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The Causality Relationship between Population Growth, Economic Growth and Capital Stock in OIC Countries and Its Policy Aspects

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ABSTRACT

This paper examines the long run and short run relationship between population growth, GDP growth and capital stock in OIC countries during 1980 to 2018. Using panel Cointegration and causality techniques, the results show that there is the long run relationship, when GDP growth and capital stock are dependent variables. In the long run the impact of population on economic growth is positive and statistically significant. Also, the bidirectional relationship between Population and economic growth in the short-run has been accepted for OIC countries. Theoretically the population growth is a national savings that create additional capacity in the economy. Given these points, from a policy perspective, it can be argued that population growth is a stimulus for economic growth and not an obstacle to it. Therefore, rather pessimistic view of the population and its control, economic policymakers must reduce important economic barriers through a structures reform, increasing management capability as well as implementing proper monetary and fiscal policies.

1. Introduction

The relation between population and economic growth has been the subject of debate among economic researchers for many years. From perspective view of McNicoll (1984) and Hammer (1986), Population growth through

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impacting on demand and supply for saving and increasing capital's efficiency can effect on economic performance.

However, in recent decades two different viewpoints for the relationship between population and economic growth have been formed among economists. The first group believes that a linear relationship between population and economic growth exists. While, the second one believes that more increase in population causes less increase in economic growth. In this paper, the relation between population and economic growth is studied both theoretically and empirically for OIC countries[1] during 1980 to 2018. The relation between population and economic growth is evaluated by using econometric methods.

Iran as an important member of the OIC countries has experienced a fluctuating trend in population and economic growth in recent decades. For Iran economy, the variables trend show that the average growth of the population during the last decade has been declining and on the other hand the economic growth has been in a fluctuating trend. The population growth trend has decreased from 3.72 and 4 percent in 1980 and 1985 to 1.2 and 1.38 in 2015 and 2018, and during this period the average population growth in the Iranian economy has been about 2 percent. On the other hand, Iran's economic growth has been positive since the revolution and the beginning of war in the 1980s and also in the 1990s, this growth increased to more than 3%, but from 2010 to 2018 the economy decrease to 2.2% and during this period the Iranian economy experienced low population growth. Among the OIC member countries, the highest population growth was for Oman and Jordan with growth of 3.8 and 3.7, respectively, and the lowest was for Guinea and Albania, at 0.001 % and 0.2% respectively.

The paper is organized as follows. In section ٢ we describe the effect of population on economic growth in different economic growth theories. Literature review has been considered in section 3. Also the model and

1. The Organization of the Islamic Conference (OIC) is the second largest inter-governmental organization after the United Nations which has membership of 57 states spread over four continents. The Organization is the collective voice of the Muslim world and ensuring to safeguard and protect the interests of the Muslim world in the spirit of promoting international peace and harmony among various people of the world.

methodology is introduced in section ۴. The empirical results and their interpretations are presented in section 5 and concluding remarks are given in the final section.

2. Theoretical Views

Economists have been interested in the relationship between population and economic growth trend for many years. Adam Smith believed that wealth is created by human work. Therefore, more increase in human work efficiency causes more increase in wealth. He considered that work division and labor specialization are the main reasons for efficiency increment. From Adam Smith's point of view, population in any society causes development in wealth. Other economists expressed their objection against Adam Smith's theory for population (Smith, 1776).

Opposed ideas against population growth were due to Malthus's theory. We are familiar with Malthus's defaults. For instance: "The food is vital for human life (Malthus, 1992, p.15).", and food supply could only be expected to increase at an arithmetic ratio, while population if unchecked would increase at a geometric ratio. By these assumptions Malthus showed that there would be a constant tension between population and available resources (Portner, 1996, p.4). Malthus says that population growth cannot be a reason for economic development and he believes that population growth can only increase wealth when it can develop effective demand. In his opinion, capital is the only effective element on economic growth.

In Keynes's ideology, the relationship between population and economic growth can be examined in Harrod - Domar's growth model. In this model, growth rate depends on two elements: ratio of saving and ratio of capital to product. Since the ratio of saving depends on social psychological parameter (security growth rate) and the ratio of capital to product is related to technology element (real growth rate). For staying in a stable growth condition, real growth rate, security growth rate and natural growth rate should be equal. Since each of these elements is exogenous and is out of control, continuous and stable growth rate existence with complete employment is totally coincidental and reaching it is not probable.

Therefore, in many conditions, economy can be placed in a superior or inferior situation than complete employment.

