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**Sovereign treasury solvency and financial performance management
in Nigeria**

Christopher Enyioma Alozie

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Full Length Research Paper

Sovereign treasury solvency and financial performance management in Nigeria

Christopher Enyioma Alozie

Department of Accountancy, Chukwuemeka Odumegwu Ojukwu University, Anambra State, Nigeria.

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The paper assessed sovereign treasury solvency and financial performance management in Nigeria from 1999 through 2016. The aim of this study is to determine the degree of solvency in Nigeria's sovereign treasury. Ex-post 'facto' empirical analysis is the research method employed. Financial analysis was employed with financial performance indicators; descriptive statistics, econometric evaluation processes, and combined multiple discriminant analysis with logistic regression model as techniques of analyses. Result of the measure of solvency yields "A" performance grade score and credit rating, indicating that Nigeria's sovereign treasury is solvent and in stable, holding other factors constant. The paper recommends obtaining public loans, which should be restricted to 50% of revenue or reserve financial assets as new policy measure to minimize excessive debt accumulation.

Key words: Sovereign treasury solvency, financial health index, management of financial resources, financial performance management.

INTRODUCTION

The paper assessed the degree of solvency in Nigeria's federal treasury with the view to determine its capacity in satisfying current obligations without recourse to exceptional financing and compromising growth and national development (DMO, 2014). The aim of this study is to objectively establish public financing leverage and degree of solvency in Nigeria's national treasury. Evaluation of sovereign treasury solvency is designed to establish the realistic financial health status in Nigeria's federal treasury is very necessary in the national treasury management because it provides useful information on the leverage in public financing structure, solvency and liquidity. It can also serve an early warning signal by producing symptoms or probability of imminent public

financial distress in government entity with emphasis on Nigeria's national treasury. This research was undertaken at a time when government revenues, especially revenue from crude-oil export sales dwindled and public resources are shrinking to the lowest level. Relevant authorities of Nigerian government, citizens, markets and stakeholders with commercial, economic and political interest in the Nigerian economy with concerns about the current level of shortage of public funds confronting the federal treasury and consequences within last two or three years will find this study useful too.

As background information on the issue of solvency in sovereign treasury involves measures of the relationship between public debt and financial resources base or

E-mail: krisnedum2@gmail.com.

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revenue generating capacity of a national treasury, which can be relied upon as financial shelter to cover the debt portfolio of government entity (Roubini, 2001). In other words, treasury solvency provides simplified description of public debt to available financial resources performance indicators. Contextually, it gauges the degree of relationship existing between sovereign debt stock as compared to the available financial resource assets and/or certain public infrastructure assets. Furthermore, public finance solvency considers the leveraging of debt-to-financial assets or available financial resources in the financing structure of a government entity, thus, it gauges the extent to which available resources in a given treasury is capable of sustaining fiscal operation/spending in either the short term, medium term or even in the long-run.

Financial position of a government entity can either be in a state of solvency or distress. Ncube and Vacu (2014) state that treasury solvency refers to the situation when there are adequate financial resources to meet government expenditures and other payment obligation without resorting to short term borrowing. Whereas financial distress or fiscal stress in a government entity's treasury on the extreme is a negative financial condition in which available financial resources available to government is grossly inadequate to sustain aggregate fiscal commitments. Roubini (2001) and Ncube and Vacu (2014) explained that government entity is considered financially distressed, when public revenue generated is grossly inadequate to meet aggregate government expenditures in any particular financial years.

Nigerian media reported that about 33 states out of the 36 states in Nigeria are currently owing their workforce salary arrears for six months or more presently (Federal Radio Corporation of Nigeria (FRCN), 2015). This is a clear indication of the fact that there is shortage of short term funds in the public sector of the Nigerian economy. Despite the prevailing gloomy posture, there is scarcity of empirical studies that have assessed and report on the true and reliable state of solvency position in Nigeria's sovereign treasury that stakeholders/investors in the country's public sector can use to evaluate the level of solvency decision making presently. This is subtle evidence that there could be some solvency and liquidity issues in the Nigerian general government sector.

The decline in federation account due to dwindling revenue from crude-oil export appears to inflict severe negative impact on fiscal solvency in the treasury of Nigerian government treasuries to the extent that many state governments are currently experiencing budgetary stress and illiquidity. The federal government is also facing serious financial liquidity due to the trend of steady decline in government revenues and insufficient revenue allocation from the federation account. While the sub-national units' surreptitiously look up to the federal government for bail-out funds for part-finance their essential operational expenditure requirements.

Sub-optimal internally generated revenue (IGR) of government entities including the federal treasury has exposed the inadequacies of Nigeria's public revenue generating capacity, with its adverse impact on fiscal solvency, treasury liquidity and financial performance (Okogu, 2014). In view of these developments, it is expedient to analyze and measure public finance solvency in Nigeria's sovereign treasury with the view to determine whether the federal treasury is financially distressed, or solvent. Similarly, Nigerian citizens, stakeholders and trading partners may be interested in knowing the true state of financial situation of the Nigerian federal treasury.

Statement of the problem

Many authors have conducted empirical studies that measured and reported the public finance solvency and financial health (capacity) for sovereign treasury and central public treasury of sub-governmental entities in different countries. For instance, studies by Roubini (2001), Alogosfikous (2013), Mupunga and Le-Roux (2014), Masengo (2011) for Mexico, Greece, Zimbabwe and Zambia, respectively assessed public finance solvency and sustainability in those countries. Roubini (2001) argued that high leverage in an entity often result to acute debt burden, liquidity constraint and fiscal insolvency. Reporting from Brooking Institution, Okonjo-lweala and Kwaafor (2007) confirmed that lack of accurate and proper record of public debts, debt sustainability analysis, debt management strategies and balancing of public finances-to-debt compounded Nigeria's debt problems in pre-debt relief fiscal years. Okonkwo (2014) observed that Nigerian government have reverted to debt excessive accumulation and a resurgence of excessive debts in sovereign treasury within the past three fiscal years could worsen fiscal solvency and result in inter-generational transfer of debt burden. Yet, there is no empirical studies that have attempted to measure the state of solvency in federal treasury. To the best of the authors' knowledge, empirical studies that reported financial solvency of the Nigerian federal treasury are very scarce if they exist at all. As a result, there is paucity of research papers conducted on Nigeria's federal treasury presently. Thus, a study on sovereign treasury solvency and measure financial health in Nigeria is expedient at this period that the federal treasury and many of the state's sub-treasuries are facing serious liquidity and financing plans/programmes.

