IMPACT OF MATERNAL MORTALITY ON SUSTAINABLE DEVELOPMENT IN THE SELECTED WEST AFRICAN COUNTRIES

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ARTICLE INFO
Original scientific Article
Received: 14.08.2019
Revised: 15.11.2019
Accepted: 29.11.2019
doi 10.7251/ACE1931051A
UDC 314.14:618.7(6-15)

Keywords: *maternal mortality, sustainable development, cross-sectional dependence, West Africa, female*

JEL Classification: I12, O47, Q01

ABSTRACT

Over half a million females die every year as a result of pregnancy and birth complications. The vast majority of these fatalities can be avoided. SDG 3.1's objective is to reduce the global maternal mortality ratio by 2030 to below 70 per 100,000 live births. Despite a number of policies put in place maternal mortality in Africa remains unacceptably high. This study investigates the impact of maternal mortality on sustainable development in 9 selected West African countries for the period from 1990 to 2015. Data used were adjusted net savings, maternal mortality, consumer price index, per-capita income and financial development. The second-generation econometric methods were employed: cross sectional dependence, slope homogeneity, Westerlund cointegration, Eberhadt and Teal AMG regression, and the Emirmahmutoglu and Kose bootstrap Granger causality test. Findings confirm the following: First, cross-sectional dependence and slope heterogeneity exist among the West African countries. Second, there is a long run relationship between maternal mortality and sustainable development. Third, maternal mortality impacted negatively and significantly on sustainable development. Fourth, the direction of causality varies across countries between maternal mortality and sustainable development. Lastly, causality runs from maternal mortality to sustainable development when analyzing the causal relationship among all countries. The findings suggest that the West African government needs to commit more funding to the health care sector and ensure access to free healthcare service to pregnant women or at low cost with quality and effective health care services if the countries must attain sustainable development by 2030.

1. INTRODUCTION

The Sustainable Development Goals (SDGs) target is now less than twelve years to finish, but target 3.1 to reduce the worldwide maternal mortality ratio by 2030 to less than 70 per 100,000 livebirths is still unrealistic in most African countries. Approximately 830 females die every day from preventable causes linked to pregnancy and childbirth, according to the World Health Organization (2018). It is disheartening that while maternal mortality, which is pregnancy-related death, is preventable, it has continued to rise in many nations around the globe, particularly in the countries of Western Africa. It is also unfortunate that 99% of all maternal deaths in the globe happen in developing countries where the bulk of state claims to have invested more in the health industry in an effort to guarantee health care efficiency and effectiveness (Bhalotra et al., 2018; WHO, 2018 ; Olonode et al., 2019).

Literature has recently disclosed that one female dies in pregnancy per minute around the globe and that half of these fatalities still happen in sub-Saharan Africa. Despite advancement in many nations in growing maternal health care accessibility, most females throughout Africa stay without complete access to this care (Africa Progress Panel Policy Brief, 2010; Say et al., 2014; WHO, 2019). A recent research by McArthur, Rasmussen and Yamey (2018) demonstrates that researchers are now more concerned about how many lives are at risk in an effort to achieve sustainable development with high maternal mortality. They are also concerned about how far the nation has to go by the end of 2030 to achieve the goal of less than 70 maternal deaths per 100,000 live births.

Recognizing these problems, the worldwide community has once again created history by agreeing on a common front to tackle some of today's most daunting development problems of humanity. As a consequence, at the end of 2015, the objective of maternal mortality was included in the objective of sustainable development. Goal 3 of the SDGs calls for ensuring healthy lives and promoting well-being for all ages, and the global goal is to reduce the global maternal mortality ratio (MMR) to less than 70 maternal deaths per 100,000 live births by 2030, while the national goal for countries is to reduce their MMR by at least two-thirds from their 2010 baseline by 2030. Finally by 2030, there should be no nation with MMR higher than 140 maternal deaths per 100,000 live births, twice the worldwide target (Garenne, 2015; Maternal Health Task Force, 2019; Piane, 2019).

However, the trend is still on the rise despite many measures put in place to decrease maternal deaths in Western African nations. The issue that comes to mind is, what effect does maternal mortality have on West Africa's sustainable development? Is there a long-term connection between maternal mortality and sustainable development? If so, what is the causality direction between maternal mortality and sustainable development? As a result of the bordering questions, the effect of maternal mortality on sustainable development in West Africa is therefore essential to investigate. Hence, the objective of this paper is to examine the impact of maternal mortality on sustainable development in some selected West African countries.