Some of the growth rate antagonists believe that one of the reasons of unemployment in developing counties is the increasing growth in population that occurred in previous years. But as Keynes mentions, unemployment and population are not related. From Keynes's point of view, unemployment is a kind of unbalance and this may occur for any reason that is not related to population (Simon, 1998, p.122). For example, economic unbalance may be because of decrease in purchasing power or high money interest rate in economy. The higher interest rate causes the more limited investment and employment level decrease. Keynesians and post Keynesians approved that population growth has a positive effect on investment by increasing demand for capital intensive items such as housing and public services.

In neoclassic growth pattern, population growth rate is growing in a constant and exogenous way and it is not affected by economic events. Solow and Swan (1956) after presenting fundamental neoclassic equation concluded that they can reach offset growth. In this model, continuous and constant growth is equal to constant and exogenous growth rate of labor force. Therefore, long time growth rate in neoclassic pattern and population growth rate are the same.

In another theory, Phelps (1961) wants to find an optimum saving rate that maximize per capita consumption in a way that is compatible with constant growth condition. As a result, his search results are well-known as golden principle. This principle suggests that reaching the best saving rate needs that final production and population growth rate should be the same and this shows positive relationship between population and economic growth.

Phelps believes that population has mustard effect. Based on this theory, more population has more "Mozart effect" In another words, more population has more intelligent. This idea forms modern growth models. In these new models, the ratio of yield to scale, increases. This theory is due to believing in the effect of science and ideology on growing pattern. As Jones mentioned, more population produces more Isaac Newtons and Thomas Edisons, leading to more ideas (Jones, 1998).

In contrast to Phelps's model, in which saving rate was regarded as an endogenous parameter; the rate of population growth was considered as an exogenous parameter in Ramsy's pattern by Cass and Koopmans. Their model derives the evolution of the capital stock from the interaction of maximizing households and firms in competitive markets. They concluded that the economic growth is a function of both preference time rate and population rate.

In endogenous growth models, population growth is a function of evolutions inside the model. However, all models confirm the positive effect of population on economic growth. Arrow (2003) believed that population has a non-negative shadow price. And population is not a controllable variable. Because in dynamic programming models, including optimum growth and endogenous growth models, population growth rate exists in both aim and stipulation functions therefore if population is considered as a controllable variable, the aim function will wrongly be stipulated two times by stipulation and aim functions. If we consider population as state variable we can extract a non-negative shadow price for population (Arrow, 2003, p. 217). Considering the endogenous technological changes, the effect of population growth on economic growth is positive. From this perspective more population stimulates the advancement of technical progress, and so it leads to a larger economic scale and also greater number of geniuses (Bucci et al, 2019).

Kremer, (1993) explained that all exogenous growth models, in which knowledge was supposed endogenous, predict that technology progress is a rising function of population. He mentioned as we have more specialist people in a large population it can effect on per capita production. From the perspective of Sen (2006) in one-sector growth models, an increase in the population growth rate increases the economy's growth rate but lowers steady-state welfare. On the other hand, it can raise the steady-state welfare in a two-sector overlapping generation's model.

Prettner (2014) within R&D-based economic growth model found that if population growth is low and the education sector of an economy is well-

developed then in the long run, faster population growth harms economic growth.

3. Review of Empirical Studies

Previous economic researchers worked on the inverse relation between population and economic growth, there are many empirical works on this issue, but we review few of the latest ones.

Bucci et al. (2019) within a multi-sector growth model in a closed economy under Human Capital Accumulation and Endogenous Technological, found that the impact of population growth on per-capita income growth depends on the contrast of two opposing effects. The first is *dilution effect*[1], which has negative effect and the second is the *ideas effect*[2]. This effect is positive if *dilution effect* is not large. However, depending on the size of the *dilution effect*, there is different correlation between population and economic growth rates.

Lee and Shin (2019) have recognized the effects of population aging on economic growth, using panel data for 142 countries for the period from 1950 to 2014. They have found that population aging hinders economic growth largely in countries with aged population. However, there is a positive relationship between the share of working-age population and economic growth.

Hassan, (2010) empirically examines relation between population and per capita income with using multivariate- vector autoregressive model for mainland china from 1952 to 1998. His result shows that a negative long-runs causal relationship from per capital income to population. Also according to neoclassical growth model population growth has positive effect on per capita income growth.

Thornton, (2001) investigated the long-run relationship between population and per capita income in seven Latin American countries for the period 1990 - 1994. Using Granger causality test and one-step error correction mode, his results indicate that population and per capita income

[1] . An increase in population, by diluting the stock of physical capital, lowers the long-run (or steady-state) level and the short-run growth rate of physical capital per capita

[2]. The effect that population growth may have on the economy's innovation rate

do not share any common trend and do not exhibit a long –run linear relationship.

