Fiscal Sustainability and Demographic Transition in Nigeria

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Abstract
This study investigates the impacts of demographic changes on fiscal sustainability in Nigeria. The study employed the Autoregressive Distributed Lag model with times series data from 1980-2021. It was found that old-age and young-age dependency directly impact government balance in the short-run and long-run. Health and education expenditures have negative effects on government balance. There is an increased government debt in a developing old-age and young-age economy. It was concluded that the demography transition has a comprehensive effect on fiscal sustainability; hence government needs adequate reviews of public health spending and reduces unnecessary expenses to maintain fiscal balance in Nigeria.

Keywords: Demographic transition; population ageing; fiscal sustainability
JEL Classification Codes: H30, H51, H55, J11, J14,

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1. Introduction

The demographic transition theory predicts that the central stage of demographic transition has a large percentage of workers with increased aggregate consumption, cumulative investment, and total labour inputs, which causes output to increase. The first demographic dividend occurs at this stage. Due to low fertility rates and a reduction in death rate, as the transition progresses, countries experience a high decrease in labour supply and lessened expected gross domestic product (GDP) and national savings. The changes in patterns of economic behaviour at this level will create lower consumption and less investment that, adversely affect the overall economic prosperity. Due to population ageing, this phase requires technological progress and investment in human capital to attain the second demographic dividends. The last demographic stage leaves countries with an aged population with a high proportion of old-age dependents. The impacts of the old-aged population could drive fiscal imbalance through decreasing working population and reduced productivity with decreased government tax revenue and increased public health expenditure (Korwatanasakul *et al*., 2021).

The change in population structure due to long-term reduction in fertility leads to an increase in the relative importance of the working-age populations, generating the first demographic dividend. Further reduction in fertility rates will reduce the growth rate of the working-age population and brings a rise in the proportion of the aged and total dependency (Reher, 2011). Demographic transition has made ageing a phenomenon that is common across the globe, in industrialised economies and third-world countries. On one part, this is due to the drop in global fertility rates and longer life from medical advancement on the other hand. Lower fertility reduces the rate of population growth so that the relative number of older people is becoming greater than the younger population (Atkinson, 2001). Population ageing is documented to put pressure on the fiscal balance due to a drop in tax revenues increase in government spending on pensions, healthcare provision and social security (Bhaskar & Bashir, 2022).

Findings from the effect of demographic transition in terms of population ageing on fiscal balance and health spending are mainly for developed countries such as those in the European Union, Asia, Australia and the United States (Lee et al., 2017; Nartey, 2019; Yoshino & Sirivunnabood, 2019; Korwatanasakul *et al*., 2021; Bhaskar & Bashir, 2022). This is because the population's age structure in developed countries differs from that of developing economies. That is, different regions of the world are at different stages of population transition. The elderly population, for instance, is rising in developed countries faster than in developing regions such as Africa and the Middle East. The social provisions in developed economies for the elderly also strain public finance and health care systems (Krueger, 2004). The extant literature has established that an increase in the elderly share of the population influences economic output through the labour market, savings and inflation because it comes with reductions in the share of the economically active population (Hondroyiannis & Papapetrou, 2000; Sanz & Velazquez, 2007). A reduction in the labour force, combined with a growing old-age dependency ratio, reduces tax revenues and increases pension payments. This stifles the government's capacity to fund social welfare systems and provide other public goods (Dolls *et al*., 2017).

Empirical findings provided by Nartey (2019) in the United States (US), for instance, on the impact of the aged population on public spending and revenues using the system GMM approach showed that a one per cent increase in the old-age dependency ratio, reduced state fiscal balance by $104/person. In a similar study, Korwatanasakul et al. (2021), using panel data from East and Southeast Asia and the Fixed and Random effect model, showed an indirect impact of the demographic transition on government balance by inducing a rise in government spending for old age-related health conditions. Regarding the role of the

demographic transition on fiscal balance, Bhaskar and Bashir (2022) showed that the total internal debt increases by 0.83% for a 1% increase in the old age population in India. In a related study, Nordin et al. (2015) compared findings for the impact of the ageing population on healthcare spending in China and India using time series data and the Autoregressive Distributed Lag (ARDL) model. Findings showed relatively higher healthcare expenditure in the old-aged for China and India. The results further suggest a stronger effect of the ageing population on healthcare expenditures in China relative to India.