The remainder of this paper is structured as follows, in addition to the introduction: section 2 provides the literature review, section 3 defines the information used by the adopted methodology, section 4 introduces the empirical outcomes, and section 5 concludes the research and recommends.

2. MATERIALS AND METHODS

2.1. Data requirements and source

The research sample used involves: Benin, Gambia, Ghana, Guinea Bissau, Mali, Niger, Nigeria, Senegal and Togo. The covered period runs from 1990 to 2015. Selecting the nations used and selecting the time frame is based on the accessibility of information for each of the nations in West Africa. Therefore, a panel information series for 5 variables was produced to examine the impact of maternal mortality on sustainable development in the chosen West African nations. Sustainable development, consumer price index, GDP per capita, financial development and maternal mortality are included. Sustainable development data, inflation rate, income per capital and maternal mortality data were retrieved from the World Development Indicators (http://data.worldbank.org). Data for financial development were sourced from the site http://data.world/imf/financial-development-fd. The adjusted net savings is used as a proxy for sustainable development (World Bank, 1997; Farida, Arifin & Abdol, 2015).

2.2. Model specification and methods of estimation

The adjusted net savings were accepted by the World Bank as an indication for sustainable development (Faridah et al., 2015) and are calculated from the fixed capital depreciation, education expenditure, natural resource depletion and pollution damage. The adjusted net savings are therefore calculated

$$ANS = \frac{GNS - Dh + CSE - \sum R_{n.i} - CD}{GNI}. \tag{1}$$

Where ANS = Adjusted Net Saving Rate, GNS = Gross National Saving, Dh = Depreciation of produced capital, CSE = Current (non-fixed-capital) expenditure on education, Rn,i = Rent from depletion of natural capital, CD = Damages from carbon dioxide emissions and GNI = Gross National Income at Market Prices.

Since the intention of this paper is to examine the impact of maternal mortality on sustainable development in some selected West African countries, we specify a typical sustainable development equation that takes the functional form:

$$SD = f(MM,\ CPI,\ PCINC,\ FINDEV) \tag{2}$$

Where SD = sustainable development proxied by the adjusted net savings, MM = maternal mortality, CPI = consumer price index, PCINC = Per-capita income and FINDEV = financial development. Equation (2) in a linear econometric log form is re-specified as:

$$LSD_{it} = \beta_0 + \beta_1 MM_{it} + \beta_2 CPI_{it} + \beta_3 PCINC_{it} + \beta_4 FINDEV_{it} + \varepsilon_{it} \tag{3}$$

Where LSD = log of sustainable development, β_0=constant term, β_k(k = 1, 2, 3, 4) = coefficients on independent variables, ε_{it}= error term. In equation 2 only sustainable development (dependent variable) is in logarithmic form. The above log linear model will be estimated using the Eberhardt and Teal (2010) Augmented Mean Group estimation techniques for panel data. Although the objective of the study was to determine the effect of maternal mortality on sustainable development, we also introduce other variables that are generally accepted as determinants of sustainable development to serve as control variables. These variables include: consumer price index, per capita income and financial development.

2.3. Estimation techniques

In order to prevent an unreliable parameter, an 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 lack of control of the effect of these two issues, which exist in the data series, may result in spurious regression. Four distinct cross-sectional dependence trials are available. These include the LM test of Breusch-Pegan (1980), Pesaran Scaled LM (2008), Bias - the corrected LM test of scale and the Pesaran CD test.

Breusch-Pagan (1980) LM test: this LM statistics for reliance is provided under a null hypothesis of no cross-sectional dependence as follows:

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

Where $\hat{p}_{ij}^{2}$ is the correlation coefficient of the residuals extracted from the equation in (4). However, Pesaran (2004) provides a more effective test for data sequence involving high number 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.

$$LM_{s} = \sqrt{\frac{1}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} (T_{ij} \hat{p}_{ij}^{2} - 1) \rightarrow N(0.1) \tag{5}$$

The Bias - corrected Scaled LM test by Baltagi, Feng & 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 is given under the same null hypothesis of no cross-sectional dependence as:

$$LM_{BC} = \sqrt{\frac{1}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} (T_{ij} \hat{p}_{ij}^{2} - 1) - \frac{N}{2(T-1)} \rightarrow N(0.1) \tag{6}$$

