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Demographic Window of Opportunities (DWO) and Economic Growth in Egypt

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Abstract: The demographic transition theory and the demographic window of opportunity (DWO) have been tested in several developed and most likely developing countries since the beginning of the 1990s. Regarding Egypt, demographic data from The Central Agency for Public Mobilization and Statistics (CAPMAS) predicts that the country is about to enter the DWO phase. In order to realize how to maximize the possible benefits from this DWO in Egypt, two main models were developed in this paper in an attempt to determine the main economic and demographic variables that influence the dependency ratio and thus economic growth over the period 1980-2022.The results reveal that; total number of students enrolled at all levels of pre-university education, Total Educational Attainment and GDP per capita are the main variables with highest significant effect on the dependency ratio in Egypt and that the latter is the most influential. The strong relation between GDP per capita and dependency ratio can be explained as with the reduction in the dependency ratio, public and private savings will increase and eventually will be directed towards increased human and capital investments. On the other side, the Employment to Population Ratio, Gross Domestic Savings and Government Effectiveness are found to have significant impact on economic growth with the latter being the most influential. This indicates that government effectiveness plays the major role in channeling domestic savings that's expected to increase as a result of reduced dependency ratio to finance economic growth.

Keywords: demographic window of opportunity, demographic transition, dependency ratio, economic growth, ARDL model.

INTRODUCTION

Demographic transition theory has evolved in 1929 based on the notable writings of the American sociologist Warren Simpson Thompson in an attempt to analyze international changes in population variables through his book "Danger Spots in World Population" and his article "Population" in the American Journal of Sociology. Also, his book" Population Problems", published in 1930, was a main source for most population studies for the following 30 years. Through his contributions, Thompson presented the basics for the famous demographic transition theory as he subdivided countries into three categories according to their birth and death rates.(Caldwell, 2006)

Later, the systematic demographic transition theory has been developed and by 2009, the effect of demographic changes on economic performance became one of the most recognized research areas in social economics.

There are four basic stages according to the classical demographic transition theory:
Historically, the first stage began in pre-industrial societies after the agricultural revolution in Great Britain during the 18th century when population growth rate was almost stable due to the equilibrium between birth and death rates.

The second stage began in the 20th century. In one side, the improvement in farming techniques increased food supplies and on the other side; upgrading sanitation; access to clean water and later; reducing female illiteracy lead to enhancing public health. These factors altogether contributed to reducing death rates, increasing life expectancy and thus population growth.

The third stage began with the decline in birth rates due to increased; female education; female participation in labor market; urbanization and decreased child labor. This stage started earlier in Europe at the second half of the 19th century and later in other countries. Rapid population growth rate began. (UN, 2005)

In the fourth stage, both birth and death rates are low. This took place during the late 20th century in several developed European countries and Japan, where the advanced lifestyle lead to declining population growth rate. (Mahmud,2020)

Empirically, the demographic transition theory has been tested in several countries during the 1990s and the beginning of 2000s through the analysis of Robert J. Barro, Bloom, Mason, Williamson, Kelley, Schmidt and many others who developed and tested the concept of "the demographic window of opportunity DWO". (Barro et al, 1989) This DWO has been defined by the United Nations' Population Division as "a period in which the ratio of under 15 population reaches to less than 30 percent of the total population and the ratio of 65 years and older population is still less than 15 percent" (UN, 2004). During this period, the population dependency ratio falls to less than 0.5 which can have significant effects on countries' economic performance conditional to appealing government development policies to benefit from these increasing human resources.

Most of these empirical investigations determined three main channels of the demographic window stage on economic development and growth, namely; human development following the increase in schooling years (Nasser et al, 2017); labor productivity due to the

development of human capital and; domestic savings and thus domestic investment as a consequence for the reduction in dependency ratio.(Kelly & Schmidt, 2005)

Concerning Egypt, the percentage of working age population (15-64 years old) has been stable over the 1980s and then started to increase steadily since 1990 to increase from 54.5% of total population to 62.5% in 2010 to decline slightly after the political turmoil in 2011 to 62% in 2017 and then increases again.

The percentage of population aged 65 and above has been fluctuating since 1980s between 4 and less than 5 % (4.9% of total population in 2022). Whereas The percentage of young population (0-14) also has been stable during the first half of the 1980s and then started to decline slowly from 41% of total population in 1991 to 33% in 2009 then, it passed through several annual fluctuations in the following ten years to restore its declining path again slowly in 2019 to reach 32.86 in 2022. (El-Saharty et al, 2022)

The Central Agency for Public Mobilization and Statistics (CAPMAS) expected further declines in the young aged population (0-14) due to the decreasing fertility rate from 3.4 births per woman in 2017 to 2.1 in 2032 rates (CAPMAS, 2017) which will eventually lead to reduction in the increasing rate of young population. All these demographic data are quite promising that Egypt is about to enter the DWO phase.

The contribution of the current paper is to investigate the possible channel for reaping the benefits of the DWO through determining the main variables that can affect the dependency ratio and economic growth in Egypt over the study period 1980 till 2022.

