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Demography and Economic Growth in Namibia

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***Abstract*— *The paper contributes to the ongoing debate about the influence of demographic change on economic development in Sub-Saharan Africa, with a focus on Namibia. Annual data covering 42 years for total fertility rate, infant mortality rate, age-dependence ratio, population growth and per capita gross domestic product are used to provide insights into how changing demographics of Namibia society may impact its future economic growth. Several techniques including the Autoregressive Distributed Lag bound test, Granger causality test and variance decomposition are utilized in the analysis. The findings reveal the existence of a long-run relationship between economic growth and the key demographic variables. The findings also point toward the presence of a unidirectional causality running from demographic variables to economic growth. Overall, the results support the hypothesis that demographic events account for Namibia's economic growth and subsequently its economic development over the studied period.*
Keywords*— cointegration, demographic transition, economic growth, variance decomposition.

I. INTRODUCTION

Demographic transition, a process during which populations move from high fertility and high mortality rates; to a period of low mortality rates and high fertility; and finally to both low fertility and low mortality rates [1], is a fundamental component of development [2] that occurs often, but not always, in tandem with economic growth [3]. Although the process has been widely studied in the Asian emerging markets, where as much as one-third of East Asia's economic "miracle" is attributed to demographic change [4], very little is known in the case of Sub-Saharan Africa [5, 6, 7]. This study, therefore, contributes to the current body of knowledge by offering such a perspective, with a focus on Namibia. The question of whether economic growth causes demographic transition or vice versa was addressed by looking at the relationship between Namibia's GDP per capita and infant mortality rate, total fertility rate, population growth, and age-dependence ratio. Statistical results of such empirical examination will provide insights into how the changing demographics of Namibia society may impact its future economic growth.

In the way of background, Namibia is located in Southern Africa, bordered by the Atlantic Ocean in the west, Angola and Zambia in the north, Botswana in the east, and South Africa in the south and east [8]. Before independence in 1990, Namibia's relatively small population grew at about 3% annually, but declining fertility and the impact of HIV/AIDS slowed this growth to around 2% [8]. The 2017 estimates show Namibia's population at 2.3 million. Like other countries in the region (Botswana, Lesotho and South Africa), Namibia is witnessing a major demographic transformation, with more than 65% of its population expected to be in the working age group by 2050 [9]. Namibia's fertility rate has fallen over the last fifteen years – from 4 children per woman in 2000 to 3.4 children in 2016 – due to increased contraceptive use, higher educational attainment among women, and greater female participation in the labor force [10]. The total dependency ratio has decreased from 78% in 2000 to 68% in 2016, with the youth dependency ratio also falling from 72% to 62% over the same period [10]. Despite rapid urbanization—the percentage of the population residing in urban areas has increased steadily from 32% in 2000 to 48 percent in 2016—Namibia is still mostly rural, with about four in ten people living in urban areas [9, 8].

Estimates generated by the United Nations (UN) inter-agency group for child mortality reveals that Namibia's infant mortality per 1,000 live births improved from 48.5 in 2000 to 32.3 in 2016; under-five mortality per 1,000 live births also improved from 74.6 to 45.2; and maternal mortality ratio declined by 25% – from 352 deaths to 265 deaths per 100,000 live births from 2000 to 2015. Similarly, immunization coverage improved from 69% in 2000 to 85% in 2016 [11]. Experience from other countries suggests that similar transitions boost potential growth, but if not managed properly, lead to long-term stagnation, inequities, and less inclusive growth [9]. Thus, the aim here is to generate information that can guide policy-makers in formulating development policies that capitalize on the evolving demographic transformation in Namibia.

The rest of the paper is organized as follows. Section 2 briefly presents a review of existing literature on demographic changes and economic growth. Section 3 contains the descriptive data and the theoretical

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framework and derivation of the estimation models, followed by the econometric results and concluding remarks in Sections 4 and 5.

II. LITERATURE REVIEW

Several studies have analyzed the relationship between demographic changes and economic growth, and although researchers have found significant relationships, the findings have varied depending on the data, and models used in the analysis [12, 13, 14]. In studying this relationship, researchers have not only tried to find the existence of common long-run trends, but also sought if causality existed. Equally, researchers have tried to determine the endogenous or exogenous nature of the variables to develop a coherent theory that explains economic growth [12]. Among notable studies, Doran [15] provides an insight into how the changing demographics of Irish society may impact on future economic growth. An increasing old-age dependency ratio was found to reduce economic output, while a declining fertility rate was found to increase economic output. The study also highlighted the inter-relatedness of the fertility rate, labor effort, and the old-age dependency ratio and their impact on the economic development of Ireland. Tests of Granger causality indicated that fertility rate has a significant causal impact on a nation's economic development with the impulse response function indicating that a positive fertility shock causes a decrease in economic output. Herzer et al. [16] examined the long-run relationship between fertility, mortality, and income for twenty countries using panel cointegration techniques on data from 1900 to 1999. The results showed that mortality changes and growth of income contributed to the fertility transition. They observed, however, that fertility reduction triggered by falling mortality was not enough to overcompensate the positive effect of falling mortality on population growth.

