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The Impacts of Banking System Stability on Sustainable Development: Conditional Mean-Based and Parameter Heterogeneity Approaches

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Abstract

We explored the impacts of banking system stability on sustainable development for the period 2000-2016 as well pre and post-global financial crisis periods. We employed econometric frameworks of dynamic fixed effects, system GMM and most recent estimator - panel quantile regression with fixed effects to provide robust results from the conditional mean-based and parameter heterogeneity approaches. Our results revealed that, conditioning on other sustainable development determinants, banking system stability have significant impacts on sustainable development as well as empirical evidence of parameter heterogeneity response of sustainable development for countries conditionally distributed on low and high sustainable development path for both short-run and long-run. In addition, we established that, countries distributed on low sustainable development paths gain more from bank stabilization policies compared to countries on middle and higher sustainable development paths. Finally, we established vanishing adverse effects of banking system stability on sustainable development in the post-global financial crisis period.

Keywords: Banking system stability, sustainable development, system GMM, panel quantile regression with fixed effects.

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Introduction

Sustainable development (SD) has been the focus of the 21st century. The concept of SD has taking hold around the world. It is for this reason that since 2016, the United Nations' Sustainable Development Goals (SDGs) has replaced the Millennium Development Goals (MDGs). On September 25, 2015, world leaders of the 193 UN Member States adopted the 15-year program (SDGs) (Zuev, et al., 2016). The program was entitled "Transforming Our World: 2030 Agenda for Sustainable Development". This has attracted attention of both local and international communities as well as groups to adopt various policies to promote SD programs (e.g G20 Action Plan for Sustainable Development) (Zuev, et al., 2016).

Over the years, global discussion has placed financial sector as the keystone to achieving SD (Zadek & Kharas, 2018). Hence, the global financial sector is placed at the center of humanity's attempt to accomplish the SD (Schmidt-Traub & Shah (2015). Schmidt-Traub and Shah (2015) pointed out that the SDGs will requires an additional annual investment of US$2.4 trillion in the area of low-carbon infrastructure, health, education, energy, agriculture and other sustainability sectors globally. The banking system is responsibility for mobilize this capital for the SDG agenda (Murphy, et al., 2017). However, a particularly important sector for the stability of financial systems is the banking sector (Hartmann, et al, 2005). Banks play a central role both in the money creation process and payment system. The role of the banking system in the economy and broader society is to provide the necessary financing and liquidity for human and economic activity to thrive – not only today but also tomorrow. Its role is to fund a stable and sustainable economy (Alexander, 2014; Hartmann, et al, 2005). Thus, banking system is an integral part of future growth and sustainability (Murphy, et al., 2017). Therefore, financial regulators play a key role in ensuring that excessive risks that threaten the stability of the banking system – and hence imperil the stability and sustainability of the economy are minimized (Alexander, 2014).

However, the global financial crisis in 2007/2008 exposed systemic weaknesses in the financial system specifically banking system, which affected the entire economy. To address these weaknesses, many countries, groups and international community implemented a number of regulatory activities to reshape and stabilize their banking system (Vander Stichele, 2015; Bremus & Lambert, 2014). Thus, the wider community acknowledges the role of the banking system in in both local and international development. The logical argument is that, a stable banking system is in a better shape to fund many SD projects within and across countries. For instance, the Bank of America has a strong record of supporting SDGs (i.e. environmental initiatives) and that is evident in environmental business commitment of $125 billion to direct capital to low-carbon, sustainable business activities (Manier, 2018). With all these initiatives to ensure the stability of the banking system as well as the critical role banks are playing in SD agenda, researchers and policy makers are keen to know how stability in the banking system influence SD.

