The Effects of Public Health Spending on Maternal Mortality in Nigeria

Christopher E. Nwankwo

Social Sciences Unit, School of General Studies, University of Nigeria Nsukka. Enugu State Nigeria

Abstract
This study attempts to examine the effects of public health spending on maternal mortality in Nigeria. It is informed by the escalating nature of maternal mortality outcomes in Nigeria. A panel data regression analysis was employed from the years 2003 to 2015 from selected 25 States in Nigeria. The study adopted instrumental variables strategy as a solution for possible endogeneity for its econometric analysis. After controlling for other relevant covariates like female per capita income, female literacy rate, and urbanization, we realized that public health expenditure is a vital factor in reducing incidences of maternal mortality in Nigeria.
Keywords: Maternal Mortality, Public Health Spending, Nigeria, Health Expenditure
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SECTION 1
1.1 Introduction

Maternal mortality is "death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes" (WHO 2010) and some pregnancy related crisis according to Katerini T. Storeng et al (2012) end in a "near miss," a situation in which a woman survives a crisis but would have died without urgent medical intervention and may have an unresolved illness or injury. Nwosu et al (2009) in highlighting the global incidence of maternal mortality opined that an estimated 500,000 women die each year throughout the world from complications of pregnancy and childbirth. They went further to assert that about 55,000 of these deaths occur in Nigeria; and Nigeria, with only 2% of the world's population, accounts for over 10% of the world's maternal deaths. In 2003, the WHO and Federal Ministry of Health (FMoH), Nigeria reported that about 145 women die every day in Nigeria as a result of causes related to childbirth. They asserted further that the risk of a woman dying from childbirth is 1 in 18 in Nigeria compared to 1 in 61 for all developing countries, and 1 in 29,800 in Sweden. Freedman (2003) warned that aside more than half a million women dying each year from complications in pregnancy or childbirth, for each death, another 30 to 50 women suffer short or long-term disability due to some complications. Complications of pregnancy and child-birth experts note, are the leading causes of disability and death in women between the ages of 15 and 49 in developing countries aside AIDS, hunger, disease, or war.

While these numbers alone are disturbing, the most startling fact of all is that the principal causes of these deaths are known, and are either preventable or treatable. WHO (2004) maintained that approximately 75 percent of all obstetric deaths result from just five causes: hemorrhage, hypertensive diseases, unsafe abortion, infection and obstructed labour. The second fact is that treatment can save lives: most serious obstetric complications cannot be predicted or prevented but they can all be treated, and it is a known fact that access to emergency obstetric care (EMOC) provided by skilled individuals is critical to saving lives. The World Bank estimates that full use of existing interventions, especially comprehensive emergency obstetric care, would reduce maternal deaths by nearly 75 percent. Together, these facts mean that the vast majority of maternal deaths are unnecessary. We know how to prevent them but we are not doing that (WHO, 2004).

Public Health System in Developing Countries each year realized that an estimated 60 million women in developing countries give birth without the support of skilled birth attendant, a marked contrast to the developed world where skilled care is virtually universal. The reasons for this deficit are many. At the health system level, developing countries face a shortage of skilled attendants, particularly in rural areas, and health workers often lack the skills needed to save lives in cases of serious complications. In addition, many health care facilities do not have the equipment and supplies needed to provide crucial services. Other factors include long distances between populations and health services, and the fact that many poor women are unable to pay the cost of transport, service fees, drugs, or supplies. At a societal level, women often lack empowerment within the family to make decisions, or hesitate to utilize the services because of social and cultural norms (WHO, 2004).

It may not be a surprise from the foregoing that WHO (2000) ranked the performance of Nigeria's health-care system 187th among 191 United Nations member States in the year 2000, and presently Nigeria still occupies this ignoble position. The fact that Nigeria is ranked second to India in the World and first in Africa as the country with highest maternal mortality ratio prior to the year 2000 MDGs is a confirmation that her health care system is in a shambles. Again, her inability to meet the MDG[4] by 2015 lays credence to the shambolic state of her health system even though she is currently ranked 4th in the world according to CIA Fact book (2018) and India ranked

who previously was ranked 1st is currently 53rd. India's improvement according to CIA Fact book report shows the significant improvement of her health system and an indication that efficient public health spending is a sine qua non for addressing the scourge of maternal mortality

The war against the scourge of maternal mortality was one of the critical issues that took the forefront burner at the Beijing Conference held at the instance of women activists from across the globe in 1995. Other issues considered at the conference were the need to address escalating household poverty, ensure economic empowerment, improve on women's health-care status, promote girl-child education and uphold their human rights. Five years after the Beijing conference, precisely at the Millennium Summit in 2000, maternal mortality yet was a subject of discourse depicting its magnitude and the need for nations to abate it by year 2015. Sustainable Development Goal 3 (Good health and well-being) according to United Nations (2017-http://www.un.org/sustainabledevelopment/health) noted that maternal mortality ratio – the proportion of mothers that do not survive childbirth compared to those who do – in developing regions is still 14 times higher than in the developed regions which questions the effectiveness and efficiency of her health sector.

