

Natural Resources And Population Growth; What Is The Relationship?
Evidence From Oil-Based Economy.

Dr.Tloba Abdelatif *

University of Musurata Libye

Publication date: 31/12/2019

Abstract

Writings on natural resources and population growth had started since Malthus had published his pioneered idea on population-natural resources connection. Recent years the relationship became rare. This paper aims to investigate the potential effect of natural resources on population changes once again in one of the highest dependence economies on oil. It lays a question whether natural resources (oil wealth) and its fluctuations have impacts on population growth. Employing vector error correction model VECM utilizing data covered 56 years on variables of interest. Findings reveal that variables related to natural resources showed a strong causal relationship with population changes: however, government spending is likely the most influential, seeming to be the main channel for natural resource impacts on population changes in both the long and short run. More specifically, current government spending (i.e. government consumption) has a significant positive effect on both periods, while development expenditure shows a significant negative in the long-run and positive and weak effect in the short term. These results are consistent with theoretical fundamentals since development spending is expected to lower population growth. The interesting finding is that the strong influence of natural resource abundance on population growth because through government

social expenditure is strong. This effect is high to the point that fluctuations in the global oil market can be observed in the variations of population growth rates.

Key words: Exhaustible Resources and Economic Development, Fertility, National Government Expenditure, Population

JEL: Q32, J13, H5, R23

“It stands to reason that countries with larger populations might enjoy long-run economic advantages. People are the raw material of economic growth, after all”

The Economist. April 17th 2019¹

1. Introduction

Population in the Middle East and North Africa (MENA) has grown four-fold since 1950 (Gardner, 2003). High population growth is also one of the notable characteristics of Libyan society as part of this region.

The common question in economics and related research is how does population affect economic growth? The answer is still debatable, as population growth can be detrimental or beneficial to economic growth for any country. While some researchers argue that low population growth may increase capital accumulation and productivity in turn, others assert that population expansion is preferable to widen markets and production later on. For Libya, looking at population pyramids, show that the growth rate been on high levels-even by decades. These rates rose from the late 1950s/early 1960s up to the 1970s then, decreasing from the early 1980s up to the 1990s. The population pattern to this point is not surprising baring in mind the common pattern of population growth in developing societies. However, an unexpected trend towards increased growth in the 1990s can be noticed. This also can be observed again in 2012. In both dates, it coincides with an oil prices boom

¹ The Economist, <https://www.economist.com/finance-and-economics/2019/04/17/where-growth-is-concerned-is-population-destiny?cid1=cust/dailypicks/n/bl/n/20190423n/owned/n/n/dailypicks/n/n/A/231321/n> Accessed, 24 April 2019 15:00pm.

(Taloba and Jaroushi, 2015). Thus, growth rates appear to rise in conjunction with high oil prices and vice versa. This prompts the question of what causes lead to population changes in Libya, and calls for investigation of a potential relationship between population growth and natural resource abundance and wealth. Nevertheless, the question arises of whether economic growth contributes to population or the opposite assumption of population growth as a result of natural resources is true.

2. Literature Review

Population growth is influenced by many factors: however, it is well-known that “demographic transition” is one of economic development’s consequences in human societies. Determinants influencing population growth are often grouped into five categories. They are; demographic characteristics, socioeconomic variables, natural amenities, transportations accessibility and finally, land use and development (Lutz & Qiang, 2002).

The second, socio-economic variables, will be considered here. It includes economics-related conditions such as income per capita, employment, and wages, as well as development. It is claimed that regions with low unemployment rate and good economic aspects tend to witness higher rates of population growth (Alvarez-Dias et al. 2018).

Theoretical debate discusses whether population growth affects or is affected by level of economic development. Many studies’ findings show mixed results. As Hagen (1959) and Thirlwall (1972) concluded, it is difficult to confirm any systematic causal connection between population growth and standards of living². In this context, researchers are still divided into three groups: one claims that

² A good example of contradiction in the population-economic growth relationship can be found within the United Nations, “Inquiry among Governments on Population Problems Resulting from the Interaction of Economic Development and Population Change, Doc. E/3895/Rev. 1, 24th November 1964.

population growth promotes economic growth; another argues that it restricts it; while others suggest that the relationship between them is neutral (Bloom et al., 2003). More recently, while there was a significant negative relationship between income level and population growth in most American cities, Glaeser and Shapiro (2003), Huang et al. (2016) and González-Val (2015) find a positive effect.

Darrat and Al-Yousif (1999) show that there are at least three schools in this context. One, the Malthusian or “orthodox” view, claims that the relationship is indeed negative where rapid growth of population leads to a poverty and by control fertility rates to foster economic growth, while “revisionism” argues that higher population growth supports human capital and thus contributes to economic growth positively. They find that in twenty developing countries, higher population promotes economic growth in more than half of the sample. Therefore, the direction of causality is from population to economic growth, while other patterns of causality (reverse and bi-directional) still featuring for several countries. They also argue that in the early stages of development, population expansion seems a consequence rather than a cause of poverty (Darrat & Al-Yousif, 1999). In this context, Srinivasan (1988b) and Bloom et al. (2001) provides a good review for these three aspects and criticised them of blaming inappropriate policies for deleterious consequences instead of rapid population growth.

On the other hand, “transition” theory claims that population growth is driven by income change, which reverses causality. Dominant macroeconomic fact in developed economies is that continuous growth for nearly two centuries came mainly from labour productivity rather than labour force (Blanchard, 2000; Blanchard et al., 1989). This argument assumes that population structure is more important than population size for economic growth. Similar ideas can also be understood from Malthus (Malthus, 1798).

Sinding (2009) argues that although there is less agreement that lower population growth would contribute to economic growth, there is increased evidence of the

positive effect of low birth rates on economic conditions. Adelman (1963) supports this argument, he claims that socioeconomic variables seem to have less influence on population than economic development.