These two sets of variables will be realized through examining the Short-run (direct) impact of the changes in population age structure (the increasing working-age population/ dependency ratio) on economic growth rate (proxied by GDP per capita) as well as examining the Long-run (Indirect) impact of the reduction in population density and dependency ratio on total factor productivity (TFP proxied by GDP per worker). (Kelly & Schmidt, 2005)

LITERATURE REVIEW

I- In Egypt:

a) The study of Ghada Gomaa A. Mohamed and Morrison Handley Schachler (2011):

The study in hand applied a regression analysis to test the effect of several economic variables reflecting economic stability and demographic variables reflecting gender, age and geographical structure on GDP per capita as a proxy for economic growth rate of Egypt over the period 1981 till 2007.

The study proved that the population growth rate has a negative significant short run effect on per capita growth that deteriorates in the long run due to autoregressive relation between both variables. Concerning the remaining explanatory variables, the study also proved that their effect on economic growth rate is insignificant neither in the short-run nor on the long-run. This coincides with theories of economic growth for open economies.

Finally, the study encouraged doing deeper researching on the relation between the rapid population growth on economic performance in Egypt and in other middle income countries.(Mohamed & Handley-Schachler, 2011)

b) The study of Mahmoud Mohamed ElSarawy (2011):

This study used multiple linear and non-linear regression analysis to measure the impact of several demographic variables on economic growth over the period (1980-2010). Several Demographic changes have been revealed over the study period where the dependency ratio fell from 90% to 57% which has been explained by the decrease in both population growth rate and fertility rate together with the increase in: the working age population, women participation rate in the labor market and life expectancy at birth.

The study then concluded that there is strong to moderate correlation between the explanatory variables and dependency ratio. Where a positive relation was found between fertility rate and dependency ratio (97%), against a negative one among the working age population and the dependency ratio (96%). Besides, the study presented Scatter plot matrix for the independent variables together with the dependent variable (GDP) that showed strong relationships (sometimes even linear) among these variables. The study also encouraged doing deeper research to analyze the overlaps among demographic variables in Egypt and to prepare proper developmental plans that can benefit from these demographic changes and achieve economic growth. (ElSarawy, 2011)

c) The study of Reham Rizk (2018):

This paper used an extended exogenous Solow-Swan growth model over the period 1971–2015 to examine the impact of the changes in working age population, savings, tertiary enrolment, trade openness on GDP per capita.

The study concluded that; gross savings has a positive impact on GDP however the share of elderly population has been declining over the study period and that tertiary enrolment has a long-run effect on economic growth. Eventually, the study realized that among these demographic and economic variables, economic growth in Egypt is affected more by the increase of working age population than by the rise in gross savings.

The study also revealed that the deterioration of the labor market in Egypt through the reduction of employment rate and rise in the unemployment rate of the educated population are among the main reasons that hinder the economy from benefiting from the population and education changes. (Rizk, 2018)

ii) Other developing Countries:

d) The study of Hom Nath Chalise (2019) in Nepal;

This theoretical study observed and analyzed demographic data in Nepal over the period of 1981- 2001 and found thatseveral demographic variables have witnessed serious changes. For instance; the decline in both fertility rate (from

6.3 to 4.1%) and crude death rate (from 13.5 to 9.6%) whereas an increase in life expectancy (from 49 to 60 years). All lead to reduction in population growth rate and changes in population composition as the percentage of youth (0-15 years) declined, whereas the working age population (15-59 years) increased.

The study also showed and analyzed the country's population pyramid of (1997-2017) that clearly proved that Nepal, over the study period has been passing through demographic transition and that the government is taking actions to reap benefits of DWO. (Chalise, 2019)

e) The study of M. Mazharul Islam (2020) in Oman:

The paper's main goal was to analyze the reasons behind the huge demographic shifts in Oman over the period (1950–2019) and to estimate further demographic changes for the following 50 years (till 2070). In doing this, the paper differentiated between the age-structure dependency ratios through calculating; total dependency ratio, young dependency ratio and elderly dependency ratio. Besides, to find out the timing and duration of the demographic window, the paper used a model relating income per capita with output per worker (proxied by income per worker) and labor force participation rate.

The study found that; the reduction in mortality rates (decreased from 2.8% in 1950 to 0.3 % in 2015) and in fertility rates (decreased by more than 60% between 1988 and 2008) and rising in net migration (increased from less than 1% in 1970 to more than 44% in 2015) has led to age-structure transformation over the period 1980-2015.

The study also found that, Oman has two demographic windows of opportunities. The first lasted from 1985 till 2000, whereas the second window started in 2010 and is expected to continue till 2040.

