages. First, the structural break(s) is allowed under the null and the alternative hypothesis. Second, avoid the problem associated with the previous tests of bias and spurious rejections .Third, the procedure of minimum Lagrange Multiplier (LM) unit root test corresponds to Perron's exogenous structural break with change in the level and the trend. Fourth, the minimum LM unit root test determines the break points endogenously from data. Fifth, it enables accurate break point estimation.

Lee and Strazicich (2001, 2003) 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).The following regression can be used to obtain the LM unit root tests with one and two structural breaks.

$$\Delta y_t = \hat{\delta} \Delta Z_t + \emptyset \hat{S}_{t-1} + \sum_{i=1}^{k} y_i \Delta \hat{S}_{i-1} + u_t \quad (5)$$

Where $\hat{S}_{t-1} = y_t - \hat{\psi}_x - Z_t \hat{\delta}$, t = 2,…….., T; $\hat{\delta}$ are coefficients in the regression of Δy_t on ΔZ_t; The lagged augmented terms$\Delta \hat{S}_{i-1}$ are included into the model to remove the serial correlation problem; $\hat{\psi}_x$ is given by $y_t - Z_t \hat{\delta}$; and y_1 and Z_1 denote the first observations of y_t and $Z_t$respectively. $Z_t$is a vector of exogenous variables. In the case of one structural break unit root test, Z_t= [1, t,D_{1t},DT_{1t}] while in the case of two structural breaks unit root test, Z_t = [1, t,D_{1t} ,D_{2t} , DT_{1t} , DT_{2t}] , where D_{Jt} =1 , DT_{jt}= t - T_{Bj} for t ≥ T_{Bj} + 1 , j= 1,2 and zero otherwise.$T_{Bj}$is the time period of the structural break(s) and$\hat{\delta}$ = (δ_1, δ_2,δ_3). The LM unit root tests statistic is given by $\hat{\tau}$ = t-statistic for testing the null hypothesis of a unit root (∅ = 0). The location of the structural break(s) (T_{Bj})is determined by selecting all plausible break point(s) for the minimumstatistic as follow:

$$Inf\ \hat{\tau}(\tilde{\lambda_i}) = Inf_{\lambda}\ \hat{\tau}(\lambda)\text{ , where } \lambda = \frac{T_B}{T} \qquad (6)$$

Lee and Strazicich (2003) also applied their two-break minimum LM unit root test to Nelson and Plosser’s (1982) data and compared it with the two-break Lumsdaine and Papell test. They found stronger rejections of the null using the Lumsdaine and Papell test than the LM test. At the five percent significance level, they rejected the null for six series with the Lumsdaine and Papell test and four series with the LM test. Only the unit root null of industrial production and the unemployment rate are rejected by both the Lumsdaine and Papell and LM tests. Furthermore, Lee and Strazicich pointed out that the null was rejected at the five percent significance level for real GNP, nominal GNP, per-capita real GNP and employment using the Lumsdaine and Papell test, but the null for these variables was only rejected at the higher significance level with the LM test. Results from different methods of the unit root tests using the Nelson and Plosser’s data-set are summarized below in Table (1).

Table 1: Unit Root Tests with the Nelson and Plosser's data-set (1982)

Empirical Studies by:	Type of Model	Unit Root	Stationary
Nelson and Plosser (1982)	ADF test with no break	13	1
Perron (1989)**	Exogenous with one break	3	11
Zivot and Andrews (1992)*	Endogenous with one break	10	3
Lumsdaine and Papell (1997)*	Endogenous with two breaks	8	5
Lee and Strazicich (2003)**	Endogenous with two breaks	10	4

* Assume no break (s) under the null hypothesis unit root.

** Assume break (s) under both the null and alternative hypothesis.

V. Basic Research Methodology

In order to achieve the research objective, two statistical estimation techniques will be used in this study. First, EVIEWS 5 package will be used to investigate the null hypothesis that main macroeconomic variables have a unit root, against that they do not, in the level of variables as well as in their first differences.

Second, The GAUUS programming codes will be also used to compute LM unit root test with one and two structural break(s) in order to examine the hypothesis that Libyan macroeconomic variables have a unit root, and to identify the major structural breaks in the data for the Libyan economy.

5.1 Data Sources

Due to data limitations, the period of analysis will be from 1980 to 2011. The relevant data was obtained from different local and international sources such as:

1. Central Bank of Libya (CBL), Economic Bulletin: http: //www.cbl.gov.ly/en/.
2. National Authority for Information and Documentation: http: //www.gia.gov.ly/.
3. International Financial Statistic, IFS, International Monetary Fund.
4. World Development Indicators (WDI), World Bank.