Empirically, Masoud and Al-Ghusain (2015) report that population growth negatively affected economic growth for Libya for the period 1970-2010. This leads to the main aim for this paper to investigate the causal relationship between the two main variables; namely, natural resources measured by per-capita GDP and population growth over the period of 1962 to 2017 which covers the era of oil. Per-capita income is the most-used proxy to measure economic growth. However, variables such as unemployment rate, intervention of the public sector, level of wages, level of industrial specialization and sectoral structure are often used to explain changes in population growth rates (Glaeser et al., 1995; Clark & Murphy, 1996; Cullen & Levitt, 1999; Faria et al., 2006; Baum-Snow, 2007; Duranton & Turner, 2012; González-Val, 2015).

Although urbanisation is the most significant feature of modern societies, and might be a necessary condition for growth without being sufficient. However, when rural-urban migration occurs due to easy money, and its incentives are governmentally provided and do not result in genuine economic opportunities, it is argued that urbanisation does not lead to economic growth (Huq et al. 2009). In many developing countries, the key concerns are that the urban population may rise quickly to the point that it hinders growth due to intractable and unmanageable problems such as unemployment and degradation of the urban environment (Huq, Clunies-Ross et al. 2009). While urbanisation has spread widely in MENA countries since 1970, and half of these populations are living in urban areas (UNDP, 2010). In Libya, this urbanisation trend was quicker than most neighbouring countries (Madbouly 2009).

3. Brief Review on Population Growth and Structure in Libya

On overall scope, while the whole MENA region witnessed high growth and structural change in population during the last five decades (UNDP, 2010). Libya recorded almost the highest rates in this context. The population grew nearly six-fold between 1954 and 2012, from just 1.04 to 6.02 million, and created some of the most intense pressures on labour markets anywhere in the post-World War II world (IBRD, 2004).

In the world context, Libya mirrors Canada in many ways in having almost identical population densities a large area, and the population concentrated in a narrow strip, with a total surface area of 1,760,000 square kilometres (685,000 square miles).

Table 1 Population Development in Libya

<i>Census year</i>	<i>Population</i>	<i>Average Growth.</i>
1931	704000	-
1936	849000	4.8
1954	1041599	1.21
1964	1515501	4.25
1973	2252372	5.08
1984	3561059	4.69
1995	4789739	3.01
2006	5723991	1.80
2012	6027953	1.04
2016*	6754507	2.89

Thus, the population started to grow rapidly after independence in 1952. Ten years later, oil had been discovered and standards of living improved, which encouraged growth in population. These two factors contributed to population growth later on, (Attwairi, 2017). Annual average growth showed

significant increase in the period 1954-1973, before declining.

Source: ³ Statistics and census Authority, Population=

It fell steadily from 1973-1984 then, it dropped notably from 1984-1995, before falling less quickly in the mid-1990s.

³ = Census (1964, 1973, 1984), Statistics and Census Authority, Employment Census (2012).

*2017, <https://www.cia.gov/library/publications/the-world-factbook/geos/ly.html>

General Information Authority, Census (1995, 2006) results.

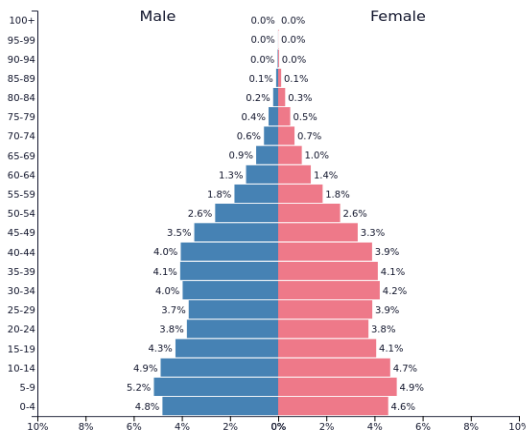
Al-gzeari, Saad, (2002), Urbanisation Expansion and Geographic re-distribution of Population.

Taloba and Jaroushi, Population of Libya, Developing and Future aspects, (2015), Journal of Economics and Finance Researches, Vol, 3, Issue, 2, (12, and 2015).

http://mdr.misuratau.edu.ly/bitstream/handle/123456789/601/189.pdf?sequence=1&isAllowed=y&fbclid=IwAR09q_MWlddT7CQBy0wjJEfQM1riaPjWMwCCWAFce1myowojSqVZhgnnAvo

According to “demographic transition” perspectives, it is expected for any population to grow rapidly in the early stage of developing, then starts to decrease over time. (Birdsall, 1988; Bloom & Williamson, 1998). For Libya, this period had started by the early 1950s and lasted until the late 1970s before started to work by the early 1970s when birth rate slowed down steadily due to urbanisation and female education expanded as Barro & Lee, (2001) claimed. Population pyramid in Figure (1) demonstrates that population structure in Libya had developed following a predicted pattern of typical developing countries up to the year 2000.

Figure 1 Libyan population pyramid 2018



Unexpectedly, growth rates increased once again starting from 2002. The most important reason behind this is the fertility rate, which started to increase again by the end of 1990s. Therefore, the Libyan population structure was maturing up to the late 1990s as with many developing countries, but then turned once again towards a youthful population structure as shown in Table (2).

Source: <https://www.populationpyramid.net/libya/2018/>

The table shows that the ‘children’ category increased from 43.15% in 1955 to 51.4% in 1973 when it peaked, resulting in the workforce shrinking to 44.4%.

Table 2 Population structure over the studied period

Age Category Census Year	Less than 15		15- 64		Above 65		Total No.
	No.	Percent	No.	Percent	No.	Percent	
1955	529268	43.1	653296	53.2	45436	3.7	1228000
1965	772112	45.1	873120	51.0	66768	3.9	1712000
1973	1054609	51.4	910032	44.4	86731	4.2	2052372
1984	1610939	49.9	1503607	46.5	116318	3.6	3231059
1995	1714263	39.1	2504042	57.0	171434	3.9	4389739
2006	1645833	31.1	3427413	64.7	224906	4.2	5298152
2012	1936200	32.9	3701200	63.0	240700	4.1	5878100
2017	1648852	26.2	4385177	69.6	265883	2.4	6300541

Source: World fact Book, 2016. Public Institute for Information, Statistical Book2006. General census 2012.