The effectiveness and efficiency of health system of any country determine her health outcomes. The neglect of the health sector had caused many developing countries like Nigeria to fall far short of the standard set by the WHO on the issue of Safe Motherhood. The dismal state of health sector in the country- particularly primary health-care - contributes to these adverse health outcomes like maternal health. Nigeria Federal Ministry of Health (2004) document acknowledged that "the health system in Nigeria and the health status of Nigerians are in a deplorable state", and noted numerous problems including, low motivation for professional health workers, an annual budget preparation process which the report calls a 'ritual', a culture of corruption, and little consultation between the Federal and State health authorities and between the Federal Ministry of Health and other ministries. A study edited by Nwosu et al (2009) affirms mal-administrative nature of health care in Nigeria. Affirming this mal-administration, former Minister of Health Professor Babatunde Osotimehin, lamented that "our competence as health-care professionals are not in question. What is in question is the ability to administer the country better than the ways we are administering it now. How did we end up in a situation where we spend about 70-80% of the resources available for health care on less than 5-10% of the population?" This question therefore necessitated examining the effectiveness of public health spending in Nigeria vis –a vis its role in reducing the menace of maternal mortality using secondary data from Nigerian States.

Evidence abound that Nigeria budgetary allocation on health from the onset has been on the increasing trend though the trend is not stable. Yet, in spite of this increasing trend both at the federal, state and local government levels, maternal deaths continue to escalate. One wonders whether there were adequate project appraisal on health sector before the budgetary allocation to the sector or simply an affirmation/ confirmation of what the FMoH Document (2004) refers to as a ritual, a culture of corruption and little consultation between the Federal and State health authorities and between the Federal ministry of Health and other ministries. Ambassador Chiedu Osakwe succinctly asserted at an interview granted to Channel Television in 2016 that Nigeria's budget is based on speculations not on reality. In 2003 and 2007 for instance, the national health spending was N39, 685.5billion and N122, 400billion respectively (Central Bank of Nigeria, 2007). In the same years, maternal mortality ratio at the national level stood at 980 and 900 ratios per 100,000 live births, respectively. Total health expenditures (THE) on the other hand were estimated at N661.662 billion in 2003. It grew nominally by 18% to N788.72 billion in 2004 and to N976.69 billion in 2005

Total health expenditure as a proportion of GDP was estimated as 12.25% in 2003 and rose to 18.56% in 2005. Federal government health expenditure was estimated as N47.02billion in 2003, and grew nominally by 145% to 115.06billion in 2004 and 14% [to 130.76billion] in 2005. The corresponding estimate of health expenditure in the States was N48.02billion in 2003. This grew by 19% [N56.96billion] in 2004 and 38% [N78.78billion] in 2005. Estimated health expenditure by LGAs was N28.63billion rising by 26% [N36.18billion] in 2004 and by 23% [N44.64billion] in 2005. Specifically, States like Edo, Kaduna and Kano's respective health spending in 2003 were N21.02 billion, N26.55 billion and N26.78 billion respectively (National Health Accounts,2003-2005) while their respective maternal mortality ratio stood at 675, 1300 and 1000 per 100,000 live births respectively. Apart from Individual States health expenditure, Federal government has spent a total of N1652.65 billion from 2012 to 2017 according Budget office report.
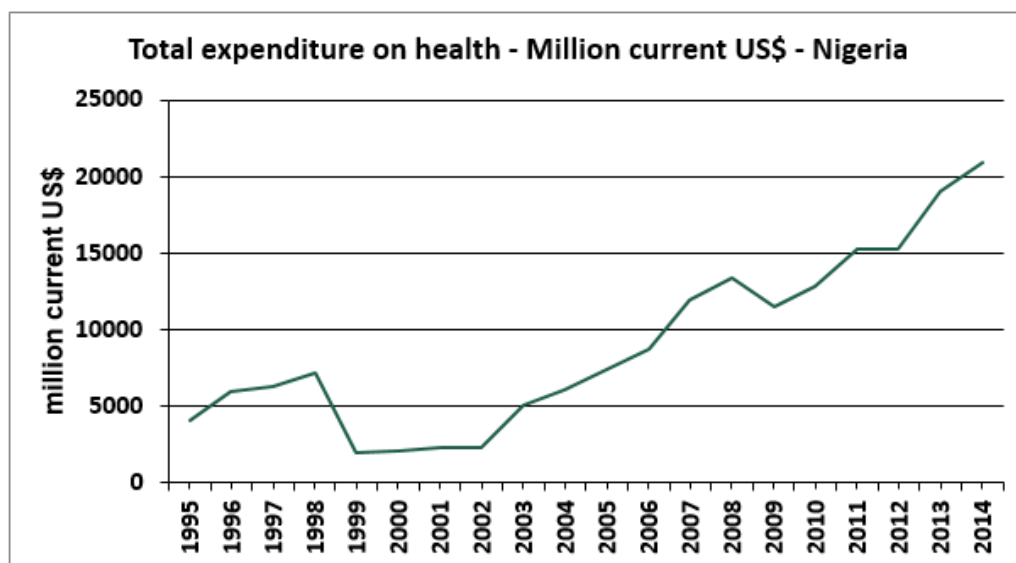
Fig.1   Trend in Nigeria health Expenditure 1995-2014

Source: Source: National health Accounts 1995-2014. (www.knoema.com)

The overall rise in government expenditures and increasing trend of public health expenditures as mentioned above unfortunately have not translated to meaningful growth and development in the health sector as expected as witnessed by negative health outcomes like maternal mortality. What then is the criteria and rationality behind monetary allocation to the health sector? What are the efficiency criteria of health budgetary allocation? The research findings will ascertain the effectiveness of health spending and its impact on curbing maternal mortality in particular among all the health outcomes in Nigeria.