The empirical investigation of this subject has rather focused on the relationship between banking system and long-term economic growth. The findings have been varied. While some studies found positive relationships among the variables (Ntarmah, et al., 2019; Jayakumar et al., 2018; Aluko & Ajayi, 2018; Wasiu & Temitope, 2015; Jiang, 2014), or negative, weak or no relationship (Tongurai & Vithessonthi, 2018; Demetriades & Rousseau, 2016; Ayadi et al., 2015) others found vanishing effect (Arcand et al., 2012; Rousseau & Wachtel, 2011). Thus, SD is reduced to long-term economic growth leading to limited number of studies in the real BSS and SD relationships. Regardless of the renewed interest and efforts to establish the clear link between the banking system and SD, empirical evidence is by far very scarce. The limited number of studies on BSS and SD can be attributed to two key common limitations. Firstly, a complication in assessing BSS is that, in contrast to other elements of the financial system, such as securities values, interbank relationships that can be at the origin of bank contagion phenomena or the values of and correlations between loan portfolios are particularly hard to measure and monitor (Hartmann, et al, 2005; Blavarg & Nimander, 2002). While earlier studies limit stability measures to only z-score and bank deposit ratio (Al-Moulani & Constantinos, 2017) others limit BSS measures to only non-performing loans (Jiang, 2014). Secondly, most policy makers and researchers relied on macroeconomic stability indicators like GDP per capita, real output growth, etc. as a measure of sustainability. However, these indicators fail to offer a comprehensive viewpoint of the true meaning of SD. It is interesting to note that due these limitations; research linking the two variables is scarce leaving this area of research underdeveloped and creating difficulty in incorporating BSS variables in SD forecast.

It is clear from the literature that the banking system, which is a critical component of the financial system are playing key role in financing SD projects. In addition, several initiatives are in place to stabilize the banking system - locally or internationally. Logically, a stable banking system can fund many sustainable development projects. Intuitively, funding a SD projects implies banks are having impact on SD. Where lies clear empirical evidence to support the second claims? Does economists and financial policy makers have enough empirical evidence to justify whether BSS can be incorporated in SD forecast? It appears literature has not been able to establish this fact. In other words, it appears the impact of BSS on SD is underdeveloped largely due to the reasons outlined earlier.

The objective of this study is in two-folds. First, we investigate the impact of banking system stability (BSS) on sustainable development (SD) and try to find out if the impact of BSS on SD varies depending on conditioning a country to a particular sustainable development path. Secondly, we tried to provide empirical evidence to establish vanishing effects of the impact of BSS on SD between the period leading to the global financial crisis and post crisis period, which marks the period where a number of regulatory initiatives have been put in place to stabilize the banking system (Wyman, 2015; Vander Stichele, 2015; Bremus & Lambert, 2014).

Our study differ from earlier studies in a number of ways. First, it extends literature by providing empirical evidence of whether BSS affects SD by employing reliable measures of the variables of interest over the period 2000-2016. Such approach minimizes likely endogeneity problem resulting from measurement errors found in earlier studies (Al-Moulani & Constantinos, 2017; Jiang, 2014). Secondly, we applied dynamic panel data estimators and estimation procedures to validate and ensure robustness in our findings as well as establishing whether the results vary with conditioning countries based on their existing state of sustainable development. Thus, we applied conditional mean-based models - dynamic fixed effect and system GMM as well as recent heterogeneous response model - panel quantile regression with fixed effect developed by Machado and Santos Silva (2019). This helps to clarify the inconsistent results reported by some researchers like Azeez and Oke (2012) as banking system does not positively and adequately affecting Nigeria's economic growth or the main driver of economic growth (Ntarmah, et al., 2019; Jayakumar et al., 2018). These estimators are among the class of estimators in current econometric literature, which provide valid, consistent and reliable results compared to OLS and other estimations and proving to be useful for dealing with endogeneity problems (Machado & Santos Silva, 2019; Roodman, 2009a). Furthermore, we tried to provide empirical evidence to establish the vanishing effect of the impacts of BSS on SD between two periods: period leading to global financial crisis and post crisis period.

The rest of the paper is organized as follows: section 2 deals with the materials and methods. It covers variables, data, econometric modelling and endogeneity checks. Section 3 deals with results and discussions. It presents the results based on the objectives of the study. Finally, section 4 present the conclusion and possible policy recommendations.

