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The impact of Demographic Transition on Economic Growth in Sudan

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ABSTRACT

The process of demographic transition changes the demographic characteristics of any country, this transitions have had economic and social implications, whether long or short-term. Sudan is now in the second phase of demographic transition. This paper aims to studies the impact of demographic transition on economic growth of Sudan. The study used short time series from 1990 to 2019 and the data have collected from Central Bureau of Statistics (Sudan). The Autoregressive Distributed Lag (ARDL) model has been applied. The study results showed a positively impact for the demographic transition on economic growth in Sudan in the long run and negatively in the short run.

1. Introduction

Numerous researchers are interested in determine the relationship between economic growth and population growth, the theory of demographic transition is of great importance in the field of population studies, and the model holds great scientific value in explain the two phenomena, economic growth represents Gross Domestic Product growth and modern economic growth means the ability to provide goods and services per capita (Kuznets, 1973, p257).

The researchers came up with three theories regarding this model: Population growth benefits economic growth, restricts it, or is independent of it (Bloom et al, 2001, p2). Countries of the world differ in process and duration of the demographic transition, which takes 50-150 years to complete this transition. The process of demographic transition in developed countries has been completed, developing countries are still not yet in the process of transition. For a high percentage of dependents (children and elderly), a high percentage of resources have been directed to care for them, creating large employment opportunities and large investments.

The world experienced a decline in population growth at the end of the 19th century and the beginning of the 20th century, especially in Latin America and Asia (Galor, 2005, p499). Ireland experienced a demographic return that had a strong impact on economic growth. As for the Arab and African countries, some of which have not yet begun the process of demographic transition or are in the early stages of this process. (Bloom et al, 2001, p42).

The inflation of the youth population is a key feature of developing countries, and countries that have succeeded in reducing infant mortality. Countries with a large youth population are vulnerable to rapid population growth even as total fertility rates fall to replacement level and this process is called population momentum (Bloom et al, 2001, p19).

There are five stages through which the population goes through the process of demographic transition, the most advanced countries are in the fourth stage, while the most developing countries are in the second and third stage. Sudan ranks 34th in the world's population, with a population of 34 million in 2010 to 43 million in 2020, and according to current trends, the United Nations expects Sudan to rank 23rd , its population increasing to 81 million in 2050 (United Nations, 2020). Sudan is go across the second stage of demographic transition, with mortality and fertility rates declining, although they are still high, there are expectations that the age group (15-24) will increase (Ahmed, 2014, p229), theoretically, unless youth inflation is offset by the implementation of policies and strategies, these increases in

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the youth group will become a problem and there will be no opportunities for economic development (Urdal, 2006, p618).

We will highlight the analysis of the case of demographic transition on population growth trends and their economic implications. The change in the age structure due to demographic transition has economic implications such as high youth ratios and lower tax revenues, as well as its impact on productivity across the structure and population of working age (Fyerer, 2007, p104). A high population leads to higher per capita income when stimulating human capital.

Changing the age structure of the population at different ages is a vital index for economic growth and productivity, people in the age group (0-14) years need an influx of investments in health and education, while people over 65 years of age need health care and old age benefits. The age group of young people of working age leads to population growth while population growth has a negative impact on demographic growth (An and Jeon, 2006, p108).

In study (Fekir and Yousfat, 2020, p72) for the different sources of diversification that affect economic growth in some Mena countries based on GDP growth, the static analysis of the panel data model showed that the appropriate data model for the study is the model of random impacts. (Benamra and Aznag, 2020, p123) mentioned in their study the case of Algeria, and using the VAR model the study founded that the growth rate of wages and public expenditure are the most important sources of local inflation in Algeria in the short term during the study period. In Algeria also job creation plays an important role in economic growth and development by absorbing unemployment (Razika, 2020, p4).

2. Data Sources and Methodology

Sudan time series data were used from 1990 to 2019, and included variables were Economic Growth (ECGR), Gross Domestic Product (GDP), Life Expectancy (LE) and Rate of Natural Increase (RNI). The data were obtained from the Central Bureau of Statistics in Sudan and global development indicators.