The problem of the size distortion was a major flaw of the Pesaran scaled LM test. Pesaran (2004) created an alternative test statistics called the Pesaran CD test to tackle this deficiency. This test is based on the average of coefficients of correlation $\hat{p}_{ij}$. The test also assumes no cross-sectional dependence, i.e. null hypothesis. The statistics of the Pesaran CD test is shown in equation 7 below.

$$CD_{p} = \sqrt{\frac{1}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} T_{ij} \hat{p}_{ij} \rightarrow N(0.1) \tag{7}$$

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

$$H_{0} : \hat{p}_{ij} = cor(\mu_{it,} \mu_{jt}) = 0 \;\; for \;\; i \neq j \tag{8}$$

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 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.

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

From 6, $\hat{\alpha}_i$ is the pooled OLS estimator, $\hat{\alpha}_{WFEP}$ is the weighted fixed effect pooled estimator and δ_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

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

Westerlund cointegration test

The four-panel cointegration experiments to test no cointegration established by Westerlund (2007) are used to determine whether there is a long-term connection between the variables. 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) testing against the option that the panel is cointegrated will also be calculated for the result of no cointegration. The statistics of the group-mean is calculated as:

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

and

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

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

The panel statistics is constructed as:

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

and

$$P_{-\alpha lpha} = T\hat{\alpha} \tag{15}$$

Bootstrap panel Granger casualty test

The direction of causality between sustainable development and maternal mortality among the nations used is one thing that is more essential to be identified in this research. To achieve this, Emirmahmutoglu and Kose (2011) suggested the bootstrap panel causality method based on meta-analysis in heterogeneous mixed panels. This test is an extension of the techniques of Toda and Yamamoto (1995) to test coefficient restrictions for an integrated or co-integrated process in a level VAR model. However, the pattern of ensuring that the variables in the underlying VAR system are stationary does not follow this test. Therefore, the use of this test may be appropriate to apply for panels composed of stationary, non-stationary, cointegrated and non-cointegrated series (see Seyoum et al., 2014, for instance). Therefore, pre-test bias associated with stationary testing and cointegration is prevented. This is because, in a lag-augmented VAR (LA-VAR), the technique uses a modified Wald (MWALD) test that has a standard asymptotic chi-square distribution when estimating a VAR (p+dmax). The value of p is the lag order and dmaxis is the maximum integration order assumed to occur in the computing process. Therefore, following Emirmahmutoglu and Kose (2011), the panel causality test equation system includes two sets of equations:

$$SD_{it} = \alpha_{1i}^{SD} + \sum_{j=1}^{L_{SD}+dmax_i} \beta_{1ij} SD_{it-j} + \sum_{j=1}^{L_{MM}+dmax_i} \gamma_{1ij} MM_{it-j} + \varepsilon_{1it}. \tag{16}$$

$$MM_{it} = \alpha_{2i}^{MM} + \sum_{j=1}^{L_{SD}+dmax_i} \beta_{2ij} SD_{it-j} + \sum_{j=1}^{L_{MM}+dmax_i} \gamma_{2ij} MM_{it-j} + \varepsilon_{2it}. \tag{17}$$

In equation (16) and (17) SD_{it}, i=1,...,N denotes sustainable development and $MM_{i,t}$=1,...,N denotes maternal mortality. N represents the number of the countries included in the panel (j=1,...,N), t is the time period (t=1,2,3,4,5,6,7,8,9), 1 is the lag length and $dmax_j$ represents the maximal order of integration. However, if cross-sectional dependence exists in the data series used, the limit distribution of the Fisher test statistics is assumed to become invalid. To prevent such an issue, the bootstrap strategy used Emirmahmutoglu and Kose test for causality of Granger in the presence of cross-sectional dependence. The work by Emirmahmutoglu and Kose (2011) provides details of the bootstrap procedure. We estimate equations (13) and (14) with bootstrap critical values and perform panel Granger causality tests. Emirmahmutoglu and Kose's Granger causality employs the statistical method of meta-analysis of Fisher (1932). It performs N amount of distinct time series trials and combines meaningful individual p-values in a single panel test statistics. The test statistics has a chi-square distribution with 2N degrees of freedom. The Fisher test statistics (λ) is specified as

$$\lambda = -2\sum_{i=1}^{N} ln_{(pi)} \qquad i = 1, 2, \ldots, N. \tag{18}$$

In equation (15) *pi* represents *ρ-value* for the Wald statistics of the *ith* cross sections.