By 1973, the ‘work’ category started to increase, which created continuing problems in the labour market lasted to now. One economic consequence of this structural change was the rise in the dependency ratio⁴, which in turn increased stress on government provision of public goods and on the labour force segment and affected growth in the non-oil GDP because of its pressure on social expenditure and increased numbers of students (Shaafi and Al-Ghosain, 2015). Considering the high rate of unemployment, the high rate of work category becomes more harmful, as it goes up with unemployment.

With no potential explanatory reason, it is worth exploring the causes that might affect this unusual trend, taking into account that there was no government policy targeting population.

4. Methodology and Data Description

4.1. Problem Statement

This paper aims to investigate the potential effect of natural resources on population changes during the period of natural resource abundance in Libya (1960s and beyond)?

To answer this question, the changes in population will be connected to the most well-known variables of natural resources to examine the relationships in the long run.

4.2. The Model

A simple model is suggested to capture this influence of natural resource represented by government social spending over the period (1962-2017) as follow:

$$PopGrowth_t = f(Social\ Government\ Expenditure) \dots\dots (1)$$

Due to the nature of rent-seeking economies, government current expenditure and investment expenditure are considered as a proxy for social expenditure. Therefore,

⁴ Dependency ratio, defined as the number of people aged under 14 and over 64 years to the number of people of working age, i.e.15-64.

In Libya, the government budget is often divided into two parts, namely: current includes wages for public sector. Development: includes new projects and investment.

$$PopGrowth_t = f(PerCex_t, Perinv_t) \dots \dots (2)$$

Where, $PopGrowth_t$ population growth in the period t .

$PerCex_t$, per capita current expenditure for the period t .

$Perinv_t$, per capita development expenditure (investment) for the period t .

Accordingly, the equation to be estimated is in the following expression:

Since all variables of interest are stationary at first difference I (1), and the co-integrating relationship has been confirmed, the Vector Error Correction Model [VECM] is recommended. Granger and Newbold firstly draw attention to this method for time-series problematic properties (Granger & Newbold, 1974; Granger et al., 2001). Then Davidson et al. (1978) developed an approach that includes short-run dynamics implied by first differences, as well as the long run relationship between original values, incorporated into the model as an error correction mechanism (ECM) (Davidson et al., 1978). Engle and Granger (1987) explains that this method is possible only if the variables under consideration are co-integrated (Engle & Granger, 1987).

This technique has some advantages that suits the current study's goal: first, it adjusts to both short and long-run changes and deviations from long-run equilibrium. Also, it determines adjusting dynamics based on whether the estimating model will return to equilibrium. It also estimates the speed at which the dependent variable returns to a state of equilibrium after change in other variables. This approach outweighs the previous ECM technique, which is restricted to one single equation with a specific variable as dependent, and explained by another that is assumed to be exogenous. In addition, the ECM approach requires the stationarity of variables of interest at I (0) or I (1). The VECM approach addresses these

disadvantages, as pre-testing is not necessary, there can be more than one co-integrating equation and all variables can be treated as endogenous (Engle and Granger 1987).

The relationship will be estimated in a semi-log formula as follows:

$$\ln (Pop_{gr})_t = \beta (PerCex)_t + \gamma (PerInv_t) + u_t \dots \dots (3)$$

Where $\ln (Pop)_{gr}$ is the natural logarithm of annual growth in population, β , γ are the desired parameter of per-capita current government expenditure and development government expenditure respectively, while u_t is the error term of estimation varying across time with zero mean. All data are in 2010 prices.

4.3. Data Description and Sources

As demonstrated in Table (3), dependent variable will be proxied by annual population growth, from 1962-2017. Meanwhile, natural resource is proxied by social government expenditure because the potential effect of NR will definitely come through social government expenditure. This effect results from oil revenues and influence living standards for the population. Independent variables are government current expenditure, government development expenditure. They could be considered as proxies for per-capita income, since the government is the main actor at an economic level in Libya. In the meantime, per-capita income is often used as an explaining factor for population changes and living standards may provide a good interpretation in this regard (Glaeser et al., 1995; Clark & Murphy, 1996; Cullen & Levitt, 1999; Faria et al., 2006). Thus, living standards will be proxied by government spending. The study will be carried out in two steps: the first is to look for causation between population growth on one hand and other independent variables on the other, secondly estimating the relationship between population growth and variables that present a causal effect on population in the first step.

Table 3 Variables employed for the model

Proxies for Independent Variable		Proxies for Dependent Variables	
Variable Name	Var. logo	Variable Name	Var. logo
Population	Pop	Per capita government current expenditure	PerCex
Annual population growth	(Pop)gr	Per-capita gov. investment expenditure	PerInv

5. Estimation and Results

5.1. Pre-estimation Tests

Before proceeding, some tests are required to determine what variables are reliable for econometric analysis and what variables are more related to the study's goals.

A. Correlation

Correlation between variables can be considered a primer indicator. The table below shows that all variables under consideration in both nominal and real values are correlated positively with population, and some are correlated above 0.5. Although nominal values are usually not considered often, it is well-known that the money illusion of on the macroeconomic level influences expectation among the public. These expectations are crucial in decisions that affect population trends, such as new families and new births, which are in fact the most related variables to population change.

Table 4 Correlation matrix of employed variable

	<i>Pop</i>	<i>(PerCex)r</i>	<i>(PerInv)r</i>	<i>(Cex)n</i>	<i>(InvExp)n</i>
<i>Pop</i>	1.000				
<i>(PerCex)r</i>	0.359	1.000			
<i>(PerInv)r</i>	0.183	0.381	1.000		
<i>(Cex)n</i>	0.650	0.761	0.043	1.000	
<i>(InvExp)n</i>	0.594	0.342	0.738	0.417	1.000

B. Stationarity Test

Stationarity tests are also conducted. Results show that proxies considered by our model are all stationary at first difference.