In conclusion, the study recommended that policymakers and governments in Oman should set demographic changes among their priorities to maximize benefits from the demographic changes.(Islam, 2020)

MEASURING DEMOGRAPHIC CHANGES IN EGYPT: EMPIRICAL ANALYSIS

In an attempt to end the controversy regarding the significance of demographic changes on economic growth in many previous studies conducted in Egypt, two main models were developed in this paper. The first model measures the relation between dependency ratio {measured as: (population – working-age population)/ (working –age population)} and several economic and demographic variables over the period 1980- 2022 as well as differentiating between the short and long run effects.

$$DR_{it} = \beta_0 + \beta_1 EDUA_{it} + \beta_2 EDUT_{it} + \beta_3 YW_{it} + \beta_4 S_{it} + \beta_5 EMP_{it} + E_t \ldots.(1)$$

The second model measures the impact of several variables on economic growth in Egypt (proxied by the GDP per capita) (Crombach & Smits, 2022)over the same period. Government Effectiveness has been added because good governance is conditional to absorb growing labor and increasing resources.

Likewise Net Migration has been added for the believed importance of this variable on economic growth in Egypt. Net Migration is the difference between immigrants (foreigners coming into Egypt) and emigrants (Egyptians leaving Egypt). Since the beginning of the 1980s and the declaration of the Emigration and Sponsoring Egyptians Abroad Law No. 111 of 1983, emigration has been viewed as a reasonable solution for the high unemployment rate. However**,** the beginning of the 1990s witnessed several international changes that started with The Iraq-Kuwait war in 1991(Zohroy & Harrell-Bond, 2003)," followed bycivil war in Algeria and UN embargo on Libya in 1992 altogether changed migration trends over the period 1990-2020.

$$YN_{it} = \beta_0 + \beta_1 EDUA_{it} + \beta_2 MIG_{it} + \beta_3 YW_{it} + \beta_4 S_{it} + \beta_5 EMP_{it} + \beta_6 GOV_{it} + E_t \ldots.(2)$$

The beginning of this time-series analysis in year 1980 is meant to analyze the effects of population increase in Egypt that has reached an unprecedented rate of 2.8% during the 80s, a phenomenon that was described as "population explosion". All data are obtained from the World Bank and UNISCO data base, except for the years of schooling (EDU A and EDU T) obtained from the ministry of Education data base.

Symbol	Variable	Proxy
Y_w	GDP per worker	GDP per person employed
Edu	Years of schooling	**EDU A**total number of students enrolled at all levels of pre-university education
		EDU T Total Educational Attainment
MIG	Migration	Net Migration
S	Domestic Savings	Gross Domestic Savings
DR	Dependency Ratio	Age Dependency ratio
Emp	Employment	Employment to Population Ratio
Y_N	Economic growth	GDP Per Capita
Gov	Measuring Government Performance	Government Effectiveness

It's worth mentioning that two education variables were included in the model to reflect the Education indicator. The first one is the total number of students enrolled at all levels of pre-university education (EDU A) represents the number of students who are attending school from nursery till post-secondary, non-tertiary education. The second is Total

Educational Attainment (EDU T) which represents the highest level of education completed and is measured by the average years of schooling. Both are included to explain the different effect of; the current participation of students' enrolled at all pre-university education and the students' past completion of education on dependency ratio.

The Auto-Regressive Distributed Lag Model (ARDL) has been used here to monitor the causal relationship between variables and their direction. (Pesaran et al, 2001)This also has been proved by the simulation results of the E-Views 12 program which showed that the ARDL model is the optimal model, through which we obtain the lowest value for the Akaike Information Criteria (AIC) standard to determine the optimal number of lag periods that show the difference between short and long terms effects of changes in the independent variables of both models.

The ARDL model consists of two models: The lag-distributed model and the Autoregressive model:

1) Jarque – Bera Test [i]

The Jarque–Bera test (a goodness-of-fit test) indicated that all the variables included (YW – DR – EMP – YN – GOV – S – MIG – EDUA – EDUT) follow the normal distribution.

2) Dickey- Fuller test(Dickey &Fuller, 1979)

To overcome the problem of autocorrelation between variables, the extended Dickie-Fuller test[ii] has been used.(Gujarati et al, 2013) As expected, the variables (YW-DR-YN-S-EDUA-EDUT) were non-constant at level;however, after testing them again at first difference, they became constant at the first level.

3.1 Models Evaluation:

3.1.1 ARDL modelsin the short term, Bound Tests and Models Validity:

The Result of the ARDL test results for model (1) [iii]confirms that all estimation coefficients are significant and that almost 90% of the changes in the Dependency Ratio are due to the estimated model independent variables; GDP per worker, Years of schooling (with its two main variables: EDU T and EDU A), Migration, Domestic Savings and Employment. [iv]

$$DR_{it} = 0.430 + 0.390 *D(EDUA) - 0.326 *D(EDUT) - 0.540 *D(YW) - 0.014* D(S(-2))- 0.003 * D(EMP(-3))$$

The ARDL[v] test results for Model (2)[vi] confirms that all estimation coefficients are significant and that the estimated R2 value is (0.885) which means 88.5% of the changes in Economic growth (GDP Per Capita as a proxy) are due to the variables of the estimated model; total number of students enrolled at all levels of pre-university education, Net Migration, Gross Domestic Savings, Employment to Population Ratio, Government Effectiveness and GDP per person employed.