However, the limit distribution of the Fisher's test becomes unacceptable when cross-sectional dependence exists in the data series. The paper uses the Emirmahmutologu and Kose Bootstrap Granger causality test in the presence of cross-sectional dependence in order to find a way out of this issue. Equation (18) and (19) are estimated using the bootstrap critical value of Emirmahmutologu and Kose panel Granger causality tests.

3. RESULTS AND DISCUSSION

3.1. Trend of maternal deaths

Figure 1 demonstrates the trend in maternal death in chosen nations in West Africa. From 1990 to 2004, maternal mortality rose in Benin. The mortality between 2004 and 2009 was stable and declined in 2010. However, maternal death has been diminishing and stable since this era. Maternal death has increased over the years in the Gambia. In Ghana, maternal death declined from the beginning of 1990 to 2008 and began to rise from 2009 to 2015. Guinea Bissau's maternal mortality fell from 1990 to 2004 but has risen since 2005. It decreased again from 2005 to 2010, where the amount of maternal deaths for Mali has risen again, the amount of fatalities has not been also stable, but it demonstrates that the amount of fatalities is declining in Mali and Togo, as well as in Nigeria. After attempts to lower the rate since 2010 Senegal has reported a stable maternal death.

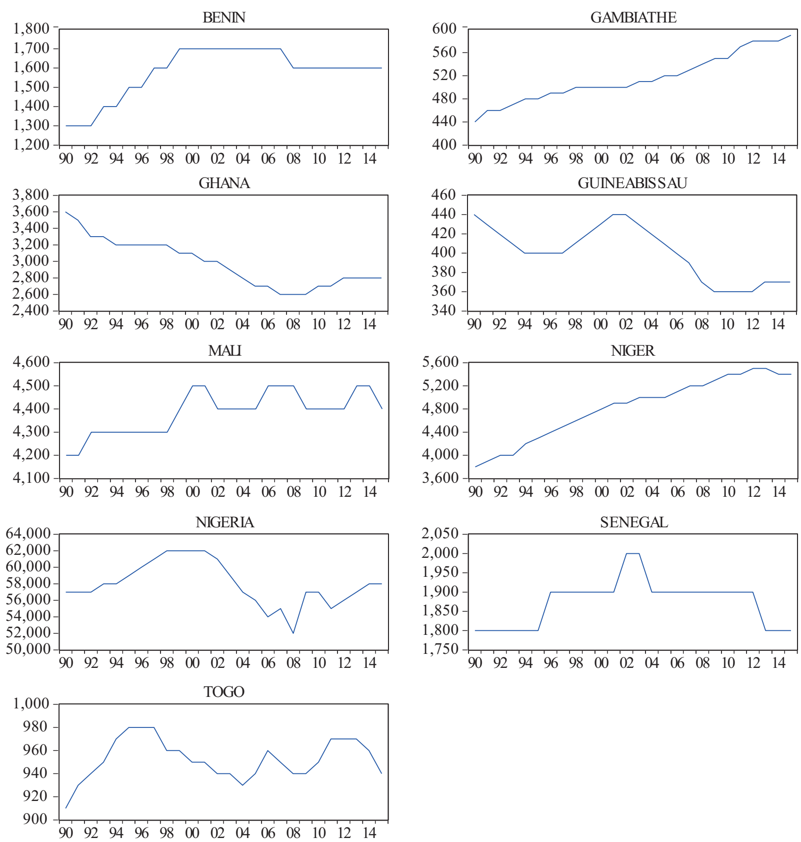

Figure 1. Trend of maternal death in the selected West African countries
Source: World Bank data base, 2019

3.2. Summary of statistics

Table 1 provides an overview of the descriptive statistics of variables. Nigeria has the highest mean value for sustainable development for the period 1990-2015, followed by Senegal, whereas the lowest is in the Gambia. The largest peak value for sustainable development was also reported in Nigeria while the minimum was recorded in the Gambia. The largest peak value for sustainable development was also reported in Nigeria while the minimum was recorded in the Gambia. Ghana recorded the highest mean value in terms of inflation followed by Nigeria. Senegal reported the least mean value. Nigeria has the highest mean value for per capita income followed by Senegal. The lowest mean value was recorded by Ghana. Nigeria also has the average maximum values (2563.09), whereas Niger has the minimum value (322.16).