The research questions that guided the process of analytical investigations aimed towards proffering solutions to the problems of measurement and determination of a true and realistic financial health position in Nigeria's federal treasury are: To what direction does public debt-to-government revenue ratio induce treasury solvency? To which direction and

dimension does external debt-to-export revenue affect solvency in federal treasury? To which direction does Nigeria's public debt-to-external reserve ratio affect external liquidity? To which direction does debt service/public revenue ratio affect financial condition in the federal treasury? To which direction does national debt /GDP ratio drive sovereign treasury solvency? And finally, what is the composite financial health index/credit worthiness rating of Nigeria's federal treasury?

The main objective of this study is to measure sovereign treasury solvency and financial performance management in Nigeria. Specific objectives are to:

- (1) Determine the extent to which the ratio of public debt-to-revenue affects treasury solvency;
- (2) Examine the direction to which external debt-to-export revenue ratio affects solvency in the federal treasury;
- (3) Determine the extent to which public debt-to-foreign reserves affect external treasury solvency;
- (4) Ascertain the degree to which the ratio of debt service/public revenue or expenditure affect solvency in the federal treasury;
- (5) Determine the extent to which national debt/gross domestic product (GDP) ratio affects solvency in Nigeria's treasury.
- (6) Establish the level of credit worthiness or treasury risk rating for Nigeria's sovereign entity.

The study is highly significant to management of sovereign treasury by analyzing, assessing and establishing a realistic level of solvency in the federal treasury. The paper provides valuable information to guide the Nigerian government on fiscal policy and in borrowing and investing decisions in order to ensure that financing needs and future repayment capacity are duly taken into consideration. The outcome of this research can be useful to the relevant authorities responsible for sovereign or sub-public treasury on reasonable limits of its public debt in carrying portfolio vis-à-vis funding options. The study also renders research-based information that can guide government on national budget financial plan estimates.

The scope of the paper is to utilize pertinent key financial performance indicators as performance metrics to measure public financial performance to determine solvency in the Nigerian national treasury for 18 financial years, starting from 1999 to 2016. Specifically, the scope of the study relates mainly to use five sets of pair-wise key financial performance indicators (KPIs) as for public debt/financial resources for measuring sovereign treasury solvency. The time frame of the study spans over a total of 16 financial years, commencing from 1999 to 2016 with the 2016 financial years as cut-off date. Adoption of the financial year 2016 as cut-off date of the research is considered appropriate because Nigeria's 2016 financial reports are the most recent and readily available public finance statistics as well as the period recession was

very visible in the economy.

REVIEW OF RELEVANT LITERATURE

Conceptual framework

Sovereign national treasury is the department of government entity statutorily responsible for managing financial resources including borrowings, fund investment and sourcing long term finance for execution of capital projects. Management of national public treasury is conventionally under the headship, coordination and supervision of a full ranking cabinet minister which in the case of Nigeria is referred as the Honourable Ministry of Finance and the Federal Ministry of Finance (FGN, 2014). In other countries like the USA, Britain, and Australia, the department responsible for managing public money is known as the department of treasury and headed by the secretary (equivalent of Minister). Under normal arrangements, there are several agencies and extra-ministerial departments that deeply involves in the management of public financial resources and economy. These include but not restricted to the office of the Accountant-General, federal board of internal revenue service, customs and exercise service, the budget office, debt management office, national central bank and the office of the auditor general or comptroller general and head-supreme national audit institution. Debt Management Office (DMO) is an organ of the Federal Ministry of Finance charge with responsibility for debt management functions in Nigeria in collaboration with the Central Bank of Nigeria. Public finance committee, budget appropriation committee and public accounts committee of the national legislature exert oversight functions on the overall management of national treasury in the Nigerian model.

Public debt management in sovereign and sub-national government treasury falls within the statutory functions of the national debt management agency; and in the Nigerian case, it is the DMO. The DMO works closely with the Central Bank of Nigeria (CBN), under direct supervision by the Federal Ministry of Finance and the Minister of Finance; who in-turn report to the Presidency (Executive Arm) on public finance and debt management policy matters. Treasury solvency, a state of sound financial health (solvency) is a necessary condition under which governments must operate. Public finance solvency and debt sustainability is a critical issue and the central thrust of liquidity and debt management policies undertaken by the finance ministry in Nigeria and many other countries with little variation. Treasury solvency often involves gauging of the public financing mix between government debt and financial resource flow/ stock base of a government entity. Solvency in public treasury relates to the measurement of the relationship between public debt portfolio and available public

financial resources and the fiscal capacity to meet public expenditures, debt service and other financial commitments of government entities as the fall due.

Public finance solvency is a financial condition in a public treasury in which available financial resources is sufficient to meet current fiscal spending commitments and debt service without resorting to borrowing and/or other exceptional financing arrangements (Roubini, 2001). Following this definition, public treasury solvency is concerned with determination of the level of solvency in a public treasury using pertinent fiscal aggregates based on certain internationally established thresholds/benchmarking. Sovereign treasury solvency is a broad, complex concept with short and long-term implication that describes the level of domestic liquidity, external treasury liquidity, the degree of debt/public finance solvency in determining financial health in a government entity in the context of its overall economic and financial environment (Padovanni, 2016).

In contrast, public financial distress or insolvency in government entity on the other extreme is the phenomenon of corporate insolvency arising from high degree of indebtedness and lack of financial capacity to meet short-to-medium term payment obligation confronting government organizations either as sovereign nation, state (provincial) or local councils as units of government. Financial distress in the context of public treasury and public financial management has been defined in Ncube and Vacu (2014) and Padovanni (2016) and understood as sustained inability of a government entity to possess enough fund required for delivery of services and other requirements in accordance with the constitutional mandate. Public financial distress in government entity is a fiscal condition where available public financial resources are generally inadequate and with far reaching implications for political, social and macroeconomic state of affairs in government entities (Trussel, 2013).