$$YN_{it} = 0.090 + 0.03 *D(EDUA) + 0.008 *D(MIG) + 0.534 *D(S) + 0.364* D(EMP(-1)) + 0.905 * D(GOV) + 0.218 *D(YW(-1))$$

A Long-run equilibrium relationship between the two models' variables has been confirmed after applying a Bound test depending on the F-test values.[vii]

Besides, some additional tests were applied to verify the validity of both models;

- The Jarque-Bera test results shows that the residuals of model (1) and model (2) follow a normal distribution[viii].
- The F-Test value for the BGLM tests indicate that both models (1) and (2) residuals' do not contain the problem of serial autocorrelation[ix].
- The variance stability tests indicate that both Models (1) and (2)are adequate and free of the problem of variance stability.[x]

Thus, the previous tests confirm the quality of the estimated standard models and both are free of measurement problems.

The structural stability of the estimated models' coefficients has been tested through the Cumulative Sum of Residuals (CUSUM) and the Cumulative Sum of Residuals Square (CUSUMSQ) tests.

The tests' results show that coefficients in model (1)[xi] are structurally stable over the period from 2008 till 2022 and likewise, the coefficients of Model (2)[xii] are structurally stable over the period from 2016 till 2022. This indicates that there is consistency between the long-term and short-term results of both estimated models.

3.1.2 Estimation of long-term Coefficients:

The results of model (1) parameter estimates in the long term[xiii]show that the effect of "total number of students enrolled at all levels of pre-university Education" on dependency ratio decreases in the long-term with a value of 0.580, whereas the effect of; GDP per worker, Gross Domestic savings, Employment to Population Ratio and Total Educational Attainment (YW - S - EMP - EDUT)on dependency ratio increases in varying proportions.

Likely, after estimating the parameters of model (2)over the long run[xiv], it was found that all variables are statistically significant at a significance level of less than 5%. Besides; the results reveal that the following explanatory variables; Gross Domestic Savings; Employment to Population Ratio; Government Effectiveness and GDP per person employed (S- Emp - Gov- Y_w) have an increasing effect on economic growth over the long run.

Whereas, total number of students enrolled at all levels of pre-university education and Net Migration (EDU A and MIG) do not have significant effect on economic growth in neither the short nor the long terms.

MODEL RESULTS AND CONCLUSION

Three main variables were found to have significant effect on dependency ratio in Egypt over the period 1980-2022. Namely; total number of students enrolled at all levels of pre-university education (EDU A), Total Educational Attainment (EDU T) and GDP per capita (Yw). The other two variables with limited negative effect on dependency ratio are Gross Domestic Savings and the Employment to Population Ratio and both are lagged by two and three periods respectively.

GDP per capita is the most influential. This coincides with economic literature as according to the neoclassical economic analysis, GDP per capita is directly affected by

changes in the dependency ratio mainly through savings. This can be explained as when the dependency ratio decline, government and individual resources are released and directed towards increased savings which in turn will be directed towards increased investments in both real and human capital. (Fayissa& Gutema, 2010)

All the independent variables except EDU A have negative effect on the Dependency Ratio in the short term which is logical since most students enrolled at the pre-university stage of education are supported by their families.

The negative relation between savings and dependency ratio also coincides with economic literature as the life cycle hypothesis of saving suggested by Modigliani (1970) argues that individuals tend to save more over their working-age lifetime and to save less after retirements. Thus, as the older age dependency ratio (OADR) increases, domestic savings decreases.(Hyung, 2013)

In Egypt we can find that the percentage of old-age population (65 years and above) has been slowly increasing from 4.2 % in 1980 to 4.5% in 2000 to decrease to 4.1% in the next following ten years and then increase again to 4.9 % in 2022. (Sayed, 2018) Also the old dependency ratio (as percentage of working age population) has been stable at around 7.7% to decline over the same period (2000-2010) to 6.6%. This can partially explain the weak negative relation between dependency ratio and domestic savings in Egypt.
Likewise, many economic and demographic variables affect economic growth in Egypt. However, the employment to Population Ratio at 1 lag period, Gross Domestic Savings and Government Effectiveness are the variables with the highest effect on economic growth.

On the contrary; it was found that both; total number of students enrolled at all levels of pre-university education and Net Migration (EDU A and MIG) do not have significant impact on economic growth in neither the short nor the long terms.

Government effectiveness is thus believed to play the major role in channeling released domestic savings to finance economic growth. Two main pillars are necessary to translate this possible demographic opportunity into dividend. Firstly, to increase the working age population and reduce the dependency burden, especially for young dependent (0 -14) and thus increase domestic savings and investment.

Secondly, to increase the government effectiveness through raising; the quality of public and civil services; government independence from political changes and the quality of policy formulation and most importantly implementation.

