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## DETERMINANTS OF LIFE EXPECTANCY IN MINT COUNTRIES

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### **Abstract**

*This study investigated the determinants of life expectancy in the MINT countries from 2000-2018. Variables used are adult literacy rate, fertility rate, number of physicians per 1000 population, people using at least basic drinking water services percentage of population, people using at least basic sanitation services percentages of population, government current expenditure on health and per capita income were assessed. The second-generation econometric methods were employed; cross sectional dependence, slope homogeneity and Westerlund cointegration test as well as the panel multiple regression. Findings confirm the following; First, cross-sectional dependence and slope heterogeneity exist among the MINT countries. Second, there is a long run relationship between life expectancy and variables used. Third, of the variables included in the model, adult literacy rate, fertility rate, people using at least basic drinking water services percentage of population, government current expenditure on health and per capita income are were found to be significant in explaining life expectancy in MINT countries. The study recommended that there is the need for lowering the cost of education to improve the literacy rate, higher income levels employment of skilled health personnel to man the health system, population control as well as increasing budget for health expenditure are top priority in order to improve life expectancy. This no doubt will keep the country in their attempt to attain sustainable development come 2030.*

**Keywords:** *Life expectancy, MINT countries, Slope homogeneity, Cross sectional dependence, fertility rate*

**JEL Classification Codes:** *I11, I12, J13, J17*

## 1. INTRODUCTION

Life expectancy at birth, widely used as an indicator of overall development country, has increased over the last ten years in most countries of the world. This has a particular indication for the developing world since they are striving earnestly for achieving socio-economic progress

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through investing significantly on social sectors like health, education, sanitation, environmental management and sustainability, and social safety net in their quest to attain sustainable development (Kabir, 2008).

In 2001, the world began talking about the BRIC countries - Brazil, Russia, India and China - as a potential power bloc of the world economy. The BRIC, especially China justified this prediction by returning double digit growth rates between 2003 and 2008. MINT is a new acronym referring to the economies of Mexico, Indonesia, Nigeria, and Turkey. The term is being popularized by Jim O'Neill of Goldman Sachs, who had created the term BRICS. The idea is that Mexico, Indonesia, Nigeria and Turkey have very favorable demographics for at least the next 20 years, and their economic prospects are encouraging. As a result, since 2013, the "MINT" countries have been identified as emerging economic giants becoming the rallying point of an economic grouping that is now an important player in international economic relations for a number of reasons. Even though they have diverse history, culture and geopolitics, they share some commonality in terms of economic conditions.

Good health is essential to sustainable development and the 2030 Agenda reflects the complexity and interconnectedness of the two. Progress have been made against several leading causes of death and disease and Life expectancy has increased dramatically however, the progress has been uneven, both between and within countries in terms of life expectancy and other health outcomes. For example, the World Health Organization in 2019 estimated that there's a 31-year gap between the countries with the shortest and longest life expectancies. And while some countries have made impressive gains, national averages hide that many are being left behind. Paragraph 26 of the 2030 Agenda states: "To promote physical and mental health and well-being, and to extend life expectancy for all, we must achieve universal health coverage and access to quality health care. No one must be left behind", thus highlighting the role of health sector in addressing the needs of the most disadvantaged and vulnerable. In addition, the SDG 3 focuses on ensuring healthy lives for all at all ages. 'Leaving no one behind' in terms of life expectancy requires identifying and understanding the major determinants of life expectancy in terms of political, economic, social, or environmental that which shape the conditions of daily lives (WHO, 2019).

Several studies have investigated the determinants of life expectancy both in the developed, emerging economies and developing countries with different outcomes (see for example, Kabir, 2008; Arikpo, Eke and Obafemi, 2019, Bayeti, Akbarian and Kavosi; 2013, Garcia & Aburto, 2019,; Sede and Ohameng 2015; Shaw, Howace and Vogel, 2014). Findings from their studies have been inconclusive as to what are the major determinants of life expectancy. Moreover, studies have not investigated the key determinants of life expectancy in the MINT countries seeing that they stand as an important player in international economic relation in the recent time. Therefore, the objective of this paper is to determine the key factors that determine life expectancy in the MINT countries.

Apart from the introduction, the remainder of this paper is structured as follows, section 2 provides the literature review, section 3 deals with the data and methodology employed, section 4 presents the empirical findings, and sections 5 concludes and provide suggestions.