Section Two: Literature Review

Section 2: Literature Review
2.1 Public Health Spending on Maternal Mortality

 The advent of welfare economics expanded the role of the state in the area of infrastructural provision and the theory of public expenditure which is attracting increasing attention. As economy grows, demand for goods and services grows, and individuals left alone cannot efficiently provide these goods and services, hence the state intervention in its provision. Piana (2001) classified public expenditures into three. First, the kind of goods and services bought. Secondly, the official body and organization from macro-function at which it is directed namely, justice and public order infrastructure, military system, education system, environmental protection, health care, support for the poor, the old, and the disadvantaged; support for firms, export polices for rural and urban areas; and special policy expenditures. Thirdly, as economy grows, demand for goods and services grows and individuals left alone cannot efficiently provide these goods and services, hence the state intervention in its provision. It is in this third classification of public expenditures that health, which is our area of concentration falls, and our analysis will be based on its perspective.

Conceptually, a healthy person cannot only work more effectively and efficiently but also devote more time to productive activities. Research at the macro level can better capture the potential externalities of health sector interventions and the existing studies are supportive of the positive contribution of health capital to growth. Bloom and Canning (2003), Bloom and Canning (2004), and Gyimah-Brampong and Wilson (2004) found out that health capital indicators positively influence aggregate output. They found that about 22 to 30 percent of growth rate is attributed to health capital, and improvements in health conditions equivalent to one more year of life expectancy are associated with higher GDP growth of up to 4% per year. One may wonder the contributions and relatedness of maternal health to these positive influences of health outcome to aggregate output. Maternal health cannot be ignored because mothers contribute significantly to the quality and quantity of labour force. Maternal mortality rates, according to (Roberts, 2003), are perhaps a better indicator of the effectiveness of a health system, but they are not measured so accurately and are slow to change. A healthy mother begets a healthy child and if mothers are not properly handled with care before and after pregnancy, they will end up begetting unhealthy children who in the long run affect both the quality and quantity of labour force. The Igbo people of Nigeria in their adage opined that "whatever a snake begets must always be elongated". This Igbo adage supports the popular saying that 'nemo dat quod non habet (Nobody gives what he has not). So a healthy/unhealthy mother will always beget healthy/unhealthy children. On another note, mothers are stratum of labour force and if mothers die as a result of pregnancy-related problems, unarguably, it will reduce not only the quantity but also the quality of labour force,

and this will impact negatively on the aggregate output of an economy.

Early studies on the impact of health expenditure on health outcomes discovered that there is either evidence or no evidence of impact of total spending on health outcomes. In some developed countries like the United States who spent five times more on health than Republic of Korea yet achieves similar health outcome. Despite the fact that the United States spent five times more than Republic of Korea and both countries achieved similar health results, yet the United States was neither discouraged nor dissuaded from spending more on health care because of her belief in its long-run effect. Maruthapu, KY Ng, Williams, Atun, Agrawal and Zeltner (2016) found that reductions in government healthcare spending are associated with increased maternal mortality rates in the EU which occur through a variety of mechanisms such as reductions in the number of births attended by skilled health professionals. They also discovered that policies aimed at reducing government healthcare spending, such as the implementation of austerity measures and budgetary cuts, may worsen maternal mortality in the EU. These findings from Maruthapu et al (2016) may be worse in developing countries and should be a catastrophe in underdeveloped countries.

The findings in literature that health spending has no impact on some health outcomes have not dissuaded those countries involved from health care spending. Musgrove (1996) for instance found no evidence of effect total health spending has on child mortality which is a health outcome closely related to maternal mortality. Filmer and Pritchett (1997) presented empirical evidence that suggest that public spending on health is not the dominant driver of child mortality outcomes. Income, income inequality, female education and cultural factors such as the degree of ethno-linguistic fractionalization, explain practically all of the variations in child/maternal mortality across countries. Filmer and Pritchett (1999) again found that government health expenditures account for less than one-seventh of one percent variation in under-five mortality across countries. Although the result was not statistically significant, yet countries like the United States, France, and Germany have continued to increase their health expenditures and canvass for strong health care policies. Burnside and Dollar (1998) found no significant relationship between health expenditure and the change in infant mortality in low-income countries.

On the other hand, Wagstaff and Cleason (2001) using a model similar to Filmer & Pitchett (1977,1999), discovered that good policies and institution (as measured by the World Bank's Country Policy and Institutional Assessment or CIPA index) are important determinants of the impact of government health expenditures on health outcome. In particular, as the quality of polices and institutions improve, the impact of government health expenditures on maternal mortality, under-weight children, under-five and tuberculosis mortality also increased and is statistically significant. The foregoing findings support the popular saying that life is bigger than logic and therefore any investment for life-saving purpose should not be judged by its contributory effect. This is because there are some other researchers who discovered a bi-directional relationship between health outcomes and public spending on health. They found out that public health spending has negative effect on health outcome and health outcomes like maternal mortality have negative effect on GDP.