Materials and Methods

Variables

Our variables of interest are sustainable development (SD) as the dependent variable and banking system stability (BSS as the independent variable). We proxied SD using three variables – ecological footprint (EF), adjusted net savings rate (ANSr) and GDP per capita (GDPpc) to satisfy the theoretical arguments surrounding sustainable development. We used six indicators to measure BSS - Non-performing loans as percent of all bank loans (NPL), Bank credit as percent of bank deposits (BCD), Banking system z-scores (BSZ), Bank liquid assets to deposits and short-term funding (BLA), Banking system capital percent of assets (BSC), and Banking system regulatory capital to risk-weighted assets (BSR). However, we included a set of control variables that are identified as other SD determinants to control for their impacts in our model.

Selection of Sustainable Development Variables

In the literature, there is no single indicator that broadly measures SD – integrate social, environmental and economic sustainability. Hence, the concept still undergo debate among policy makers, especially ecological and classical economists. Traditionally, economic theory suggest that countries with high GDP per capita growth are on a sustainable development path. However, the general debate surrounding the true indicator for measuring sustainable development broadly originate from weak and strong sustainability perspectives. While weak sustainability focus on economic value, strong sustainability focus on ecological value[2] (Refer to Romero & Linares, 2013 and Ferreira et al., 2008 for extensive discussion on strong and weak sustainability). Thus, weak

[2] Weak sustainability rely on assumption of perfect substitutability among different capitals, including natural capital while strong sustainability reject perfect substitutability assumption and proposes different quantifying method, in which different sources of capitals are taken into account separately.

sustainability proposes indicators including Adjusted Net Savings rate, Index of Sustainable Economic Welfare (ISEW), Environmental Performance Index (EPI) and Genuine Progress Indicator (GPI). On the contrary, strong sustainability advocates for indicators such as Ecological Footprint (EF), Emergy, Human Appropriation of Net Primary Production (HANPP) and Living Planet Index (LPI) (Romero & Linares, 2013 and Ferreira et al., 2008). However, economies are dynamic and evolving, hence, sustainability perspectives allows us to think about how economic systems interact to achieve sustainable development. To account for these, we selected one index of SD each from strong sustainability perspective (Ecological Footprint) and weak sustainability perspective (Adjusted Net Savings rate) as well as traditional GDP per capita index. We chose these indicators for a number of reasons: 1. Its relevance in current sustainable development literature; 2. Suitability for national and global study (Romero & Linares, 2013); 3. Widely accepted and applied in many studies; and 4. Availability of data within our sample period.

Selection of Banking System Stability Variables

As indicated earlier, one of the complicated issues in BSS study is a complication in assessing the variables, in contrast to other elements of the financial system (Hartmann, et al, 2005; Blavarg & Nimander, 2002). This has led to narrowing down these measures to z-score and bank deposit ratio and/or non-performing loans (Al-Moulani & Constantinos, 2017; Jiang, 2014). The World Bank Group (2019) makes it clear that these indicators have their own weaknesses and hence stability measures should not be limited to just few of the measures. Thus, these indicators fail to offer a comprehensive viewpoint of the true meaning of BSS. However, NPL, BCD, BSZ, BLA, BSC and BSR are the broad measure of BSS by both the World Bank and the Global Economy (For details see TheGlobalEconomy.com and WDI of the World Bank). In addition, we performed series of estimations to establish each of these variables within our models to establish the true measure of BSS. We utilized these variables in our model since they increase the model fit and they are jointly significant as revealed by F-test.

Selection of Control Variables

Usually, empirical results presented in economic literature suffer from inconsistent empirical estimates and model uncertainty. The most common of them is omitting variables, which if they correlated with other explanatory variables may result in endogeneity issues. The next problem arises due to unclear theoretical guidance and tradeoffs on selection of true regressors for SD and this may results in misspecification and contradictory outcomes (Brock & Durlauf, 2001; Durlauf & Quah, 1999). To deal with these problems, Baysian Model Averaging (BMA) has been a coherent mechanism and a complete solution for model uncertainty. Hence, a number of researchers not limited to Tsangarides (2005) and Fernandz, Ley and Steel (2001a) used BMA to establish growth and sustainability determinants. Throughout literature, variables – initial level of secondary education; inflation rate, initial government final expenditure, initial trade openness and foreign direct investment have been established and used as SD determinants, which needs to be control in model specification (Ntarmah, et al., 2019; Arcand et al., 2012; Dufrenot, et al. 2009).