Appendix

a) Tables

Table (1) Jarque – Bera Result

	DR	EDUA	EDUT	EMP	GOV	MIG	S	YN	YW
Mean	71.04704	0.283746	6758773.	40.31442	-0.366419	-7487.227	13.62630	1653.231	31081.07
Median	69.35400	0.290000	7671031.	42.07000	-0.374726	-6046.000	14.29940	1170.805	30821.63
Maximum	83.64480	0.430000	10310870	48.73000	-0.115729	163449.0	21.08844	4295.407	48920.03
Minimum	59.73153	0.160358	2807158.	21.31000	-0.782056	-79150.00	4.340928	493.0132	21103.37
Std. Dev.	9.983636	0.089355	2178544.	5.653232	0.166169	48283.16	4.354025	1094.604	7939.902
Skewness	0.150793	0.103316	-0.402451	-0.2638566	-0.553968	0.472828	-0.496113	0.840810	0.657112
Kurtosis	1.257898	1.656726	1.926424	1.5254734	2.817780	2.787624	2.489092	2.352164	2.481114
Jarque-Bera	5.600526	3.309352	3.225777	3.422758	2.258805	2.069439	2.231591	5.818509	3.576930
Probability	0.060794	0.191154	0.199311	0.388566	0.323226	0.429556	0.327655	0.054516	0.167217

Source: E-views 12 output.

Table (2) ADF Test Results

Variables	Level			first difference			degree of integration
	Direction	T-test	p-value	Direction	T-test	p-value	
YW	Constant	2.860	0.990	Constant	-5.019	0.000	1(1)
DR	Constant	-0.923	0.769	Constant	-3.721	0.008	1(1)
EMP	Constant	-5.029	0.000	-	-	-	1(0)
YN	Constant	0.381	0.979	Constant	-3.959	0.004	1(1)
GOV	Constant	-3.257	0.023	-	-	-	1(0)
S	Constant	-1.515	0.516	Constant	-6.807	0.000	1(1)
MIG	Constant	-5.147	0.000	-	-	-	1(0)
EDUA	Constant	0.807	0.993	Constant	-7.766	0.000	1(1)
EDUT	Constant	-1.177	0.675	Constant	-6.556	0.000	1(1)

Source: E-views 12 output.

Table (3) ARDL test results for model (1)

Variable	Coeficient	t-Statistic	prob.
D(EDUA)	0.390	3.341	0.005
D(EDUT)	-0.326	-6.171	0.000
D(YW)	-0.540	-2.210	0.043
D(S(-2))	-0.014	-4.510	0.000
D(EMP(-3))	-0.003	-2.853	0.012
C	0.430	4.607	0.000
R-squared	0.899	F-statistical	1.206
Durbin-watson stat	2.294	Prob	0.000

Source: E-views 12 output.

Table (4) ARDL test results for model (2)

Variable	Coeficient	t-Statistic	prob.
D(EDUA)	0.030	8.634	0.000
D(MIG)	0.008	13.853	0.000
D(S)	0.534	4.490	0.002
D(EMP(-1))	0.364	4.037	0.005
D(GOV)	0.905	10.140	0.000
D(YW(-1))	0.218	9.140	0.000
C	0.090	11.617	0.000
R-squared	0.885	F-statistical	155.110
Durbin-watson stat	2.506	Prob	0.000

Source: E-views 12 output.

Table (5) Results of estimating long-term Coefficient for model (1)

Variable	Coeficient	t-Statistic	prob.
EDUA	0.580	4.252	0.007
EDUT	-0.423	4.136	0.009
YW	-0.606	3.002	0.000
S	-0.067	4.606	0.000
EMP	-0.065	3.294	0.000
C	-0.290	3.740	0.000

Source: E-views 12 output.

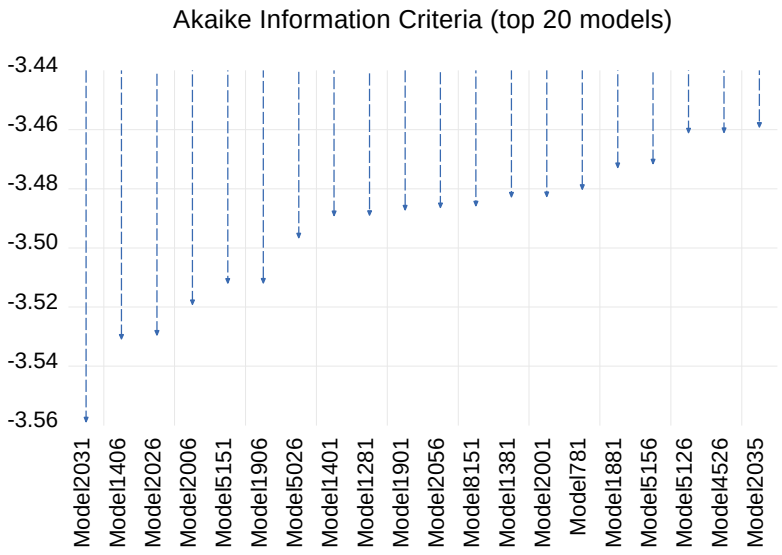
Table (6) Results of estimating long-term Coefficient for model (2)

Variable	Coeficient	t-Statistic	prob.
EDUT	0.070	-11.288	0.000
MIG	0.010	6.564	0.003
S	0.624	-9.681	0.000
EMP	0.555	-3.816	0.012
GOV	0.986	2.681	0.032
YW	0.381	15.523	0.000
C	0.471	3.625	0.008

Source: E-views 12 output.