The works of Kirigia, Oluwole, Mwabu, Gatwiri and Kainuyu (2005) for instance discovered that maternal mortality has significant negative effect on the gross domestic product (GDP) in the WHO African region. Their reasons are based; firstly on the premise that maternal deaths could reduce the quantity and quality of labour force, and hence the number of people involved in output production. Secondly, mothers play a vital role in nursing sick household members back to their normal health status, thus the death of a mother spells the loss of a strategic household care-giver or nurse. Thus, when the mother dies, the father (or some other person) is forced to reallocate time to provide care to the bereaved children. This constitutes a loss of economically productive time. Thirdly, mothers not only care for the children and spouses but also for the elderly. This is particularly important in Africa since homes for the elderly are almost non-existent, and also it is not cultural to commit them to important role as family and community life counselors, arbitrators of conflicts in relationships (e.g. marriage), and transmitters of indigenous 'tacit' knowledge and values to the youth. Unfortunately, maternal mortality severs the life time for the elderly leading in turn to their premature mortality and hence, loss of intra and intergenerational social value hitherto added by the elderly. Fourthly, there are high funeral related costs, which at times may force households to sell some of the output producing assets (e.g. land, farm machinery and equipment) to pay for funerals. In African economies characterized by low capital-labour ratios, depletion of assets spontaneously erodes household production. Fifth, maternal mortality has an adverse effect on future human capital creation process on the quality of labour force and hence future levels of GDP. This can be attributed to a number of factors: (i) Given that mothers play prominent roles in the production of household food, their death is likely to have negative effect on the nutritional status of the children, and hence, their physical and cognitive development. (ii) In many African communities, mothers play critical roles in nurturing, socializing and educating children, thus, when a mother dies, a teacher dies; (iii) the children of maternal mortality victims may be forced to leave school early to perform their duties hitherto performed by their bereaved mothers thus weakening their future economic prospects.

(iv.) There is growing epidemiological evidence that maternal deaths frequently lead to infant deaths which in turn reduces the size of future labour force. Lastly, premature mortality of mothers who are in active labour force may lead to a reduction in total household consumption expenditure, government tax revenues, private

business and personal savings and hence the resources available for investment. All the above factors combined only serves to stifle growth in GDP (Kirigon et al 2005). Ilboudo et al (2015) affirm that Women and their households may experience adverse effects for years following a pregnancy-related crisis. Maternal illness or injury may interfere with the social, emotional, physical, and financial well-being of women and their families. Maternal illness also contributes to lost work productivity and expenditures that disrupt household economics. Even a small expenditure on health care may force an already impoverished household to reduce food consumption, drain savings, borrow money, or sell assets—all potential contributions to further impoverishment. A maternal death can have an even greater impact due to the loss of a caregiver and/or income earner. Thus, maternal health is central to the well-being of women, families, and communities.

Burnside and Dollar (1998) found no significant relationship between health expenditure spending and change in health outcomes like infant mortality in low-income countries. The World Bank (2004) too, in her report on health expenditure and health outcome (infant mortality) using a panel data for Indian states, found no effect of health expenditure on mortality rates once state fixed effects and a linear trend are included in the model.

On the contrary, Gupta et al (1999) using data for fifty developing and transition countries, observed that health expenditure reduces mortality rates. Cremieux (1999) and Kee (2001), using a pooled generalized least square estimation procedure, examined the relationship between health indicators and total (public and private) per capita spending on health. They regressed indicators of population health status on a number of variables including real per capita public health expenditure using instrumental variables estimation to control for possible simultaneity between health status and public spending on health. They found a statistically significant relationship on health status and both health spending and per capita income. Anyanwu and Erhijakpor (2004), in examining the relationship between health expenditure and health outcomes in Africa, used Robust ordinary least square (ROLS) method of estimation. In their findings, they realized that health expenditures are statistically significant. The relationship between them is inverse. An increase in health expenditure will result in corresponding reduction in health outcome ceteris paribus. A study of eighty-one countries covering mainly low income and middle income countries conducted by Gottret and Scieder (2006) find that an increase in government health expenditure has a larger impact in reducing under-five mortality and maternal mortality than an increase in education, roads and sanitation. This research is informed and based on the fact that scholars have theorized on the effect of government role on socio-economic development both in developed and developing countries. Abu and Abdullahi (2010) and Cooray (2004) discovered that government function of provision of socio-economic goods like defense, roads, education, health and physical infrastructures encourage economic growth. They argued that government expenditure on health and education raise the productivity of labour force and increase the growth of national output. It is based on the foregoing that serious examination of the relationship between maternal mortality and public health expenditures in Nigeria is necessary. The research finding will enable us proffer recommendations on how to utilize public health spending in reducing maternal mortality in Nigeria which is part of SDG$_3$ to achieve good health and well-being by 2030.

These research findings of differences in health outcomes given health differences in spending, call for investigation especially in Nigerian to find out the effect public health spending have on maternal mortality which is a more worrisome health outcome . The main objective of the study is to determine the effect health expenditures has on maternal mortality. Effectiveness is one yardstick for evaluating performance in monetary and fiscal policies. This is because the budget is indisputably a key government tool for the implementation of social, political and economic policies and priorities. Investigating if both female per capita health expenditure and state per capita health expenditure have any effect on maternal mortality ratio in Nigeria will be ascertained also. This investigation will attempt to answer questions like; (i) will Public Health Expenditure have any effect on maternal mortality in Nigeria? (ii) Will both female per capita and State per capita health expenditures have any effect on maternal mortality in Nigeria?