Treasury solvency is different from budgetary solvency, because budgetary solvency or distress is more appropriately related to annual fiscal operating performance when public revenue inflows fall short of aggregate recurrent expenditures (Trussel, 2013). However, sovereign treasury solvency encompasses public debt/financial resource flows and stocks ratios and in the context of this paper focuses on the trend performance in treasury solvency or insolvency indicators in national or sub-national government treasury of public debt, flow and stocks fiscal aggregates.

Assessment of treasury solvency or public finance solvency has been found very efficient and veritable financial performance management strategy in detecting corporate financial distress, predicting early warnings signal (symptoms) of fiscal distress in the treasury (Padovanni, 2016; Ncube and Vacu, 2014; Padovanni, 2016; Trussel, 2013). Sovereign financial crises can be averted through proactive corrective measures before its

occurrence or remedies to the incidence, thereby saving valuable human, physical and financial resources (Ncube and Vacu, 2014). Thus, periodic measurement of the dimension of treasury solvency helps in prevention of potential financial distress or insolvency in government treasury, which undoubtedly makes significant positive impact on the macro-economy since it acts as an early warning by preventing incidence of financial unhealthiness (Liu and Pleskovic, 2010).

Kattelus (2013) identified three broad factors that determine financial solvency or contribute to prevalence of financial distress in government treasury to include environmental factors, financial factors-capacity of government to generate sufficient cash flows and organizational factors. Sometimes grey areas exist in intergovernmental relations, especially regarding who is responsible or accountable for fiscal activities (Trussel, 2013) particularly in a federating sovereign entity. Kattelus (2013), Padovanni (2016) and Carmeli (2008) stated that environmental factors affecting solvency in sovereign treasury include population, size of government, community needs, available revenue sources, inter-governmental transfers and domestic revenue/taxing power constraints, political culture, disaster risks and external economic conditions. Kattelus (2013) further stressed that financial factor includes revenue generating capacity, aggregate public expenditure, size of government fiscal operating balances, debt portfolio, unfunded liabilities and state of public infrastructure.

Financial performance management (Key Financial Performance Indicators)

Financial performance management involves the measurement of relationship between public debt and the available public financial resources to determine the degree of solvency and otherwise in a public treasury. Management of government financial performance utilizes array of financial performance indicators as performance metrics to gauge public debt portfolio and the existing financial resources in debt management of government entities (Roubini, 2001). It serves as a medium to establish whether public debt portfolio and available public financial resources can meet debt repayment obligations without constraining other financial commitment in government entities. Treasury solvency as defined in Roubini (2001) as a measure of the relationship between the financial resources available to a government entity. There are two common types of public finance/debt financing leverage in a public treasury as it is the case in private company. Low leverage is an indication of lower insignificant debt burden whereas a high leverage is indicative of excess debt burden, higher debt expense, higher risk exposure and vulnerability to distress. Financial leverage is measured by the

proportion of debt and equity in the capital/financial structure.

Specifically, public debt-to-financial resources ratio relates liquidity, solvency or insolvency in a government treasury in this measurement of government's financial resources. It measures the direction of the effect of debt burden on the available public funds/leverage in the financial structure of government treasury, that is, on debt service, stress and solvency in public debt management. The financial performance indicators frequently employed public debt management to measure solvency in public treasury include public debt-to-financial resources ratio. This is used primarily to gauge relationship between the public debt portfolio and available public financial resources at their known contractual book values. Public debt/resource capacity ratio in this context is the equivalence of leverage in financial structure (capital and debt ratio) in the companies. Financial performance management represents the independent variables in this research. Pair-wise key financial indicators which represent the independent variables commonly utilized as criteria for evaluation of performance management of solvency in public treasury include: public debt-to-government revenue; national debt-to-foreign reserve liquid assets; foreign public debt-to-exports revenue; public debt-to-gross domestic product (GDP); debt service-to-government revenues or aggregate expenditure. The normative values of the aforementioned pair-wise variables are normally employed as predictors in a sovereign treasury solvency evaluation model which is based on the traditional accounting approach (Roubini, 2001). Thus, this approach is preferred for adoption as the measures of solvency in this study.

It is pertinent to state that high leverage ratio in the financial structure in government entity indicates that the government is relying heavily on borrowed funds in meeting recurrent spending and capital development programmes. Similarly, a high leverage trend pattern in treasury fund management is also an indication that an entity spends significant proportion of the revenue inflows on debt service payment. To buttress this fact, Masengo (2011) explained that the consequences of high debt ratio include imposition of financial constraints in meeting creditors' obligations and current expenditure commitments. High leverage in public financing structure often lead to defaults, higher debt service costs, loss of credit worthiness and confidence in the financial markets and the prevalence of financial distress similar to the corporate failure in the corporate world. A low public debt to financial resources ratio shows that the level of debt to available resources as well as debt service is on lower side; and in comfort zone of the risk of debts in a public treasury. In effect, the relationship between solvency in public treasury and financial performance management in government entity has wide-ranging impact on financial health as well as on economic growth and development.

Theory of leveraging in financing structure/sovereign treasury solvency

The foundation of public finance solvency theory is rooted in the neo-classical theory of fiscal imbalance or the inter-temporal budgetary constraints as originally conceptualized, developed and adopted by Keynes (1939). In Keynesian hypothesis of the fiscal imbalance phenomenon, Keynes (1939) argued that it is necessary for governments or government entities to adopt deficit budgeting and utilize deficit (overdraft) financing by borrowing from the public or banking system in operating expansionary expenditure fiscal regime with view of repaying later in the future. Under this Keynesian fiscal model, it is more beneficial to the society if government borrows now to pursue expansionary economic programmes and increase domestic productivity and near full employment of factors of production in the economy.