Table 1. Summary of statistics

Country	Mean	Std. dev	Minimum	Maximum
Panel A: Sustainable development				
Benin	-0.32	1.64	-2.93	4.31
Gambia	-12.18	6.18	-22.94	4.11
Ghana	-0.40	8.23	-17.84	9.78
Guinea Bissau	-6.26	6.54	-19.27	8.89
Mali	2.23	4.34	-8.99	10.77
Niger	-2.42	7.61	-15.67	9.25
Nigeria	20.83	11.97	0.08	43.92
Senegal	4.06	4.23	-3.83	12.26
Togo	1.45	8.95	-12.81	31.20
Panel	0.78	11.06	-22.94	43.92
Panel B: Consumer price index				
Benin	4.41	7.68	-1.00	38.53
Gambia	5.90	3.96	0.84	17.03
Ghana	20.45	12.42	7.13	59.46
Guinea Bissau	16.02	22.38	-3.50	69.58
Mali	3.04	5.75	-6.24	23.18
Niger	2.91	7.94	-7.80	36.04
Nigeria	18.89	18.09	5.38	72.84
Senegal	2.75	6.50	-2.25	32.30
Togo	4.39	8.00	-1.00	39.16
Panel	8.75	13.58	-7.80	72.84
Panel C: Per capita income				
Benin	707.87	69.30	609.35	833.64
Gambia	521.37	17.99	488.55	562.48
Ghana	1114.97	268.95	832.59	1642.42
Guinea Bissau	568.18	60.23	508.70	731.10

Country	Mean	Std. dev	Minimum	Maximum
Mali	610.58	83.98	481.25	726.25
Niger	346.24	20.44	322.16	388.34
Nigeria	1795.63	431.65	1347.89	2563.09
Senegal	1150.37	105.59	995.42	1346.36
Togo	532.50	45.07	419.28	622.35
Panel	815.42	466.02	322.17	2663.09
Panel D: Financial development				
Benin	.09	.01	.07	.10
Gambia	.08	.01	.06	.09
Ghana	.11	.01	.09	.14
Guinea Bissau	.04	.01	.02	.06
Mali	.09	.02	.06	.11
Niger	.07	.02	.05	.12
Nigeria	.12	.03	.07	.19
Senegal	.10	.01	.09	.11
Togo	.09	.01	.07	.12
Panel	.09	.03	.02	.19
Panel E: Maternal mortality				
Benin	510.77	58.05	405	577
Gambia	862.15	107.70	706	1030
Ghana	434.5	101.50	319	634
Guinea Bissau	717.31	114.80	549	907
Mali	779.46	137.23	587	1010
Niger	742.11	95.33	553	873
Nigeria	1057.81	196.02	814	1350
Senegal	446	70.20	315	840
Togo	469.73	73.93	368	573
Panel	668.87	233.50	315	1350

Source: Author’s computation (2019) using Stata 12

3.3. 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). Wrong assumption 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 & Sarantis, 2002).

Second is the question of the presence of slope heterogeneity in parameters. Erroneous assumption that slope coefficients are homogeneous across cross-sections when in reality they are heterogeneous, will result in inconsistent data parameter estimates. The paper therefore test for both to prevent the presence of spurious results.

The empirical findings of cross-sectional dependence and slope homogeneity respectively are presented in Table 2 and Table 3. Table 2 results provide adequate proof for nine 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 3 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 various nations of slope heterogeneity among the series.

Table 2. Cross-sectional test dependence result

	Test stat. and prob.				
	ANS	CPI	PCINC	FINDEV	MM
LM (Breusch & Pegan, 1980)	180.69***	813.27***	370.78***	180.84***	840.29***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
CDlm (Pesaran, 2004)	15.99***	90.57***	38.39***	16.01***	93.72***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
CD (Pesaran, 2004)	15.81***	90.36***	38.22***	15.83***	93.54***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LMadj (PUY, 2008)	1.78**	28.48***	12***	7.76***	28.96***
	(0.07)	(0.00)	(0.00)	(0.00)	(0.00)