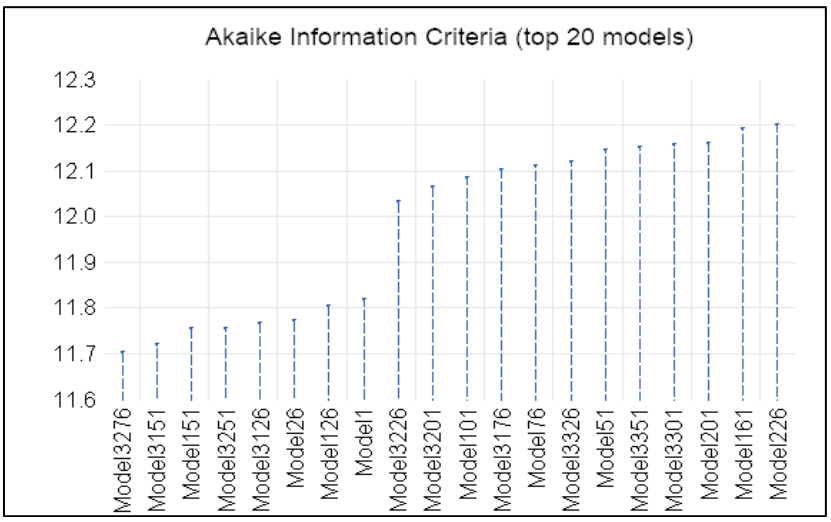
b) Figures:

Figure (1) Akaike Information Criteria (AIC) test results for Model (1)



Source: E-views 12 output.

Figure (2) Akaike Information Criteria (AIC) test results for Model (2)



Source: E-views 12 output.

Figure (3) Bound Test results for model (1)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	6.263253	10%	2.08	3
k	5	5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15

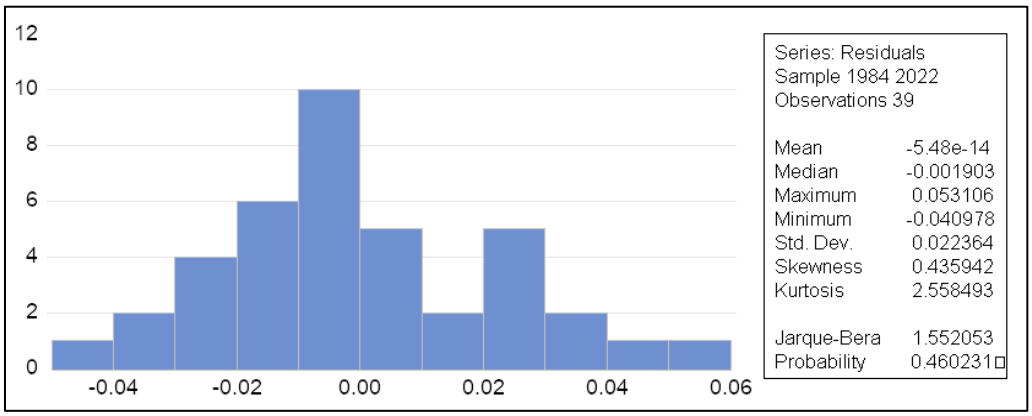
Source: E-views 12 output.

Figure (4) Bounds Test results for model (2)

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	8.435679	10%	1.99	2.94
k	6	5%	2.27	3.28
		2.5%	2.55	3.61
		1%	2.88	3.99

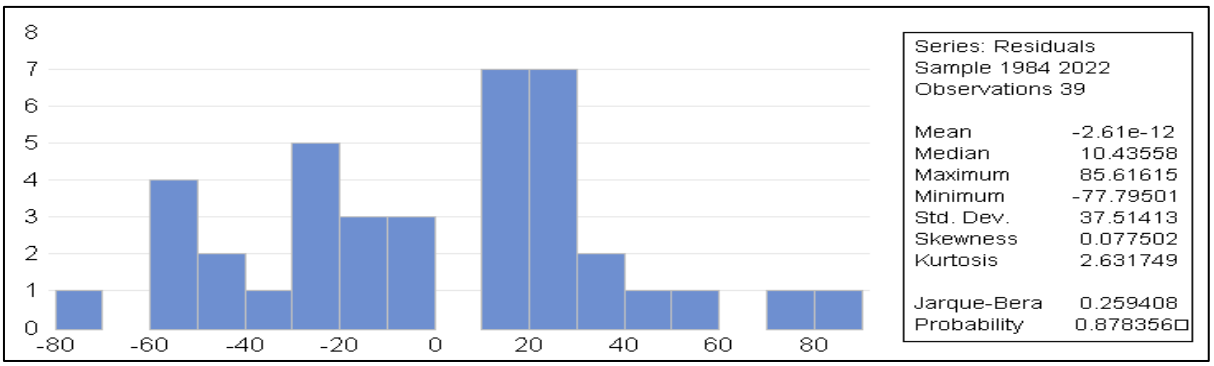
Source: E-views 12 output.