Darrat and Al-Yousif, (1999) considered a long-run relationship between population and economic growth in twenty developing countries using Phillips Perron and weighted symmetric tests form 1950 to 1996. Their results show that population persuasion economic growth in more than half of the countries.

Using econometric and statistical methods, Bloom and Freeman (1998) investigated the relationship between population growth and economic growth for developing countries during the period 1965 to 1985. They concluded that the components of population growth is a main element in the processes of economic development. They also found that the income growth is related to the time path of population growth.

Fouger and Merette (1999) have investigated the effect of population ageing on economic growth with OLG models for seven industrialized countries. They have used endogenous growth model that is generated by the accumulation of both physical and human capital. Their results show that population ageing could make more opportunities for future generations to invest in human capital formation and motivate economic growth.

4. The Basic Model

Based on the objective of paper, we intend to specify, estimate and test the bi-variate causality relationship between population growth and economic growth. Despite the importance of this issue, empirical evidence about the relationship between population growth and economic growth for some Muslim countries including OIC countries are significantly scarce. For this purpose, we extended the study of Hasan (2010) both theoretically and methodologically for OIC countries within the framework of panel VECM.

The bi-variate causality relationship between economic growth and Population growth had been studied in recent years. Yet, it is now clear that the results of the bi-variate causality test between two variables may be invalid due to the omission of an important variable affecting both population growth and economic growth in the causality model (Lutkepohl,

(1982) and Hasan (2010)). Hence In this study we inter capital stock growth as intermediate variables and apply the panel cointegration technique and FMOLS (Fully Modified OLS) and OLS estimators to investigate the long-run and causal relationships among population growth, economic growth and capital stock growth in OIC countries for the period 1980–2016. Hence we have three models as following:

Model 1: $GDP = f(POP, CAP)$ (1)

Model 2: $POP = f(GDP, CAP)$ (2)

Model 3: $CAP = f(GDP, POP)$ (3)

Where GDP is GDP Per capita growth, POP is population growth and CAP is of Real Capital Stock growth. Data used in the analysis are annual time series during the period 1980–2018 for OIC countries were collected from World Development Indicator (WDI).

Also 34 selected countries from Organization of the Islamic conference are includes: Albania ,Algeria, Bahrain, Bangladesh, Benin, Burkina Faso, Gabon, Gambia, Cameroon, Chad, Comoros, Egypt, Guinea-Bissau, Guyana, Indonesia, Iran, Jordon, Malaysia, Mali, Mauritania, Morocco, Mozambique, Niger, Nigeria, Oman, Pakistan, Saudi Arabia, Senegal, Sierra Leone, Sudan, Togo, Tunisia, Turkey, Uganda.

5- Econometric Techniques

5-1. Panel Unit Root and Panel Cointegration Tests

In the first step of our empirical analysis, as a pre-test for the cointegration analysis, it is crucial to clarify the integration properties of the data series. Therefore we apply panel individual unit root tests established by Fisher-type tests of Maddala and Wu (1999) and Choi (2001) using ADF and Phillips–Perron type and also we apply IPS (Im, Pesaran and Shin .2003) and LLC (Levin-Lin-Chu. 2002), which are widely used in panel analysis. The null hypothesis is non stationary in these tests, while the alternative hypothesis indicates there is no unit root.

The results imply that for the population growth, economic growth and capital stock growth the null hypothesis of unit root are not rejected. But as table 1 shows, in the first difference with trend and no trend, all of the

variables are stationary at the 1% level and null hypothesis are rejected. This result implies that each three variables are integrated of order one.

Table1. Panel Unit Root Tests in The First Difference of Variables

Variables	ADF	ADF	PP	PP	IPS	IPS	LLC	LLC
	No Trend	Trend	No Trend	Trend	No Trend	Trend	No Trend	Trend
ΔGDP	953.32* (0.000)	1029.18* (0.000)	916.69* (0.000)	7483.63* (0.000)	-37.02* (0.00)	-34.95* (0.00)	-26.09* (0.00)	-21.04* (0.00)
ΔPOP	-693.7* (0.000)	760.35* (0.000)	166.09* (0.000)	107.75* (0.009)	-26.98* (0.00)	-27.45* (0.00)	-21.37* (0.00)	-21.45* (0.00)
ΔCAP	1005.17* (0.000)	1000.36* (0.000)	786.99* (0.000)	8208.95* (0.000)	-38.80* (0.00)	-36.31* (0.00)	-27.08* (0.00)	-21.33* (0.00)