In Malaysia, findings by Yun (2021) using the ARDL model. Findings showed a significant positive effect of population structure on public health care expenditure. Other studies have also established a significant effect of a population over 65 years in increasing public health care expenditure (Yong, 2015; Yap & Selvaratnam, 2018; Baharin & Saad, 2018). Khan et al. (2016) showed that the increase in the dependency ratio stifles resource allocation to other sectors of the economy. This is because persons less than 15 years of age and the elderly, who comprise the group of dependants, are not economically active and need more health spending. Earlier findings by Rahman (2008) suggest that individuals under 15 do not significantly affect healthcare expenditure. Zweifel et al. (2004) suggest that the ageing population may not be driving healthcare expenditure, and Getzen (1992) did not also find any link between the age structure of the population and healthcare costs. Andersen (2008) on fiscal sustainability and demographics showed that approaching demographic shifts are raising concerns about fiscal sustainability in most OECD countries. This is to distinguish between increases in the dependency ratio driven by changes in fertility and longevity. The rise in dependency ratio is driven by longevity, so the solution is to raise the retirement age.

In a developing economy like Nigeria, the effects of ageing due to demographic transition may follow a different literature. This is because the population is characterised by more young individuals, with about 62% of the populace below 25 (World Bank, 2022). More so, the impact of the ageing population on public finance and health spending may be ambiguous, as only about 5% of Nigerians are covered by health insurance (Reem, 2018). Most Nigerians spend out-of-pocket on health, which accounts for about 77% of the current health expenditure in Nigeria. With inconclusive evidence in the literature on the role of the demographic transition on the macroeconomy and paucity of findings on its effect in developing economies, focus on its role in Nigeria becomes pertinent. This study attempts this directive with a focus on the relationships between demographic transition, fiscal balance, government health expenditure, and government debt using data from the Nigerian economy.

The remainder of this study is organized as follows. Section 2 presents material and methods. Section 3 reports and discusses the results. Section 4 concludes.

2. Material and methods

2.1 Theory and empirical model specification

Lerner's (1943) theory of functional finance is the first theory that examined the fiscal behaviour of governments by their functionalities. This theory is based on the effective demand principle and Chartalism.[1]. It states that government should finance itself to meet stated goals, such as controlling the business cycle, achieving full employment, and ensuring growth and low inflation. The theory assumed government intervention to achieve a booming economy and budget management and its impact on the economy. It states that government spending should be matched with the level of economic activity; taxes

[1] Chartalism is a descriptive economic theory that describes the process and effects of using government-issued tokens as the unit of money, i.e. fiat money. The modern Chartalism theory is called Modern Monetary Theory (MMT).

should be levied for their economic impact rather than to raise revenue. Demographic transition influences the pattern of economic behaviour in society. In the early phase of the demographic transition, an increase in the proportion of workers enhances aggregate consumption, cumulative investment, and total labour input; thus, the output is called the demographic dividend. As the transition progresses, a significant drop in labour supply due to lower fertility and mortality rates lowers aggregate output and domestic savings, thus decreasing investment. This change in economic behaviour can cause sluggish economic growth and endanger economic stability, which can be corrected through Lerner's (1943) postulated fiscal policy rules.