The data from these different sources for the entire time series from 1980 until 2011, except few of them, is only available in the form of annual data. Consequently, this study has chosen annual data instead of quarterly data. Like many other developing countries, some of data is either not available or may be available but not always in the form of a consistent time series.

5.2 Specification of the Models

The theoretical frameworks of models have its foundation in the contributions of Dickey and Fuller (1979, 1981), Phillips and Perron (1988), and more recently and importantly Lee and Strazicich (2001, 2003).

To analyze whether the variables used in this study are stationary or non-stationary, as well as to determine the main structural breaks in Libyan time series, three models will be used. The first model is estimated by the following regression:

$$\Delta y_t = \mu + \beta_t + \propto y_{t-1} + \sum_{i=1}^{n} \delta_i \Delta y_{t-1} + \in_t \qquad (7)$$

Where Δ denotes the first difference operator, y is a time series, t is a linear time trend,μ is a constant,n is the number of lags which are included in the model to ensure that the error term$\in_t$ is serially uncorrelated, hence obtaining an unbiased estimate of $\propto$ (i.e. $\in_t$ is white noise with zero mean and constant variance).

The second model will be used to test the unit root hypothesis PP used the following specification:

$$\Delta y_t = \mu + \rho y_{t-1} + u_t \qquad (8)$$

Where Δ denotes the first difference, μ is an intercept, u is an error tern with zero mean and constant variance, and t is the time trend variable

The third model will be used to obtain the LM unit root tests with one and two structural breaks by the following regression:

$$\Delta y_t = \hat{\delta} \Delta Z_t + \emptyset \hat{S}_{t-1} + \sum_{i=1}^{k} y_i \Delta \hat{S}_{i-1} + u_t \quad (9)$$

Where $\hat{S}_{t-1} = y_t - \hat{\psi}_x - Z_t \hat{\delta}$, t = 2,…….., T; $\hat{\delta}$ are coefficients in the regression of Δ y_t on ΔZ_t; The lagged augmented terms$\Delta \hat{S}_{i-1}$ are included into the model to remove the serial correlation problem; $\hat{\psi}_x$ is given by y_t - $Z_t \hat{\delta}$; and y_1 and Z_1 denote the first observations of y_t and $Z_t$respectively. $Z_t$is a vector of exogenous variables. In the case of one structural break unit root test, Z_t= [1, t,D_{1t},DT_{1t}] while in the case of two structural breaks unit root test, Z_t = [1, t,D_{1t} ,D_{2t} , DT_{1t} , DT_{2t}] , where D_{Jt} =1 , DT_{jt}= t - T_{Bj} for t ≥ T_{Bj} + 1 , j= 1,2 and zero otherwise.$T_{Bj}$is the time period of the structural break(s) and$\hat{\delta}$ = (δ_1, δ_2,δ_3).

VI. 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 inclusion of the trend can be justified in that most of times series considered here have a trend. The graphs of the times series of interest are revealed in Figure 1.The Schwarz Bayesian Criterion (SBC) and Newey-West Bandwidth are utilized to select the optimum lags in ADF and PP respectively. The null hypothesis of a unit root is rejected if the value of the ADF test statistic and /or PP test statistic is greater than the critical value. The findings in Table 1 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.

More specifically, the ADF and PP statistics for level series of output gap (g) exceeded their critical value at 5% level of significance and this implies that this variable is stationary in level. On the other hand, ADF and PP statistics for levels series of the rest of variables did not exceed their critical values at 5% level of significance and this implies that the rest of variables are not stationary in levels. Therefore, testing the rest of variables in their first differences is performed. The ADF and PP tests statistics for first differences of the rest of variables namely narrow money supply (M^S), real income (Y), domestic price level **(**P), exchange rate (EX), expected inflation (e)**,** and imported inflation (p^f), exceeded their corresponding critical values at 5 percent. As a consequence, the null hypothesis of the existing of a unit root in the first differences of money supply (M^S), real income (Y), domestic price level **(**P**)**, exchange rate

(EX), expected inflation (e), and imported inflation(p^f), is rejected and this implies that these variables are stationary in first differences.

Overall, the stationary test results of time series variables using traditional unit root tests show that only output gap (g) is found to be to reject the null hypothesis of no stationary at level and this implies that the time series variable is relatively stable and integrated of order zero. While rest of time series variables accept the null hypothesis of no stationary at levels and are differenced once to make them stationary. This implies that the rest of variables data are not stable at levels but stable at first difference, i.e. integrated of order one.