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## 2. LITERATUR REVIEW

Life expectancy refers to the number of years a person can expect to live. According to the World Health Organization (2019), it reflects the overall mortality level of a population. There have been several empirical works in the literature ranging from the developed developing and emerging economy on the determinants of life expectancy. Kabir (2008) assessed the determinants of life expectancy in developing countries using 93 countries between 1990 to 2003. The study makes use of multiple regression and probit model on both the aggregated and disaggregated data. He concluded that per capita income, adult illiteracy rate, health expenditure, population planning, and access to safe drinking water are major determinants of life expectancy in the developing countries.

Ralugh (2019) estimated the trend in life expectancy in EU and other OECD countries and why are the improvement slowing. He concluded that the causes of slowdown in the life expectancy varies across countries. Also, the pace of mortality improvement has slowed down in several EU and OECD countries due to influenza outbreaks impacting on older people, disease of older ages, drug related and accidental poisoning are all causes of slowdown in the improvement of life expectancy in the EU and OECD countries. Bayeti, Akbarian and Kavasi (2013) examined the determinants of life expectancy in Eastern Mediterranean region for 21 EMU countries. Panel data using fixed effect parameter based on Hausman test was employed to determine the relationship between life expectancy and socio - economic factor. They concluded that income per capita, level of education, food availability, level of urbanization and employment ratio are the key determinants of life expectancy in the EMU countries. The study however failed to determine whether a cross sectional relationship exist among the countries.

Ferda (2010) examined the determinants of life expectancy in Turkey for the period of 1965 to 2005. Bound testing and cointegration were used to determine the economic, social and environmental factors that determine life expectancy. He concluded that nutrition, food availability and smoking are major determinants of life expectancy in Turkey. However, while nutrition and food availability improve life expectancy in the country, smoking causes mortality in the economy. In the same vein, Garcia and Aburto (2019) examine the impact of violence on Venezuela life expectancy and life span inequality between 1996 to 2013 using continuous change model. They concluded that increase in violence related deaths among young men slowed down male life expectancy and increase life span inequality. Nkalu and Edeme (2019) using generalized autoregressive conditional heteroscedasticity (GARCH) to study environmental hazard and life expectancy in Africa from 1960 to 2017. They concluded that carbon dioxide (CO<sub>2</sub>) emission from solid fuel consumption, income proxied by GDP and population growth are major determinants of life expectancy.

In Nigeria, Sede and Ohemeng (2015) highlighted the socio – economic determinants of life expectancy between 1980 and 2011 using the vector autoregressive (VAR) and vector error correction model (VECM) concluded that per capita income, level of education and expenditure on health are major determinants of life expectancy. However, Yaya et al (2017) study on the prevalence and determinants of childhood mortality using DHS data and applying descriptive statistics and ordinary least square regression concluded that age, region, residence, education,

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wealth, age at first birth and religion of father and mother are key determinants of childhood mortality.

Kristanto, Daerobi and Samudro (2019) examined Indonesia life expectancy focusing on the role of health infrastructure and socio – economic status from 2010 to 2016. The study uses fixed effect panel data set for 34 provinces in Indonesia. They find that health personnel and health insurance highly improve life expectancy, availability of health facilities and income inequality have weak relationship with life expectancy while dependency ratio and undernourishment show negative impact on life expectancy. They concluded that health personnel and insurance are major determinants of life expectancy in terms of health infrastructure while dependency ratio and poverty are key determinants in terms of socio - economic factor. Arikpo, Eke and Obafemi (2019) assessed the determinants of life expectancy in Nigeria for the period covering 1980 to 2015 using the Ordinary least square estimation techniques. They concluded that among the macroeconomic variables, the major determinants of life expectancy are income inequality, income per capita, government capital health expenditure, carbon dioxide emission and physician per 1,000 population. The study however failed to determine if a long run relationship exist between life expectancy and the macroeconomic variables used.

### 3. METHODOLOGY

#### 3.1 Data requirements and source

The research sample used involves the MINT countries which are Mexico, Indonesia, Nigeria and Turkey. The acronym MINT refers to a group of countries with the potential to realize rapid economic growth. The specific countries were selected based on specific demographic, geographic, and economic factors. The covered period runs from 2000 to 2018. Selecting the time frame is based on the accessibility of data for each of MINT country. Therefore, a panel information series for 7 variables was used to assess the major determinants of life expectancy in the MINT countries. The data used were life expectancy at birth, total adult literacy rate, total fertility rate, number of physicians per 1000 people, people using at least basic sanitation services percentage of population, people using at least basic water services, current health expenditure per capita PPP and GDP per capita. All the data were retrieved from the World Development Indicators (<http://data.worldbank.org>).