Table 5 Stationarity tests for employed variables

Test Variable	A.D.F. Test			P.P. Test		
	Calculated Stat.	Trend Intercept	Stationary at...	Calculated Stat.	Trend Intercept	Stationary at...
<i>ln(Pop)gr</i>	-10.05***	Non	(I)	-9.82***	Non	(I)
<i>(PerCex)r</i>	-6.99***	Non	(I)	-6.99***	Non	(I)
<i>(PerInv)r</i>	-8.41***	Non	(I)	-7.39***	Non	(I)

*I. Intercept. T. Trend. Non. No intercept, no trend. *** significant at 99 percent.

C. Causality Test

Causality test is conducted to ensure the causation relationship in the model of interest. Two and four lags have been considered. Results show that the causation relationship influencing population is running in one direction, from all variables of interest to population, except for current government expenditure, which reveals a bi-directional causality when four period lags are set. This means that a long-run relationship between population growth and current expenditure, while for investment expenditure, the causation relationship is only uni-directional, running from investment expenditure to population growth for two and four lags. This can be explained in the context of the government budget procedure in Libya. Most current expenditure consists of wages for labour in public services, which increased remarkably after oil discovery in consistent with population increase.

Table 6 Granger Causality test

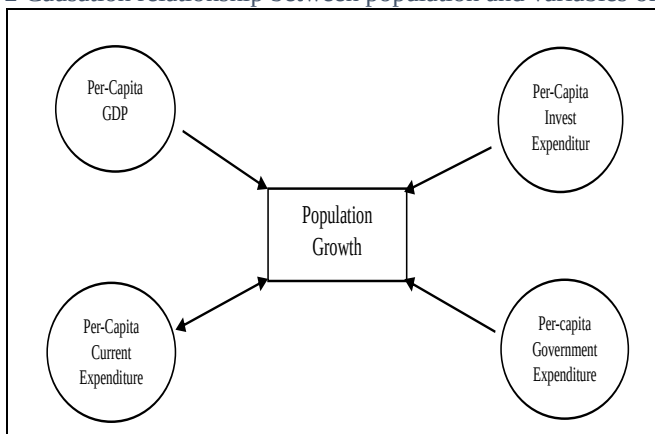
Null Hypothesis:	Obs.	No. of Lags	F-Statistic	Prob.	Result
<i>(PerCex)r</i> does not Granger cause <i>ln(Pop)gr</i>	54	2	6.933	0.002	Rejected
<i>ln(Pop)gr</i> does not Granger cause <i>(PerCex)r</i>	54	2	2.789	0.071	Accepted
<i>(PerInv)r</i> does not Granger cause <i>ln(Pop)gr</i>	54	2	6.066	0.004	Rejected
<i>ln(Pop)gr</i> does not Granger cause <i>(PerInv)r</i>	54	2	0.075	0.928	Accepted
<i>(PerInv)r</i> does not Granger cause <i>ln(Pop)gr</i>	52	4	19.23	0.000	Rejected
<i>ln(Pop)gr</i> does not Granger cause <i>(PerInv)r</i>	52	4	1.327	0.275	Accepted
<i>(PerCex)r</i> does not Granger cause <i>ln(Pop)gr</i>	52	4	2.712	0.042	Rejected
<i>ln(Pop)gr</i> does not Granger cause <i>(PerCex)r</i>	52	4	13.76	0.000	Rejected

Lags are chosen for 2 and 4 periods

In practice, when allocating this part of the public budget, the number of labour in the public sector is considered. By time, these numbers have expanded to an unprecedented level. Taking into account that government is dominant the economic activities and play the main resort of employment, a causation relationship running

from population and current expenditure is expected. Accordingly, the influence of natural resources via income and social government expenditure can be presented in the following diagram.

Figure 2 Causation relationship between population and variables of interest



D. Test for co-integration

To detect the associations between variables of interest, an unrestricted co-integration rank test is conducted and the results are demonstrated below. It also indicates the existence of at least one co-integrating relationship which means a long-run relationship between population on one hand and the investment government expenditure and current government expenditure.

Table 7 Johansen co-integration test for the estimated equation

Hypothesized No. of CE(s)	Eigen value	Trace			Max Eigen		
		Statistic s	0.05 Crit. Val.	Prob.*	Statistics	0.05 Crit. Val.	Prob.*
None*	0.41832	40.679	29.797	0.002	27.092	21.132	0.006
At most 1	0.20536	13.587	15.495	0.095	11.494	14.265	0.131
At most 2	0.04101	2.0937	3.8415	0.148	2.0937	3.8415	0.148

Both tests indicate 1 co-integrating equation at the 0.05 level

(*) Denote rejection of the hypothesis OF NO Co-integration at the 0.05 level

(**) MacKinnon-Haug-Michelis (1999) p-values

Because there is only one equation to be estimated, VECM can be employed to estimate the suggested relationship. Therefore, the lag selection test is conducted and results for the optimal lags are illustrated below:

Table 8 Lag selection test

Criterion Lags	Log L	LR	FPE	A/C	SC	HQ
0	-871.53	NA	1.57e+11	34.30	34.41	34.34
1	-783.31	162.6	7.05e+09	31.19	31.64	31.36
2	-757.76	44.09	3.70e+09	30.54	31.34	30.84
3	-729.70	45.11	1.77e+09	29.79	30.93	30.23
4	-685.76	65.48	4.58e+08	28.42	29.90*	28.99
5	-670.53	20.91*	3.70e+08*	28.18*	29.99	28.87*

Endogenous variables: $\ln(Pop)_{gr}$, $PerCex$, $PerInv$

Five lags are recommended according to four criteria; LR, FPE, A/C and HQ, except for SC criterion. Therefore, estimation will include five lags.

5.2. Results

The estimation results are followed by coefficient and residuals diagnosis are given below.