Jemna [17] evaluated the existence of a causality relationship between fertility and economic growth at a regional level in Romania using the VAR and the Granger methods. The results highlighted the presence of a bi-directional causality relationship between fertility and economic growth. Ranganathan et al. [18] show that the transition is best described regarding a development cycle involving child mortality, fertility, and GDP per capita. They further noted that fertility rate decreases when child mortality is low and is weakly dependent on GDP. As fertility rates fall, GDP increases, and as GDP increases, child mortality falls. Iqbal et al. [19] present the case of Pakistan using data from 1974 to 2011. Their results from the bound testing approach to co-integration showed that demographic transition impacts economic growth significantly in the long-run. They also utilized the error correction mechanism to examine the short-run link and found a significant negative impact of demographic variables on economic growth, except the total literacy rate. They concluded that demographic variables might boost or slow down economic growth during a process of demographic transition, but noted that this was a temporary phenomenon.

Among the few Sub-Saharan Africa studies, Asumadu-Sarkodie and Owusu [20] analyzed the causal nexus between child mortality rate, fertility rate, GDP, household final consumption expenditure and food production index in Ghana using the Autoregressive and Distributed Lag (ADL) method. The results showed evidence of long-run equilibrium relationship running from fertility rate, food production index, GDP, and household final consumption expenditure to the mortality rate. They also reported evidence of a bi-directional causality running from household final consumption expenditure to fertility rate. Evidence from the Variance Decomposition Analysis showed that almost 6% of future fluctuations in mortality rate were due to shocks in the food production index, while 2% of future fluctuations in mortality rate were due to shocks in fertility rate. The study concluded that increasing levels of social determinants like gross domestic product and household final consumption expenditure could help reduce child mortality rates in Ghana.

In Kenya, Thuku et al. [5] employed VAR technique on data from 1963 to 2009 to establish the relationship between economic growth and population growth. They reported that population growth and economic growths were positively correlated and that an increase in population would have a positive impact on economic growth. The study concluded that population growth promotes economic growth and subsequent economic development.

III. METHODOLOGY

3.1. Data Description

Annual data on total fertility rate (TFR), infant mortality rate (IMR), age-dependency ratio (ADR), population growth (POPG) and per capita gross domestic product (GDP) are assembled to study the relationship between demographic structure change and economic growth in Namibia. The demographic data series from 1975 through 2016 are sourced from the Namibia Data Portal [21], while the GDP annual series are sourced from the United Nations Statistics [22]. The variable description and descriptive statistics are reported in Table 1.

Table.1: Descriptive analysis.

Variable	Description	Mean	Std. Dev.	Skewness	Kurtosis
GDP	Per capita Gross Domestic Product	$ 2,737	$ 1,363	0.991	2.63
POPG	Population growth rate	2.53	0.89	0.53	2.75
IMR	Infant Mortality Rate (# of children under one year died per 1000 live births).	49.36	9.49	-0.05	2.16
TFR	Total Fertility Rate (births per woman).	4.79	1.15	0.37	1.60
ADR	Age-dependence ratio (% of working-age population)	84.34	11.62	0.14	1.68

3.2. Stationarity and Cointegration Analysis

A three-stage procedure is followed to account for the time structure of the data. In the first stage, the order of integration is tested using the Augmented Dickey-Fuller method; hereafter ADF [23]:

$$\Delta y_t = a + g y_{t-1} + \sum_{i=1}^{k} b_i \Delta y_{t-i} + e_t \qquad (1)$$

where Δ represents the first difference operator, *a*,*g* and *b* are the parameter to be estimated, and the lag length *k* is chosen to generate a white noise error term e_t. To determine whether y_t is nonstationary, the null hypothesis of nonstationarity is evaluated by testing whether $g = 0$ against the alternative of stationarity $g < 0$. To eliminate the heteroscedastic phenomenon, all variables are transformed by taking the natural log (L). The second stage involves determining the long-term relationships between the variables.

In a large number of past studies, the Johansen cointegration technique has been used to determine the long-term relationships between the variables of interest. Recently, however, a series of studies by Pesaran and Pesaran [24] and Pesaran *et al*. [25] have introduced an alternative cointegration technique known as the Autoregressive Distributed Lag (ARDL) bound test. The technique has some advantages over the Johansen cointegration technique. First, it is the more statistically significant approach to determine the cointegration relation in small samples [26]. A second advantage of the ARDL approach is that, unlike the other cointegration estimation methods, a different number of lag terms can be used without the requirement of symmetry lag lengths. Lastly, Pesaran and Shin (1998) show that cointegration among variables can be estimated with either I(0), I(1) or a combination of I(0) and I(1) variables, but not I(2). For these reasons, the ARDL bound test is used to examine cointegration among the variables in the current study. The base model used is specified as:

$$LGDP_t = \beta_0 + \beta_1 TR + \beta_2 LPOPG_t + \beta_3 LIMR_t + \beta_4 LTFR_t + \beta_5 LADR_t + \varepsilon_t \qquad (2)$$

where LPOPG, LIMR, LTFR, and LADR are log-transformed variables described in Table 1, TR represents the trend, while *t* represents the year, ε_t is the error term and $\beta_0,\ldots,\beta_5$ are coefficients to be estimated. Following Pesaran *et al*. [27], Equation 2 is modified to obtain the ARDL version of the unrestricted error correction model:

$$\Delta LGDP_t = \alpha_0 + \alpha_1 TR + \sum_{i=1}^{n} \alpha_{2i} \Delta LGDP_{t-i} + \sum_{i=0}^{n} \alpha_{3i} \Delta LPOPG_{t-i} + \sum_{i=0}^{n} \alpha_{4i} \Delta LIMR_{t-i} + \sum_{i=0}^{n} \alpha_{5i} \Delta LTFR_{t-i} + \sum_{i=0}^{n} \alpha_{6i} \Delta LADR_{t-i} + \beta_1 LGDP_{t-1} + \beta_2 LPOPG_{t-1} + \beta_3 LIMR_{t-1} + \beta_4 LTFR_{t-1} + \beta_5 LADR_{t-1} + \varepsilon_t \qquad (3)$$

where α_0 is the drift component, *t* denotes year, *n* represents the lag order, ε_t represents the white noise residuals, *L* is the log operator, and Δ represents the first difference operator. The left-hand side in Equation 3 represents economic growth, while the first expressions on the right-hand side with the summation sign represent the short-run dynamics of the model ($\alpha_2,\ldots,\alpha_6$). The remaining expressions on the right-hand side correspond to the long-run relationship ($\beta_1,\ldots,\beta_5$).

To investigate the presence of long-run relationships among the variables in Equation 3, the bound testing procedure under Pesaran, *et al*. [25] is used. The bound testing procedure is based on the F-test, which is a test of the hypothesis of no cointegration among the variables against the existence or presence of cointegration, denoted as $Ho: \beta_1 = \ldots = \beta_5 = 0$ (i.e., there is no cointegration among the variables) versus $Ha: \beta_1 \neq \ldots \neq \beta_5 \neq 0$ (i.e., there is cointegration among the variables). Two critical values are given by Pesaran *et al*. [25] for the cointegration test. The lower critical bound assumes all the variables are I(0), meaning that there is no cointegration relationship between the examined

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variables. The upper bound assumes that all the variables are I(1), meaning that there is cointegration among the variables. When the computed F-statistic is greater than the upper bound critical value, then H_0 is rejected (the variables are cointegrated). If the F-statistic is below the lower bound critical value, then H_0 cannot be rejected (there is no cointegration among the variables). When the computed F-statistics falls between the lower and upper bound, then the results are inconclusive (Pesaran *et al*. [25]. One of the most critical issues in the process is the selection of the order of the distributed lag function. According to Pesaran and Shin [27], the Schwarz Bayesian Criteria (SBC) is preferred over other criteria because it tends to define more parsimonious specifications. In this study, the small data sample is another reason to prefer the SBC over the other tests.

In the third stage, the short-run dynamics of the variables are obtained using the ARDL error correction representation model:

$$\Delta LGDP_t = \alpha_0 + \alpha_1 TR + \sum_{i=1}^{n} \alpha_{2i} \Delta LGDP_{t-i} + \sum_{i=0}^{n} \alpha_{3i} \Delta LPOPG_{t-i} + \sum_{i=0}^{n} \alpha_{4i} \Delta LIMR_{t-i} + \sum_{i=0}^{n} \alpha_{5i} \Delta LTFR_{t-i} + \sum_{i=0}^{n} \alpha_{6i} \Delta LADR_{t-i} + \lambda EC_{t-1} + u_t \quad (4)$$

where λ represents the speed of adjustment parameter, and EC is the residuals that are derived from Eq. (2).

3.3. Causality and Variance Decomposition Analysis

The next step is examining the question of whether economic growth causes demographic transition or vice versa. According to Engle and Granger [28], if a set of variables is cointegrated, they must have an error correction representation. In this case, the Vector Error Correction Model (VECM) links the long-run equilibrium relationship between the variables implied by cointegration with the short-run dynamic adjustment mechanism that describes how the series react when they move out of long-run equilibrium. In this study, the direction of causality within the VECM is tested using the Granger procedure. The advantage of VECM is the reintroduction of the information lost by differencing the data [28].

To further examine the dynamic characteristics of the variables and variance decomposition analysis (VDA) are explored. The VDA measures the percentage of a variable's forecast error variance that occurs as the result of a shock from a variable in the system. If a variable is truly exogenous concerning the other variables in the system, own innovations will explain all of the variables forecast error variance [29].