The guiding hypotheses for this work are;

    (i)   State health expenditure (SHE) has no significant effect on maternal mortality ratio in Nigeria.

    (ii)   Female per capita income (FPCI), Female Literacy Rate (FLR) and Skilled Birth Attendants (SBA) do not have any effect on maternal mortality in Nigeria.

SECTION 3: METHODOLOGY

3.1 Materials, Variables and Methods

Explaining the relationship between the model variables is important as it will help us understand clearly why these variables are chosen for the analysis. In accordance with the literature reviewed earlier, State health expenditure as an indicator of the volume of resources flowing into State's health is expected to have a negative effect on maternal mortality. Thus, an increase in State health expenditure both in absolute and per capita terms implies a broader access to health care services which helps to decrease maternal mortality. Given the redistributive influence of public intervention, a positive correlation between public financing and maternal mortality is expected. Female per capita income, a proxy for national poverty and socio-economic status of women on the other hand,

has been shown to be a crucial determinant of human capital outcomes (Roberts, 2003). Thus, Gupta et al (1999) had stated that the populations' health status improves as per capita incomes rise, suggesting that increasing income would be associated with lower maternal mortality and other health outcomes. In addition, higher incomes per capita lead to improved public health infrastructure, such as water and sanitation, better housing and the ability to pay for health care like maternal health (Cutler et al, 2006). Basic economic theory suggests that if everything is held constant and if health care is a normal good, an increase in per capita income will lead to increase in the demand for health care. The above assertion therefore means that increase in female per capita income (FPCI) will lead to increase in state per capita health expenditure and female per capita health expenditure which will also have significant effect in reducing maternal mortality. Income also increases the capacity of governments and other players to supply more and better health care and to improve access to health care through better infrastructure. , Female Literacy Rate is the proportion of women aged 15 years and above who can read, write and carry out simple arithmetic calculations. This feature implies pregnant women's ability to adhere to health instructions and is considered a major variable for the research. Also, as Ricci and Zachariadis (2006) noted, as the number of physicians – (skilled birth attendants -doctors, nurses and midwives per 100,000 populations) improves, they are expected to lower not only maternal deaths but also other related health outcomes. Urbanization on other hand is meant to capture the relative difference in the availability of health infrastructure – like hospitals, primary health centres, doctors, nurses - between rural and urban areas. State's tax revenue and non-tax revenue was used for two fiscal variables as instruments for public health expenditure .The nature of these chosen variables suggest presence of simultaneity which will be addressed to avoid spurious and unreliable results.

Simultaneity bias has been identified as one of the reasons for weak results of the effect of public health expenditure on maternal mortality and other related health outcomes in a panel data analysis. The OLS estimate of the effect of public health expenditure on maternal mortality will be biased if the bi-directional causality between the two variables holds. The major contribution of this paper is to address this possible problem of endogeneity using instrumental variables strategy. We will be identifying the causal effect of public health spending on maternal mortality in Nigeria using data from 25 Nigerian States and making generalizations based on our findings. The selected States represent areas where the maternal mortality are more pronounced relatively to other States. We are also interested in investigating whether the effect of public health expenditure on MMR can be interpreted as a causal effect. We use two types of instrumental variables for public health expenditure namely; fiscal variables (State's tax and non-tax revenue) and political variables (the effective number of parties in a state government). We included a full set of controls that have been highlighted as important determinants of MMR in existing studies: female literacy (Subbarao and Raney, 1995; Caldwell, 1986, 1990; Anand and Barnighausen, 2004), female per capita income (Pritchett and Summers, 1996), urbanization (NIMS et al.2012), and state and year fixed effects.

3.2 THE EMPIRICAL MODEL

There are many other covariates that could be correlated with both public health expenditure and MMR. To account for the possible effect of many such determinants of MMR, we can use the following structural relationship:

$$Y_{irt} = Z_{it}\alpha_1 + X'_{it}\beta_1 + \mu_i + \delta_t + \sum_r \eta_r t + \varepsilon_1 it \text{--}(1)$$

where i= 1,2, . . . n indexes states, t= 1,2, . . . T indexes years (so that we have a total of N= n×T observations), Y_{irt} denotes average maternal mortality rate, Z_{it} denotes State health expenditure, x'_{it} is a ((k−1)×1) vector of controls that include the female literacy rate (FLR), female per capita income (FPCI), skilled birth attendants (SBA), and urbanization rate, μ_i denotes a state-level fixed effect, δ_t is a year fixed effect, and $\sum_r \eta_r t$ are regional time trends.

The set of controls correspond to important determinants of the MMR that have been highlighted by existing studies. Most studies find female literacy rate to be important because standard public health interventions that can reduce MMR are enhanced by the ability of the mother to read and follow basic instructions. FPCI is an important determinant because it acts as a proxy for the level of female private expenditure that can complement public expenditure in improving health status. Urbanization is meant to capture the relative difference in the availability of health infrastructure – like hospitals, primary health centres, doctors, nurses – between rural and urban areas. Finally, state fixed effects control for unobserved state-level factors (like cultural norms) that change slowly over time, and time fixed effects control for factors that impact all States over time (like technological change).

3.3 Identification through Instrumental Variables

We will use instrumental variables estimation strategy to deal with the possible problem of endogeneity of public health expenditure using two different types of instruments for public expenditure on health care namely; fiscal variables, and political variables.