A. Long and Short Run Coefficients

The long-run equation is presented in Table (9). The results show that explanatory variables are significant. The low values of both parameters are expected, due to the formula of the estimated equation (semi log).

Table 9 Long-run co-integrating Equation

Variable	$\ln(Pop)_{gr}$	$PerCex_R(-1)$	$PerInv_R(-1)$	C
Coefficient	1.000000	-0.000797	0.000628	0.224975
Standard Error		(0.00015)	(0.00013)	
t-Statistic		-5.3993	4.949	

This result reveals that, in the long-run, population growth $(Pop)_{gr}$ will change by 0.08 and -0.06 units if per capita current expenditure and per capita development expenditure increased by one unit respectively.

B. Short-run relationship

Actually, the short-run effect is important, because the factors that influence decisions related to population growth in the short run are more effective. Accordingly, the short-run relationship is shown in the table below.

Table 10 Short run relationship for estimated equation

Error Correction:	$D(\ln Pop)_{gr}$	$D(PerCEx)_r$	$D(PerInvExp)_r$
CointEq1	-0.195449	370.6954	537.9259
	(0.05267)	(210.377)	(469.605)
	[-3.71091]	[1.76205]	[1.14549]

The short-run coefficients and their corresponding significance is demonstrated in Table (11) below:

Table 11 Short-run Coefficients

Variable	Lag	Parameter	Coefficient	Std. Error	t-Statistic	Prob.
$\ln (Pop)_{gr}$	-1	C(1)	-0.1955	0.0527	-3.71	0.001
$D\ln (Pop)_{gr}$	-1	C(2)	-0.0685	.1579	-0.434	0.667
$D\ln (Pop)_{gr}$	-2	C(3)	1.337	0.1854	7.211	0.000
$D\ln (Pop)_{gr}$	-3	C(4)	1.476	0.3091	4.773	0.000
$D\ln (Pop)_{gr}$	-4	C(5)	0.7660	0.3729	2.054	0.048
$D\ln (Pop)_{gr}$	-5	C(6)	0.0075	0.2756	0.0271	0.979
$D (PerCex)_R$	-1	C(7)	-0.000024	0.000051	-0.4762	0.637
$D (PerCex)_R$	-2	C(8)	0.000129	0.000049	2.625	0.013
$D (PerCex)_R$	-3	C(9)	0.000004	0.000043	0.0889	0.929
$D (PerCex)_R$	-4	C(10)	0.000005	0.000045	0.10092	0.920
$D (PerCex)_R$	-5	C(11)	-0.000056	0.000043	-1.2965	0.204
$D (PerInv)_R$	-1	C(12)	0.000092	0.000040	2.3192	0.027
$D (PerInv)_R$	-2	C(13)	-0.000190	0.000036	-5.3829	0.000
$D (PerInv)_R$	-3	C(14)	0.000142	0.000047	3.0495	0.005
$D (PerInv)_R$	-4	C(15)	-0.000052	0.000052	-1.00858	0.321
$D (PerInv)_R$	-5	C(16)	0.000006	0.000049	0.11860	0.906
Constant	-	C(17)	0.08442	0.02513	3.35897	0.002
R-squared		0.925	Mean dependent Variable			-0.011
S.E. of regression		0.07296	D.D. depend variable			0.219
Sum squared residual		0.1758	Akaike info criterion			-2.133
Log likelihood		70.315	Schwarz criterion			-1.483
F-statistic		25.49	Hannan-Quinn criterion			-1.885
Prob (F-statistic)		0.0000	Durbin-Watson stat.			2.144

Based on the results and statistical criteria, it can be claimed that the estimated model is statistically acceptable because the sign of the parameter $C(1)$ [coefficient of the speed of adjustment] is negative and significant, as predicted, and satisfies the condition of the error correction term (ERT). This coefficient equal to (-0.196) and

shows that last period deviations from long-run equilibrium (errors) are assumed to be corrected in five periods. Consequently, it can be claimed that $C(1)$ explanatory variables cause population growth in the sense of the Granger causality process.

5.3. Coefficient Diagnosis

To discuss short- and long-run causality: firstly, as $C(1)$ is negative and significant, a long-run causality is assumed running from independent variables to population growth. This result supports the Granger causality test results. Secondly, estimated parameters need to be checked for difference from zero, to assess whether short-run causality exists employing WALD test.

Table 12 WALD Test for (β)

Test Statistic	Value	Df.	Probability
<i>F-statistic</i>	2.78086	(6.29)	0.0292
<i>Chi-square</i>	16.6852	6	0.0105

Null Hypothesis: $C(7) = C(8) = C(9) = C(10) = C(11) = 0$

Result shows that the null hypothesis can be rejected, and short-run causality confirmed running from the independent ($PerCex$) to the dependent variable (Pop)_{gr}.

Similarly, for the second explanatory variable, development government expenditure ($PerInv$) as shown below:

Table 13 WALD Test for (γ)

Test Statistic	Value	df	Probability
<i>F-statistic</i>	26.170	(6.29)	0.0000
<i>Chi-square</i>	157.021	6	0.0000

Null Hypothesis: $C(12) = C(13) = C(14) = C(15) = C(16) = 0$

Moreover, *R-squared* shows that 0.93% of changes in population growth can be explained by independent variables. The *F-statistic* of the whole estimation is 25.5 with *P-value* of almost zero. Therefore, it can be said that the whole estimated model has a good fit.

5.4. Residual Diagnostic

The error term is also one of the most important criteria to assess the estimated model. In this context, three tests are employed as follows:

A. Serial correlation

Table 14 Breusch-Godfrey Serial Correlation LM test

<i>F-statistic</i>	1.096838	<i>Prob. F(2,27)</i>	0.3483
<i>Obs*R-squared</i>	3.681965	<i>Prob. Chi-Square(2)</i>	0.1587

Null Hypothesis: No serial correlation at up to 2 lags

As the *P-value* of chi-squared is greater than 0.05, the null hypothesis cannot be rejected. Accordingly, it can be claimed that the model is free of serial correlation, which is the most problematic issues for this type of estimations.