#### 3.2 Model specification and methods of estimation

Since the intention of this paper is to assess the major determinants of life expectancy in the MINT countries, we specify the Panel data regression equation used in this research is:

$$LE=f(ALR, FR, PHY, PUBWS, PUBW, CHE, PCI) \quad (1)$$

Where LE = life expectancy at birth. ALR = Adult literacy rate. PHY = number of physicians per 1000 people. PUBW = number of people having access to sanitation services. PUBW = number of people having access to water services. CHE = current health expenditure and PCI = Per-capita income and Equation (2) in econometric log form is re-specified as:

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$$LE_{it} = \beta_0 + \beta_1 ALR_{it} + \beta_2 FR_{it} + \beta_3 PHY_{it} + \beta_4 PUBS_{it} + \beta_5 PUBW_{it} + \beta_6 CHE_{it} + \beta_7 PCI_{it} + \varepsilon_{it} \quad (2)$$

The difference of the unit value of research variable in the equation, cause regression equation must be made with natural logarithm model to avoid heteroscedasticity, know coefficient showing elasticity, and closer scale of data. Thus, the panel data equation changes to: In other to determine the elasticity of the independent variable on the dependent variable, equation 3 is re – specified to take a logarithm format in the form

$$\ln LE_{it} = \beta_0 + \beta_1 \ln ALR_{it} + \beta_2 \ln FR_{it} + \beta_3 \ln PHY_{it} + \beta_4 \ln PUBS_{it} + \beta_5 \ln PUBW_{it} + \beta_6 \ln CHE_{it} + \beta_7 \ln PCI_{it} + \varepsilon_{it} \quad (3)$$

On apriori the study expect as follows  $\beta_1 > 0$ ,  $\beta_2 < 0$ ,  $\beta_3 > 0$ ,  $\beta_4 > 0$ ,  $\beta_5 > 0$ ,  $\beta_6 > 0$ , and  $\beta_7 > 0$

### 3.3 Estimation Techniques

In order to prevent an unreliable parameter, estimate from the factors used, as a first step in this research, we check the existence of cross-sectional dependence and slope heterogeneity in our data sequence to determine the most suitable unit root and cointegration tests to be used. This is because not controlling for the effect of these two issues when in fact they exist in the data series may result to spurious regression. Four distinct cross-sectional dependence trials are available. These include the LM test of Breusch-Pagan (1980), Pesaran Scaled LM (2008), Bias – the corrected LM test of scale and the Pesaran CD test. Breusch-Pagan (1980) LM test: this LM statistic for reliance is provided under a null hypothesis of no cross-sectional dependence as follows:

$$LM = \sum_{i=1}^{N-1} \sum_{j=i+1}^N T_{ij} \hat{\rho}_{ij}^2 \rightarrow \chi^2 \frac{N(N-1)}{2} \quad (4)$$

Where  $\hat{\rho}_{ij}^2$  is the correlation coefficients of the residuals extracted from the equation in (4). However, Pesaran (2004) provides a more effective test for data sequence involving high numbers of nations than the Breusch-Pagan (1980) LM test. This test is considered to be the LM test scaled by Pesaran. It is also a test of null hypothesis under no cross-sectional dependence. The Pesaran (2004) LM statistics and equation are shown below.

$$LM_s = \sqrt{\frac{1}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^N (T_{ij} \hat{\rho}_{ij}^2 - 1) \rightarrow N(0,1) \quad (5)$$

The Bias – corrected Scaled LM test by Baltagi, Feng and Kao (2012) is the third cross-sectional dependence test. This test results in asymptotic bias corrections to the scaled LM test statistics, and the LM test statistics are given under the same null hypothesis of no cross-sectional dependence as:

$$LM_{BC} = \sqrt{\frac{1}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^N (T_{ij} \hat{\rho}_{ij}^2 - 1) - \frac{N}{2(T-1)} \rightarrow N(0,1) \quad (6)$$

The problem of size distortion was a major flaw of the Pesaran scaled LM test. Pesaran (2004) created an alternative test statistic called the Pesaran CD test to tackle this deficiency.