3.3.1 Fiscal Instrument variables

State's tax revenue and non-tax revenue was used for two fiscal variables as instruments for public health expenditure. In Nigeria, total revenue of a state is the sum of tax and non-tax revenue. The tax revenue, in turn, is the sum of tax revenue (tax revenue collected by the state government. Similarly, the non-tax revenue is the sum of non-tax revenue and grants from the State government. Thus, the sum of a State's tax and non-tax revenue can be used to capture the "*fiscal space*" of a state. The larger the tax and non-tax revenue a state can collect, the easier it will be for the state to finance public health expenditure.

3.3.2 Political Instrument variables

Index of the effective number of parties in the government is the political variable that we use as an instrument. For State level assembly election years, the index of the effective number of parties in any State government is computed as

$$N = \frac{1}{\sum_{i=1}^{n} p_i^2}$$

Where; N is the effective number of parties in a state government, i= 1, 2, ... n indexes parties in the State government, and P_i is the share of party i in the government. The value of the index remains unchanged until the next election year, when a new government is formed and a new configuration of parties emerge as the governing coalition. N measures the amount of "hyper-fractionalization" of political power in the State government, a process that is accentuated by the growth to prominence of coalition governments over the last two decades. If a single party forms a government, the value of N is unity, and as the number of parties increase, the value of N increases. The effective number of parties in power can have contradictory effects on public health expenditure. On the one hand, higher fractionalization can reflect higher political competition and lead to higher expenditure by governments on health care. For instance, higher competition among political parties might mean that parties which increase public expenditure on healthcare, education, nutrition, etc., increase their chances of getting re-elected. Thus, higher fractionalization might be associated with higher public expenditure on health care. On the other hand, it might also lead to higher rent-seeking behaviour, and militate against expenditures that are in the long term benefit to the populace. For instance, coalition governments with a higher number of parties in the ruling coalition make the coalition unstable and increase the probability of dissolution of the government before the end of the full 4 year term. This increases the incentive for each party in the coalition to make expenditure that cater to their narrow support bases, rather than undertake expenditure that would have long term benefits for the population. Thus, depending on the strength of these opposite effects, fractionalization might have a positive or negative effect on public health expenditure. We will discuss possible concerns about the instrumental variables when we discuss robustness checks of our main results.

3.4 Simultaneity Bias

To fix ideas, let us posit the bi-directional causality in terms of two structural relationships. The first is a re-written version of equation (1), and captures the causal effect of public health expenditure (z) on MMR (y),

$$y_{it=} z_{it} a_1 + u'_{it}\beta_1 + \varepsilon_1 it \text{ -----------------------------------(2)}$$

and the second captures the causal relationship running the opposite direction from MMR(y) to public health expenditure (z)

$$z_{it} = y_{it}\alpha_2 + v'_{it}\beta2 + \varepsilon_{2,it,} \text{--(3)}$$

where i= 1,2, . . . n indexes states, t= 1,2, . . . T indexes years, u'_{it} = (1, $v_{1,it}$, $u_{2,it}$, . . . , $u_{k-1,it,}$) and v'_{it}= (1,$v_{1,it}$, $v_{2,it}$, . . . , $v_{k-1,it,}$) are k-vectors of strictly exogenous variables (including a constant),β_1,β_2 are vectors of parameters, and $\varepsilon_{1,it}$, $\varepsilon_{2,it}$ are structural errors with

$$\begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2,t} \end{pmatrix} \sim \begin{pmatrix} \sigma_1^2 & 0 \\ 0 & \sigma_1^2 \end{pmatrix}.$$

Basic economic theory and intuition suggests that the partial effect of public health expenditure on MMR will be negative so that $\alpha1 < 0$; similarly, the partial effect of MMR on public health expenditure is likely to be positive, so that $\alpha2 > 0$. These will be crucial for our subsequent analysis and so we re-write them as

Assumption 1

For the models in (2) and (3), the key parameters have $\alpha_1 < 0$, $\alpha_2 > 0$.

We can re-write the structural relationships given by (2) and (3) as

$$\begin{bmatrix} 1 & -1\alpha \\ -2\alpha & 1 \end{bmatrix} = \begin{bmatrix} y_{it} \\ z_{it} \end{bmatrix} = \begin{bmatrix} u'_{it}\beta_1 + \varepsilon_{1,}it \\ v'_{it}\beta_2 + \varepsilon_{2,}it \end{bmatrix}$$

As long as the matrix on the left is non-singular, which is guaranteed by *Assumption 1*($\alpha1\alpha2 \neq 1$), we can get the

following reduced form equations
$$\begin{bmatrix} y_{it} \\ z_{it} \end{bmatrix} = \begin{bmatrix} 1 & -1\alpha \\ -2\alpha & 1 \end{bmatrix} - 1 \begin{bmatrix} u'_{it}\,\beta_1 + \varepsilon_{1,it} \\ v'_{it}\,\beta_2 + \varepsilon_{2,it} \end{bmatrix}$$

This gives us the following reduced form equation for public health expenditure,

$$Z_{it} = \left(\frac{\alpha_2}{1-a_1a_2}\right) u'_{it}\,\beta_{1+} \left(\frac{1}{1-a_1a_2}\right) v'_{it}\,\beta2_+ \left(\frac{\alpha_2}{1-a_1a_2}\right) \varepsilon_{1,it} + \left(\frac{1}{1-a_1a_2}\right) \varepsilon_{2,it}$$ showing that

$$E(z_{it}\varepsilon_{1,it}) = \left(\frac{a_2}{1-a_1a_2}\right)^{\sigma_1^2}$$ ------------------------------(4) because u'_{it} and v'_{it} are vectors of strictly exogenous variables, $\varepsilon_{1,it}$ and $\varepsilon_{2,it}$ are uncorrelated (because they are zero mean, structural errors), and we use the fact that $E(\varepsilon^2_{1,it}) = \sigma^2_1$.