IV. RESULTS AND DISCUSSION

4.1. Unit Root Tests

Table 2 presents the unit root test results suggesting that, with an intercept, all variables except for LTFR, are stationary at levels, but non-stationary at first difference; hence, LGDP, LPOPG, LIMR, and LADR variables are integrated of order one or I(1). LTFR is integrated of order two or I(2). To the contrary, when both intercept and trend are included in the ADF test, the results reveal that LIMR and LTFR are integrated of order zero or (I0), while LGDP, LPOPG, and LADR are integrated of order one or I(1). The next step is to examine the cointegration results from the ARDL bound test.

4.2. Cointegration Results

Selecting the order of the distributed lag function is one of the critical steps when examining cointegration using the bound test. In the current study, the optimum ARDL order is determined using the SBC and is found to be the order of ARDL (1, 2, 1, 1, 1). The results based on this selection are presented in Table 3, and since the estimated F-statistic (6.674) is outside the Pesaran *et al*. [25] critical bounds, as well as the Narayan [30] critical values, which are quoted in small samples, it can be concluded that there is a long-run relationship between economic growth and the selected demographic variables.

4.3. Estimated Long-run Effects

The long-run effects of the demographic variables are extracted from the unrestricted error correction model (Equation 3) as the ratio $-(\beta_i / \beta_1)$ when $\alpha_i = 0$. As reported in Table 4, the estimated R-square value (0.65) is relatively high while the Durbin-Watson statistics are low. Turning to the individual long-run effects between economic growth and demographic variables, only the coefficients for LPOPG and LADR are statistically significant at the 10% level or higher. The results suggest that population growth and age-dependence tend to reinforce a downward economic spiral in Namibia. The magnitude of the downward spiral is more pronounced for age-dependence, with a one unit increase leading to 4.6

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Table.2: Augmented Dickey-Fuller unit root test

	Constant no trend					Constant with trend				
		Levels		Differences		Levels		Differences		
	t-Stat	Lags	t-Stat	Lags	Decision	t-Stat	Lags	t-Stat	Lags	Decision
GDP	-0.923	4	-3.641***	4	I(1)	-2.833	3	-4.289***	9	I(1)
LPOPG	-1.781	5	-3.373**	3	I(1)	-3.025	8	-3.315**	3	I(1)
LIMR	2.060	7	-4.613***	6	I(1)	-4.756***	4	-5.333***	8	I(0)
LTFR	-2.087	4	-2.160	4	I(2)	-3.742**	4	-1.231	3	I(0)
LADR	-1.817	0	-6.457***	0	I(1)	-2.085	0	-6.412***	0	I(1)

*,**,*** Denotes rejection at 10%, 5% and 1% levels, respectively.

Table.3: ARDL Bounds Test

Test statistic	Value	k
F-statistic	6.674	5
Pesaran, Shin and Smith critical value bounds		
Significance levels	I(0) Bound	I(1) Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06
Narayan critical values for a small sample (30-80 obs.)		
10%	2.496	3.346
5%	2.962	3.910
1%	4.068	5.250

A unit decrease in economic growth. Similarly, a one unit increase in population growth leads 0.85 unit decrease in economic growth. Although not statistically significant, the coefficient for infant mortality rate is also negative. The long-term implication here is that Namibia could improve its economic growth prospects by implementing policies geared at controlling population growth, lowering age-dependence and mortality rate in the country. This observation is supported by Bloom and Canning [31] and Kalemli-Ozcan [32] who found evidence for instance that, mortality decline in developing countries tends to raise educational attainment and savings rates and thus to increase investment in both physical and human capital. Furthermore, Dyson [2] show that mortality decline aids economic growth and hence leads to an increase in the standard of living.

Equally, understanding the relationship between fertility and economic growth has great significance in making similar economic and population policy and promoting long-term economic development. Although the estimated long-run coefficient to fertility is not statistically significant, the estimated multiplier (1.2) suggests that a one unit increase in fertility rate can lead to a 1.2 unit increase in economic growth. This finding is in line with Luci-Greulich and Thevenon [33] who analyzed the association between GDP per capita and fertility in OECD countries and found a positive association, which they attributed to the changing relationship between female employment and fertility. As cited by Fox *et al*. [34], similar results have been reported by Myrskylä *et al*. [35], who linked the empirical findings to gender aspects. They argued that the observed trend towards a positive association between GDP per capita and fertility is mostly driven by countries with comparatively high gender equality levels; and according to the Organization for Economic Co-operation and Development (OECD), Namibia is among the few countries in Sub-Saharan Africa with high gender equality levels [36].

4.4. Estimated Short-run Effects and Diagnostic Tests

Table 5 presents the estimated short-run coefficients from Equation 4. Most of the coefficients are not statistically significant at the 5% level or higher, but the coefficient of the error-correction term, *EC* (-1), is negative and highly significant, which confirms the existence of a stable long-run relationship as revealed by the ARDL bounds test. The absolute value of the error-correction term indicates that roughly 71% of the disequilibrium in economic growth is offset by short-run adjustment in each period.