In addition, we performed series of estimations with the potential SD determinants and its variants to establish whether indeed the variables are SD determinants proxied by the variables used in our study. In all our estimations, the selected control variables retained their strong predictability. Furthermore, we found the lagged dependent variables to be significant determinants in our model. Hence, the set of control variables used in our study are initial level of secondary education; inflation rate, initial government final expenditure, initial trade openness and foreign direct investment and lagged values of the SD proxies used in our study.

Data

Our sample comprises annual data from all countries in the world. We employed panel data of 93 countries from 2000–2016. The number of countries excluded were due to data unavailability. With the exception of ecological footprint data, which was retrieved from the Global Footprint Network database (Global Footprint Network, 2019), we retrieved the rest of our data from the World Bank through St. Louis Federal Reserve bank and World Development Indicators databases (World Bank 2019). We used natural log for all the variables except ANSr. Since the ANSr data comprises of both negative, approximately zero and positive numbers, applying the natural log to this variable becomes inappropriate as natural log of zero and negative is undefined. Thus, using natural log result in loss of huge data. Therefore, we applied the appropriate and alternative log-transformation - inverse hyperbolic sine (IHS)-transformation to ANSr (Arcand, et al., 2012; Barro & Lee, 2010; Burbidge et al., 1988). Both natural log and IHS transformations are common practice in econometric analysis to reduce heteroscedasticity in the data. See appendix for variable description.

Econometric Modelling

Our study utilized econometric frameworks – dynamic Fixed Effects, system GMM and recent panel quantile regression with fixed effects developed by Machado and Santos Silva (2019). These model frameworks are widely known for their robustness and ability to deal with serial correlation, heterogeneity and endogeneity in economic studies as well as providing consistent and valid results especially system GMM and panel quantile regression with fixed effects. Following the literature, we combined these models to ensure robustness in our results as well as providing efficient, consistent and valid estimates. We modified the models to reflect dynamic models including the lagged values of the SD proxies and time dummy variables. This follows recent methodologies of Al-Moulani & Constantinos (2017), Barajas et al. (2013b) and Arcand et al. (2012) to control for potential endogeneity in the models.

Consider a classical regression as represented in Eq. (1).

$$y_{i,t} = \gamma_j x_{i,t} + v_{it} \qquad (1)$$

Where *y* is dependent variable (SD), *x* is the independent variable (BSS), *v* is the error term. The index *i*,*t* refers to a country *i* observed in time *t*. The pooled OLS does not account for unobserved fixed effects in our data. Therefore, applying Hausman's test revealed FE model to be appropriate for dealing with this effect than pooled OLS and

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random effects models. Hence, we utilized dynamic FE as one of our conditional mean-based model for the study. The pooled OLS is modified to give dynamic FE model as:

$$y_{i,t} = \alpha_i + \beta y_{i,t-1} + \gamma_j x_{i,t} + \delta_j z_{i,t-1} + \zeta_j w_{i,t} + v_{it} \qquad (2)$$

Where $(y_{i,t-1})$ is the first lag of SD. It is assumed that the net effect on Y of unobservable factors for the *ith* unit that are constant over time is a fixed parameter, designated α_i, *z* is the control variable (other determinants of SD), and w account for time fixed effects. Other variables are defined. However, the FE model can be biased in dealing with endogenous regressors (Al-Moulani & Constantinos, 2017; Roodman, 2009a). Thus, we implement two-step system GMM model, which is powerful to deal with endogenous regressors. The simplified system GMM model is given as:

$$y_{i,t} = \beta y_{i,t-1} + \gamma_j x_{i,t-j} + \delta_j z_{i,t-1} + \zeta_j w_{i,t} + v_{it} \qquad (3)$$

where $(x_{i,t-j})$ represents the current and time lagged measures of BSS. All other variables are defined. However, the classical econometric techniques such as pooled OLS, FE, GMM and instrumental variable estimators assume parameter homogeneity and thus estimate the parameters based on conditional mean E(Y/X) which may lead to inconsistent results especially considering the sample in our study where different countries are found on different levels of SD.