B. Heteroscedasticity

Time-series modelling is based on the assumption that disturbances (u_i) have the same variance across employed observations. When this assumption cannot be approved, the estimated model is described to have heteroscedasticity. Although the estimated parameters of regression are unbiased when this assumption is violated, the estimator of the covariance matrix can be biased and inconsistent under the existence of heteroscedasticity (Hayes & Cai, 2007) The table below demonstrates the test result for this test:

Table 15 Breusch-Pagan-Godfrey Heteroscedasticity test

<i>F-statistic</i>	0.8924	<i>Prob. F(21,27)</i>	0.6009
<i>Obs*R-squared</i>	20.076	<i>Prob.(Chi-Square(21))</i>	0.5164
<i>Scaled explained SS</i>	5.6959	<i>Prob.(Chi-Square(21))</i>	0.9996

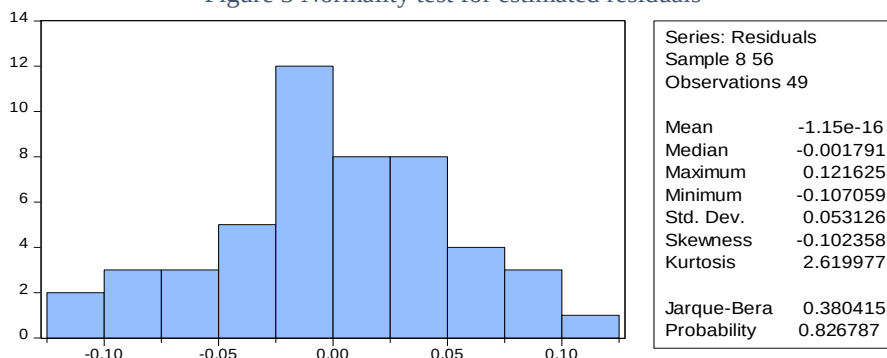
Null Hypothesis: Homoscedasticity

Based on the null hypothesis of this test and since the *p-value* of *chi-squared* is greater than 0.05 therefore, the estimated model can be said to be free of heteroscedasticity.

C. Error Distribution Test

The normality test also reveals that the errors in the model are normally distributed.

Figure 3 Normality test for estimated residuals



5.5. Impulse Response

To understand the magnitude and direction of each independent variable's effect on population changes, impulse response function and decomposition of variance have been estimated and the results are displayed in Figure (4) and Table (15) respectively.

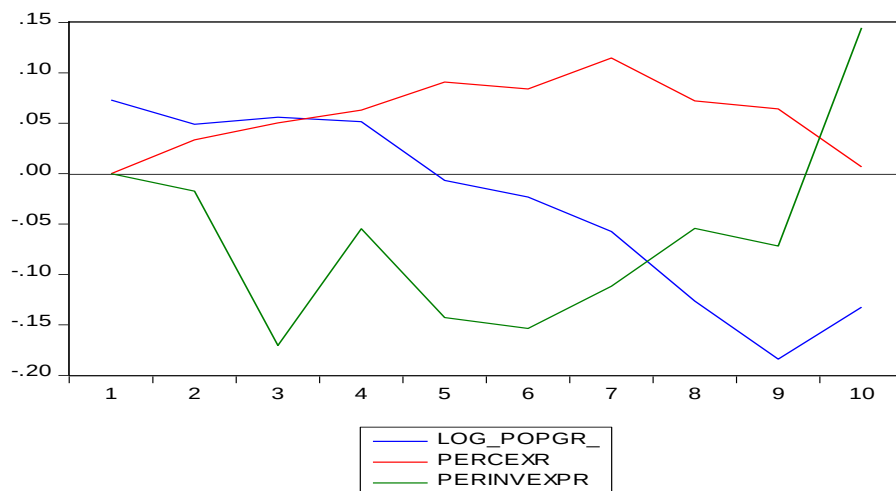
A. Contribution of each variable

Results show that per-capita government current expenditure (red line) has a positive and higher contribution to population change up to period (t_7), then it begins to decrease. In the meantime, investment expenditure (green line) works negatively up to period (t_3), when it turns positive and then fluctuated up to period (t_6), when its impact becomes significantly positive. This means that current government expenditure has relatively steady positive influence in short and medium term because most households rely on this type of government spending in their daily life and income. While investment allocations are not reliable because they are not stable since government often reduces its investments in response to global oil price decline. However, these investments have higher influence when the government injects adequate funds in some years. The effect of investment expenditure is higher in the long run due to the influence of social expenditure to enhance welfare, such as spending on healthcare and education infrastructure. This type of investment needs more time to become productive and affect standards of living.

Natural Resources and Population Growth; What is the Relationship?

Evidence from Oil-based Economy

Figure 4 Response of Ln (Pop) gr to Innovations using Cholesky (d.f. adjusted) Factors



B. Variance Decomposition

Variance decomposition has also been estimated, to understand the influence attributed to each explanatory variable in each period. The table below shows that changes in population can be attributed to the variable itself are equal to 84% in the second period, while current and investment expenditure contributes only 12% and 3% respectively. This trend changes notably in the third period, when development expenditure's contribution rises to 67% at the expense of current expenditure, remaining at almost the same level up to (t_6). Over the same time, current expenditure's contribution increases to 20-25% of change in population growth. This result confirms the conclusion above about the importance of development (investment) expenditure over current one for medium and long run. Also, it confirms the important role of government current expenditure in the short run and high dependency on oil revenues in turn.