Figure (5) Jarque-Bera test results for model (1)



Source: E-views 12 output.

Figure (6) Jarque-Bera test results for model (2)



Source: E-views 12 output.

Figure (7) Results of the serial correlation test for model (1)

Breusch-Godfrey Serial Correlation LM Test:			
Null hypothesis: No serial correlation at up to 1 lag			
F-statistic	0.554474	Prob. F(1,14)	0.4688
Obs*R-squared	1.485762	Prob. Chi-Square(1)	0.2229

Source: E-views 12 output.

Figure (8) Results of the serial correlation test for model (2)

Breusch-Godfrey Serial Correlation LM Test:			
Null hypothesis: No serial correlation at up to 1 lag			
F-statistic	1.715404	Prob. F(1,6)	0.2382
Obs*R-squared	8.671062	Prob. Chi-Square(1)	0.0032

Source: E-views 12 output.

Figure (9) Results of Heteroskedasticity test for model (1)

Heteroskedasticity Test: Breusch-Pagan-Godfrey Null hypothesis: Homoskedasticity			
F-statistic	0.587603	Prob. F(23,15)	0.8781
Obs*R-squared	18.48439	Prob. Chi-Square(23)	0.7307
Scaled explained SS	2.130754	Prob. Chi-Square(23)	1.0000

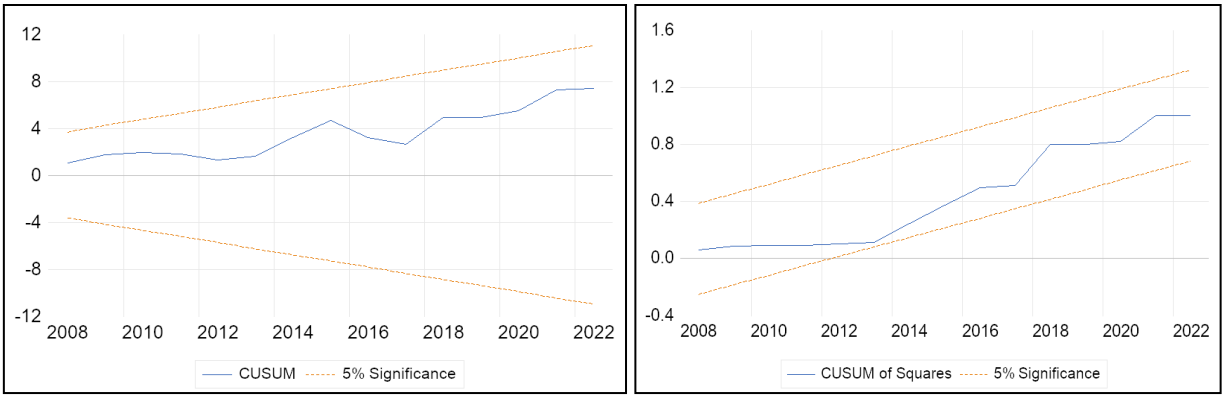
Source: E-views 12 output.

Figure (10) Results of Heteroskedasticity test for model (2)

Heteroskedasticity Test: Breusch-Pagan-Godfrey Null hypothesis: Homoskedasticity			
F-statistic	2.184193	Prob. F(31,7)	0.1429
Obs*R-squared	35.34587	Prob. Chi-Square(31)	0.2703
Scaled explained SS	0.929028	Prob. Chi-Square(31)	1.0000

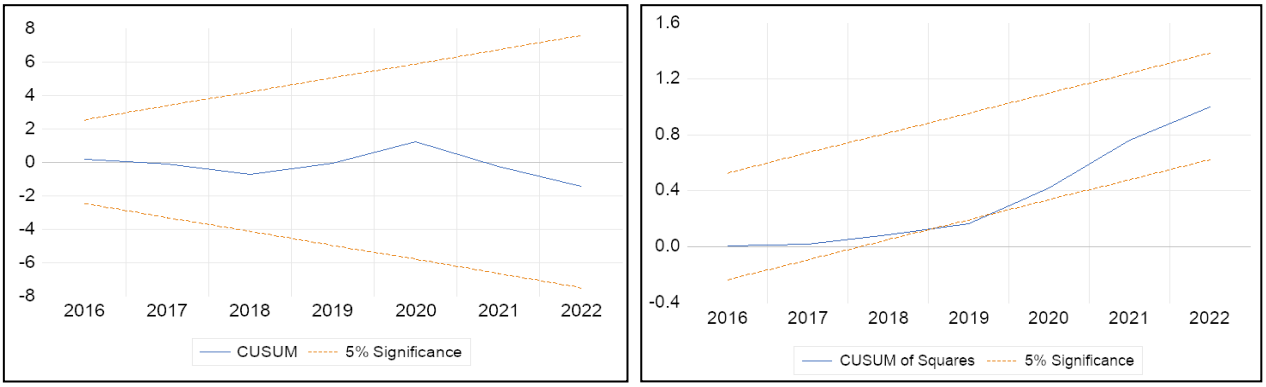
Source: E-views 12 output.