To address these weaknesses in the conditional mean-based estimators, we implement conditional quantile regression (which account for parameter heterogeneity) to estimate our results on different quantiles of the conditional distribution to provide evidence of heterogeneous responses. We used the recent panel quantile regression method (MM-QR) of Machado and Santos Silva (2019). This estimator is superior to earlier quantile regression estimators due to its usefulness in handling panel data models with individual effects and models with endogenous explanatory variables. Quantile regression is noted for its robustness to outliers and ability to capture all essential relationships which OLS and other classical econometric methods fail to address. Unlike earlier quantile regression methods, MM-QR is used to estimate results via moment conditions (Machado & Santos Silva, 2019) which does not assume presence of moment function or make distributional assumptions (Zhu, et al, 2016a; Sherwood & Wang, 2016)., this method estimate panel through moment conditions.

Therefore, we consider estimating conditional quantiles $Q_Y(\tau|X)$for location-scale in the form:

$$Y_{it} = \alpha_i + X'_{it}\beta + (\delta_i + Z'_{it}\gamma)U_{it} \qquad i=1,2,\ldots,n \qquad t=1,2,\ldots,T \qquad (4)$$

with $P\{\delta_i + Z'_{i,t}\gamma > 0\} = 1$. The parameters (α_i, δ_i)capture individual fixed effects and Z is a k-vector of known differentiable (with probability 1) transformations of the components of X. The sequence $\{X_{i,t}\}$ is *i.i.d.* for any fixed *i* and independent across *t*. $U_{i,t}$ is *i.i.d.* (across *i* and *t*), statistically independent of$X_{i,t}$, and normalized to satisfy the moment conditions. However, Eq. 4 suffers the incidental parameter problems weakening its superiority over advantages over other quantile models. The introduction of jackknife bias correction and applying a bias-correction version to the model help minimize the problem especially reducing the problem caused by fixed effects in the entire distribution (Dhaene and Jochmans, 2015). This is illustrated in Eq.5.

$$Q_Y(\tau|X_{it}) = \left(\alpha_i + \delta_i q(\tau)\right) + X_{it}'\beta + Z_{it}'\gamma q(\tau) \quad (5)$$

Where the scalar coefficient $\alpha_i(\tau) \equiv \alpha_i + \delta_i q(\tau)$ is a quantile-τ fixed effect for the individual i, or the distributional effect at τ. In general, the distribution effect differs from the usual fixed effect in that it is not a shift in location. That is, the effects of the distribution represent the effects of individual invariant-time characteristics, which, like other variables, are permitted to have different effects on various regions of the conditional distribution of Y. The fact that $\int_0^1 q(\tau)d\tau = 0$implies that$\alpha_i$can be interpreted as the average effect for individual i. Thus, the jackknife correction introduced in Eq. 5 essentially removes the bias without a significant loss of precision (Machado & Santos Silva, 2019). In addition, the conditions established in Eq.5 do not imply strict exogeneity and therefore, diminishes endogeneity problems. Eq. 5 can be simplified to capture the specific variables as:

$$Q_\tau(y_{i,t}) = \alpha_\tau + \beta_\tau y_{i,t-1} + \gamma_{j_\tau} x_{i,t} + \delta_{j_\tau} z_{i,t-1} + \zeta_{j_\tau} w_{i,t} + v_{it} \quad (6)$$

where Q_τ denotes parameters of panel quantile regression of the τth distributional point, τ specifies the distributional point for the variables. Thus, Eq. 6 denotes the panel quantile regression equation of SD being regressed on fixed effects (α_τ), BSS, control variables and time specific effects. In addition, the implementation of quantile regression in our data was useful since the widely accepted Quantile-Quantile (Q–Q) normality test showed that our data is not normally distributed. Apart from the ability of quantile regression to estimate complex models, another important feature of the estimator used in this study is that it leads to estimates of the regression of quantiles that do not cross, a crucial requisite often ignored in empirical applications (Chernozhukov, et al., 2010).