Table 15 Variance decomposition of employed variables

Period	S.E.	Ln(Pop)gr	PerCexR	PerInvExpR
1	0.072986	100.0000	0.000000	0.000000
2	0.095580	84.50262	12.20677	3.290607
3	0.209421	24.73937	8.329235	66.93139
4	0.231229	25.24004	14.27874	60.48122
5	0.286632	16.48007	19.33961	64.18032

6	0.336607	12.42611	20.24994	67.32394
7	0.377125	12.20791	25.38809	62.40400
8	0.407886	20.05230	24.82780	55.11990
9	0.457721	32.08673	21.68252	46.23075
10	0.497997	34.18502	18.33519	47.47978
<i>Cholesky Ordering: Ln(Pop)_{gr} PerCE_{xR} PerInvExp_R</i>				

6. Discussion

Results obtained confirm that changes in Libyan population are influenced strongly by social government expenditure. Among many variables tested for potential impact on population growth, current and development government spending had the most significant effects on population. In fact, these two variables are strongly related to natural resources, since both are determined by oil revenues and controlled by the government. Results show that there is a causation effect running from both variables to population, and this causation is bidirectional only for current expenditure. Furthermore, there is a co-integration between both variables on one hand and changes in population on the other hand.

For instance, estimated parameters seem very low, but this is expected, for two reasons: firstly, this regression uses semi-log-level estimation. Changes in the explanatory variables by 1 unit is expected to alter the dependent variable $(Pop)_{gr}$ by $100(\beta)$ and/or $100(\gamma)$ respectively. Therefore, changes in population growth in response to per-capita current and development expenditure are considered high, at 0.08 and 0.063 respectively. Secondly, taking into account many other factors affecting population changes, it is not expected for these two variables contribute much to population growth.

In the long-run, the impacts of both variables are almost equal in magnitude and opposite in sign. Current government expenditure shows a positive relationship with the population, while development expenditure reveals a negative effect. This result can be explained in the context of rent-seeking states, as natural resources are often used to enhance living standards for the population, which in turn promote

population growth in such developing countries. Therefore, current expenditure is expected to have positive effects, due to the immediate influence of this type of government expenditure on every-day decisions. In the meantime, bidirectional causation is expected in rent-seeking economies⁵. In the Libyan context, more than one third of current expenditure is simply wages for public service employees and/or related to labour force. These wages are usually determined annually, not dependent on productivity, but based on the total number of existing workers in addition to new entrants. In addition, because the government dominates economic activities, the public sector is the main employer and last resort for the newest labour market entrants. Therefore, the two variables (i.e. population and current expenditure) both influence each other in strong bi-directional causation. In this context, some scholars argue that population is endogenous because fertility decisions taken by households recognise government policy signals which affect their future welfare (Srinivasan 1987).

On the other hand, per-capita development expenditure shows negative sign. This result is expected in the context of development and urbanisation effects on population growth among developing countries. The main goal of investment expenditure is to develop society and in turn lowers growth in population in the long run.

In the short run, estimators of development expenditure are significant for the periods (t_{-1} , t_{-2} and t_{-3}), (coefficients $C12$, $C13$ and $C14$) as demonstrated in Table (11). However, these parameters have different signs. This may explain the low effect of this variable $(PerInv)_R$ in the long run. Conversely, current expenditure shows positive and significant effect on population growth for the lag (t_{-1}), as seen

⁵ In rent-seeking economies', taxes are not significant in funding the government budget. This fact leads to a non-rational allocation of oil revenues, and due to high dependency on these revenues and wealth abundance, more spending is expected, as social expenditure is considered a kind of wealth distribution.

for *C8*. This also explains why the influence of current expenditure is higher in the short run.

7. Conclusion

To conclude, variables related to natural resources showed a causal relationship with population: however, government spending is likely the most influential, seeming to be the main channel for natural resource impacts on population changes in both the long and short run. Findings reveal that current spending specifically (i.e. government consumption) has a significant positive effect on both periods, while development expenditure shows a weakly positive role in the short term but a significant negative effect in the long-run. These results are consistent with theoretical fundamentals. Development spending is expected to lower population growth in developing societies, due to its impact on urbanisation, female enrolment in education, female participation in the labour market etc. The interesting finding here is that the strong influence of natural resource abundance on population growth because government consumption expenditure is strongly related to the resources represented by oil revenues. This effect is high to the point that fluctuations in the global oil market can be observed in the rate of population growth. This pattern is clear in years of oil price collapse in the mid-1980s and price booms in the late 1990s. While current government expenditure promotes population growth in the short-run, development expenditure seems to have a negative and weak influence on population growth in the long run. Taking in account there were no policies that related to population over the studied period, these results could be considered as proof on the natural resource effect on population changes. Therefore, development expenditure is unlikely to outweigh the positive impact of current expenditure. It is likely for expansion in current expenditure to harm the efforts of development in Libyan society, due to the trade-off between development allocation and current spending allocation in the long run. By time, an increasing population requires a larger social spending, which will lower development spending over time, since the

government cannot guarantee either higher prices or greater quantities of oil exports. Thus, growth in population seems to be at the expense of development. This is clear in recent years, in which current expenditure almost completely monopolised the governmental budget. In this regard, the World Bank has warned that enduring subsidies on consumption would have the potential to hinder exports of oil, which is the only source of earnings (World Bank, 2006, pp14). Therefore, it is expected that Libya will experience difficulties if high dependency on non-renewable resources continues along with high population growth. It seems that population growth is endogenous as a response to the availability of oil. Thus, it is necessary for policy-makers to monitor the trend of population growth, taking into account the fact that resources are non-renewable, and that oil alone will not be sufficient for a growing population.