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This test is based on the average of coefficients of correlation  $\hat{\rho}_{ij}$ . The test also assumes a non-cross-sectional dependence, null hypothesis. The statistics of the Pesaran CD test are shown in equation 7 below.

$$CD_p = \sqrt{\frac{1}{N(N-1)} \sum_{i=1}^{N-1} \sum_{j=i+1}^N T_{ij} \hat{\rho}_{ij}} \rightarrow N(0,1) \tag{7}$$

Given the four different variations of the cross-sectional dependence test statistics, the null hypothesis of no cross-sectional dependence is denoted as:

$$H_0: \hat{\rho}_{ij} = cor(\mu_{it}, \mu_{jt}) = 0 \text{ for } i \neq j \tag{8}$$

### 3.4 Slope Homogeneity Test

Another major issue for this study is the heterogeneity of the slope (cross-country). An indication that important economic shock discovered in one nation is not necessarily imitated in the other nations is the presence of slope heterogeneity in a series. Pesaran and Yamagata (2008) slope heterogeneity tests were therefore used to prevent this, using the standardized version of the Swamy (1970) homogeneity test called delta tests. However, a modified version of the Swamy test (1970) is first calculated as shown in the equation below.

$$\hat{S}_w = \sum_{i=1}^N (\hat{\alpha}_i - \hat{\alpha}_{WFEP})' X_i' \frac{M_{TX_i}}{\delta_i^2} (\hat{\alpha}_i - \hat{\alpha}_{WFEP}) \tag{9}$$

From 6,  $\hat{\alpha}_i$  is the pooled OLS estimator,  $\hat{\alpha}_{WFEP}$  is the weighted fixed effect pooled estimator and  $\delta_i^2$  is the estimator. The standard dispersion statistics of equation 6 is computed to take the form specified in equation 7 and 8 below

$$\hat{\Delta} = \sqrt{N} = \left( \frac{N^{-1} \hat{S}_w - k}{2k} \right) \tag{10}$$

Otherwise, the bias adjusted version of the standard dispersion statistics in 8 can be computed as

$$\hat{\Delta}_{adj} = \sqrt{N} \left( \frac{N^{-1} \hat{S}_w - E(\hat{Z}_{it})}{\sqrt{var}(\hat{Z}_{it})} \right) \tag{11}$$

### 3.5 Westerlund (2007) Cointegration test

The four-panel cointegration experiments for the test of no cointegration established by Westerlund (2007) are used to determine whether there is a long-term connection between the variable. These tests are designed to determine if the term of error correction in a model of conditional error correction is equal to zero. Rejecting the null of no error correction will cause the null of no cointegration to be rejected. Through bootstrapping, all four tests can handle particular slope parameters and cross-sectional dependence. Two of the four tests (group mean statistics) test against an alternative for the null of no cointegration in which at least one section of the panel is cointegrated. The other two tests (panel statistics) against the option that the panel is cointegrated will also be calculated for the result of no cointegration. The statistics of the group-mean are calculated as:

$$G_{-tau} = \frac{1}{N} \sum_{i=1}^N \frac{\hat{\alpha}_i}{SE(\hat{\alpha}_i)} \tag{12}$$

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and

$$G_{-alpha} = \frac{1}{N} \sum_{i=1}^N \frac{T\hat{\alpha}_i}{\hat{\alpha}_i(1)} \quad (13)$$

In which  $\hat{\alpha}_i$  = error correction estimate, and  $SE(\hat{\alpha}_i)$  = standard error of  $\hat{\alpha}_i$ .

The panel statistics are constructed as:

$$P_{-tau} = \frac{\hat{\alpha}}{SE(\hat{\alpha})} \quad (14)$$

and

$$P_{-alpha} = T\hat{\alpha} \quad (15)$$

## 4. FINDINGS AND DISCUSSIONS

### 4.1 Descriptive Statistics

Table 1 presents an overview of descriptive statistics for the variables used among the MINT countries. Mexico recorded the highest mean value for life expectancy for the period used with 75.00, followed by Turkey with 74.01 then Indonesia with 68.74 while Nigeria recorded the lowest with 50.27. In descending order also, Turkey has the highest maximum years for life expectancy with 77.40 while the minimum value is reported in Nigeria with 46.27. In terms of adult literacy rate, Mexico has the highest mean value with 92.85 followed by Indonesia 90.70 then Turkey with 86.12 while Nigeria recorded the least value with 53.21. Turkey however reported the highest maximum value for adult literacy rate with 96.17 followed by Mexico with 95.38 while Nigeria recorded the minimum value with 51.08. For fertility rate the maximum value was reported in Nigeria with 6.11 while the minimum is reported in Turkey with 2.07. Mexico recorded the highest mean value in terms of Physicians per 1000 people with 2.01 followed by Turkey with 1.62. also, the maximum value reported was found in Mexico with 2.89 followed by Turkey with 1.81 while the minimum value were in Indonesia and Nigeria with 0.13 and 0.18 respectively. Looking at access to sanitation services, Turkey reported the highest with 97.35 followed by Mexico with 92.06 while the minimum reported among the MINT countries was found in Nigeria with 29.49. similarly, the mean reported value in terms of access to water services shows Mexico with the highest value followed by Turkey with 94.88 while the least was reported in Nigeria with 60.39. for current health expenditure, the maximum value reported was in Turkey with 1211.31 followed by Mexico with 978.93 while Nigeria and Mexico recorded the least with 82.31 and 90.05 respectively. Mexico reported the highest average value in terms of per capita income in the MINT countries with 8772.63 followed by Turkey with 8758.95 respectively. The maximum value in the MINT countries was recorded by Turkey with 12560 then followed by Mexico with 10510 while the minimum values reported were in Nigeria and Indonesia with 470 and 580 respectively

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<b>Table 1. Summary statistics</b>				
Countries	Mean	Std. Dev.	Minimum	Maximum
<b>Panel A: Life Expectancy</b>				
Mexico	75.00	0.23	74.34	75.30
Indonesia	68.74	1.88	65.77	71.53
Nigeria	50.27	2.66	46.27	54.36
Turkey	74.01	2.34	70.01	77.46
Panel	67.01	10.21	46.27	77.46
<b>Panel A: Adult Literacy Rate</b>				
Mexico	92.85	1.74	90.27	95.38
Indonesia	90.70	5.12	81.52	95.66
Nigeria	53.21	2.81	51.08	62.02
Turkey	86.12	13.16	62.02	96.17
Panel	80.72	17.67	51.08	96.17
<b>Panel A: Total Fertility Rate</b>				
Mexico	2.40	0.18	2.13	2.72
Indonesia	2.46	0.07	2.31	2.52
Nigeria	5.82	0.22	5.39	6.11
Turkey	2.21	0.13	2.07	2.50
Panel	3.22	1.52	2.07	6.11
<b>Panel A: Physician Per 1000</b>				
Mexico	2.01	0.33	1.50	2.89
Indonesia	0.23	0.10	0.13	0.48
Nigeria	0.38	0.19	0.18	0.85
Turkey	1.62	0.16	1.35	1.81
Panel	1.06	0.80	0.13	2.89
<b>Panel A: Access Sanitation Services</b>				
Mexico	83.83	5.26	75.20	92.06
Indonesia	57.97	10.46	41.09	73.13
Nigeria	34.01	3.37	29.49	39.93
Turkey	90.69	5.57	81.95	97.35
Panel	66.63	23.52	29.49	97.35
<b>Panel A: Basic Water Services</b>				
Mexico	94.88	3.36	89.04	99.75
Indonesia	83.25	4.41	75.65	89.34
Nigeria	60.39	7.75	48.15	72.73
Turkey	97.51	1.20	95.49	98.90
Panel	84.01	15.48	48.15	99.75
<b>Panel A: Health Expenditure</b>				
Mexico	804.58	166.71	480.46	978.93

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Indonesia	232.93	103.04	90.05	424.88
Nigeria	194.34	56.20	82.31	293.75
Turkey	811.07	250.97	442.89	1211.31
Panel	256.33	208.76	82.31	1211.31
Panel A: Per Capita Income				
Mexico	8772.63	1246.39	6210	10510
Indonesia	2264.74	1205.74	580	3840
Nigeria	1742.63	828.40	470	2990
Turkey	8758.95	3225.22	3550	12560
Panel	5384.74	3873.17	470	12560

Source: Author’s computation, 2019 using STATA13 and SPSS20

#### 4.2 Trend of Life Expectancy in the MINT countries

Figure 1 shows the trend of life expectancy among the MINT countries for the period of 2000 to 2018. The figure shows that right from 2000 to 2018, Nigeria has the least life expectancy from the trend. Mexico has the highest life expectancy from 2000 to 2009. From 2010 to 2018, Turkey recorded the highest life expectancy. Indonesia life expectancy though low was however higher than the life expectancy in Nigeria. The low life expectancy in Nigeria may be attributed to the high level of unemployment, rising poverty rate and the poor health budget due to the high level of corruption among the government. However, in all the MINT countries the trend of life expectancy is rising.