Endogeneity Checks

The key issue in current econometric modelling is dealing with endogeniety problem. Apart from the earlier approach to correct model uncertainty to minimize potential endogeneity, we applied endogeneity test to each of the explanatory variables. First, the correlation test did not identify any of the regressors to be highly correlated among each other. Second, we identified potential endogeneous variables – initial values of the dependent variables, trade openness and inflation using instrumental variable approach from the literature. Thirdly, we performed both Sargan and Basman tests of overidentifying restriction for the quality of the instrument and confirmed the validity of the instrument set for our models. To deal with the issue of endogeneity identified in our study, we applied three different class of dynamic panel data models, which are most appropriate methods for estimating short panels due to its consistency, efficiency, and reliability as well as the ability to deal with endogeneity problems (Machado & Santos Silva, 2019; Roodman, 2009a). Thus, we utilized dynamic FE and conventional methodologies such as system GMM and the recent panel quantile regressions with fixed effects.

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Results and Discussions

To allow for short-run and long-run impacts, we estimated our sustainable development equations as an error correction model. The short-run impact is given by the coefficients of the banking system stability while long-run impact was estimated as the value of the ratio of the short-run coefficients to one minus the lagged dependent variable. The general formula for estimating the long-run impact is given as:

$$Y_L = \beta_k \div (1 - \phi) \quad (6)$$

where Y_L is SD in the long-run, $\beta_k$represents the coefficients of the independent variables and ϕrepresents the coefficients of the lagged dependent variable. For the purpose of this work, we estimated long-run impacts for the significant independent variables of interest. The first objective deals with establishing the impacts of banking system stability on sustainable development for the whole sample period. Tables 4 and 5 present the estimated results of the impacts of the variables on SD based on their proxies. The results on 25th, 50th and 75th quantile represent the distribution of countries on low, median and high sustainable development path respectively. Using STATA version 15, we implemented the commands 'xtreg, xtabond2 and xtqreg' involving the variables for dynamic fixed effects, system GMM and panel quantile regression estimates respectively.

Table 4. Impacts of banking system stability on sustainable development – Strong and Weak Sustainability Perspectives

	Strong Sustainability: Ecological Footprint					Weak Sustainability: Adjusted Net Savings Rate				
	FE	Sys GMM	Panel Quantile Regression with Fixed Effects			FE	Sys GMM	Panel Quantile Regression with Fixed Effects		
			.25	.5	.75			.25	.5	.75
llnansr	-	-	-	-	-	0.660*** (0.074)	0.655*** (0.140)	0.670 (0.767)	0.658** (0.318)	0.650*** (0.102)
Llnef	0.628*** (0.048)	0.902*** (0.062)	0.611*** (0.049)	0.628*** (0.037)	0.645*** (0.049)	-	-	-	-	-
Lnbsz	0.023*** (0.007)	0.005 (0.007)	0.028** (0.013)	0.023** (0.009)	0.019 (0.012)	0.170 (0.058)	-0.017 (0.094)	0.071 (1.659)	0.191 (0.687)	0.270 (0.220)
Lnbsr	-0.033* (0.018)	-0.014 (0.032)	-0.039 (0.027)	-0.033 (0.020)	-0.026 (0.027)	-0.063 (0.205)	0.466* (0.254)	0.272 (5.556)	-0.137 (2.302)	-0.404 (0.738)
Lnbla	0.015* (0.008)	0.010 (0.016)	0.020* (0.011)	0.015* (0.008)	0.011 (0.011)	-0.110 (0.088)	-0.227* (0.120)	-0.252 (1.599)	-0.079 (0.662)	0.034 (0.213)
Lnnpl	-0.025*** (0.005)	-0.019* (0.010)	-0.027*** (0.006)	-0.025*** (0.005)	-0.024*** (0.006)	-0.024 (0.049)	-0.118* (0.066)	-0.072 (0.864)	-0.013 (0.358)	0.025 (0.115)
lnbsc	0.016 (0.016)	0.026 (0.022)	0.013 (0.025)	0.016 (0.018)	0.018 (0.024)	-0.162 (0.176)	-0.273 (0.189)	-0.270 (4.317)	-0.138 (1.788)	-0.052 (0.572)
Lnbcd	0.022*** (0.001)	0.017*** (0.001)	0.034*** (0.002)	0.022*** (0.001)	0.010*** (0.002)	-0.353 (0.183)	-0.066 (0.140)	-0.477 (2.901)	-0.326 (1.202)	-0.227 (0.385)
lnltrade	0.047** (0.022)	0.029 (0.024)	0.062** (0.028)	0.047** (0.021)	0.033 (0.028)	0.432*** (0.032)	-0.020*** (0.002)	0.459*** (0.111)	0.426*** (0.073)	0.404*** (0.045)
Lnlfdi	-0.001 (0.004)	-0.012 (0.017)	-0.005 (0.004)	-0.001 (0.003)	0.004 (0.004)	0.00***3 (0.041)	0.018*** (0.044)	-0.015*** (0.519)	0.008*** (0.215)	0.022*** (0.069)