Source: Author's computation (2019) using Eviews 9: ***and **, indicate rejection of the null of no cross-sectional dependence at the 1%, and 5% levels, respectively

Table 3. Slope homogeneity test results

Delta Tests	Test stat. and prob.				
	ANS	INF	PCINC	FINDEV	MM
Delta tilde	4.832***	1.083	2.101**	1.017	6.727***
	(0.00)	(0.14)	(0.02)	(0.16)	(0.00)
Delta tilde adj.	5.137***	1.152	2.234**	1.082	7.152***
	(0.00)	(0.13)	(0.01)	(0.14)	(0.00)

Source: Author's computation (2019) using GAUSS 14. *** and **denotes sig. at 1% and 5%, respectively.

3.4. Panel unit root test results

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 tests were used and the test results are presented in Table 4 and Table 5. In Table 4, where intercept and trend were presented at the first difference, the result shows that all variables at levels were not stationary but only after the first differencing in Table 5.

Table 4. Panel unit root test results with intercept and trend at levels

Countries	Test statistics					Critical values		
	ANS	CPI	PCINC	FINDEV	MM	1%	5%	10%
Benin	-1.47	-0.41	-3.25	-0.91	-4.06	-6.40	-4.87	-4.00
Gambia	-0.16	-0.30	-3.05	-1.96	-3.43	-6.40	-4.87	-4.00
Ghana	-0.21	1.12	-2.73	-2.01	-0.95	-6.40	-4.87	-4.00
Guinea Bissau	-1.68	-0.98	-3.19	-3.30	-1.71	-6.40	-4.87	-4.00
Mali	-2.20	-0.21	-2.39	-1.87	-3.37	-6.40	-4.87	-4.00
Niger	2.94	1.46	-1.80	-3.37	-1.92	-6.40	-4.87	-4.00
Nigeria	-2.66	0.60	-0.44	-3.23	-2.08	-6.40	-4.87	-4.00
Senegal	-0.39	-0.36	-2.56	-1.31	-2.25	-6.40	-4.87	-4.00
Togo	0.36	-0.10	-1.30	-2.73	-2.71	-6.40	-4.87	-4.00
CIPS stat. for all countries (panel)	-0.61	0.09	-2.30	-2.30	-2.43	-3.30	-2.94	-2.76

Source: Author's computation (2019) using GAUSS14

Table 5. Panel unit root test results with intercept and trend after the first difference

Countries	Test statistics					Critical values		
	ANS	CPI	PCINC	FINDEV	MM	1%	5%	10%
Benin	-2.67	-3.64	-1.47	-1.80	-4.01	-6.40	-4.87	-4.00
Gambia	-2.74	-2.51	-2.96	-2.83	-6.63	-6.40	-4.87	-4.00
Ghana	-3.31	-1.50	-2.81	-4.39	-2.84	-6.40	-4.87	-4.00
Guinea Bissau	-2.77	-4.50	-2.35	-5.03	-1.81	-6.40	-4.87	-4.00
Mali	-4.28	-4.48	-2.70	-2.56	-2.82	-6.40	-4.87	-4.00
Niger	-3.32	-2.86	-1.75	-3.21	-3.95	-6.40	-4.87	-4.00
Nigeria	-4.29	-3.02	-1.43	-2.59	-3.14	-6.40	-4.87	-4.00
Senegal	-2.92	-3.57	-1.38	-1.48	-4.71	-6.40	-4.87	-4.00
Togo	-2.36	-4.28	-2.40	-1.94	-4.96	-6.40	-4.87	-4.00
CIPS stat. for all countries (panel)	-3.18	-3.73	-2.58	-2.87	-3.87	-3.30	-2.94	-2.76

Source: Author's computation (2019) using GAUSS14

Westerlund cointegration test result

As shown in Table 6, when the long-term relationship between the sustainable development (SD) and all the explanatory variables (MM, CPI, PCINC, FINDEV) is tested, two out of the four cointegration tests reject the null of no cointegration, i.e., $P_{\_tau,}$ and $P_{\_alpha}$ test statistics rejects the null hypothesis at the 5% significant level. Hence, the result indicates that there is a long run relationship between SD and MM, CPI, PCI and FD. The evidence of a long run relationship between MM and SD indicate that maternal mortality has implication on the attainment of sustainable development to come by 2030.