The Autoregressive Distributed Lag Model (ARDL) [(1)] was launched by Pesaran and Shin "1997" and developed by Pesaran et al "2001", (ARDL) approach to co- integration is distinct from other co- integration methods, the Bound Testing Approach can be applied regardless of whether it is independent variables I(0) or I(1). However, it is required that the dependent variable be at the level, i.e. I(0) not a higher rank, which is appropriate for the current study data that uses the co-integration test under ARDL , the stationary of the variables is tested by Unit Root Tests Augmented Dickey-Fuller (ADF) that can be applied to small-size samples. ARDL approach estimates the long-term and short-term relationships, in addition the results of Error Correction Model.

3. Literature Review

Demographic transition refers to the transition from high (birth and death) rates to low rates as the country develops. The literature showed various results of the impact of demographic transition on economic growth in several countries using time series. In the United States, economic development has raised wages, and the replacement of employment has led to lower fertility (Greenwood and Seshadri, 2002, p155).

In Pakistan, demographic transition has played a major role in an economic dividend (Hussain et al, 2009). demographic transition in China contributed by 15-25% to economic growth (Feng, 2011, p178). During the period from 1961 to 2003, economic growth was 31% in India and 25% in Pakistan (Igbal et al, 2015, p45).

The Middle East and North Africa is still in the early stages of demographic transition, sub-Saharan Africa has not documented any decline in fertility, with these countries known for their high fertility rates, with most of their countries reporting total fertility rates (TFR) of 6 infant per woman (Mboup and Saha, 1998, p6).

4. Results and Discussion

Initially, we tested the validity of the ARDL model applied to the time series data. As a first step, Lag Order Selection Criteria using Akaike information criterion(AIC), Schwarz information criterion(SC), Hannan-Quinn information(HQ).

Table 1: Results of Lag Length Criteria Test

Lag	AIC criterion	SC criterion	HQ criterion
0	24.44847	24.64349	24.50256
1	9.435629	10.41073	9.706080
2	8.634720	10.38990	9.121532

3	7.581234	10.11650	8.284408
4	6.710212	10.02555	7.629747
5	-2.333918*	1.761505*	-1.198022*

* indicates lag order selected by the criterion

Source: Authors' calculation based on study data analysis using (E views. v9)

Through the results of Table 1, it is clear to us that the 5^{th} Lag is the most appropriate for data during the study period.

Then we examined the level of stationarity of the variables (ECGR, GDP, LE and RNI) is tested by Augmented Dickey-Fuller (ADF) [(2)] Test at the level I(0) and at first difference I(1) to know the order of integration. (ADF) test is evolved from testing the existence of unit root.

Table 2: ADF Test of Stationarity at Level

Variables	ADF value with C	Critical value at 5%	probability	Test for unit root in
ECGR	-5.424479	-3.574244	0.0007	Level
GDP	-3.700104	-4.532598	0.0477	Level
LE	-2.810107	-3.808546	0.0747	Level
RAI	-3.989236	-4.532598	0.0280	Level

Source: Authors' calculation based on study data analysis using (E views. v9)

To determine the Stationarity of the variable is done through two methods, either by comparing the calculated value and critical value of Augmented Dickey-Fuller, if the calculated value is greater than the tabulated value, this refers to Stationarity of the variable, as shown in Table 2.

The second method represents in the comparison between the level of significance in test statistics at 5% and Probability, if the level of significance is less than 5%, This indicates to Stationarity of the variable.

The model measuring the impact of demographic transition on economic growth in Sudan as Autoregressive Distributed Lag Model (ARDL) can be written as follows:

$$\Delta \mathrm{ECGR} = \beta_0 + \beta_1 \Delta \mathrm{ECGR}_{t-i} + \beta_2 \Delta \mathrm{LOG}(\mathrm{GDP}_{t-i}) + \beta_3 \Delta \mathrm{LOG}(\mathrm{LE}_{t-i}) + \beta_4 \Delta \mathrm{LOG}(\mathrm{RNI}_{t-i}) - \mathrm{CointEq}_{-1} + \sum_{j=1}^{n} \mathrm{Y}_1 \mathrm{LOG}(\mathrm{GDP}) + \sum_{j=1}^{n} \mathrm{Y}_2 \mathrm{LOG}(\mathrm{LE}) + \sum_{j=1}^{n} \mathrm{Y}_3 \mathrm{LOG}(\mathrm{RNI}) + \mu_t$$

Where $\beta_1, \beta_2, \beta_3$ represent Short-Run Coefficients, $\mathrm{Y}_1, \mathrm{Y}_2, \mathrm{Y}_3$ symbolize Long-Run Coefficients, $\mathrm{CointEq}$ shows the coefficient of error correction ,Δ illustrates the difference of the variables while (-1) implies the lag.