Therefore, the theoretical framework of public debt, public finance solvency and the leveraging therein in management of public treasury is anchored on the inter-temporal budgetary constraint model which arguably commences with consideration of fiscal imbalance phenomenon, which was originally conceptualized and developed by Keynes (1939), as cited and adopted in Roubini (2001) and Buiter and Urjit (2005). The theory describes the trends in government revenues, expenditures that normally lead to either budget surpluses or deficits which characterize the inter-temporal budget constraint and fiscal imbalance theory. Thus, the theory of fiscal imbalance or inter-temporal budget constraints is the foundation of every other theoretical framework and empirical modeling invented for the analysis, evaluation and measuring of public finance leverage/solvency in literature (Roubini, 2001; Buiter and Urjit, 2005).

Roubini (2001) further prescribed public finance solvency as the fundamental theoretical framework for empirical model upon which public finance solvency is anchored (historical book values of public debt). He argued that the measures of fiscal solvency and treasury liquidity rely on the traditional financial ratio analysis rather than current market value of budget deficit balances, public debts and their corresponding fiscal resource aggregates. Studies in public finance and fiscal stress have confirmed that excessive public debt if not properly utilized and managed may influence insolvency in public treasury (Buiter and Urjit, 2005; Roubini, 2001; Masengo, 2011).

Drawing some lessons from the incidence of sovereign treasury insolvency/financial crisis in Greece, Ireland and Spain for instance, excessive debt accumulation and debt overhang triggered insolvency in the treasury and also imposed transfer of inter-generational debt burden and severe financial constraint on tax payers and future generation in most of the affected economies (Kouretas and Vlamis (2011). It is evident therefore that a high

leverage in public finance is a major cause of financial distress in government entities in the same manner, inadequate revenue generation contributes to citizenship distress. Government's indulgence in the practice of deficit financing without proper policy direction, monitoring and management often resulted to excessive debt accumulation and huge debt overhang as reported in Greece by Buiter and Urijit (2005), Mupunga and Le-Roux (2014) and Okonkwo (2014).

Management of public debt function is an integral part of Nigeria's public finance and public financial management system appears to be sub-optimal at least during the period preceding debt year 2000. Okonjo-Iweala and Kwafor (2007) observed that lack of accurate and proper record of public debts, debt sustainability analysis, debt management strategies and balancing of public finances-to-debt vis-à-vis weak-based fiscal consolidation system compounded Nigeria's debt problems. Okonjo-Iweala (2011) suggested that Nigeria's federal budget was not good enough for proper growth in the economy. Annual budgetary allocation for public capital investment and infrastructure development is less than 30% of the approved total annual expenditures. Total annual actual capital spent is about an average of 15% yearly during the last decade (FGN, 2014).

Okonkwo (2014) observes that Nigeria's public debt is increasing in leaps and bounds in the recent years, before the sharp and steady decline in crude oil export revenues. Okonkwo (2014) warns that the government (FGN) to desist from the practice of excessive accumulation of public debt and there resurgence of excessive debts in sovereign treasury within the past three fiscal years could worsen fiscal solvency and result in inter-generational transfer of debt burden. Going by the current revenue generating capacity, the latest trend in debt accumulation, may lead the country into another round of debt burden, and the resultant effect of excessive public debt, debt overhang is fiscal distress. The stakeholders in the Nigerian macro-economy, financial capacity or health are now apprehensive of the challenges of the Nigerian state(s) with the worsening reduction in government revenue; the nation's public debt might reach an uncontrollable level in the nearest future which may lead to further deterioration of the federal treasury's financial condition.

Conclusively, policy makers, researchers and practitioners utilize solvency indicators as key financial performance metrics to measure and determine margin of safety on public stock and public financial resources in public debt management through measures of sovereign risks by adoption of the credit worthiness ranking of the international credit agencies (CRAs) on one hand (Fitch Ratings (Fitch), 2014). Accumulation of debt is beyond the level which the public revenue generating capacity or the foreign reserve/financial investment assets are grossly inadequate to meet debt service obligations, thus default and problem of debt overhang emerges.

Therefore, regular appraisal of government debt portfolios, assessment and measures of treasury solvency and liquidity is very essential in detection and prevention of national financial stress or emergence of full blown sovereign debt crisis (Alogosfikous, 2013).

Review of public finance solvency empirical studies

Empirical studies that analyzed, evaluated and measured public finance solvency, stress or insolvency, acute state of illiquidity and distress in national or sub-national government treasury are very scarce because few scholars have developed models that measure financial mix or leverage in financing structure government entities in the past years. Consequently, empirical evaluation studies of sovereign treasury of national governments are quite nascent. Thus, empirical studies that measured fiscal or treasury solvency in different countries were chosen and presented in this sub-section to drive home the relationship or interconnectivity between public debt, government financial resource flows-stock variables in the management of national treasury on one side and public finance solvency.

Masengo (2011) assessed government revenue with public debt solvency for Zambia as one of the public debt pruned developing countries in Africa from 1980 to 2010. The author adopted dynamic debt simulation method with econometric models that utilized annual time series of public debt and resources flows-stocks data. Results suggest that domestic debt of Zambia is sustainable with and/or without grants. This situation emerged after the cancellation of most of the nation's external debt with great relief from external debt service charges. The author expressed concerns not minding the prevailing public finance sustainability; Zambia's domestic debt might still be threatened by her over dependency on revenue from coppers as the main source of fiscal revenue.

Roubini (2001) examined the public money (financial resources base) in Ecuador to be around 1990s and up to the year 2000. Results of the study stated that if there are pure or semi-pure liquidity cases, there are alternative fiscal policy measures to mitigate such solvency problems that do not involve debt forgiveness. Mendoza and Oviedo (2003) utilized debt-to-GDP indicator in its public money and debt leverage analytical study to assess the direction and magnitude of the degree of public solvency in Mexico from 1999 to 2002. Results showed that a 4% of the GDP reduction in government total spending during fiscal crises, in a simulated model for Mexico yielded a natural debt limit at 0.05, which is slight above the observable average debt-to-GDP ratio of 0.0459 for year 1999 to 2002. The authors concluded that natural debt limit is very sensitive to small variations to changes in tax revenues, interest rate and public expenditure.