References:

- Adelman, I. (1963) An econometric analysis of population growth. *The American Economic Review*, 53(3), 314-339.
- Alvarez-Dias, M., et al. (2018). The Determinants of Population Growth: Literature review and empirical analysis.
- Attwairi, A. (2017), "The Contribution of Population growth to the Libyan Rapid Urbanization", Geography Department University of Zawia, July 2017, On-line, accessed; 05 Mar 2019 9:30 am, https://www.researchgate.net/publication/320567362_The_Contribution_of_Population_Growth_to_the_Libyan_Rapid_Urbanization
- Barro, R. J. & Lee, J. W. (2001) International data on educational attainment: updates and implications. *oxford Economic papers*, 53(3), 541-563.
- Baum-Snow, N. (2007) Suburbanization and transportation in the monocentric model. *Journal of Urban Economics*, 62(3), 405-423.
- Birdsall, N. (1988) Economic approaches to population growth. *Handbook of development economics*, 1, 477-542.
- Blanchard, O. J., Fischer, S. & BLANCHARD, O. A. (1989) *Lectures on macroeconomics*. MIT press.
- Blanchard, O. (2000) What do we know about macroeconomics that Fisher and Wicksell did not? *De Economist*, 148(5), 571-601.
- Bloom, D. E., Canning, D. & Sevilla, J. (2001) Economic growth and the demographic transition.
- Bloom, D., Canning, D. & Sevilla, J. (2003) *The demographic dividend: A new perspective on the economic consequences of population change*. Rand Corporation.

- Clark, D. E. & Murphy, C. A. (1996) Countywide employment and population growth: An analysis of the 1980s. *Journal of Regional Science*, 36(2), 235-256.
- Cullen, J. B. & Levitt, S. D. (1999) *Crime, urban flight, and the consequences for cities*. MIT Press.
- Darrat, A. & Al-Yousif, Y. (1999) On the long-run relationship between population and economic growth: Some time series evidence for developing countries. *Eastern Economic Journal*, 25(3), 301-313.
- Davidson, J. E., et al. (1978). "Econometric modelling of the aggregate time-series relationship between consumers' expenditure and income in the United Kingdom." *The Economic Journal* 88(352): 661-692.
- Duranton, G. & Turner, M. A. (2012) Urban growth and transportation. *Review of Economic Studies*, 79(4), 1407-1440.
- Engle, R. F. and C. W. Granger (1987). "Co-integration and error correction: representation, estimation, and testing." *Econometrica: journal of the Econometric Society*: 251-276.
- Faria, J. R., Leon-Ledesma, M. A. & Sachsida, A. (2006) Population and income: Is there a puzzle? *The Journal of Development Studies*, 42(6), 909-917.
- Gardner, E. H. (2003) *Creating Employment in the Middle East and North Africa*. International Monetary Fund, available at: <https://www.elibrary.imf.org/view/IMF073/01426-9781589062320/01426-9781589062320/01426-9781589062320.xml?redirect=true>
- Glaeser, E. L., Scheinkman, J. & Shleifer, A. (1995) Economic growth in a cross-section of cities. *Journal of monetary economics*, 36(1), 117-143.
- Glaeser, E.L. and Shapiro, J.M., 2003. Urban growth in the 1990s: Is city living back?. *Journal of regional science*, 43(1), pp.139-165.
- González-Val, R. (2015) Cross-sectional growth in US cities from 1990 to 2000. *Journal of Geographical Systems*, 17(1), 83-106.
- Granger, C. W. & Newbold, P. (1974) Spurious regressions in econometrics. *Journal of econometrics*, 2(2), 111-120.
- Granger, C. W., Newbold, P. & Econom, J. (2001) *Spurious regressions in econometrics. A Companion to Theoretical Econometrics*, Blackwell, Oxford, 557-561.
- Hagen, E. E. (1959) Population and economic growth. *The American Economic Review*, 49(3), 310-327.
- Hayes, A. F. & Cai, L. (2007) Using heteroskedasticity-consistent standard error estimators in OLS regression: An introduction and software implementation. *Behavior research methods*, 39(4), 709-722.
- Huq, M., et al. (2009). *Development economics*, McGraw Hill.
- IBRD, (2004), *Unlocking the employment potential in the Middle East and North Africa: Toward a new social contract*". World Bank
- Lutz, W. & Qiang, R. (2002) Determinants of human population growth. *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, 357(1425), 1197-1210.
- Madbouly, M. (2009) *Revisiting urban planning in the Middle East North Africa region*. Regional study prepared for UN-Habitat Global Report on Human Settlements.

- Malthus, T. R. (1798) An essay on the principle of population as it affects the future improvement of society, with remarks on the speculations of Mr. Goodwin, M.
- Masoud, N. M. (2014). "A Review of Libyan? s Economy, Structural Changes and Development Patterns." Business and Economics Journal 2011
- Shaafi, and Al-Ghosain, (2015), Impact of Investment in Education on Economic Growth in Libya, An Econometric Analysis, Arabic Journal for High Education Quality, Vol (8), (22) 2015. In Arabic, file://adir.hull.ac.uk/home/481/481273/Downloads/851-Article% 20Text-1721-1-10-20150912.pdf.
- Sinding, S. W. (2009) Population, poverty and economic development. Philosophical Transactions of the Royal Society B: Biological Sciences, 364(1532), 3023-3030.
- Srinivasan, Thirukodikaval N. (1987): Population Growth and Economic Development, Center Discussion Paper, No. 539, Yale University, Economic Growth Center, New Haven, CT. At: <https://www.econstor.eu/bitstream/10419/160461/1/cdp539.pdf>
- Srinivasan, T. N. (1988b) Population growth and economic development. Journal of Policy Modeling, 10(1), 7-28.
- Taloba, A. and Jaroushi, M. (2015), Population of Libya, Developing and Future aspects,(In Arabic), (2015), Journal of Economics and Finance Researches, Vol, 3, Issue, 2, (12,2015). Available at: <http://mdr.misuratau.edu.ly/bitstream/handle/123456789/601/189.pdf?sequence=1&isAllowed=y&fbclid=IwA%20R09q%20MWlddT7CQBy0wjjlEFqM1riaPjW%20MwCCWAFce1%20myo%20wojsqvZhgnnAvo>
- Thirlwall, A. P. (1972) A cross section study of population growth and the growth of output and per capita income in a production function framework. *The Manchester School of Economic & Sosial Studies, University of Manchester*, vol. 40(4), 339-356.
- UNDP, 2010, United Nations Developing Program, Regional Bureau for Arab States, "Arab Human Development Report", Research Paper Series.
- World Bank, (2006), Socialist People's Libyan Arab Jamahiriya, Country Report, July 2006.