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An Empirical Analysis of the Impact of Selected Macroeconomic Variables on Capital Formation in Libya (1970–2010)

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***Abstract*—**This study is carried out to provide an insight into the analysis of the impact of selected macro-economic variables on gross fixed capital formation in Libya using annual data over the period (1970-2010). The importance of this study comes from the ability to show the relative important factors that impact the Libyan gross fixed capital formation. This understanding would give indications to decision makers on which policy they must focus to stimulate the economy. An Autoregressive Distributed Lag (ARDL) modeling process is employed to investigate the impact of the Gross Domestic Product, Monetary Base and Trade Openness on Gross Fixed Capital Formation in Libya. The results of this study reveal that there is an equilibrium relationship between capital formation and its determinants, also indicate that GDP and trade openness largely explain the pattern of capital formation in Libya. The findings and recommendations provide vital information relevant for policy formulation and implementation aimed to improve capital formation in Libya.

***Keywords*—**ARDL, Bounds test, capital formation, Cointegration, Libya.

I. Introduction

STUDYING determinants of capital formation is important in economic growth because it has vast implications in handling the issue of low capital formation in developing countries. Capital formation facilitates infrastructure development, and utilizes internal resources for production and manufacturing, encourage savings by increasing the number of financial institutions that ultimately lead to higher economic growth. Countries that were able to accumulate high levels of investment achieved faster rates of economic growth and development.

The effects of capital formation on economic growth are two-fold. Firstly, demand for investment goods forms part of aggregate demand in the economy. Thus a rise in capital formation will stimulates production of investment goods which in turn leads to high economic growth and development. Secondly, capital formation improves the productive capacity of the economy in a way that the economy is able to produce more output. Also, investment in new plant and machinery raises productivity growth by introducing new technology, which would also lead to faster economic growth. [6].

Raising the level of economic activity has always been the major concern of decision makers and economists. This concern comes from the importance of pinpointing the causes that may stand behind increasing economic activity, which in turn, has positive social, political, and economic consequences. There are different reasons that may raise the level of economic activity; two of them are investment and money supply [5].

There is general agreement that, in all countries, the process of economic growth and investment/capital formation is closely interconnected. Both neo-classical and Marxist economists have placed main emphasis on capital accumulation as the engine of economic growth [2].

An important use of capital is to increase the production of capital intensive goods. The consumption of such goods generally increase with the growth of income through which capital accumulation promotes growth of income [13].

A major factor determining the cost of capital is the interest rate. It affects all three of the major components of investment, fixed investment, inventory investment, and residential investment. Higher interest rates reduce both fixed and inventory investment because it increases the opportunity cost of funneling money into these two investment channels. It also reduces residential investment by reducing the demand for housing, thereby lowering home prices and the profitability of investing in housing [4].

The main purpose of the study is to investigate the short and long run effects of various macroeconomics variables on capital formation in Libya as one of the developing economies that seeking to encourage domestic investment as well as enhancing the performance of its economy.

The reminder of the paper is organized as follows: Section II reviews the evolution of the fixed capital formation in Libya. This is followed by the relevant theoretical and empirical consideration in the methodology section. Section IV contains data description and empirical results. Finally, the last section contains the conclusion remarks.

Libya's development relies on a number of positive factors such as its abundance of oil and gas resources, its relatively small population (5.8 million of inhabitants) and a very useful geographical location between Europe, Africa and the Arab countries of the Gulf. The economy of Libya depends largely upon revenues from the oil sector, which contribute practically all export earnings. These oil revenues have allowed the government to accumulate gross official reserves worth 115 billion Libyan Dinar (L.D.). Following the suspension of the United Nations (UN) sanctions in 1999, Libya has been trying

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to increase its attractiveness to foreign investors and several foreign companies have visited Libya in search of business opportunities.

Therefore, sufficient domestic saving is necessary for economic growth because it provides the domestic resources needed to fund the investment effort of a country.