This study employs Lerner's (1943) theory of functional finance as the theoretical framework. It is assumed that changes in government fiscal stance due to demographic transition can be managed by Lerner's (1943) fiscal policy rules. For instance, reduced savings and investments due to a shrinking working population created by population ageing can be corrected by reducing interest rates and limiting national debts. Thus, the relationship between fiscal sustainability and demographic transition depends on whether an economy is ageing, aged, or youthful. Thence, an adjusted form of the Korwatanasakul *et al*. (2021) model is used to examine the linkage between demographic transition and government balance as:

$$Govt\ balance_t = \beta_0 + \beta_1 Demo\ trans_t + \beta_2 X_t + \varepsilon_t \qquad (1)$$

In equation (1), *government balance* is measured by the net lending or borrowing as a share of GDP. The measure of *demographic transition* for an ageing/aged and young society is proxy by four variables: the ratio of older dependents (people aged 64+ to the working-age population), the ratio of young dependents (people aged 0-14 to the working-age population), government health expenditure and education expenditure as a share of GDP. These indicators are used because older people need more healthcare while young people need to be educated for a productive economy. *Xt* is a set of control variables: GDP growth, the unemployment rate, inflation rate, trade, and annual population growth. The unemployment rate captures the changes in fiscal expenditure to stabilise macroeconomic conditions. These changes are automatic stabilisers, such as unemployment benefits. The study also examined the relationship between demographic transition, government health expenditure, and government education expenditure using the model below:

$$Govt\ hea/educ\ expend_t = \beta_0 + \beta_1 Demo\ trans_t + \beta_2 X_t + \varepsilon_t \qquad (2)$$

Government health expenditure or education expenditure is the current health expenditure or education expenditure as a percentage of GDP. Old age dependency ratio and youth dependency ratio are used for *demographic transition*. The dependency ratios are expected to impact government health or education expenditure. The aged or ageing population and government health expenditure are expected to move in the same direction, while government education expenditure and the young population will be directly related. As mentioned earlier, X_t is the set of control variables. The relationship between demographic transition and government debt was examined with the adjusted model of Bittencourt (2015) thus:

$$Govt\ debt_t = \beta_0 + \beta_1 Demo\ trans_t + \beta_2 X_t + \varepsilon_t \qquad (3)$$

Here *government debt* is the gross debt as a percentage of GDP. The indicators for *demographic transition* are old-age dependency and young-age dependency. Other variables remain as earlier defined. Economic growth may be highly linked to external debt, as higher growth can curb rising debt. High

inflation can lead to high government debt through high nominal interest rates. Unemployment can increase debt through high unemployment benefits and fiscal stimulus packages.

The data for the study are demographic transition, fiscal balance, and other macroeconomic indicators extracted from the World Development Indicators, Fiscal Monitor of the International Monetary Fund (IMF), and Statistical Bulletin of the Central Bank of Nigeria covering 1980 - 2021. The analysis uses three variables related to fiscal balance: (i) government balance, (ii) government revenue as a share of GDP; and (iii) government debt. Four variables are used for demographic transition: (i) government health expenditure, measured as the current health expenditure as a share of GDP (ii) government education expenditure, measured as the current education expenditure as a share of GDP (iii) youth dependency, measured as a share of youth dependents (0-14 years) in the working-age population and (iv) old-age dependency, defined as the share of older dependents (64+) in the working-age population. The control variables are (i) annual GDP growth; (ii) annual inflation rate; (iii) population growth (iv) trade openness, defined as exports plus imports as a share of GDP; and (v) unemployment rate.

2.2 Estimation Technique

The stationarity test used Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) test statistics. Equation (4) shows the expression for the ADF test:

$$\Delta y_t = \alpha + \beta_t + \gamma y_{t-1} + \delta \Delta y_{t-1} + \ldots \delta_{\rho-1} \Delta y_{t-\rho+1} + \varepsilon_t \quad (4)$$

In equation (4), $\boldsymbol{\alpha}$ is a constant, $\boldsymbol{\beta}$ is the coefficient of time trend and $\boldsymbol{\rho}$ denotes lag order. After the stationarity test, Autoregressive Distributed Lag (ARDL) model is employed for the estimation of equations (1) - (3). The ARDL forms of equations (1) - (3) are shown in equations (5), (6) and (7) thus:

$$\begin{aligned} \Delta lngovtbalance_t &= \alpha_0 + \sum_{k=1}^{n} \alpha_1 \, \Delta lngovtbalance_{t-k} + \sum_{k=1}^{n} \alpha_2 \Delta \, lnDemotrans_{t-k} + \sum_{k=1}^{n} \alpha_3 \, \Delta lnX_{t-k} \\ &+ \tau_1 Ingovtbalance_{t-1} + \tau_2 InDemotrans_{t-1} + \tau_3 InX_{t-1} + \varepsilon_t \end{aligned} \quad (5)$$