***** Indicates statistical significance at the 1% level. Probability values are in parenthesis

At the second step of our estimation, we look for a long run relationship among GDP, POP and CAP. For this purpose we use Pedroni (1995, 1999) test for used variables in models. Consider the following model:

$$y_{it} = \alpha_i + \omega_i t + \beta_{1i} x_{1i,t} + ... + \beta_{Mi} x_{Mi,t} + \varepsilon_{i,t} \qquad (4)$$

$$\text{For } t = 1,...,T ; i = 1,...,N ; m = 1,...,M$$

Where T refers to the number observations over time. M refers to the numbers of regression variables and N refers to the number of individual provinces in the panel. The parameters of α_i and ω_i are individual and trend effects which may be set to zero if desired. Pedroni (1999) had suggested two types of test for cointegration analysis: The first four are based on the within-dimension approach and are known as panel cointegration statistics that are includes: panel v-statistic, panel ρ statistic,

panel PP-statistic and panel ADF-statistic. The last three are based on the between-dimension approach and are known as group-mean panel cointegration statistic that are includes: group ρ statistic, group PP-statistic and group ADF-statistic. The group- mean panel cointegration statistic is based on estimators that simply average the individually estimated coefficients for each member i. As pedroni (1999, 2004) had expressed, ADF and PP tests are more reliable for small sample properties than the other tests. The results of pedroni's (1999) panel cointegration tests are reported in table 2. As results show, when GDP and CAP are dependent variables the null of no cointegration are rejected. But when POP is dependent variable the null of no cointegration is accepted. Hence we discovered that there exists the long run relationship in the models 1 and 3.

Table 2. Panel Cointegration Test

	$(GDP \mid POP, CAP)$	$(POP \mid GDP, CAP)$	$(CAP \mid GDP, POP)$
Panel PP-Statistic	-20.85* (0.002)	1.36 (0.91)	-27.52* (0.000)
Panel ADF statistic	-12.60* (0.000)	0.57 (0.71)	-17.92* (0.000)
Group PP-statistic	-25.88** (0.020)	3.23 (0.99)	-41.10* (0.000)
Group ADF-statistic	-14.68* (0.000)	1.99 (0.97)	-20.79* (0.000)

* and ** indicates statistical significance at the 1% and 5% level respectively. Probability values are in parenthesis

5-2. Estimating the Long Run Relationship

Having found a cointegration relationship at the models 1 and 3, in this section we estimate the long run coefficients on the impact of population growth and Real capital stock on GDP growth and the impact of GDP growth and Population growth on Real capital stock. To achieve this

purpose, we use FMOLS (Fully modified ordinary least square) and OLS estimators.

The results of FMOLS and OLS estimators are reported in Table 3. As the results show, the impact of POP and CAP on GDP are positive and statistically significant. For instance, 1% increases in POP lead to a 0.38% and 0.37% increase in GDP in FMOLS and OLS estimators respectively. Also the coefficients on CAP, implying that 1% increases in CAP causes a 1.03% and 0.96% increases in GDP in two estimators.

These results confirm the first group beliefs that a linear relationship between population and economic growth exists. Theoretically, as Keynesians and post Keynesians have said, population growth has a positive effect on investment by increasing demand for capital intensive items such as housing and public services. And according to neoclassical growth model population growth has positive effect on per capita income growth.

On the other hand we find when CAP is dependent variable, the impact of GDP and POP on CAP are positive and statistically significant. As 1% increases in GDP and POP in OLS estimator causes a 0.006% and 0.02% increases in CAP which also is statistically significant.

Table3. The Long Run Coefficients

	Dependent Variables			
	GDP		*CAP*	
Independent Variables	OLS	FMOLS	OLS	FMOLS
GDP	-	-	0.006* [2.69]	-0.03 [-0.98]
CAP	0.96* [2.69]	1.03* [26.77]	-	-
POP	0.37** [2.09]	0.38* [78.31]	0.02** [1.79]	0.01** [2.24]

* and ** indicates statistical significance at the 1% and 10% level respectively. T-statistics are in the *bracket*. The results of Hausman test for OLS estimator shows that we should use fixed effect estimations for two

equations, because χ^2- statistics for *GDP* and *CAP* are $\chi^2 = 64.8(prob = 0.00)$ and $\chi^2 = 22.01(prob = 0.00)$ respectively.

5-3. Panel Causality Test

In this section to examine causal relationship between the variables, we investigate panel Granger causality by estimating vector error correction model (VECM).