Suppose one neglected paying attention to the possible bi-directional causality and estimated the parameters in (2) by OLS. This would give her biased and inconsistent parameter estimates because of equation (4).

We can go further and find the sign of the asymptotic bias in the OLS estimator of α_1. To proceed, let us replace the full set of exogenous variables in equation (2) with a constant and a linear combination of the non-constant exogenous regressors as

$$u'_{it}\beta = \beta_0 + \beta_1 x_{1,it}$$ --------------------------------------- (5)

Where

$$X_{1it} = u_{1it} + \frac{\beta_2}{\beta_1} u_{2,it} + ... + \frac{\beta_{\kappa-1}}{\beta_1} u_{k-1,it}$$ which can always be done without loss of generality by choosing the exogenous regressor with a non-zero coefficient as $\mathbf{u_1}$. Using this, we can re-write (2) as

$$y = w\beta + \varepsilon_1$$ ------------------------------------- (6)

Where W= (z 1 X$_1$), with $\mathbf{z}$ a (N×1) vector (where N= n×T) and $\mathbf{x_1}$ a (N×1) vector, and $\mathbf{\beta'} = (\alpha_1\,\beta_0\,\beta_1)$, with $\mathbf{\alpha_1}$ the scalar parameter of interest (the partial effect of public health expenditure on MMR). Our main result about the asymptotic bias in the OLS estimator of $\mathbf{\alpha_1}$ is given as

Proposition1: Let $\hat{\alpha}_1$ denote the OLS estimator of α_1 in the model in equation (2). Let V (z) > 0 denote the variance of z and r_{z,x_1} denote the correlation coefficient between z and x_1. Then, the asymptotic bias is given by

$$\operatorname*{Plim}_{N\to\infty} \hat{\alpha}_1 - \alpha_1 = \frac{1}{v(z)\{1-r^2_{z,x_1}\}} \left(\frac{\alpha_2}{1-\alpha_1a_2}\right)\sigma_1^2 \geq 0$$

Proposition 1 has an important implication. Since the expected sign of α_1 is negative, a positive bias might lead to an estimate of α_1 that is not distinguishable from zero indicating that the researcher did not address the simultaneity bias adequately. This would explain why many existing studies have reported lack of significant effect of public health expenditure on the MMR.

3.5 Empirical Results

The results of our empirical analysis are contained in Table 1. The dependent variable in the model is the maternal mortality ratio; the independent variables are State health expenditure (SHE), log of female per capita income (logFPCI), the female literacy rate (FLR), skilled birth attendant (SBA), urbanization rate, and State and Year fixed effects. The primary interest is in the partial effect of the public health expenditure on the MMR.

In the regression table, the coefficient of -5.92 for SHE means that a percentage increase in public health would reduce maternal mortality rate in Nigeria by approximately 6 deaths per 1000 live births. This is an economically meaningful and statistically significant effect and suggests that increasing SHE would have a significant effect on the reduction of maternal mortality in Nigeria.

Female literacy rate and urbanization emerge as significant and strong determinants of MMR because of their adherent to negative apriori sign especially for the female literacy rate. An increase in the female literacy rate by 10 percentage points would reduce MMR in Nigeria by 0.3, and an increase in the share of urban population by 10 percentage points would reduce MMR in Nigeria by 1.5. These results are in line with existing studies and suggest two things. First, increasing female literacy must feature as one of the important elements of any strategy to improve the health status of the population in Nigeria and maternal mortality in particular. Secondly,

urbanization improves MMR reduction, possibly through better access to basic health care facilities that are lacking in remote and rural areas especially in the northern parts of Nigeria where maternal mortality is relatively higher. Female per capita income on the other hand conforms to apriori expectation and is significant at 5% level. Increasing FPCI by 10 percent would reduce maternal mortality by approximately 4 per 1,000 live births. The coefficient of skilled birth attendant (-0.443033) indicates conformity to apriori sign even though it is statistically insignificant. Its conformity to apriori expectations indicate that it is a major factor needed in reducing maternal mortality in Nigeria.

3.6 Reduced Form and First Stage Regression
In Table 3, we reported estimates from the reduced form model – where the dependent variable (MMR) is regressed on the excluded instruments and the included regressors – and the first stage model – where the endogenous regressor (SHE) is regressed on the excluded instruments and the included regressors. The parameter estimates for the reduced form model are meaningful in magnitude and sign. The three instruments – tax revenue, non-tax revenue and political competition – have negative coefficients in the reduced form model and positive coefficients in the first stage regression (though some of these effects are imprecisely estimated). This implies that increase in revenue of States – both tax and non-tax revenues reduce MMR through increasing fiscal space. On the other hand, political competition reduces MMR by increasing S HE. This suggests that the positive effect of political competition outweighs its negative (rent seeking) effect.