Furthermore, the estimated model was subjected to a series of diagnostic tests. First, the computed R-square value suggests that 58% of the variations in economic growth in Namibia can be explained by the demographic change variables. The low Durbin-Watson statistic (2.1) indicates that autocorrelation is not an issue, and the test of skewness and kurtosis of residuals (Jarque-Bera test) confirm that the residuals are normally distributed.

Table.4: ARDL Long-run coefficient estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Elasticity
Long-run coefficient estimates					
Constant	26.484**	11.507	2.302	0.030	
Trend	0.011	0.055	0.210	0.835	
LPOPG(-1)	-0.774*	0.433	-1.787	0.086	-0.852
LIMR(-1)	-0.649	1.506	-0.431	0.670	-0.714
LTFR(-1)	1.061	1.898	0.559	0.581	1.167
LADR(-1)	-4.195***	1.336	-3.141	0.004	-4.614
Diagnostic Tests					
R-squared	0.65				
Adj. R-squared	0.43				
Log likelihood	48.79				
F-statistic	2.94***				
D-W stat	2.40				

Table.5: Short-run coefficients estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.159**	0.071	2.234	0.034
Trend	-0.002	0.002	-1.000	0.326
D(LGDP(-1))	0.603***	0.162	3.725	0.001
D(LPOPG)	0.212	0.764	0.277	0.784
D(LPOPG(-1))	-0.642	1.227	-0.523	0.605
D(LPOPG(-2))	0.692	0.745	0.929	0.361
D(LIMR)	2.600	2.283	1.139	0.264
D(LIMR(-1))	-2.433	2.309	-1.054	0.301
D(LTFR)	20.871*	11.100	1.880	0.071
D(LTFR(-1))	-15.822	10.375	-1.525	0.139
D(LADR)	0.067	0.708	0.094	0.926
D(LADR(-1))	0.538	0.697	0.772	0.447
EC(-1)	-0.713***	0.161	-4.424	0.000
Diagnostic Tests				
R-squared	0.578	Ramsey RESET Test		1.727 [0.198]
Adjusted R-squared	0.398	Breusch-Godfrey LM Test:		0.509 [0.482]
Log likelihood	43.139	Breusch-Pagan-Godfrey Test		0.368 [0.965]
Akaike info criterion	-1.470	Jarque-Bera statistic		0.149 [0.928]
Schwarz criterion	-0.927	F-statistic		3.201 [0.005]
Durbin-Watson stat.	2.066			

Furthermore, the model passes the RESET test using the square of the fitted values for the functional form and the Lagrange multiplier test of serial correlation. Thus, these results confirm that the model is in its operational structure and that there is no autocorrelation or serial correlation in the residuals. Lastly, the CUSUM and CUSUM of Squares tests are used to ascertain the stability of the parameters of the estimated model. The results are plotted in Figure 1, and since the plots in the CUSUM and CUSUM of Squares tests lie within the 5% significance level, the parameters of the equation can be considered stable enough to examine causality.

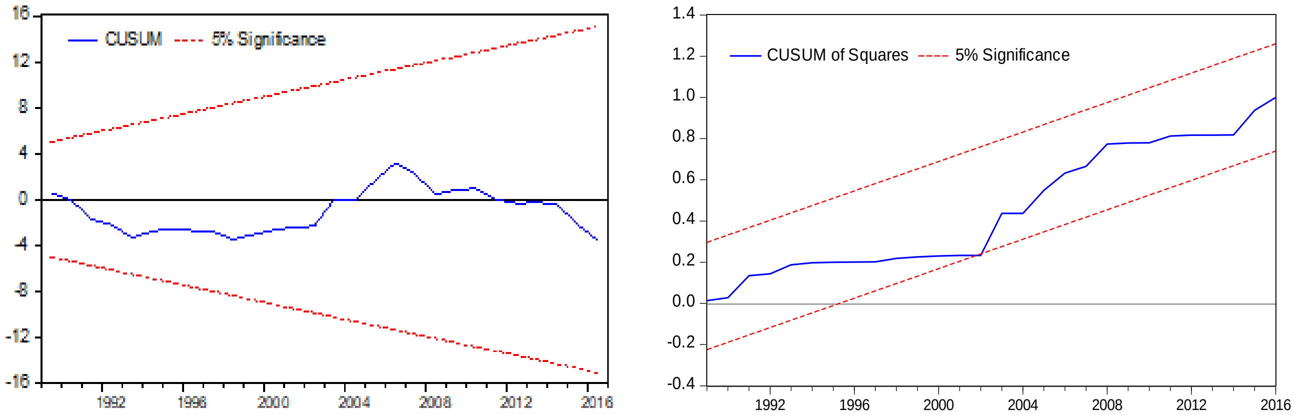

Fig.1: Stability test of ARDL model using CUSUM and CUSUM of squares

4.5. Granger Causality Results

Table 6 present the results of the Granger causality test revealing that there is a feedback (bidirectional) causal relationship between health outcomes (infant mortality) and economic growth (GDP per capita). The findings show that infant mortality changes are both cause and consequence of economic development such that the income-mortality interaction provides a virtuous cycle of demo-economic development. Thus, investments in health may provide returns regarding higher GDP. With regards to the direction of population growth-economic growth nexus, the null hypothesis that population growth does not Granger-cause economic growth is rejected at the 1% significance level. It implies a one-way Granger causality, running from population growth to economic growth. Similar findings were reported by Chang *et al*. [37] in Finland, France, Portugal, and Sweden. However, the conclusion is contrary to results published by Dawson and Tiffin [38] and Thornton [39] who found no causal relationships between population growth and economic growth in India and seven Latin American countries, respectively.