Granger causality itself is a two-step procedure. In the first step we estimate the residual from the long-run relationship. Incorporating the residual as a right-hand side variable, the short-run error correction model is estimated at the second step. The tri-variate Granger causality test for models 1 to 3 based on error-correction model can be expressed as following equations:

$$\Delta GDP_{it} = \delta_{1j} + \sum_k \delta_{11ik}\Delta GDP_{it-k} + \sum_k \delta_{12ik}\Delta POP_{it-k} + \sum_k \delta_{13ik}\Delta CAP_{it-k} + \lambda_{1i} ECM_{t-1} + u_{1it}, (5)$$

$$\Delta CAP_{it} = \delta_{2j} + \sum_k \delta_{21ik}\Delta CAP_{it-k} + \sum_k \delta_{22ik}\Delta GDP_{it-k} + \sum_k \delta_{23ik}\Delta POP_{it-k} + \lambda_{2i} ECM_{t-1} + u_{2it}, (6)$$

$$\Delta POP_{it} = \delta_{3j} + \sum_k \delta_{31ik}\Delta POP_{it-k} + \sum_k \delta_{32ik}\Delta GDP_{it-k} + \sum_k \delta_{33ik}\Delta CAP_{it-k} + \lambda_{3i} ECM_{t-1} + u_{3it}, (7)$$

Here Δ denotes the first difference of the variable, k denotes the lag length, ECM_{t-1} is the lag error correction term and λ_i is the adjustment coefficient. The direction of the causality is determined by the lagged error correction term and Wald F-statistic. The t-statistic on the coefficient on the lagged error correction term represents the long run causality relationship and the F-statistic (through Wald test) on the lagged explanatory variables represent short run causality relationship.

Table 4. shows the short run and long run results of panel causality test between GDP Growth, Population and Real Capital stock.

Table 4. Panel Causality Test

	Dependent Variables		
	DGDP	*DCAP*	*DPOP*
Independent Variables			
DGDP	-	59.44* (0.00)	17.23* (0.00)

DCAP	21.73* (0.00)	-	3.66 (0.16)
DPOP	12.27* (0.00)	19.24* (0.00)	-
ECT(-1)	-0.09* [-7.74]	0.0004 [1.43]	-0.02* [-23.74]

***** *indicates statistical significance at the 1% level. T-statistics are in bracket and probs are in parentheses.*

As the results show in Table 4, it is evident that, there is a bidirectional relationship between Population and GDP growth in the short-run, whereas there exists a unidirectional relationship between Population and capital stock. Also there is long run causality from POP and CAP to GDP per capita and that have been indicated by significance of t-statistic on coefficient of ECM. In equation 5, the estimated error correction coefficient (ECM) is equal to -0.09. This coefficient is highly significant and has the expected sign and implies a fairly high speed of adjustment to equilibrium after a shock.

Also in equations 7 when POP_{it} is dependent variables, Error Correction term is statically significant with the speed of adjustment of -0.02.

6. Conclusion

In this paper we examine the short run and long-run relationship between population, economic growth and capital stock in order to determine whether population is a stimulation for economic growth in OIC countries. We use data from 34 OIC countries over the sample period 1980–2018. Using panel unit root and pedroni's panel cointegration methods, the results show there exist the long run relationship when economic growth and capital stock are dependent variables. To estimate the long-run coefficients of independent variables with respect to dependent variables, we employed the Fully Modified OLS and OLS estimators. We found that population growth and capital stock have the positive and significant effects on economic growth.

Also the impact of economic growth and population on capital stock are positive. On the other hand the results of causality explain that there is a bidirectional relationship between Population and GDP growth in the short-run.

The aim of this paper is to give a rigorous analysis of the role of varying population in economic growth, so we argue that the only consistent approach is to recognize population as another form of capital (Arrow, 2003). Hence the population growth is a national saving that creates additional capacity in the economy. Therefore, the supply side is able to give greater strength and durability to the foundation of sustainable economic growth in the long run, relying on the existence of excess capacity on demand.

However, there is no necessary direct relationship between the increase in family size and population. Households with low population can be experienced in a high population growth rate. To achieve this (much smaller households), through the proper economic policies, that can lead to lower unemployment and price levels, Marriage age can be decreased.

Finally, from a policy perspective, population growth is a stimulus for economic growth and not an obstacle to it. Therefore, rather pessimistic view of the population and its control, economic policymakers must reduce important economic barriers through a structures reform, increasing management capability as well as implementing proper monetary and fiscal policies.

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