$$\begin{aligned} \Delta lnhea/educ\ expend_t &= \alpha_0 + \sum_{k=1}^{n} \alpha_1 \, \Delta lnhea/educexpend_{t-k} + \sum_{k=1}^{n} \alpha_2 \Delta \, lnDemotrans_{t-k} + \sum_{k=1}^{n} \alpha_3 \, \Delta lnX_{t-k} \\ &+ \tau_1 Inhea/educexpend_{t-1} + \tau_2 InDemotrans_{t-1} + \tau_3 InX_{t-1} + \varepsilon_t \end{aligned} \quad (6)$$

$$\begin{aligned} \Delta lngovtdebt_t &= \alpha_0 + \sum_{k=1}^{n} \alpha_1 \, \Delta lngovtdebt_{t-k} + \sum_{k=1}^{n} \alpha_2 \Delta \, lnDemotrans_{t-k} + \sum_{k=1}^{n} \alpha_3 \, \Delta lnX_{t-k} \\ &+ \tau_1 Ingovtdebt_{t-1} + \tau_2 InDemotrans_{t-1} + \tau_3 InX_{t-1} + \varepsilon_t \end{aligned} \quad (7)$$

In equations (5), (6) and (7) α_0 are the drift factors while Δ shows the first difference, ε_t are the white noise. The ECM general form of Equations (5), (6) and (7) are formulated in equations (8), (9) and (10):

$$\Delta lngovtbalance_t = \alpha_0 + \sum_{k=1}^{n} \alpha_1 \Delta lngovtbalance_{t-k} + \sum_{k=1}^{n} \alpha_2 \Delta lnDemotrans_{t-k} + \sum_{k=1}^{n} \alpha_3 \Delta lnX_{t-k} + \emptyset ECM_{t-1} + \varepsilon_t \quad (8)$$

$$\Delta lnhea/educ\ expend_t = \alpha_0 + \sum_{k=1}^{n} \alpha_1 \Delta lnhea/educexpend_{t-k} + \sum_{k=1}^{n} \alpha_2 \Delta lnDemotrans_{t-k} + \sum_{k=1}^{n} \alpha_3 \Delta lnX_{t-k} + \emptyset ECM_{t-1} + \varepsilon_t \quad (9)$$

$$\Delta lngovtdebt_t = \alpha_0 + \sum_{k=1}^{n} \alpha_1 \Delta lngovtdebt_{t-k} + \sum_{k=1}^{n} \alpha_2 \Delta lnDemotrans_{t-k} + \sum_{k=1}^{n} \alpha_3 \Delta lnX_{t-k} + \emptyset ECM_{t-1} + \varepsilon_t \quad (10)$$

where Δ represents the first difference while $\emptyset$ is the coefficients of ECM for short-run dynamics. ECM shows the speed of adjustment in long-run equilibrium after a shock in the short run.

3. Results and Discussion

Table 1 shows the variables' description and the summary statistics for each variable.

Table 1: Descriptive and Summary Statistics of the Variables

Variables	Description	Obs	Mean	Standard Deviation	Min Value	Max Value
Fiscal Balance Variables						
Government_Balance	Net lending (+)/net borrowing (–) (% of GDP)	42	-1.13	3.67	-8.56	8.76
Government_Revenue	Revenue (% of GDP)	42	15.48	5.60	5.12	28.81
Government_Debt	Gross debt (% of GDP)	42	18.12	5.28	5.33	36.56
Demographic Transition Variables						
G_Health Expenditure	Current health expenditure (% of GDP)	42	3.62	0 .41	2.49	5.05
G_Education Expenditure	Current Education expenditure (% of GDP)	42	0.91	0.26	0.27	1.81
Old-age_Dependency	The age dependency ratio (population aged 65+ as % of the working-age population)	42	5.31	0.16	5.09	5.57
Young_Dependency	The age dependency ratio (population aged 0-14 as % of the working-age population)	42	85.71	1.97	82.59	89.47
Control Variables						
GDP_Growth	GDP growth (annual %)	42	3.07	5.32	-13.13	15.33
Inflation _Rate	Inflation, GDP Deflator (annual %)	42	21.18	34.32	0.69	219.00
Population _Growth	Population growth (annual %)	42	2.59	0.08	2.49	2.85
Trade	Trade (% of GDP)	42	32.71	12.20	9.14	53.28
Unemployment_Rate	Unemployment, total (% of total labour force) (modelled ILO estimate)	42	5.80	1.08	3.7	10.7