TABLE I
LIBYAN GROSS FIXED CAPITAL FORMATION BY ECONOMIC SECTOR
(2002 – 2006)

ECONOMIC SECTORS*	YEARS 2002	2003	2004	2005	2006
Agriculture, hunting , forestry and Fishing	1351	906	676	1227	1127
Mining and Quarrying	977	1187	1274	1706	1794
Manufacturing Industries	478	441	471	480	581
Electricity, Gas and Water	606	1797	1200	2584	2222
Building and constructions	25	28	29	34	38
Trade, Hotels and Restaurants	37	30	57	61	72
Transport and Telecommunications	775	578	1157	1415	1556
Finance, insurance, and real estate	25	18	28	41	41
Ownership of Dwellings	2218	2450	3412	3415	4178
Education, Health care and Social Services	3214	2536	2378	2370	2806
Total Gross Fixed Capital Formation	9708	9971	10682	13331	14516

*Values are in Million Libyan Dinars [14]

It is interesting to show the capital formation behavior in Libya during this period, as can be seen from Table I, the general trend of total capital formation exhibits upward trend, the capital formation increased from 9.7 billion L.D. in 2002 to 10.6 billion L.D. in 2004 and reaching a peak of 14.5 billion L.D. in 2006.

II. METHODOLOGY

In modeling the determinants of investment five broad approaches are generally considered. These major approaches of investment behavior include the simple accelerator model, the liquidity theory, the expected profits theory, the Tobin's Q Theory, and the neoclassical flexible accelerator theory. The flexible accelerator model appears to be the most popular of these theories used in applied work [3].

However, in the context of developing countries, due to data limitations and structural constraints, a variant of the flexible accelerator model has often been used in empirical research, including the literature on the determinants of investment in developing countries. Neoclassical investment theory suggests that investment is positively related to the growth of real Gross Domestic Product. Similarly, it has also been hypothesized that investment is affected positively by income level, as countries with higher income level would tend to dedicate more of their wealth to domestic savings which would then be used to finance investment [7].

There are different reasons that may raise the level of economic activity; two of them are investment and money supply. In this study, investment is proxied by the gross fixed capital formation (GFCF), the narrow definition of money (M) will stand for the money supply (M), and finally the gross domestic product (GDP) will be used as an indicator for economic activity.

Finally, Trade openness is suggested to be another important determinant of investment in developing countries.

Trade openness, as measured by total trade as a share of GDP, is expected to boost investment due to the elimination (reduction) of tariffs and non-tariff barriers and the opening of markets. This variable is often used to proxy external shocks to the economy [11].

Reducing trade barriers through liberalization creates an advantage to the export sector and thus improves the current account balance and increases investment incentives. Further, with import opportunities, the available quality and supply of inputs to production increases with increased competitiveness and productivity [8].

The study used annual time series data covering the period from 1970 to 2010. Data on investment has been obtained from the Secretariat of Planning; data on Gross Domestic Product, Trade Openness and monetary base are obtained from the Central Bank of Libya. Natural logs of the variables were taken for the estimation.

Summary statistics of the variables are presented in Table II.

TABLE II
SUMMARY STATISTICS OF THE VARIABLES

	GDP	GCF	MB	OPNS
Mean	22579	4461	4575	71
Median	8932	1558	3185	76
Maximum	116639	17562	22604	98
Minimum	1288	242	199	37
Std. Dev.	30613	5825	5171	18

Table II shows the summary statistics of the variables used in the study. These summary statistics reflect the overall picture of the variables. The value for capital formation in Libya is in average 4.4 billion L.D. over the past 40 years this indicator reached a maximum value of 17.5 billion L.D. in 2008 and a minimum value of 0.24 billion L.D. in 1970.

Many time series are non –stationary and in general if the series is nonstationary, it is not possible to use traditional econometric techniques since models with nonstationary variables might lead to a problem of spurious regression. For this reason, it is important to establish the stationary properties of the series; cointegration implies the existence of meaningful long run equilibrium [12].

So many econometric methods have been proposed for investigating long-run equilibrium (cointegration) among time series variables; including a number of cointegration tests, namely the Engle-Granger method commonly known as the two-step estimation procedure, the Phillips-Ouliaris methods and the Johansen's procedure. For the purpose of this study the Autoregressive Distributed Lag modeling approach (ARDL) is

utilized, the ARDL approach has several advantages in comparison with other single cointegration procedures, and result from the ability to estimate the long and short-run parameters of the model simultaneously, while avoiding the problems posed by non-stationary time series data. In addition, this approach does not require a prior determination of the order of the integration amongst the variables, unlike other approaches which require that the variables in the time series are integrated of the same order. Furthermore, the ARDL procedure is the more statistically significant approach to determine the cointegration relation in small samples, besides the ARDL procedure allows that the variables may have different optimal lags.