Table 6. Westerlund cointegration test result

Statistics	Value	Asym *p*–value	bootstrap *p*–value
g-tau	2.902	0.988	0.937
g-alpha	4.023	1.000	0.160
p–tau	2.372	0.991***	0.011
p–alpha	2.372	0.978**	0.019

*** and ** indicate rejection of the null of no cointegration at the 1% and 5% levels, respectively.
Source: Author's computation (2019) using GAUSS 14

Regression results

To determine the impact on sustainable development of maternal mortality, the AMG methods used by Eberhardt and Teal (2010) was employed and the results are presented in Table 7 below.

Table 7. AMG estimation results (dependent variable: sustainable development)

Variable	Coefficient	ρ value
Maternal mortality	-0.005	0.041
Consumer price index	-0.001	0.038
Per capita income	0.007	0.051
Financial development	1.023	0.510

Source: Author's computation (2019) using Stata14

The above results show the log linear result obtained from the estimated equation in 3. The Eberhardt and Teal (2010) AMG regression analysis was used. The result is in a log linear form with the dependent variable of sustainable development (LSD) in the logarithmic form while the independent variables were not logged. Maternal mortality demonstrates an inverse relationship to sustainable development as a consequence. The outcome is consistent with the theoretical postulation. Increase of 1% in maternal mortality will decrease sustainability by 0.5%. The outcome from ρ – value shows a significance of 5%. This shows that addressing the issue of maternal mortality is an important factor for achieving sustainable development in the selected countries of West Africa. The result also found a negative impact of the consumer price index (CPI) on sustainable development. The result corresponds to the a priori expectation. An increase of 1% in CPI causes LSD to drop by 0.01%. The result with ρ – value < 0.05 was significant at 5%. The significance of this result demonstrates that CPI in the chosen West African nations is an important determinant of sustainable development. Per capita income (PCINC) shows a positive relationship with sustainable development (LSD). The result conforms to the theoretical postulation too. As a consequence, 1% rise in per capita income will lead to an improvement in LSD by about 0.07%. Value $\rho < 0.05$ indicates that per capita income in the selected West African countries is an important determinant of sustainable development. Financial development outcome shows a positive but insignificant result with sustainable development outcome. The outcome demonstrates that an increase in economic growth of 1 percent will lead to an increase in sustainable development by about 102 percent. Values $\rho > 0.05$ shows that financial development is not a significant factor that determines sustainable development in the selected West African countries.

Emirmahmutoglu and Kose Bootstrap Granger causality test result

It is evident from Table 2 and Table 3 that the null of no cross-sectional dependence has been dismissed across the nine nations and that the slope coefficient is heterogeneous. A causality test must therefore be used to take into account both cross-sectional dependence and slope homogeneity. Therefore, the Bootstrap Granger causality test by Emirmahmutoglu and Kose (2011) is used to determine the direction of causality between maternal mortality and sustainable development and the outcome is displayed in Table 8 below.

Table 8. Granger causality between sustainable development and maternal mortality

Maternal mortality does not cause sustainable development		Sustainable development does not cause maternal mortality	
Countries	Wald statistics	Countries	Wald statistics
Benin	9.583*	Benin	2.189
	(-0.008)		(0.335)
Gambia	0.774	Gambia	2.011
	(-0.679)		(0.366)

Maternal mortality does not cause sustainable development		Sustainable development does not cause maternal mortality	
Countries	Wald statistics	Countries	Wald statistics
Ghana	9.031**	Ghana	3.112
	(0.011)		(0.211)
Guinea Bissau	19.128*	Guinea Bissau	3.616
	(0.000)		(0.164)
Mali	0.350	Mali	1.132
	(0.554)		(0.287)
Niger	4.965**	Niger	2.425
	(0.026)		(0.119)
Nigeria	2.082	Nigeria	6.404**
	(0.149)		(0.011)
Senegal	1.150	Senegal	4.909**
	(0.284)		(0.027)
Togo	6.557**	Togo	8.944**
	(0.038)		(0.011)
Panel Fisher	59.892	Panel Fisher	42.81
Asymptotic value	(0.000)	Asymptotic value	(0.001)
Bootstrap p value	(0.010)	Bootstrap p value	(0.789)

Note: * and ** indicate significance at 0.1 and 0.5 significance level
Source: Author's computation (2019) using GAUSS14