Aktas and Tiftik (2013) measured fiscal solvency and sustainability for practical use in the short-to-medium term fiscal policy decision making for Turkey. The authors employed the Vector Auto-Regressive (VAR) and Monte-Carlo simulation technique with econometric models and use annual time series of public debt and resources flows-stocks data. The study used public debt and public financial resources core indicators in measuring fiscal solvency and sustainability from 1991 to 2010. Results indicated that the fiscal stance adopted by Turkey during the reviewed periods has a sustainable outlook in short-term future. Mupunga and Le-Roux (2014)'s study examined the dynamics of public debt and financial resources stock-flow variables from 1985 to 2012. The study adopted dynamic debt simulation method with econometric models and utilized annual time series of public debt and resources flows-stocks data. Results show that debt dynamics in Zimbabwe are largely composed of huge stock flow adjustments to finance social and political expenditures. This underscores the need for prudent debt management to protect the treasury against unexpected changes in public debt stock, which are not explained by public investments and growth. Thus, the authors concluded that there is need to minimize interest rate differentials and to implement growth enhancing policies to ensure long term sustainability.

Alogoskoufis (2010) evaluated the solvency situation in Greece's national treasury vis-à-vis the sovereign debt crisis in Greece, employing simple numerical analysis and trend performance metrics based on public debts, fiscal flow and stock variables data between the fiscal years 1999 to 2000. The result of Alogoskoufis (2010) on sovereign debt crisis in Greece established that continuous deficit budgeting and deficit financing coupled with excessive accumulation of sovereign debt for about a decade contributed to the huge debt burden which to large extent contributed to treasury insolvency in Greece. The author further confirms that the proposal implemented in the Greek economy for tackling the financial crisis and speeding up the recovery process is sufficient to resolving the prevailing situation.

Limitations of the reviewed studies

The major limitations of the consulted prior empirical studies on public finance solvency in literature is premised on the fact that they were predominantly conducted within the economics discipline and lean purely on the use of interest rate of public debts and GDP growth rate, primary balances and GDP to econometrically estimate solvency. It is pertinent to stress that interest rate and rate of economic growth are not the only drivers of treasury solvency; consequently, results obtained from most of those studies were not explicit enough in remedying distress. Secondly, flowing from

paucity of research studies from accounting/finance discipline on public finance solvency; both in Nigeria and in other climes, studies that used core fiscal variables are very rare or almost non-existent.

More specifically, most of the previous empirical papers on public finance solvency and sustainability except Roubini (2001) were inherently defective because these studies did not incorporate external debt/export revenues; external debt and sovereign foreign reserve both in the development of models; data sets used in analysis and also in measurement of treasury/fiscal solvency. Fourthly, none of the existing empirical papers examined the state of sovereign treasury solvency and/or otherwise for Nigeria. This development contributed to the paucity of empirical research on Nigeria's treasury solvency which is scarce with a significant gap in the literature.

Value addition and contribution of the present study to knowledge

The present paper adds value to the empirical literature in public treasury solvency by providing empirical study on the Nigerian federal treasury in the first angle. It also established the state of solvency in Nigeria's sovereign treasury. Second, the author/the paper utilized pure financial aggregates in its model structure, analysis and in measuring solvency and included two vital pair-wise variables: external debt/export revenue ratio as well as national debt/Nigeria's foreign reserves ratios as the additional solvency indicators used in gauging solvency because external sector's treasury distress always have significant negative impact on financial planning, fiscal policy, liquidity and treasury management performance.

METHODOLOGY

Research design

Ex-post 'facto' empirical financial analysis design with quantitative method was adopted in this study to measure solvency in Nigeria's sovereign treasury. This approach follows similar method procedure adopted in Masengo (2011) and Roubini (2001) empirical papers. As an ex-post 'facto' empirical analysis research that involves quantitative approach, the study utilized secondary data obtained from the appropriate government agencies statutorily responsible for public debt management in Nigeria; the Central Bank of Nigeria (CBN) and Debt Management Office (DMO) and the Federal Ministry of Finance.

Data sources and method of collection

Data sets utilized in the study were extracted from the Debt Management Office (DMO)'s and Central Bank of Nigeria (CBN)'s annual accounts and reports/public finance statistics 1999 to 2016, respectively. Data collection procedure followed in data gathering is the archival data retrieval collection system is the procedure adopted for extraction of the necessary secondary data required in deriving fiscal variables in the models.

Empirical model of public finance solvency

The theoretical framework guiding the empirical model used in this sovereign treasury or public finance solvency measurement is the borrower (accounting-based) method, which is the lender-based approach derived from Roubini (2001) and Alogosfikous (2010). The paper adopted modified Altman and Hotchkiss (2010) Z-score financial distress prediction model (FDPM) technology as financial condition or index (FCI) to measure solvency in Nigeria's sovereign treasury. Equation model function of the modified financial condition index empirical model developed here as in Altman and Hotchkiss (2010) Z-Score model of financial distress index use a standard bench mark for measuring corporate financial distress in developing countries and emerging markets (Alfan and Zakaria, 2013; Mungai, 2016):

$$\text{FHI} = \text{Z-Score (Z)} = 0.50 X_1 + 0.50 X_2 + 0.5 X_3 + 0.50 X_4 + 0.50 (X_5)$$

where X_1 = public debt-to-revenue indicator; X_2 = public debt-to-foreign reserve indicator; X_3 = external debt-to-export revenue indicator; X_4 = debt service-to-revenue indicator; X_5 = public debt-to-GDP indicator. Therefore, to determine the cut-off point solvency or insolvency discrimination zone in public finance solvency measurement model, Z must be equal or > 0.50 which is a safe zone, whereas FHI or Z-Score of $0.40 < 0.50$ is considered as in a grey zone (under watch) while $0.25 < 0.40$ is seen as fully distress zone. Failure grade point is not applicable since this is a performance measurement metric system. Sovereign credit worthiness rating score ranges from 0.01 to 1.00; grade rating score ranging from 0.50 and 0.99 represents solvency and 0.01 to 0.49 is indicative of unsafe financial condition.