Source: Authors, 2022

3.2 Unit Root Test

Table 2 provides the results of the unit root tests for the order of integration of the variables, using the ADF and PP tests. The results show that some variables are stationary at levels while some are stationary at the first difference, making ARDL the appropriate estimation technique.

Table 2: Unit Root Test Results

	ADF		Phillips-Perron		
Variables	**Levels**	**First Difference**	**Levels**	**First Difference**	**Decision**
Government_Balance	-4.3806**	-	-4.3806**	-	I(0)
Government_Revenue	-1.9557	-6.8253**	-1.8595	-9.0614**	I(1)
Government_Debt	0.2409	-5.3572**	-0.0915	-5.3555**	I(1)
G_Health Expenditure	-4.1783**	-	-4.2182**	-	I(0)
G_Education Expenditure	0.1801	-5.3667**	-0.1623	-5.3645**	I(1)
Old-age_Dependency	-0.9745	-3.6147**	-0.7321	-3.8228**	I(1)
Young_Dependency	-2.5544	-2.7291**	-1.0628	-2.3704**	I(1)
GDP_Growth	-2.7955	-11.8671**	-3.7436**	-12.7290**	I(1)
Inflation_Rate	-5.9429**	-	-5.9514**	-	I(0)
Population_Growth	-6.6624**	-	-3.6567**	-	I(0)
Trade	-2.7866***	-	-3.0109**	-	I(0)
Unemployment_Rate	-5.8729**	-	-5.6604**	-	I(0)

****, ** and *** denote significance at the 1%, 5% and 10% levels respectively***

3.3 Co-integration Bounds Test Result

Following the unit root test results, which show a mixture of I(0) and I(1) series, bounds tests were conducted for the existence or otherwise of co-integration.

Table 3: Bounds Test Results

Test Statistic	Value	Significance	Lower Bound I(0)	Upper Bound I(1)
Model 1				
F-Statistics	7.245314	10%	1.76	2.77
K	11	5%	1.98	3.04
		2.5%	2.18	3.28
		1%	2.41	3.61
Model 2a				
F-Statistics	38.96289	10%	1.76	2.77
K	11	5%	1.98	3.04
		2.5%	2.18	3.28
		1%	2.41	3.61
Model 2b				
F-Statistics	6.560081	10%	1.76	2.77
K	11	5%	1.98	3.04
		2.5%	2.18	3.28
		1%	2.41	3.61
Model 3				
F-Statistics	39.02926	10%	1.76	2.77
K	11	5%	1.98	3.04
		2.5%	2.18	3.28
		1%	2.41	3.61

Source: Authors Computation

Table 3 reports the bounds test results. Given that the computed F-statistics are greater than the critical upper bound values at the conventional significance levels, the null hypothesis of no co-integration is rejected in the models. Thus, the variables are said to be co-integrated, implying that a long-run relationship exists in the models.