Furthermore, significant unidirectional causality relationships are observed between economic growth and the other demographic variables in the model, running from demographic change variables to economic growth. The general conclusion that economic growth is positively influenced by demographic change variables has important implications as regards to the elaboration of policies focusing on the demographic revival in Namibia. As quoted by Doran [15], the results provide support for the hypothesis proposed by Prskawetz *et al*. [40] for instance, that fertility rate can have implications for the rate of economic development by reducing the dependency ratio. To gauge the relative strength of the variables beyond the sample period and variance decomposition are analyzed.

4.6. Variance Decomposition Results

Table 7 present the VDA results revealing that, in the first period, LGDP (100%) is fully explained by its own innovation, which indicates its exogenous nature with respect to the other variables in the system. However, the next nine periods indicate fluctuation and by the tenth period, LGDP's own innovation has been reduced to 63%. Thus, the rest of LGDP's variation in the long-run is significantly explained by LPOPG (12%), LIMR (7%), LTFR (10%), and LADR (8%). In the short-run (2-years), the shocks to economic growth is explained more by age-dependence (5%) followed by infant mortality (3.4%), population growth (2.3%) and total fertility (0.20%). On the other hand, economic growth explains 4%, 0.14%, 2% and 19% of the shocks to LPOPG, LIMR, LTFR, and LADR, respectively (Table 7). Another interesting interaction is detected between LPOPG and LADR, mostly with LPOPG accounting for over 25% of the shocks to LADR in the long-run. To sum up, the variance decomposition results suggest that shocks to both economic growth and demographic change variables have greater long-run effects than short-run effects. Also, demographic change variables have a more pronounced impact on economic growth.

Table.6: Results of short-run Granger causality

	Endogenous Variables					
	D(LGDP)	D(LPOPG)	D(LIMR)	D(LTFR)	D(LADR)	Causality Decision
D(LGDP)		1.281 [0.527]	7.888** [0.019]	0.038 [0.981]	0.750 [0.687]	Two-way causality LGDP ⟷ LIMR
D(LPOPG)	8.520*** [0.014]		9.896*** [0.007]	0.373 [0.830]	5.448* [0.066]	One way causality LPOPG ⟶ LGDP; LIMR; LADR
D(LIMR)	10.726*** [0.005]	3.733 [0.155]		3.907 [0.142]	0.158 [0.924]	One way causality LIMR ⟶ LGDP
D(LTFR)	6.586** [0.037]	2.805 [0.246]	14.524*** [0.001]		1.083 [0.582]	One way causality LTFR ⟶ LGDP; LIMR
D(LADR)	5.135* [0.077]	0.383 [0.826]	5.520* [0.063]	0.740 [0.691]		One way causality LADR ⟶ LGDP; LIMR

*, **, *** Denotes rejection of the hypothesis at the 10%, 5% and 1% levels, respectively. [ ] represents probability value.

Table.7: Results of variance decomposition

Period	S.E.	LGDP	LPOPG	LIMR	LTFR	LADR
Variance decomposition of LGDP						
1.000	0.104	100.000	0.000	0.000	0.000	0.000
2.000	0.172	88.597	2.318	3.860	0.195	5.029
10.000	0.420	62.741	12.333	6.873	10.336	7.717
Variance decomposition of LPOPG						
1.000	0.024	2.197	97.803	0.000	0.000	0.000
2.000	0.066	2.671	96.894	0.069	0.002	0.364
10.000	0.505	4.140	75.147	12.756	4.397	3.559
Variance decomposition of LIMR						
1.000	0.007	1.968	18.598	79.434	0.000	0.000
2.000	0.015	2.151	32.672	61.412	1.567	2.199
10.000	0.099	0.135	31.788	45.268	10.997	11.812
Variance decomposition of LTFR						
1.000	0.000	0.413	0.879	3.817	94.891	0.000
2.000	0.001	0.629	0.297	7.690	91.193	0.192
10.000	0.025	2.112	4.630	2.430	90.503	0.325
Variance decomposition of LADR						
1.000	0.025	3.501	4.282	15.462	1.733	75.022
2.000	0.032	7.938	12.749	14.812	2.501	62.000
10.000	0.063	18.540	25.450	12.854	18.612	24.544

V. CONCLUSION

A model of demographic transition and its relationship to economic growth has been constructed using key indicator variables: GDP per capita, infant mortality rate, population growth, total fertility rate, and age-dependence ratio. The analysis followed Huang and Su [41] by adopting the ADF test, cointegration test, Granger causality, VEC model, and variance decomposition techniques. After detecting unit roots in the data, cointegration was examined using the ARDL bound test approach, which confirmed the presence of a long-run relationship between demographic change variables and economic growth. Causality analysis confirmed the presence of unidirectional causality running from demographic variables (total fertility, population growth, age-dependence ratio) to economic growth; and bidirectional causality between infant mortality and economic growth. The results support the hypothesis of demographic divided in Namibia. The dividends are driven mostly by the potential growth in the working-age population share of Namibia's economy, and a possible increase in savings and investment that arise as households have fewer children.