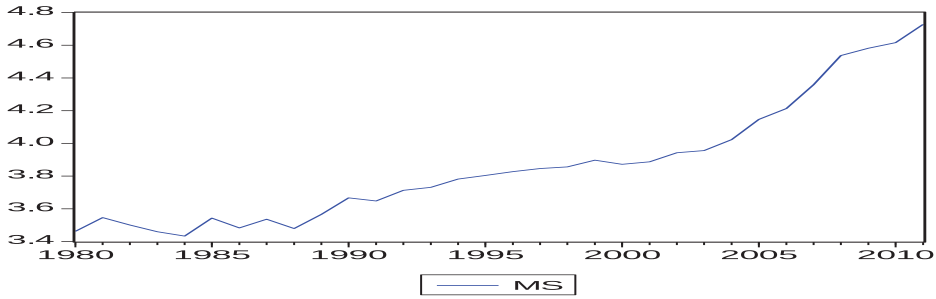
Generally speaking, results from the ADF and PP model are able to reject only 1 out of the 7, representing almost 14 percent of the variables of interest. These results may be biased towards the non-rejection of the unit root test, and the observed unit root behavior, as Perron (1989) suggested, resulting 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.

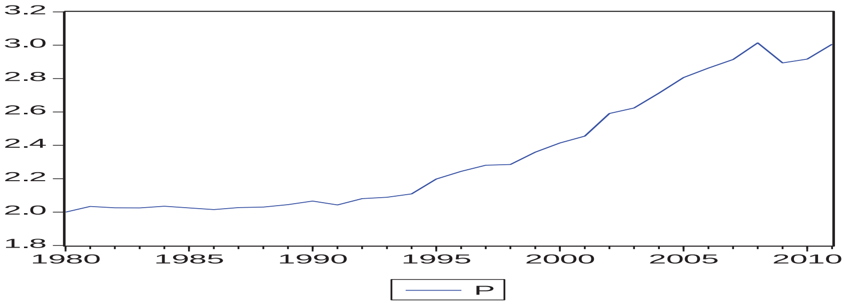
Table 2: Traditional Unit Root Tests for Stationarity (Includes an Intercept and a Linear Trend)

Variables	*I* (0)	*I (1)*	*I* (0)	*I (1)*	Decision
	ADF Test Statistics	ADF Test Statistics	PP Test Statistics	PP Test Statistics	
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.

Figure 1: Plots of the Time Series

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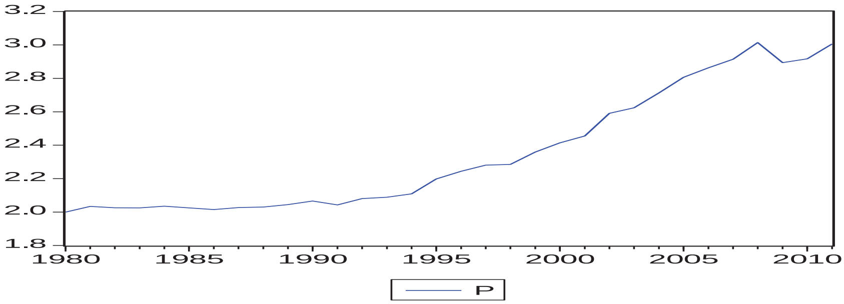
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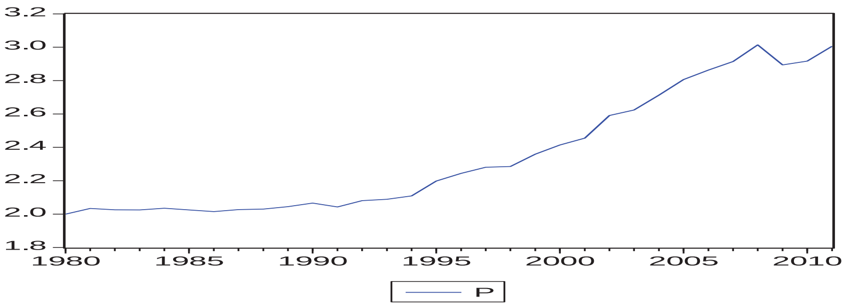
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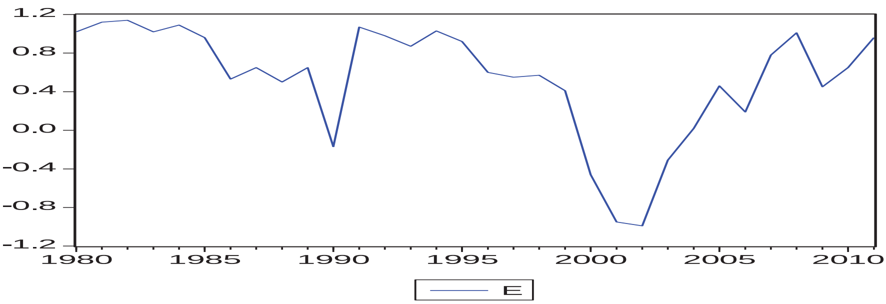
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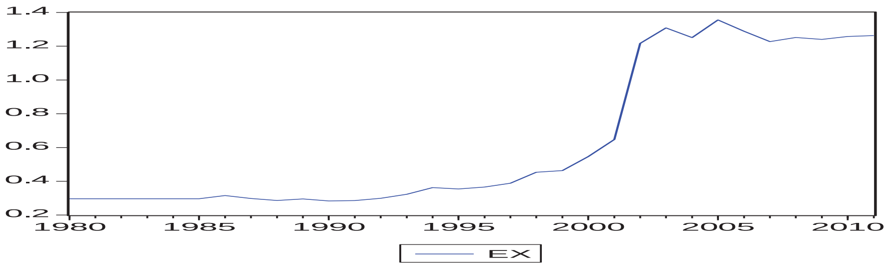