Table 4: Long-run Impacts of Demographic Transition on Fiscal Sustainability

	Model 1				Model 2			Model 3			Model 4	
	Gov Bal (1)	Gov Bal (2)	Gov Bal (3)	Gov Bal (4)	G_HX (1)	G_HX (2)	G_HX (3)	G_EX (1)	G_EX (2)	G_EX (3)	Gov Deb (1)	Gov Deb (2)
Demographic Transition Variables												
Old Aged_D	0.40 (0.11)*				0.17 (0.24)			-0.49 (0.55)			3.99* (4.99)	
Young_D		0.40 (0.11)*				0.03 (0.02)			0.04* (0.05)			0.56* (0.44)
G_HX			-0.39 (0.11)*							-0.18* (0.38)		
G_EX				-0.35 (0.11)*			-0.04 (0.01)*					
Control Variables												
GDP_G	0.13* (0.12)	0.13* (0.12)	0.14** (0.13)	0.14* (0.13)	0.01** (0.01)	0.01** (0.01)	0.01** (0.01)	0.01** (0.01)	0.01* (0.01)	0.01* (0.02)	0.16 (0.17)	0.17 (0.17)
Inf_Rate	0.01 (0.02)	0.01 (0.12)	0.01 (0.02)	0.01 (0.02	-0.04 (0.01)	(0.01) (0.02)	-0.02 (0.01)	-0.02 (0.01)	-0.01 (0.02)	-0.01 (0.02)	-0.01 (0.02)	-0.01 (0.02)
Pop_G	2.18 (7.27)	4.79 (7.06)	5.67 (7.33)	5.68 (7.33)	-1.06 (0.47)**	-0.88 (0.46)***	-0.97 (0.45)**	0.09 (1.04)	0.60 (1.01)	0.58 (1.01)	-1.76 (0.49)**	-6.79 (9.05)**
Trade	-0.03 (0.05)	-0.03 (0.06)	-0.01 (0.05)	-0.01 (0.04)	-0.01 (0.02)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.03 (0.06)	-0.03 (0.07)	-0.07 (0.08)
Une_Rate	0.08 (0.47)	0.09 (0.48)	0.03 (0.49)	0.03 (0.49)	0.06 (0.03)***	0.04 (0.03)	0.06 (0.03)**	-0.01 (0.01)	-0.01 (0.07)	-0.01 (0.07)	1.21 (0.02)**	1.13 (0.61)**
Constant	2.64 (3.12)	-5.31 (3.03)	-2.83 (0.64)	-2.83 (0.64)	4.28 (2.15)***	5.47 (2.13)*	2.96 (1.25)**	5.86 (4.73)	5.73 (4.69)	1.75 (2.97)	0.09 (3.28)**	5.62 (2.32)**
R-Squared	0.41	0.41	0.41	0.41	0.63	0.72	0.52	0.51	0.56	0.47	0.63	0.55
ARSquared	0.29	0.28	0.28	0.28	0.19	0.18	0.18	0.28	0.32	-0.13	0.19	0.21
SE of Reg	3.07	3.09	3.08	3.07	0.19	0.20	0.20	0.44	0.44	0.44	4.01	3.95
D-Watson	1.97	1.95	1.90	1.93	0.90	2.74	2.85	1.97	1.96	1.93	1.93	1.98
F-Stat	3.29	3.21	3.25	3.24	2.31	2.21	2.26	3.57	3.45	3.26	2.23	2.53
Pro(F-Stat)	0.01	0.01	0.01	0.01	0.05	0.06	0.05	0.01	0.01	0.01	0.04	0.03
Obs	41	41	41	41	41	41	41	41	41	41	41	41

Source: Authors' Computation

The long-run mechanism of demographic transition and the impacts on fiscal sustainability are shown in the results in Table 4. The estimation models (Columns 1–4) show the impacts of demographic transition measured by old-age dependency, young-age dependency, government health expenditure, and government education expenditure on government balance (model 1), general health expenditure (model 2), general education expenditure (model 3) and government debt (model 4). The coefficients of both old-age and young-age dependency are positive. This shows an increase in government balances in Nigeria. Government balance increases because the government spends on facilities needed by old and young ones. The coefficients for health and education expenditures are negative and statistically significant. Hence, increased health and education expenditures deplete the government balance.