The outcome of the granger causality test is shown in Table 8. The result shows that the following outcomes will be discovered when the variables of sustainable development and maternal mortality are displayed at their country level. Significant one-way causality in Benin, Ghana, Guinea-Bissau and Niger, from maternal mortality to sustainable development has been discovered. There is also a one-way causality in Nigeria and Senegal that runs from sustainable development to maternal mortality. In Togo, there is a two-way or bi-directional causality between sustainable development and maternal mortality. This shows the country's feedback existence. However, there was no evidence of causality in the Gambia and Mali among the two. However, the bootstrap outcome shows a one-way causality from maternal mortality to sustainable development when testing for the overall chosen West African countries. There is therefore proof of causality in the chosen West African nations between sustainable development and maternal mortality.

4. CONCLUSIONS AND RECOMMENDATIONS

This research examines the effects of maternal mortality on sustainable development in nine West African nations between 1990 and 2015. The conclusions of the study are as follows:

First, across West African nations, there is a cross-sectional dependence and slope heterogeneity. Second, there is a long-term connection between maternal mortality in the countries and sustainable development. Third, maternal mortality has had a negative impact on sustainable development and is also a major factor determining sustainable development in the nine countries. Fourth, the direction of causality between maternal mortality and sustainable development differs among countries. In Benin, Ghana, Guinea Bissau and Niger, one-way causality occurs running from maternal mortality to sustainable development. On the other hand, causality ranges from sustainable development to maternal mortality in Nigeria and Senegal, whereas there is two-way causality between maternal mortality and sustainable development in Togo and no evidence of causality between them in the Gambia and Mali. In particular, when evaluating the causal relationship between overall maternal mortality and sustainable development, causality in the chosen nations ranges from maternal mortality to sustainable development.

Accordingly, the study recommends that achieving the SDGs target of a global MMR of less than 70 maternal deaths per 100,000 live births by 2030 will require from the government of West African countries to increase funding for research, programs and policies on maternal health at the global level and highly focused action in countries. In addition, childbirth complications should be expected and resolved quickly by referral with the suitable level of good-quality obstetric care. Higher-level care access also needs a powerful referral system that involves communication with referral centers and transportation to them. Provision of fundamental instruments to enhance health of employees in the community is also necessary, as well as the development of creative incentive structures to support health of employees in the community. The price of health care for pregnant females should be minimal or free.

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УТИЦАЈ СМРТНОСТИ МАЈКИ НА ОДРЖИВИ РАЗВОЈ У ОДАБРАНИМ ЗАПАДНОАФРИЧКИМ ЗЕМЉАМА

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САЖЕТАК

Преко пола милиона жена годишње умре од посљедица трудноће или компликација на порођају. Велика већина ових смртних случајева се може избјећи. Циљ ЦДГ 3.1 јесте смањити глобални омјер смртности до 2030. године на испод 70 на 100 000 рођених. Међутим, упркос бројним политикама, смртност мајки у Африци је даље неприхватљиво висока. Ова студија истражује утицај смртности мајки на одрживи развој у девет одабраних западноафричких земаља у периоду од 1990. до 2015. године. Подаци који су кориштени су прилагођене нето уштеде, смртност мајки, индекс потрошачких цијена, доходак по становнику и финансијски развој. Кориштене су економетријске методе друге генерације: зависност попречног пресјека, хомогеност нагиба, Westerlund коинтеграција, Eberhadt&Teal AMG регресија, Emirmahmutoglu&Kose Bootstrap Granger тест узрочности. Резултати потврђују сљедеће: прво, зависност од попречног пресјека и хетерогеност нагиба постоје међу западноафричким земљама. Друго, постоји дугорочна веза између смртности мајки и одрживог развоја. Треће, смртност мајки је негативно утицала на одрживи развој. Четврто, правац узрочности између смртности мајки и одрживог развоја варира између земаља. Посљедње, узрочност се креће од смртности мајки до одрживог развоја када се анализира узрочна веза у свим земљама. Резултати сугеришу да владе западне Африке морају да обезбиједе више финансија за здравствени сектор и да се трудницама обезбиједи приступ бесплатним здравственим услугама или по ниским цијенама уз квалитетне и ефикасне здравствене услуге уколико земље желе да постигну одрживи развој до 2030. године.

Кључне ријечи:
смртност мајки, одрживи развој, зависност од попречног пресјека, западна Африка, жене.