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	Strong Sustainability: Ecological Footprint					Weak Sustainability: Adjusted Net Savings Rate				
	FE	Sys GMM	Panel Quantile Regression with Fixed Effects			FE	Sys GMM	Panel Quantile Regression with Fixed Effects		
Lnlsec	0.053*** (0.002)	0.083*** (0.006)	0.064*** (0.003)	0.053*** (0.002)	0.041*** (0.003)	0.254*** (0.042)	-0.291*** (0.021)	0.716*** (0.073)	0.151*** (0.053)	-0.218*** (0.028)
Lnlgfe	-0.029*** (0.002)	0.073*** (0.006)	-0.032*** (0.002)	-0.029*** (0.001)	-0.027*** (0.002)	0.766*** (0.067)	0.924*** (0.074)	0.448*** (0.053)	0.836*** (0.052)	1.091*** (0.122)
Lnlinf	-0.001 (0.004)	-0.010 (0.008)	0.003 (0.006)	-0.001 (0.004)	-0.004 (0.006)	0.032 (0.039)	0.032 (0.060)	-0.005 (0.568)	0.040 (0.235)	0.070 (0.075)
Long-run Impacts										
lnbsz	0.063	0.000	0.072	0.063	0.000	0.000	0.000	0.000	0.000	0.000
lnbsr	-0.088	0.000	0.000	0.000	0.000	0.000	1.351	0.000	0.000	0.000
lnbla	0.041	0.000	0.051	0.041	0.000	0.000	-0.658	0.000	0.000	0.000
lnnpl	-0.068	-0.268	-0.070	-0.068	-0.067	0.000	-0.342	0.000	0.000	0.000
lnbcd	0.059	0.173	0.087	0.059	0.028	0.000	0.000	0.000	0.000	0.000
AR2		0.185					0.559			
Hansen		0.111					0.488			

Robust standard errors are in parentheses. ***p<0. 01, **p<0. 05, *p<0.1. Year dummies are included.

The results in Table 4 show that sustainable development as viewed from strong sustainability perspective depends on its initial values in all the estimations. In relation to our variables of interest, banking system z-scores positively affect sustainable development. In the FE estimations, the result shows that 1% increase in the probability of default of the banking system is associated with 0.023% and 0.063% increase in sustainable development in the short-run and long-run respectively. This marginal impact is slightly lower compared to with countries distributed on low-sustainable development path but almost the same with countries on a median sustainable development path as depicted by quantile regression in Table 4. This implies that countries on low sustainable development path has a relatively high probability of increasing their sustainable development compared with countries on median or high sustainable development path by increasing the probability of default of their banking system.