In model 2, old-age and young dependency show a non-statistically significant positive impact on health expenditure with a higher coefficient for old age than young age. This implies that countries with a higher proportion of an ageing population may experience higher health spending (as a share of GDP) than those with a young population. The estimated result for education expenditure is negative, implying that a country that spends less on education may spend more on health and vice versa. Thus, a more educated economy may spend less on illness, given that the necessary health expenditure is constant. This result is significant at the 1% level. Model 3 shows an inverse connection between the old age economy, health expenditure, and education expenditure. However, a positive relationship between the young-age economy and education expenditure is observed. Both the coefficients for young age and health expenditure are statistically significant. These results complied with a priori expectations. The results for government debt show that an increase in aged and young individuals in a developing country increases government debt significantly at a 1% level with a large magnitude in the old age range. This is more profound given a fluctuating GDP growth as one of the control variables.

Some control variables in the estimation models are statistically significant, while the majority are not. But the striking occurrence is that almost all the coefficients for economic growth, population growth, and unemployment are statistically significant with expected signs. This similar to the findings of studies such as Bittencourt 2015; Tujula and Wolswijk 2004; Xu, Saksena, and Holly 2011. However, most of the control variables that are non-significant show expected signs. Trade shows negative signs in most of the results, which may be attributed to the volume of our imports compared to exports.

Table 5: Short-run Impacts of Demographic Transition on Fiscal Sustainability

	Model 1				Model 2			Model 3			Model 4	
	Gov Bal (1)	Gov Bal (2)	Gov Bal (3)	Gov Bal (4)	G_HX (1)	G_HX (2)	G_HX (3)	G_EX (1)	G_EX (2)	G_EX (3)	Gov Deb (1)	Gov Deb (2)
Demographic Transition Variables												
Old-Aged_D	0.69 (20.19)				0.10 (0.77)*			-1.87 (2.36)			0.28* (1.10)	
Young_D		0.59 (0.18)*				-0.05 (0.06)			(0.03) (0.19)*			2.08* (15.5)
G_HX			-0.55* (0.19)							0.53 (0.55)		
G_EX				-0.61 (0.18)*			0.06 (0.05)					
Control Variables												
GDP_G	0.26 (0.13)**	0.25 (0.13)**	0.28 (0.13)*	0.25 (0.15)**	-0.01 (0.77)*	-0.01 (0.01)*	0.01 (0.02)*	-0.05 (0.02)*	0.04 (0.12)*	0.04 (0.02)*	-0.08 (0.10)*	-0.07 (0.10)*
Inf_Rate	0.03 (0.02)	0.03 (0.03)	0.02 (0.02)	0.02 (0.02)	0.03 (0.08)	-0.02 (0.01)	0.08 (0.04)	-0.01 (0.01)	0.03 (0.02)	-0.01 (0.02)	0.01 (0.01)	-0.01 (0.02)
Pop_G	-9.34 (26.9)	-14.82 (28.80)	-4.01 (26.9)	-9.13 (27.03)	0.08 (1.03)	-0.73 (1.10)	1.17 (0.02)	1.70 (3.12)	2.52 (3.42)	2.35 (3.21)	-1.69 (0.77)	-0.73 (0.05)
Trade	0.01 (0.09)	0.01 (0.09)*	0.01 (0.09)*	0.02 (0.09)**	0.01 (0.02)*	0.01 (0.02)	0.02 (0.03)	-0.01 (0.01)	-0.01 (0.02)	-0.01 (0.01)	-0.01 0.06*	-0.01 (0.07)*
Une_Rate	0.25 (0.41)	0.25 (0.41)	0.19 (0.40)	0.24 (0.42)	0.01 (0.02)	0.01 (0.02)	0.03 (0.05)	-0.05 (0.05)	-0.05 (0.04)	-0.05 (0.04)	0.21 (0.31)	0.21 (0.31)
ECM(-1)	-0.26 (2.16)*	-0.27 (0.02)**	-0.23 (0.19)*	-0.25 (0.20)	-0.01 (0.08)	-0.01 (0.01)*	-001 (0.06)	-0.05 (0.02)*	-0.05 (0.02)*	-0.05 (0.02)*	-0.13 (0.01)*	-0.24 (0.14)*
Constant	0.03 (0.62)	0.13 (0.62)	-0.07 (0.59)	0.04 (0.60)	0.02 (0.02)	0.02 (0.02)	0.02 (0.02)	-0.01 (0.07)	-0.01 (0.07)	-0.01 (0.07)	0.45 (0.48)	0.30 (0.48)
R-Squared	0.46	0.47	0.48	0.46	0.22	0.24	0.24	0.35	0.35	0.36	0.22	0.23
ARSquared	0.32	0.33	0.34	0.32	0.01	0.03	0.04	0.18	0.17	0.19	0.01	0.03
SE of Reg	3.66	3.65	3.60	3.66	0.14	0.14	0.14	0.43	0.43	0.43	2.83	2.79
D-Watson	1.94	1.90	2.02	1.93	1.91	1.95	1.92	2.06	2.03	2.04	1.95	1.94
F-Stat	3.19	3.25	3.45	3.19	1.04	1.15	1.17	2.03	2.00	2.08	11.20	11.19
Pro(F-Stat)	0.01	0.01	0.01	0.01	0.01	0.06	0.03	0.08	0.08	0.06	0.04	0.04
Obs	39	39	39	39	39	39	39	39	39	39	39	39