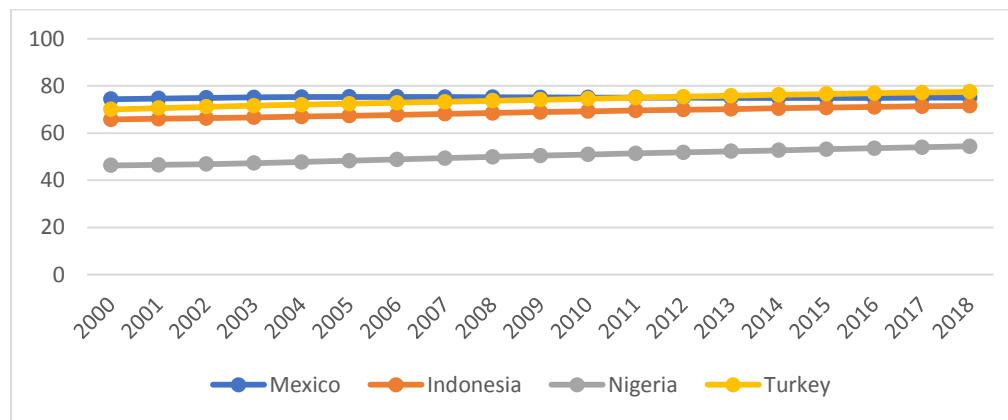


Figure 1. Trend of Life Expectancy among the MINT countries

#### 4.3 Preliminary analysis

There are two significant issues when carrying out panel-data estimates. First, is the existence of cross-sectional dependence. The probability that individual units are interdependent is an important consideration in panel-data studies (Sarafidis and Wansbeek, 2012). Wrongly

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assuming that there is no cross-correlation between data error terms (relaxation of the cross-sectional dependence hypothesis) implies that the variance-covariance matrix is likely to improve with the number of cross-sections and that the sample distributions will become spurious and invalid (Cerrato and Sarantis, 2002).

Secondly, the question of the presence of slope heterogeneity in parameters, erroneously assuming that slope coefficients are homogeneous across cross-sections when in reality they are heterogeneous, will result in inconsistent data parameter estimates. The paper therefore began by testing for cross-sectional dependence and slope homogeneity in our data to prevent the presence of spurious results in this research. The empirical findings of cross-sectional dependence and slope homogeneity respectively are presented in Table 4 and 5. Table 4 results provide adequate proof for the 9 nations to dismiss the null hypothesis of no cross-sectional dependence. The rejection of the null hypothesis was significant at 1% in all data except for the LMadj test for ANS, which was significant at 5%. Similarly, the substantial test data described in Table 5 for all delta trials and adapted delta tests led to the refusal of the null slope homogeneity hypothesis at 1%. Thus, the outcome confirms the existence in the various nations of slope heterogeneity among the series

**Table 2. Cross sectional dependent test result**

	Test Statistics							
	LE	ALR	FR	PHY	PUBS	PUBW	PHE	PCI
Breusch - Pagan LM	57.311	53.193	91.31	34.962	111.924	112.69	65.927	98.98
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Pesaran scaled LM	13.676	12.468	23.472	7.206	29.423	29.638	16.145	25.689
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Bias - corrected Scaled LM	13.546	12.358	23.361	7.095	29.319	29.527	16.034	25.578
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Pesaran CD	5.796	3.319	9.508	5.619	10.579	10.615	7.953	9.94
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Source: Author’s computation 2019 using Evies9

**Table 3. Slope Homogeneity Test**

Delta Test	Test Statistics and probability							
	LE	ALR	FR	PHY	PUBS	PUBW	HE	PCI
$\hat{\Delta}$	5.394	8.974	16.422	1.959	10.055	8.369	1.551	-0.03
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\hat{\Delta}_{adj}$	5.878	9.779	17.896	2.135	10.958	9.12	1.69	-0.033
	(0.000)	(0.000)	(0.000)	(0.000)	0(0.000)	(0.000)	(0.000)	(0.000)

Source: Author’s computation 2019 using Evies9

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#### **4.4 Cross Sectional Augmented Dickey Fuller (CADF) Unit Root Test**

To determine the type of cointegration techniques to be used for the study and to avoid a spurious regression resulting from the series, Pesaran (2007) Cross Sectional Augmented Dickey – Fuller (CADF) and CIPS panel unit root test were used and the test results are presented in Tables 4 and 5. In Table 4 we present an intercept scenario and levels only without trend. The outcome indicates that none of the variables in the MINT country was stationary at levels, but in table 5 all the variables were stationary using intercept and trend and at their first differencing. The CIPS result shows that all variables at levels are stationary. Therefore, based on the result, we conclude that after their first difference, all variables are stationary.