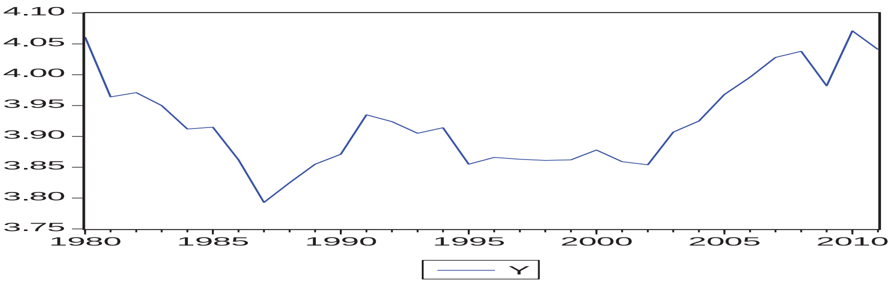

VII. Empirical results of the LM unit root test with one structural break.

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. One model is considered here; Model (C), which allows for two changes in the level and trend. All variables of interest are in log form, with exception of exchange rate. Due to the small sample size, a maximum of 4 lags was specified in GAUSS.

The results of the LM unit root test with one-structural break show a rejection of unit root null hypothesis for 4 out the 7 series. These are P, EX ,e, and g. On the contrary, the rest of variables are revealed to be non-stationary series. That is, applying the LM unit root test with one-structural break apparently indicates that the following three variables: i.e.,M^S, Y, and p^f are non-stationary.

In general, the results of the LM unit root test with one-structural break 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-percentlevel. (2)The critical values at the five percent significance level are as follows for P, eis λ= (0.4)= -4.50,for $EX$is λ= (0.3) = -4.45,and for g is λ= (0.2) = -4.47.

VIII. Empirical results of the LM unit root test with two endogenous structural breaks.

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. 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.

Overall, the two-break points in the level and trend for time series are significant for 5 time series. However, for the reminder of the time series the two breakpoints are not statistically significant in the first and/or in second break. These being narrow money supply (M^S), and real income (Y). 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 .

IX. Discussion and Conclusions

To test for the stationarity of the Libyan time series data, the ADF and PP tests were conducted for 7 time series. The regression results for ADF and PP tests with an intercept term and a liner trend indicates that the traditional unit root tests were able to reject 1 out of the 7 series, representing about 14 percent of the variables considered. Following the traditional unit root tests, the LM unit root test with one structural break was used to affirm the order of integration. The interesting features of the LM unit root test are that the break point is determined endogenously from the data; it does not exhibit spurious rejections in the finite sample when break occurs under the null hypothesis; and critical values of the test corresponds to the exogenous structural break test of Perron (1989). The results obtained from the LM unit root test with one structural break indicate a rejection of the unit root null hypothesis for 4 out of 7 variables. These results confirmed the claim of Perron (1989) that the observed unit root behavior by traditional unit root tests may have resulted from failure to account for a structural break in the data.

Lee and Strazicich (2003) concluded that in many economic time series, allowing for only one structural break may be too restrictive. Thereby, applying the LM unit root test with one structural break is insufficient, since significant structural breaks are very likely to have occurred in the Libyan economy time series. Thus, LM unit root test with two-structural breaks was used to determine the most significant structural breaks in the data. 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.

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