In conclusion, while the lack of reliable long-term data makes progress in studying the effects of demographic trends in Sub-Saharan Africa slow, the findings reported here, as well as those cited comparable research, regarding demographic transition point to the possibility that demographic variables may boost or slow down economic growth during a process of demographic transition. The magnitude of the demographic dividends could be higher if Namibia can achieve parallel policy outcomes in the areas of education and employment, primarily by closing the gender gaps.

5.1. Limitations

The main limitation of the study relates to data. The Namibia Data Portal suggests a decadal census with interpolation. The author has no information on how figures for non-census years are estimated or how data before the 1991 census are obtained–and undoubtedly their reliability has varied over time. Beyond that, demographic variables such as the age-dependency ratio are inherently stationary, since the vast majority of people counted in both numerator and denominator in period t also will be counted in t+1. Despite these shortcomings, the paper sheds light on a process that has been widely studied in the Asian emerging markets, but with very little known in the case of Sub-Saharan Africa.

REFERENCES

[1] Kirk D, 1996. Demographic transition theory. Population Studies 50(3): 361-387.

[2] Dyson T, 2010. Population and development: The demographic transition. New York, NY: Zed Books.

[3] Caldwell JC, 2006. Demographic transition theory. Dordrecht, Netherlands: Springer.

[4] Bloom DE & Canning D, 2011. Demographics and development policy. PGDA Working Paper No. 66 (http://www.hsph.harvard.edu/pgda/working.htm) (Accessed 7 June 2017).

[5] Thuku GK, Gachanja P & Obere A, 2013.The impact of population change on economic growth in Kenya. International Journal of Economics and Management Sciences, 2(6): 43-60.

[6] Canning DJ, Raja JS & Yazbeck AS, 2015. Africa's demographic transition: Dividend or disaster? Africa development forum. Washington, D.C.: World Bank Group (http://documents.worldbank.org/curated/en/131891468179371220/Africa-s-demographic-transition-dividend-or-disaster) (Accessed 4 May 2017).

[7] Ahmed SA, Cruz M, Go DS, Maliszewska M & Osorio-Rodarte I, 2016. How significant is Sub-Saharan Africa's demographic dividend for its future growth and poverty reduction? Review of Development Economics 20(4): 762-793.

[8] The Republic of Namibia, 2014. Namibia demographic and health survey 2013. Ministry of Health and Social Services Windhoek, Namibia.

[9] International Monetary Fund Country Report, 2018. 2017 Article IV Consultation—Press Release; Staff Report; and Statement by the Executive Director for Namibia. Country Report No. 18/56. (https://www.imf.org/en/Publications/CR/Issues/2018/02/28/Namibia-2017-Article-IV-Consultation-Press-Release-Staff-Report-and-Statement-by-the-45665) (Accessed 9 February 2018).

[10] United Nations Population Division, 2017. Namibia: Percent urban population. (https://www.theglobaleconomy.com/Namibia/Percent_urban_population/) (Accessed 9 February 2018).

[11] UN-IGME, 2017. Child Mortality Estimates. UNICEF Global Databases. http://data.unicef.org.

[12] Climent F & Meneu R, 2003. Demography and economic growth in Spain: A time series analysis. Department of Financial Economics (University of Valencia). (https://papers.ssrn.com/sol3/papers.cfm?abstract_id=482222) (Accessed 5 August 2016)

[13] Prettner K & Prskawetz A, 2010. Demographic change in models of endogenous economic growth: A survey. VID Working Paper 08/2010, Vienna Institute of Demography.

[14] Song S, 2013. Demographic Changes and Economic Growth: Empirical Evidence from Asia. Honors Projects. Paper 121. (http://digitalcommons.iwu.edu/econ_honproj/121) (Accessed 21 March 2017).

[15] Doran J, 2012. An analysis of the interdependence of demographic factors, labor effort and economic growth in Ireland. International Journal of Social Economics 39(3): 221 – 237

[16] Herzer D, Strulik H & Vollmer S, 2012. The long-run determinants of fertility: one century of demographic change 1900–1999. Journal of Economic Growth 17, 357–385.