3.7 Robustness Checks
The identification of the causal effect of public health expenditure on MMR rests on the validity of our instruments. To assess the validity of our instruments, we conducted standard tests and carried out several robustness checks. The standard tests relate to the strength of the regression, which we captured through the Kleibergen-Papp (Wald) F-statistic, and the over-identification test, which we captured through the J-statistic. Both statistics are reported for all specifications estimated in the Regression table. All specifications have F-statistic that are significantly larger than 10 which is the rule of thumb value for ruling out weak instrument problems with a single endogenous regressor. The p-values associated with the over-identification tests are generally larger than 0.01, suggesting that the instruments pass the exogeneity test.

SECTION 4: Conclusion and Recommendation
In this paper, we have investigated the relationship between State health expenditure (SHE) and maternal mortality Rate (MMR) using an unbalanced panel data of 25 States in Nigerian from 2003 to 2015. We have focused on the possibility of bi-directional causation between SHE and the maternal mortality rate to investigate whether the relationship can be interpreted in a causal manner. We have shown that the simultaneity bias arising from bi-directional causation is likely to be positive. This might explain why many existing studies do not find any significant negative association between public health expenditure and maternal mortality. In our empirical analysis, we addressed the issue of simultaneity causation by using instrumental variables strategy. We used State tax revenue, non-tax revenue, and the effective number of parties in a State government as instruments for public health expenditure. Our estimation results show that SHE is negatively associated with maternal mortality. Our baseline specification suggests that an increase in SHE by 1% will reduce maternal mortality rate by approximately 6 deaths per 1000 live births. This suggests that the sampled Nigerian States can reduce the high MMR by increasing health expenditure allocation provided such allocations are adequately utilized. We also find that an increase in female literacy and urbanization are associated with low maternal mortality rates as both variables help in reducing maternal deaths. We estimated several alternative specifications as robustness checks of our main findings. Since our main results hold under different specifications and for different ways of addressing possible problems of our instruments, we are reasonably confident about the robustness of our results. Increasing SHE without judiciously executing health projects will not result in any positivity on health outcome not only on maternal mortality. Women education and improvement on their income will go a long way in maternal mortality reduction in Nigeria. Last but not the least is improving the conditions of health workers so that the brain drain experienced from the medical professionals whose profession is related to maternal health in Nigeria will be reduced. This recommendation is informed by the fact that our findings suggest that skilled birth attendants reduce maternal mortality even though it is not statistically significant. Also, the complementary role of traditional birth attendants (TBA) in provision of health care in resource poor countries like Nigeria is still important because of the current inadequacy of human resource for health. In Nigeria for years to come, TBAs will remain the main providers of child deliveries in rural areas. The reduction of maternal and new-born mortality in Nigeria require rigorous efforts that should involve governments and non-governmental organizations in identifying TBAs who are known by the community to be experts.

Table 1. The Regression Results
Dependent Variable: GDP
Method: Panel GMM EGLS (Cross-section random effects)
Date: 09/22/18   Time: 15:28
Sample (adjusted): 1990 2015
Periods included: 6
Cross-sections included: 11
Total panel (balanced) observations: 66
2SLS instrument weighting matrix
Swamy and Arora estimator of component variances
Instrument specification: C GFR SBA SR HEPC GTHE GDPPC FHEPC
Constant added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-442461.7	96115.62	-4.603432	0.0730
SHE	-5.929895	13.58222	-4.513177	0.1220
LogFPCI	-3.688441	59.00340	3.437837	0.0011
FLR	-0.381692	83.86539	-4.552405	0.0000
SBA	-0.443033	2016.812	1.680174	0.0770
URBANISATION	-15.73663	97644.37	4.584691	0.0000
YEAR EFFECT	-177.6531	49.00734	-3.625031	0.13106
STATE FIXED EFFECT	5.08E-10	1.20E-10	4.247021	0.0001

Effects Specification

		S.D.	Rho
Cross-section random		0.000000	0.0000
Idiosyncratic random		915.9434	1.0000

Weighted Statistics

R-squared	-123.6819	Mean dependent var	1328.215
Adjusted R-squared	-138.7297	S.D. dependent var	1032.401
S.E. of regression	12203.74	Sum squared resid	8.64E+09
Durbin-Watson stat	0.584475	J-statistic	1.59E-13
Instrument rank	8	F-Statistic	131.2980

Unweighted Statistics

R-squared	-123.6819	Mean dependent var	1328.215
Sum squared resid	8.64E+09	Durbin-Watson stat	0.584475

The dependent variable in the regressions is the maternal mortality rate. State Health Expenditure =expenditure on medical & public health, water & sanitation, and nutrition (% of state GDP); Female Literacy =proportion of women aged 15 years and more who can read, write and carry out simple arithmetic calculations; SBA= Skilled Birth Attendants (Total number of trained birth attendants less traditional birth attendants; Urbanization = proportion of population living in urban areas. P-values (clustered by state) appear in parenthesis below estimates; *p<0.10, **p<0.05, ***p<0.01. Specification 1 is estimated by OLS. For all other specifications public health expenditure has been instrumented with tax revenue, non-tax revenue, and effective number of parties in the government. Models 1 through 6 have been estimated by 2SLS; model 7 has been estimated by LIML. The KP (F-stat) refers to the Kleibergen-Paap rk Wald statistic for weak identification; the J-stat refers to Hansen's over identification test.

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