Following the empirical literature, the standard log-linear functional specification of long-run relationship for capital formation equation may be expressed as:

$$\mathrm{GCF}_t = F(GDP_t, MB_t, OPNS_t, U_t) \quad (1)$$

where at period t GCF is the gross capital formation, GDP is gross domestic product, MB monetary base, OPNS is trade openness and U is error term.

Investigate the existence of a long-run relationship amongst the variables of (1) is tested by means of bounds testing procedure. The bounds test procedure is based on the Wald or F-statistic, the asymptotic distribution of the F statistic is non-standard under the null hypothesis of no cointegration relationship between the examined variables, irrespective of whether the explanatory variables are purely I(0) or I(1), [10]. The cointegration relationship for the capital formation equation is estimated using the bounds test, which is based on the following Unrestricted Error Correction Model (UECM) as follows:

$$\Delta \ln \mathrm{GCF}_t = bo + \sum_{t=0}^{n} b_1 \Delta \ln GDP_{t-i} + \sum_{t=0}^{n} b_2 \Delta \ln MB_{t-i} + \sum_{t-i}^{n} b_3 \Delta \ln OPNS_{t-i} + \sum_{t-1}^{n} b_4 \Delta \ln \mathrm{GCF}_{t-1} + b_5 \ln GDP_{t-1} + b_6 \ln MB_{t-1} + b_7 OPNS_{t-1} + b_8 \ln \mathrm{GCF}_{t-1} \quad (2)$$

where ΔlnGCF, ΔlnGDP, ΔlnOPNS, and ΔlnMB are the first difference of the logarithms of the capital formation, gross domestic product, trade openness and monetary base respectively.

The null hypothesis is tested by considering the UECM for capital formation equation in (2) excluding the lagged variables GCF, GDP, OPNS and MB; more formally, we perform a joint significance test, where the null and alternative hypotheses are:

$$H_O : b_5 = b_6 = b_7 = b_8 = 0$$
$$H_A : b_5 \neq b_6 \neq b_7 \neq b_8 \neq 0$$

Two sets of critical values are generated, the upper bound critical values refers to the I(1) series and the lower bound critical values to the I(0) series. For some significance level, if the F-statistic falls outside the critical bound, a conclusive inference can be made without considering the order of integration of the explanatory variables. For example, if the F-statistic is higher than the critical bound, then the null hypothesis of no cointegration is rejected. In the case when the F-statistic falls between the upper and lower bounds, a conclusive inference cannot be made. Here, the order of integration for the explanatory variables must be known before any conclusion can be drawn [10].

To find out the goodness of fit of the ARDL model, the diagnostic and stability tests are conducted. The diagnostic test examines the serial correlation, functional form, normality and heteroscedasticity associated with the model [9].

The Error Correction Mechanism (ECM) is used to examine the short run impact on independent variables upon the gross capital formation. The ECM coefficient shows how slowly or quickly variables return to the equilibrium. The appearance of ECM with a negative sign ensures that an established long run relationship can be attained. The ECM estimates the speed of adjustment to reestablish the stable equilibrium in the dynamic short run model.

III. Empirical Results

The ARDL procedure starts with determining the appropriate lag order (p) in (1). For this purpose, we use the Akaike Information Criterion (AIC), the AIC indicates that p=1 is the most appropriate lag length for the capital formation equation [9].

A more efficient univariate DF-GLS test has been utilized to explore the order of integration of the variables. The test is a simple modification of the conventional Augmented Dickey-Fuller (ADF) t-test as it applies generalized leas squares (GLS) prior to running the ADF test regression [1]. The DF-GLS test has the best overall performance in terms of sample size and power over the ADF tests. The results of unit root test are reported in Table III.

TABLE III
Modified Dicky-Fuller (DF-GLS) Unit Roots Tests

Variables	Level	First Difference
LGCF	-1.833	-3.903*
LGDP	-1.184	-5.261*
LMB	1.161	-3.380*
LOPENS	-1.564	-5.643*

* indicates significance at 5% level, -3.190

Table III reports DF_GLS unit root test results for stationarity of all the variables over the study period, all the variables are found to contain a unit root in their levels and thus are difference-stationary, i.e., these variables were integrated of order I (1).