Solvency in sovereign treasury of government entity can therefore be classified as being solvent if its credit rating score ranges from 0.50 and 0.99 (Fitch Ratings (Fitch), 2014; Moody's Investors Service (Moody), 2014; Standard and Poor, 2015 a, b). A continuous achievement of composite financial condition index score of less than 0.5 for three consecutive financial years portrays the likelihood that the entity will experience acute financial distress/instability in short and medium term (Altman, 1968).

Development of sovereign treasury solvency measurement model

Model variables, composition and descriptions

The model structure of the paper covers five pair-wise variables. As it is the convention in financial distress modeling, a composite financial distress index will be developed to measure and test financial distress or solvency and sustainability for Nigeria through the respective models. The paper adopts three models of three pair-wise financial performance indicators of the development of data for analyses and hypotheses tests. Classical financial ratio analysis is used to obtain raw financial performance indicators (KPIs) adopted in a combined multiple discriminant analysis (MDA) with dynamic financial estimation and logistic regression models to obtain a composite financial health index (FHI Z-score or Y). Summary of the pair-wise financial indicators as predictor variables is shown in Table 1.

Sovereign treasury or public finance solvency index model equation functions

Hybrid empirical analytical model is employed for analysis, beginning with specification of multiple discriminant analysis (MDA) of Altman's Z-score financial distress prediction model (FDPM) commonly employed in accounting and corporate financial analysis

alongside a logistic regression model (LRM) approach. This model followed the empirical model adopted in Roubini (2001) to measure public finance (leverage) solvency in Ecuador and Altman and Kotchkiss (2010)'s Z-Score for developing countries and emerging markets; CRAs (Fitch Ratings (Fitch), 2014; Moody's Investors Service (Moody), 2014) credit worthiness performance rating score system was blended into a hybrid model and formulation of financial health index (FHI) model score-rating was hereby modified by the author in this paper.

Poor debt management practices coupled with weak financial performances normally cause unhealthy financial condition in a government treasury. Therefore, hypotheses of research formulated for developments of model in this paper are stated in null form are as follows:

Ho₁: Public debt/revenue ratio does not cause insolvency in federal treasury.

Ho₂: External debt/export revenue ration does not influence public finance insolvency.

Ho₃: Total public debt/foreign reserve ratio does not cause solvency.

Ho₄: Debt service charges/revenue ratio does not influence insolvency in the federal treasury;

Ho₅: Nigeria's total public debt/GDP ratio does not lead to insolvency the federal treasury.

Ho₆: The overall composition of Nigeria's public debt stock/financial flows aggregate does not

Econometric model equation function is expressed as follows:

$$Y = \beta_0 + \beta_1 T_1 + \beta_2 T_2 + \dots + \beta_n T_n + \epsilon \quad (1)$$

FHI model equation:

$$\text{FHI} = f(X_1, X_2, X_3, \dots, X_n) / n \quad (2)$$

Then, followed with construction of MDA/logistic regression model as:

$$\text{FHI} = (\text{in LRM (Z)} = 1 / (W_1 \times X_{1.1} + W_2 \times X_{1.2} + \dots + W_n \times X_n) - 1 / n \quad (3)$$

where FHI or (Z-Score) is composite financial condition (or health status) index and parameter used to measure the tests $W_1 \times X_{1.1} + W_2 \times X_{1.2} + \dots + W_n \times X_n$ which is equal to weighted representative values of each indicators.

Technique of analysis for the model includes: ratio analysis, derivation of financial performance indicators, descriptive statistics, financial discounting method, multivariate discriminant analysis, logistic regression analysis, equal-weighting of performance indicators, and derivation of composite financial health index for the public finance solvency analysis.

Evaluation and econometric estimation procedure

In line with the convention of ex-post 'facto' empirical analysis research design, key financial and non-financial performance indicators (ratios) extractions from annual series and or other data-sets can be employed in their natural values or evaluated prior to analyses and measure financial performances in a financial distress prediction models. This rationale for this approach is premised on the grounds that, the trend analysis value derived for each ratio does not vary with changes in time-paths. Therefore, natural trend in normal ratios analysis in trend performance analysis do not change with passage of time. In the alternative, the model variables can also be subjected to a routine data screening, estimation, refinement and evaluation processes where necessary and this hybrid approach is followed in this research.

Table 1. Performance indicators used as predictors of public finance solvency.

Category/Performance indicators	Bases of computation	Description/Measures	Ratio rating system
Public Finance Solvency (MODEL)	-	-	-
Public Financing Leverage Solvency Criteria	-	-	-
i) Debt-to-Revenue (Capacity)	Debt Stock/Revenue	Sufficiency	Ratio = 1 : 2.5
ii) Debt-to-Foreign Reserve	Debt/Foreign Reserve	Vulnerability	Ratio = 1 : 2.5
iii) Foreign Debt-to-Export	External Debt/Exports	Liquidity	Ratio = 1 : 1.5
iv) Debt Service/Revenue	Debt Service/Revenue	Affordability	Ratio = 1 : 5.0
iv) Debt-to-GDP Ratio	Debt/National Output	Productivity	Ratio = 0.56 : 1
Total: 5 Indicators			

Source: Author's Compilation (2016), World Bank (2010), and DMO (2014).

Data evaluation and estimation procedure in models involved unit root, auto-correlation or co-integration tests designed to check and eliminate the problem of auto-correlation and disturbances in the data for analysis (if any) of the model variables, and verify the stochastic properties of the annual series. Several assumptions are made to test that multivariate regression works well, ideally with unbiased and efficient estimates. The assumptions tested in this current study were linearity, homoscedasticity of error term, no autocorrelation, and error terms normally distributed, error terms having zero mean, no multi-collinearity and that these error terms with independent variables are not correlated (Gujarati, 2003; Dickey and Fuller, 1991; Geoffrey, 1988; Gujarati and Sageetha, 2008). However, it has been proved in literature on econometric estimation procedure that the ADF has low prediction power, and Phillips-Peron (P-P) yield superior test results (Jibao et al., 2007; Gujarati and Sageetha, 2008). After confirmation of stationarity or existence of non-stationarity in the time series data and after completion of due process for co-integration, then a co-integrating regressions are obtained from the normalized coefficients of the model generated from a co-integrating vector.