[17] Jemna D, 2015. Causality relationship between economic development and fertility in Romania on the regional level. Procedia Economics and Finance. 20. 10.1016/S2212-5671(15)00081-7. (https://www.researchgate.net/publication/273524481_Causality_Relationship_between_Economic_Development_and_Fertility_in_Romania_on_Regional_Level) (Accessed 6 June 2017).

[18] Ranganathan S, Swain RB & Sumpter DJT, 2015. The demographic transition and economic growth: Implications for development policy. Palgrave

Communications. DOI: 10.1057/palcomms.2015.33. (www.palgrave-journals.com/palcomms) (Accessed 6 June 2017).

[19] Iqbal K, Yasmin N & Yaseen MR, 2015. Impact of demographic transition on economic growth of Pakistan. Journal of Finance and Economics 3(2): 44-50.

[20] Asumadu-Sarkodie S & Owusu, PA, 2016. The casual nexus between child mortality rate, fertility rate, GDP, household final consumption expenditure, and food production index. Cogent Economics and Finance 4(1): 1-15.

[21] Namibia Data Portal, 2018. AFDB socio-economic database, 1960-2020. (http://namibia.opendataforafrica.org/mehqknd/afdb-socio-economic-database-1960-2020) (Accessed 6 August 2018).

[22] United Nations Statistics, 2017. Per Capita GDP at current prices in US Dollars (all countries). (www.unstats.un.org) (Accessed 9 February 2018

[23] Dickey DA & Fuller WA, 1979. Distribution of the estimators for autoregressive time series with a unit root. Journal of the American Statistical Association 74(366): 427-31.

[24] Pesaran M & Pesaran B, 1997. Working with Microfit 4.0: Interactive Economic Analysis. Oxford University Press, Oxford.

[25] Pesaran MH, Shin Y & Smith RJ, 2001. Bounds testing approaches to the analysis of the level relationship. Journal of Applied Economics 16, 289-326.

[26] Ghatak S & Siddiki J, 2001. The use of the ARDL approach in estimating virtual exchange rates in India. Journal of Applied Statistics 11, 573-583.

[27] Pesaran M. H & Shin Y, 1998. Impulse response analysis in linear multivariate models. Economics Letters 58, 17-29.

[28] Engle RF & Granger CJW, 1987. Cointegration and error correction representation, estimation and testing. Econometrica 55(22): 251-276.

[29] Sims CA, 1980, Macroeconomics and reality. Econometrica 48, 1–48.

[30] Narayan PK, 2005. The saving and investment nexus for China: Evidence from cointegration tests. Applied Economics 37, 1979-1990.

[31] Bloom D & Canning D, 2001. Cumulative causality, economic growth, and the demographic transition. In Birdsall N, Kelley AC & Sinding S (eds), Population Matters: Demographic Change, Economic Growth, and Poverty in the Developing World, Oxford: Oxford University Press.

[32] Kalemli-Ozcan S, 2002. Does mortality decline promote economic growth? Journal of Economic Growth 7(4): 411-39.

[33] Luci-Greulich A & Thévenon O, 2014. Does economic advancement cause a re-increase in fertility? An empirical analysis for OECD countries (1960–2007). European Journal of Population 30, 187–221.

[34] Fox J, Klüsener S & Myrskylä M, 2015. Is a positive relationship between fertility and economic development emerging at the sub-national regional level? Theoretical considerations and evidence from Europe. WP 2015-006 (https://www.demogr.mpg.de/papers/working/wp-2015-006.pdf) (Accessed 13 September 2017).

[35] Myrskylä M, Kohler H & Francesco C, 2011. High development and fertility: Fertility at older reproductive ages and gender equality explain the positive link. Population Studies Center, University of Pennsylvania, Working Paper PSC 11-06. (http://repository.upenn.edu/psc_working_papers/30/) (Accessed 14 March 2017)

[36] Organization for Economic Co-operation and Development (OECD), 2014. Information about discriminatory social institutions for 160 countries and economies. Social Institutions and Gender Index. (https://www.genderindex.org/countries/?region=sub-saharan-africa) (Accessed 9 February 2018).

[37] Chang T, Chu H, Deale FW & Gupta R, 2014. The relationship between population growth and economic growth over 1870-2013: Evidence from a bootstrapped panel-Granger causality test. Working Paper: 2014-31. Department of Economics, University of Pretoria (https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2813455) (Accessed 6 May 2017).

[38] Dawson P J & Tiffin R, 1998. Is there a long-run relationship between population growth and living standards? The case of India. Journal of Development Studies 34(5): 149-56.

[39] Thornton J, 2001. Population growth and economic growth: Long-run evidence from Latin America. Southern Economic Journal 68(2): 464-68.

[40] Prskawetz A, Fent T & Barthel W, 2007. The relationship between demographic change and economic growth in the EU. Research Report N. 32, Vienna Institute of Demography.

[41] Huang F & Su J, 2010. Functionary mechanism between demographic structure and economic growth in China based on Cointegrating methods. Research in World Economy 1, 1 (www.sciedu.ca/rwe. DOI: 10.5430/rwe.v1n1p10) (Accessed 6 June 2017).