**Table 4. Cross sectional Augmented Dickey fuller Unit Root Test with No Trend and no Intercept**

Countries	Test Statistics									Critical values		
	LE	ALR	FR	PHY	PUBS	PUBW	RHE	PCI		1%	5%	10%
Mexico	-1.182	-2.018	0.041	-2.196	-1.414	-2.979	-1.486	-1.589		-4.21	-2.91	-2.37
Indonesia	-1.494	-1.861	-2.412	-3.061	-3.169	-1.168	-3.338	-2.201		-4.21	-2.91	-2.37
Nigeria	-0.703	0.574	-1.639	-1.012	7.492	1.273	-0.058	-3.753		-4.21	-2.91	-2.37
Turkey	-5.833	0.456	-0.287	-0.169	1.141	-1.599	-1.504	-1.767		-4.21	-2.91	-2.37
CIPS Stat. for all	-2.303	-0.712	-1.073	-1.61	1.013	-1.118	-1.596	-2.328		-4.31	-2.96	-2.39

Source: Author’s computation 2019 using Gauss 14

**Table 5. Cross sectional Augmented Dickey Fuller Unit Root Test with intercept and trend 1<sup>st</sup> Difference.**

Countries	Test Statistics									Critical Values		
	LE	ALR	FR	PHY	PUBS	PUBW	RHE	PCI		1%	5%	10%
Mexico	-7.149	-2.052	-1.829	-3.567	-3.987	-3.286	-2.402	-1.93		-4.21	-2.91	-2.37
Inonesia	-7.766	-1.268	-8.052	-3.85	-2.978	-2.306	-3.232	-2.104		-4.21	-2.91	-2.37
Nigeria	-5.458	-1.038	0.703	-2.158	-2.189	-2.064	-2.38	-4.201		-4.21	-2.91	-2.37
Turkey	-7.282	-1.397	-2.105	-1.614	-2.357	-2.353	-2.241	-2.143		-4.21	-2.91	-2.37
CIPS Stat. for all	-6.914	-2.437	-2.821	-2.797	-2.878	2.753	-3.564	-2.435		-4.31	-2.96	-2.39

Source: Author’s computation 2019 using Gauss 14

#### 4.5 Westerlund cointegration test result

In other to determine if a long run relationship exist among the variables in the MINT countries the cointegration test by Westerlund 2008 was used and the result is presented in Table 6. As shown in the table, when the long-term relationship between LE and other variables for the determinants were tested, the four cointegration tests ;  $g$ -tau,  $g$ -alpha,  $P$ -tau, and  $P$ -alpha test statistics reject the null hypothesis of no long run relationship among the variables at the 1% level of significance. Hence, the result indicates that there is a long run relationship between life expectancy and the variables used in the model. The evidence of a long run relationship between life expectancy and the variables is an indication that the variables are important in the long run for the MINT countries potential to realize rapid economic growth.

Table 6. Westerlund cointegration test			
Statistics	Value	Asymptotic $\rho$ – value	Bootstrap $\rho$ – value
$g$ -tau	3.345*	0.988	0.002
$g$ -alpha	4.137*	1.000	0.001
$\rho$ -tau	3.158*	0.991	0.005
$\rho$ -alpha	2.542**	0.978	0.013

Note: \* and \*\* indicate rejection of the null of no cointegration at the 1%, and 5%, levels, respectively.

Source: Author's computation 2019 using GAUSS 14

#### 4.6 Regression Result

Presented in table 7 is the result obtained from the estimation of the equation specified in 3. From the result, adult literacy rate impacted positively on the improvement of life expectancy in the MINT countries. This result conforms with the theoretical postulation that improvement in education will help improve life expectancy of individual. The result indicates that a percentage increase in adult literacy rate will improve life expectancy with 15 percent. The  $\rho < 0.01$  indicate that at 1 percent level of significance, adult literacy rate is a significant determinant of life expectancy in the MINT countries.

Fertility rate shows an inverse relationship with life expectancy. This result also conforms with apriori expectation in that higher population without birth control may increase undernourishment, unemployment rate and hence leads to malnutrition thereby increasing illness and at last reduces the life expectancy of individual. The result indicated that 1 percent increase in fertility will reduce life expectancy with 14percent. This result was also significant at 1percent with  $\rho < 0.01$ . based on the significance therefore, we conclude that fertility rate is an important determinants of life expectancy in MINT countries.