Operationalization of public FHI measurements

The score grading system of the international credit rating agencies used by Standard and Poor (2014), Fitch Ratings (Fitch), (2014) and Moody's Investors Service (Moody) (2014), which is similar to the grade score point system currently adopted in the academia is adopted in operationalizing raw financial solvency indicators derived to determine the ultimate financial condition index of the model. Values of financial distress index of a predictor in each models one, four and five, range from 0.01 to 0.99 (Ritonga, 2014); "A" = Excellent, "B" = Very Good, "C" = Average, "D" = Fair but below average, and "E" = Weak. The values from 1-49 in these first category models signify financial distress while 50 and above is an indication of positive financial performance, solvency and sustainability (Roubini, 2001). There is no outright failure grade in sovereign credit rating system.

The decision rules adopted in hypothesis testing as criterion for acceptance and the rejection is that: when the calculated FHI falls within the range of 0.01 to 0.49 and less than 0.50 (50%); then, we accepts H_0 , but if otherwise, that is, where the calculated FHI ranges from 0.50 to 0.99 (precisely 99%), H_{a3} is accepted and H_{o3} is rejected.

DATA ANALYSIS AND RESULTS

Data sets were used to analyze the results of the tests

and measure the solvency.

Screening and evaluation of the pair-wise model variables

The necessary screening tests were undertaken to ensure that data sets used in analysing and measuring of solvency model are from spurious defect and that they are not serially correlated. Augmented Dickey Fuller (ADF) and Breusch-Godfrey serial correlation test were performed to check for unit root and existence of co-integration in long-run relationship between the pair-wise variables notably public debt/revenue, public debt/foreign reserves, external debt/exports, debt service/revenue and public debt/GDP. Unit root test showed negative results, whilst Breusch-Godfrey co-integration tests for partial regression of revenue (Model 1.1, 1.2, 1.3, 1.4 and 1.5) tested positive to co-integration at that level. Thereafter, the affected variables treated and normalized at 1 (1) first difference. Furthermore, Trace statistics indicated no co-integration at 5% significance level. Wald and Dublin-Watson test all yielded values below minimum threshold of 2.4. Generally, results of these diagnosis checks and evaluation procedures undertaken established that the relevant pair-wise model variables were suitable for use in analysis of financial performance and hybrid MDA/LR analysis and also fitted the model very well. Summary of the relevant statistical analysis for the respective models are provided in the relevant tables.

Results of analysis

Computation of composite FHI used as measures of solvency in public financing structure's in Nigeria's federal treasury were based on set of system equation function stated earlier. Thus, analysis of flow and stock aggregates of the constituent pair-wise solvency indicators utilized as model variables in deriving the result of this third model is shown in Table 2.

Composite FDI on treasury solvency criteria of government financial performance in Nigeria's federal

Table 2. Geoffrey-Bresuch serial cointegration test results.

Pair-wise fiscal Variable	Eigen value	Trace statistic	Critical value	Mackn' P-Value	Solvency ratios	Prob 'R'	Adj 'R'sq
(1) Pd/gr	0.45878	7.98121	12.51798	0.2522	0.49	0.54	0.29
(2) Ped/f*	0.51735	11.1632	12.51798	0.1533	0.59	0.57	0.33
(3) Ped/p	0.57629	11.1632	12.51798	0.0833	0.64	0.70	0.48
(4) Des/r	0.39630	7.0656	12.51798	0.3378	0.30	0.03	0.01
(5) Pd/gp	0.52056	9.5567	12.51799	0.1487	0.70	0.76	0.57

Trace statistic test indicates no co-integration at the 0.05 level and rejection of the hypothesis at the 0.05 level.

Source: FGN, CBN, DMO: Compilation by Author; facilitated by SPSS and E-views 8.

treasury based on set of system equation function stated earlier is derived as follows:

$$FHI_{\text{ (Z-Score)}} = \{1/f(0.49_{x1.1} + 0.59_{x1.2} + 0.64_{x1.3} + 0.70_{x1.4} + 0.30_{x1.5})/5) - 1\} \quad (4)$$

$$FHI_{\text{ (Z-Score)}} = (0.49_{x1.1} + 0.59_{x1.2} + 0.64_{x1.3} + 0.70_{x1.4} + 0.30_{x1.5}) n/5 = 0.54 \text{ or } (54\%)$$

Result = 54% and a grade 'C+' financial performance rating score.

Decision rule: Result: $FHI_6 = 0.54 > 0.50$; therefore, H_{a6} is accepted.

Result of hypothesis tests $H_{01.2}$, $H_{01.3}$, and $H_{01.5}$ yielded 0.59, 0.64, and 0.74 and >0.50 which confirmed the alternative hypothesis of the existence of solvency in Nigeria's federal treasury. Thus, $H_{a1, 2, \text{ and } 3}$ were duly adopted. While the hypothesis test results for $H_{01.1}$ and $H_{01.2}$ were 0.49 ($x_{1.1}$) and 0.49 ($x_{1.4}$), respectively, therefore, $H_{01.1}$ and $H_{01.2}$ were accepted. However, in the final analysis, the composite FHI for (H_{a6}) yields 0.54 and $0.54 > 0.50$; therefore, H_{a6} is accepted which is an indication that there is public finance solvency in Nigeria's sovereign treasury. This result confirms a prevalence of solvency in this dimension of financial performance in the federal treasury. This hypothesis test result also conforms to the public financial management theory and practice relating to the impact of high and low leverage in financial structure (Roubini, 2001). This result further implies that Nigeria's treasury is marginally solvent, and this position requires urgent attention of the appropriate authorities of Nigeria's treasury that on the average carrying debt stock is not adequately covered with available financial resources.