In the first step of the ARDL analysis we tested for the presence of long run relationships in the model. The results of the bound test indicate that the calculated F statistics is 3.64 at 1% is higher than the upper bound critical value. This implying that the null hypothesis of no co-integration cannot be accepted and that there is indeed a co- integration

relationship among the variables. The relevant critical value bounds are obtained from Table CI(iii) in Pesaran et al. [10].

The short-run dynamics of capital formation are given in (3).

$$LGCF_t = -2.3 + 0.2LGCF_{t-1} + 1.0LGDP_t - 1.0LMB_t + 0.6LMB_{t-1} + 0.38LOPNS_t \quad (3)$$
$$(-2.44)\ (2.19)\qquad (7.18)\qquad (-4.75)\qquad (3.15)\qquad (1.85)$$

As shown in (3) above, most of the estimated coefficients have their expected theoretical or hypothesized signs except monetary base at current year. Also the results show that there is a positive short-run impact of GDP on capital formation.

Specifically, the results confirm a significant effect on capital formation in Libya at the aggregate level over the period 1970-2010.

This means an increase in GDP or aggregate demand conditions has the potential of stimulating capital formation in Libya. From the results, the coefficient of GDP is statistically significant at the 5 percent level, indicating that if the country were to increase her GDP by 1 percent, capital formation will increase by 1.01 percent.

Considering the impact of trade openness, it is significant at 5 % significant and has the expected positive impact on economic capital formation, a 1 percent increase in trade openness leads to 0.38 percent increase in capital formation.

The regression for the underlying ARDL (3) fits very well at R^2=97 %. Diagnostic tests for serial correlation, functional form, normality and heteroscedisticity are conducted and the results are showing that short run model passes through all diagnostic tests in the first stage. The results also indicated that there is no evidence of serial correlation among variables because functional form of model is well specified and there is no evidence for heteroscedisticity.

The estimated long run coefficients using the ARDL approach are shown in (4).

$$LGCF_t = -3.22 + 1.37LGDP_t - 0.49LMB_t + 0.49LOPNS_t \quad (4)$$
$$(-3.21)\ (9.70)\qquad (-3.14)\qquad (2.23)$$

In the long run, the impact of GDP and trade openness are found to be positive and significant, the magnitude of the coefficients are 1.37, 0.49 respectively.

The Error Correction Representation for the Selected ARDL Model is shown in (5).

$$\Delta LGCF_t = -2.3 + 1.01\Delta LGDP_t - 1.04\Delta LMB_t + 0.38\Delta LOPNS_t - 0.73\ ECT_{t-1} \quad (5)$$
$$(-2.44)\ (7.81)\qquad (-4.75)\qquad (1.85)\qquad (-5.89)$$

The equilibrium correction coefficient (ECT), estimated -0.73 (0.001) is highly significant, has the correct sign and imply a fairly high speed of adjustment to equilibrium after a shock. Approximately 73% of disequilibria from the previous year's shock converge back to the long-run equilibrium in the current year.

The results from the ECT reveal that Gross Domestic Product has significant implications for capital formation; this finding is consistent with the neo-classical investment theory which stipulates that greater output enhances investment.

IV. Conclusion

The paper has investigated the long run determinants of capital formation in Libya over the Period of 1970-2010.The study highlights important key macroeconomic variables that have had significant impact on capital formation in Libya over the study period. The long run estimate of the capital formation function for Libya was derived using the ARDL bounds approach. Given the importance of capital formation for the economic development, the gross domestic product and trade openness variables must be taken into account for their potential impact on investment decisions.

The results of this study indicate that GDP and trade openness largely explain the pattern of investment in Libya. The paper found evidence that capital formation, GDP, monetary base and trade openness are bound together in the long run. Also the results show that there is a positive short-run impact of GDP on capital formation. From the above analysis we conclude that GDP and trade openness are the important factors of gross capital formation of Libya.

The findings of this study are crucial for formulation of development strategies, with others; there is the need for the government to carry on creating favorable investment climate and improving the infrastructure base o the economy to boost capital formation.

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