The number of physicians per 1000 people from the findings impacted positively on life expectancy in the MINT countries. The result also conforms with apriori expectation in that increase in the number of physicians to patient will help reduce illness and safe more patient from untimely death as they wait patiently for treatment for which some died before they are

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been attended to. This no doubt will improve life expectancy. The result shows that 1percent increase in the number of physicians will help improve life expectancy by 0.8percent. The result was however not significant with  $\rho > 0.1$ . This shows that number of physicians though helps in improving the life expectancy of the citizenry in the MINT countries, but it is not an important factor that determine life expectancy in the MINT countries.

The number of people using at least basic sanitation services from the result shows a positive effect on life expectancy. This conforms with apriori expectation in that good sanitation services will help to ensure good environment and hence reducing environmental hazard and pollution thereby leading to good health. Based on the findings, 1percent increase in the access of people to basic sanitation will improve life expectancy with 4percent. The result was however not also significant with  $\rho > 0.1$ . This mean that number of people using basic sanitation services though improve life expectancy, is not a major determinant of life expectancy in the MINT countries.

The number of people having access to basic water services impacted positively on life expectancy. The result conforms with the theoretical postulation that good water will help reduces pipe borne diseases and some neglected tropical diseases arising from bad water. The findings show that 1percent increase in the access to basic water will improve life expectancy with about 43.8percent. The result however was significant with  $\rho < 0.01$  indicating that at 1percent level of significant, access to basic water stand as a major determinant of life expectancy in the MINT countries.

Health expenditure shows a positive impact on life expectancy. The result conforms with the theoretical postulation that increase in health spending will help to improve health status in terms of life expectancy. Based on the findings, 1percent increase in government spending will improve life expectancy with 3.1percent. The low improvement here may be due to low allocation to the health sector in the recent years as majority of the budget are spent on security. The result also was significant at 5 percent with  $\rho < 0.05$ . The implication of the significance of the result shows that public health expenditure is an important factor that determines health expenditure in the MINT countries.

Per capita income which measure the amount of money earned per person in a nation or geographic region shows a positive relationship with life expectancy in the MINT countries. The result shows that 1percent increase in the per capita income will improve life expectancy with 3.6percent. The result was significant at 10percent with  $\rho < 0.1$ . This means that per capita income is a major determinant of life expectancy in the MINT countries. The R square value shows that about 92percent of the variation in life expectancy is accounted for by the explanatory variables. The F-statistics value of 944.00 with  $\rho < 0.01$  indicate that the overall model is significant. The D.W value of 1.68 indicate the absence of white noise in the model.

<b>Table 7 Regression Result. Dependent Variable: Life Expectancy log(LE)</b>			
Variables	Coefficient	t-Statistics	Prob.
Log (ALR)	0.153*	5.196	0.000
Log (FR)	-0.136*	-2.837	0.000
Log (PHY)	0.008	1.550	0.126
Log (PUBS)	0.040	0.908	0.367
Log (PUBW)	0.438*	7.219	0.000
Log (HE)	0.031**	2.453	0.017
Log (PCI)	-0.036***	-1.925	0.058
R-Squared	0.928		
F-Stat	944.00		0.000
D.W	1.62		

Note: \*, \*\* and \*\*\* indicate significance at 1%, 5% and 10%, levels, respectively

Source: Author's computation, 2019 using Eviews9

## 5 CONCLUSION AND RECOMMENDATIONS

The present paper tried to explore the determinants of life expectancy in the MINT countries using panel multiple regression analysis for the period of 2000 to 2018. Seven variables comprising of adult literacy rate, fertility rate, number of physicians, number of people having basic sanitation services, number of people with access to basic water services, public health expenditure and per capita income were used. The study concluded as follows: first, cross sectional dependence and slope homogeneity in the MINT countries. Secondly, a long run relationship exists between life expectancy and the explanatory variable. Third, among the variables used, adult literacy rate, fertility rate, number of people with access to basic water services, health expenditure and per capita income are the major determinants of life expectancy while number of physicians, number of people having basic sanitation services though help in the improvement of life expectancy are not determinants of life expectancy in the MINT countries. Based on the conclusions, the study recommends that, there is need for improvement in the adult literacy rate, higher income levels and employment of skilled health personnel to man the health system, provision of infrastructure in terms of water and sanitation, improvement in health budget which is a top priority in order to improve life expectancy and the need for population control in the MINT countries. This no doubt will help to improve life expectancy in the MINT countries and create an avenue to achieve sustainable development come 2030.

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