Figure (11) CUSUM & CUSUMQ test for model (1)



Source: E-views 12 output.

Figure (12) CUSUM & CUSUMQ test for model (2)



Source: E-views 12 output.

REFERENCES

[1]. Allen C. Kelley , Robert M. Schmidt (2005). Evolution of Recent Economic-Demographic Modeling: A synthesis. *Journal of Population Economics*, 18:275–300. DOI 10.1007/s00148-005-0222-9

[2]. Barro, Robert J. & Becker, Gary S.(1989). Fertility Choice in a Model of EconomicGrowth. *Econometrica* 57(2): 481–501 Caldwell, John C. (2006). Demographic Transition Theory, Book Published by **Springer**.

[3]. CAPMAS Press Release. (2017). Egypt Future Population Projections (2017-2052). *Central Agency for Public Mobilization and Statistics (CAPMAS).*

[4]. Chalise, Hom Nath. (May 2019). Demographic Window of Opportunity in Nepal, Article in *Nepal Population Journal*. DOI: 10.3126/npj.v18i17.26428

[5]. Crombach, Lamar & Smits, Jeroen. (2022). The Demographic Window of Opportunity and Economic Growth at Sub-National Level in 91 Developing Countries. *Journal of Social Indicators Research* (2022) 161:171–189 https://doi.org/10.1007/s11205-021-02802-8

[6]. Dickey, David A. & Fuller, Wayne A. (1979). Distribution of the Estimators for Autoregressive Time Series with a Unit Root. *Journal of the American Statistical Association* . USA, vol.74, 1979, 428.

[7]. Economic and Social Commission For Western Asia (2005). Population and Development Report Second Issue, The Demographic Window; An Opportunity for Development in the Arab Countries, *UN Publications*, ISSN. 1810-0600 ISBN. 92-1-128298-5

[8]. El-Saharty, Sameh., Nassar, Heba., Hamza, Mariam M. & Zhang, Yi.(October, 2022).The Economic Impact—Forgone Savings and Potential Gains. *International Bank for Reconstruction and Development* / The World Bank

[9]. ElSarawy, Mahmoud Mohamed. (2011). The Impact of Demographic Changes on Economic Growth in Egypt, *Central Agency for Public Mobilization and Statistics (CAPMAS).*

[10]. Fayissa, Bichaka & Gutema, Paulos. (2010). Dependency Ratio and the Economic Growth Puzzle in Sub-Saharan Africa. *Middle Tennessee State University, Department of Economics and Finance*, Working Papers.

[11]. Gujarati, Damodar & Porter, Dawn & Gunasekar, S. (2013). Basic Econometrics, Book, fifth edition, Publisher: **Tata McGraw Hill Edu Priv. Ltd**

[12]. Hyung, Jinwoo. (December 2013). An Analysis on the Effect of Old Age Dependency Ratio on Domestic Saving Rate. *Berkeley Department of Economics*. University of California

[13]. Islam, M. Mazharul. (2020). Demographic Transition in Sultanate of Oman: Emerging Demographic Dividend and Challenges. *Middle East Fertility Society Journal*, 25:7 https://doi.org/10.1186/s43043-020-00022-7

[14]. Mahmud, Asif. (June, 2020). The Major Features of Demographic Transition Theory. DOI: 10.13140/RG.2.2.19763.86565.

[15]. Nassar, Heba. Osman, Magued & El-Khishin, Sara. (2017). A Micro-Investigation of the Reasons Behind the Slowdown of Demographic Transition in Egypt.

[16]. Pesaran, M. Hashem, Shin, Yongcheol & Smith, Richard J. (2001). Bounds Testing Approaches to the Analysis of Level Relationships. *Journal of Applied Econometrics* 16, no. 3 (2001): 289–326. http://www.jstor.org/stable/2678547.

[17]. Rizk, Reham. (2018). Does Demographic Transition Matter for Economic Growth? Evidence from Egypt. *The Journal of North African Studies*. DOI: 10.1080/13629387.2018.1480944

[18]. Sayed, Hussein A. (March 2018). Egypt's Demographic Opportunity. Preliminary Assessment based on 2017 Census. *UNFPA*

[19]. Zohroy, Ayman & Harrell-Bond, Barbara. (December 2003). Contemporary Egyptian Migration: An Overview of Voluntary and Forced Migration. *The Development Research Center on Migration, Globalization and Poverty*, American University in Cairo, Working Paper C3, PP. 27-28,31

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