Source: Authors' Computation

Table 5 shows the short-run effects of the demographic transition on fiscal sustainability in Nigeria. Estimations Models (Columns 1–4) show the short-run effects of the demographic transition on government balance (model 1), health expenditure (model 2), education expenditure (model 3), and government debt (model 4). The coefficients for old-age dependency and young-age dependency are positive, while the coefficients for health expenditure and education expenditure are negative, with the old-age coefficient alone not statistically significant. These results further drive home the growing effects of demographic changes on government balance. Depending on the economic growth situation in the country, old-aged or young-aged dependency increases government balance while an increase in health and education expenditure decreases government balance. Old-age and current education expenditures increase health expenditures while young-age decreases health expenditures in the short run. Only old age is statistically significant here. Young age and health expenditure have growing effects on education expenditure. The impacts of old-age dependency and young-age dependency on government debt show a statistically significant negative impact. In other words, a developing economy with a higher proportion of an ageing or aged population and a young-aged population will experience an increase in government debt. The estimated results show that a 10% increase in the share of the young-aged population is associated with a 20.8% increase in government debt, while a 10% increase in the old-aged population increases government debt by 2.8%. Therefore, a developing country like Nigeria with unfavourable macroeconomic conditions adversely affects the overall economy. This, in turn, leads to higher government debt as the debt is used to finance the economy when necessary.

The short-run results for the control variables are almost the same as the long-run in magnitude and significance. Some of the control variables are significant while some are not. However, GDP growth is significant for all the models. The lagged error correction terms have the expected negative sign. It is also statistically significant at the 1% level and less than one in value. Its absolute value connotes a moderate speed of adjustment to long-run equilibrium in the event of short-run disequilibrium.

4. Conclusions

Fiscal sustainability is the ability of the government to preserve its current tax and expenditure policy in the long run without solvency. This study examined Nigeria's demographic changes and their impacts on tax revenues, government expenditures, and fiscal balance. Using time series data from 1980-2021 to measure fiscal balance (the government balance, government revenue, and government debt) and data on demographic transition (old-age dependency, young-age dependency, government current health expenditure, and government current education expenditure), four estimations were conducted to examine the impact of the demographic transition on government balance; the impact of the demographic transition on government health expenditure; the impact of the demographic transition on government education expenditure and impact of the demographic transition on government debt both in the short-run and the long-run. The findings show increasing effects of old-age and young dependency on government balance in the short and long run. Health and education expenditures reduce government balance. The result shows that if Nigeria spends less on education, there may be more spending on healthcare. There is an increasing effect of the old-age economy on health expenditure and an increasing effect of the young-age economy on education expenditure. Young-age dependency has growing effects on education expenditure. Finally, the results indicate an increase in government debt in a developing old-age and young-age economy. These findings are crucial for fiscal sustainability and require closing the gap between revenue and expenditures through a reduction in leakages, diversification, and increase in revenue to optimise spending on healthcare, debt stabilisation, cost control and monitoring for the healthy and pro-growth fiscal balance.

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