Table 3: Results of Bound Test

K	Value	Test Statistics
3	43.2040	F-Statistic
Critical Value Bound		
Lower bound I(0)	Upper bound I(1)	Significance
2.72	3.77	10%
3.23	4.35	5%
3.69	4.89	2.5%
4.29	5.61	1%

Source: Authors' calculation based on study data analysis using (E views. v9)

Based on the statistical results of table 3, the calculated value of the test is equal to (43.2040) and is larger than the critical value of the Bound Test. This is an indication that there is a long-run relationship that is going towards the interpreted variables(GDP,LE,RNI) To the dependent variable (ECGR).

Table 4: Estimated Long-Run Coefficients by using the ARDL Model

Variable	Coefficient	Standard Error	t-Statistic	probability
GDP	-0.004325	0.000196	-2.086512	0.0288
LE	7.381703	0.200180	6.875284	0.0173
RNI	2.268464	0.327373	7.475547	0.0170
C	-5.118833	1.443003	-3.940426	0.0163
ECM(-1)	-0.428427	0.112624	-5.214725	0.0235

Source: Authors' calculation based on study data analysis using (E views. v9)

According to the table 4 the ECM (Error correction Term) is -0.428427 which shows that 42.8427 % convergence in short run to long run within a year with a change of GDP (Gross Domestic Product) impact economic growth negatively. In short run variables of RNI (Rate of Natural Increase), LE (Life Expectancy) impact economic growth positively so that demographic transition impedes economic growth in the long run(3).

Margins :

(1) Autoregressive Distributed Lag (ARDL) cointegration technique or bound test of cointegration (Pesaran and Shin 1999 and Pesaran et al. 2001) cointegration techniques have become the solution to determining the long run relationship between series that are non-stationary, as well as reparameterizing them to the Error Correction Model (ECM).

(2) an Augmented Dickey-Fuller (ADF) value with less than its critical value shows that the underlying series is non-stationary.

(3) The null of non-existence of the long-run relationship is defined by; **Ho: δ1 = δ2= 0** (null, i.e. the long run relationship does not exist) **H1: δ1 ≠ δ2 ≠ 0** (Alternative, i.e. the long run relationship exists). This is tested in each of the models as specified by the number of variables.

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Appendix

Table A1: Study Data

years	ECGR	GDP	LE	RNI
1990	-5.47	484	55.48	29.77
1991	7.51	432	55.66	29.76
1992	6.58	261	55.83	29.77
1993	4.57	320	56.00	29.76
1994	1	450	56.32	29.74
1995	6	473	56.63	29.69
1996	11.56	301	56.95	29.62
1997	6.06	379	57.26	29.54
1998	8.24	355	57.58	29.48
1999	8.39	328	57.96	29.37
2000	10.8	366	58.33	29.28
2001	6	383	58.71	29.17
2002	6.29	418	59.08	29.05
2003	5.14	485	59.46	28.91
2004	5.64	573	59.89	28.74
2005	6.53	689	60.32	28.54
2006	5.73	905	60.76	28.33
2007	3.85	1128	61.19	28.10
2008	4.5	1305	61.62	27.86
2009	6.49	1164	62.05	27.61
2010	3.79	1401	62.48	27.35
2011	0.98	1438	62.90	27.08
2012	5.62	1458	63.33	26.80
2013	7.9	1557	63.76	26.50
2014	2.68	1710	64.00	26.20
2015	4.91	1910	64.24	25.89
2016	4.7	1299	64.27	25.58
2017	4.28	1112	64.71	25.28
2018	-2.32	624	64.95	24.99
2019	-2.56	442	65.18	24.71

Source: Central Bureau of Statistics (Sudan) and United Nations.