DISCUSSION

The outcome of our hypothesis test result conforms to the public finance solvency theory and practice as suggested in Roubini (2001) on solvency public financial structure as

it relates to the effect of high and low leverage in financial structure. This implies that Nigeria's treasury is marginally solvent, which requires urgent attention of the appropriate financial authorities of Nigeria's treasury. The average carrying debt stock is not adequately covered by available financial resources. Furthermore, it affirms some of the fears expressed in some quarters including Okonkwo (2014) in effect that Nigeria has reverted to the regime of accumulating excessive public debt particularly domestic public debt via issuance of new bond and debt notes. There is urgent need for fiscal policy planners in Abuja to adopt appropriate measures to moderate the nation's fast rising debt profiles. It is expedient to recall that Nigeria has also had its fair share of treasury illiquidity and quasi-national economic crisis around 1984, due partly to the accumulation of huge public debt and debt over-hang problem, decline in crude-oil price cum oil glut and scarcity of foreign exchange.

The essence for measuring of the solvency in public financing structure in government entities is to predict and prevent insolvency and illiquidity in government treasury, which if not effectively managed and resolved promptly can crystalize and snow-ball into acute public financial distress or sovereign financial crisis. For examples, the sovereign financial crisis episode in Spain, Guillermo (2011) stated that prior to 2007/2008 financial years, the Spanish economy recorded excellent fiscal position for about 14 consecutive years. Surplus of 1.9% of GDP in Spain was maintained as at the end of 2007 when the financial crisis emerged. Whilst the episode of financial crisis in Spain was attributed to excessive accumulation of public debt, decline in revenue and debt service problems arose. Guillermo (2011) explained that the main factors responsible for Spain's financial crisis is rooted to its entry into the European Monetary Union which produced dramatic fall in interest rates, exchange rate depreciation and general decline in the average interest rate from 13% in 2004 down to 3.4% around 2007 to 2009. The second factor was that there was also general boom in the Spain's housing and construction industry in decade preceding the crisis. The explosion of immigrants to Spain, reached an estimated at 5.7 million people between 2003 and 2010 which increased the

country's labour force. The trend attracted influx of people, immigrants to the country, mostly people of working age. This event produced large expansion of credit, investment and growth in the economy. Spanish economy was reportedly growing at higher rate and attempted to catch up fast for longer periods.

Conclusions

A summary of solvency performance indicators from the models are summarized as:

- (1) Public debt/Revenue: 0.49 and within 49 percent of the minimum threshold
- (2) Public debt/Foreign Reserves: 0.59 and within 59 percent of the minimum threshold
- (3) External Debt/Exports: 0.64 and within 64 percent of the minimum threshold
- (4) Debt Service/Revenue: 0.30 and within 30 percent of the minimum threshold
- (5) Public debt/GDP: 0.74 and within 59 percent of the minimum threshold
- (6) Composite FHI: 0.54 and within 50 percent for minimum solvency

Composite FHI (Z-Score) derived from public financing leverage solvency in federal treasury sovereign financial risk for Nigeria/Nigeria's federal treasury and Nigeria's macro-economy indicates that the sovereign treasury is in a sound solvency. However, other factors need to be considered stable, all things being equal.

The result on treasury solvency and impact of leverage in public financial structure to treasury solvency in the Nigerian federal treasury during the reviewed fiscal years posted "C⁺" and a marginally above average solvency/credit worthiness rating. The result is approximately at the same range with Nigeria's sovereign credit rating of (B⁺) and (B^{*}) by Fitch Ratings (Fitch), (2014, 2015) and Moody's Investors Service (Moody), (2014), respectively. It corroborate with the sound resource management strategy introduced and maintained around 2001 to 2004 encouraged members of Paris Club of external creditors to grant cancellation of substantial portion of Nigeria's outstanding external debt amounting to \$18 billion in 2004/2005 (Okonjo-Iweala and Kwaafor, 2007). However, evidence from the literature/government sources confirmed that Nigeria has reverted to the practice of continuous huge deficit budgeting, deficit financing (fiscal overdraft) and accumulation of public debt in the past five years, which will alter the level of treasury solvency in near future.

Furthermore, the evaluation of the test of hypotheses results indicated that two out of the five pair-wise variables that is public debt-to-public revenues, and debt service/government revenue ratios fall below the minimum

range of the international threshold for developing countries like Nigeria; whereas the rest of the debt/foreign reserves, external debt/exports, debt service/revenue and debt/GDP are positive and representatives of drivers of solvency. The results conform to specified objectives of the paper and suitable for suggestions and policy decisions. On the whole, there is a marginal above average public finance solvency and credit worthiness in Nigeria's federal treasury. In effect, the financial authorities of Nigeria should exercise some degree of restraints on additional borrowing and in the accumulation of national debts for the time being.

In conclusion, the overall result derived from the core solvency performance indicators and credit worthiness performance rating for Nigeria's federal treasury is 54%. In line with international best practice in credit worthiness and/or financial risk, 54% is an above average credit worthiness rating of a sovereign treasury, Nigeria's federal treasury in focus here and holding other factors constant. The policy implication is that Nigeria's public finance authorities need to carefully consider the existing structure of her total debt portfolio each time it intends to take additional loan in future to ensure that the nation's debt exposures does impose undue heavy burden on her future fiscal activities and transferring of debt burden to other generations of tax payers and citizenry.

yield 54% (C⁺). The overall result from the mean

RECOMMENDATION

Public borrowing both at the federal level and sub-national government tiers should be minimized and possibly restricted to 50% of revenue generating capacity or reserve financial assets in order to minimize excessive debt accumulation and each additional borrowing must be evaluated and recommended by the debt management office before its sanction by the national assembly and the national economic management team. Deficit budgeting and financing at the state and federal levels must not exceed 4% aggregate revenue in past years.

LIMITATIONS

The limitation being envisaged in the full realization of the recommendation of this empirical study is perhaps due to unexpected fluctuations in flow-stock fiscal aggregate (revenues, exports and national foreign reserves) as well as the political audacity to getting the right things done in our political economy.

SUGGESTIONS FOR FURTHER RESEARCH STUDIES

This research may likely encourage other researchers to follow the financial assessment of the association of

public debt and public financial resources other than the precision-prone interest rate, economic growth rate and GDP linked sovereign treasury solvency analysis to which econometric estimation are commonly constructed.

CONFLICT OF INTERESTS

The author has not declared any conflicts of interest.

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