Similarly, bank liquid assets to deposits and short-term funding has positive impact on sustainable development from strong sustainability perspective. The FE result (similar to countries on median sustainable development path) indicates that a 1% increase in the ratio of the value of liquid assets to total deposits and short-term funding is associated with 0.015% and 0.041% increase in sustainable development in the short-run and long-run respectively, but only at 10% significant level. However, the impact is relatively high (0.020% resulting from 1% increase in bank liquid assets to deposits and short-term funding) for countries on low sustainable development path. As expected, non-performing loans has adverse impacts on sustainability of all countries. In all our estimations, non-performing loans is the single variable of interest that remained significant and negative. Its impact varies from high sustainable development countries to low sustainable development countries. Generally, the result shows that a 1% decrease in non-performing loans is associated with 0.024%-0.027% and 0.070-0.067% increase in sustainable development from high to low sustainable development countries in the short-run and long-run respectively.

On the contrary, bank credit significantly and positively influenced sustainable development. Consistent with distributional impacts, countries on low sustainable development path has stronger marginal impact of bank credit on sustainable development compared with countries on middle and high sustainable development paths. Thus, holding other factors constant, a 1% increase in bank credit will lead to 0.010%-0.034% and 0.028-0.087% increase in sustainable development from countries distributed on low to high sustainable development paths in the short-run and long-run respectively. The findings of this study validate the studies of Jayakumar et al. (2018), and Aluko and Ajayi (2018) established positive relationship between bank stability and sustainable economic growth.

The results suggest heterogeneous responses among countries distributed on different quantiles regarding how their sustainability react to the impacts of banking system stability. It should be noted that in all the estimations sustainable development from strong sustainability perspective, countries distributed on low sustainable development path seem to have stronger marginal impacts of banking system on their sustainable development than countries on high sustainable development path. The main reason accounting for these variations is due to the fact countries on low sustainable development path are mostly developing and least developed countries whose banking system is unstable compared to developed economies where the banking system is stable. Hence, extra effort by these developing and least developed countries towards stable banking system can impacts the whole economy compared to developed economies whose banking system is already stable. For instance, non-performing loans are high in developing and least developed countries compared to developed countries, hence, extra efforts to recover these loans has a greater probability of improving their economies.

From weak sustainability perspective, the results in Table 4 show that the adjusted net savings rate largely depends on its initial value than any other variable within the model. Thus, for FE and panel quantile regression with fixed effects estimations, the initial values of adjusted net savings rate influences adjusted net savings rate. The system GMM estimation shows that banking system regulatory capital to risk-weighted assets positively influences SD. Additionally, bank liquid assets to deposits and short-term funding positive as well as non-performing loans negatively affects sustainable development only at 10% significance level as depicted by the system GMM estimation. One possible reason accounting for this result can be attributed to conditional distribution of our data. For instance, unlike ecological footprint dataset, the distribution of countries along low, median or high level in our adjusted net savings rate dataset does not follow a clear pattern with countries and their development status or level of banking system stability. Said differently, both developed and developing countries with different level of banking system stability are distributed along the same sustainable development path as proxied by adjusted net savings rate. Hence, such pattern of distribution may not reveal statistically significant results even though some level of impact exist regardless of the distribution. Thus, this finding validate the studies (Gnegne, 2009; Ferreira, et al., 2008; Hmailton, 2005) that even though adjusted net savings rate has emerged as a useful sustainable development index but weak in magnitude. Thus, this study join earlier studies advocating that even though adjusted net savings rate can be used as an index of weak sustainability, it needs to be improved to a complete index with specific indicators.

ISSN 2383-2126 (Online)

Table 5: Impacts of banking system stability on sustainable development – Traditional Index (GDP per Capita)

	FE	System GMM	Panel Quantile Regression with Fixed Effects		
			.25	.5	.75
lnlgdppc	0.915*** (0.020)	0.935*** (0.015)	0.913*** (0.018)	0.915*** (0.014)	0.917*** (0.018)
lnbsz	0.020*** (0.004)	-0.002 (0.005)	0.020*** (0.005)	0.020*** (0.004)	0.020*** (0.005)
lnbsr	-0.016* (0.008)	0.006 (0.013)	-0.016 (0.010)	-0.016** (0.007)	-0.016 (0.010)
lnbla	0.005 (0.003)	0.001 (0.006)	0.004 (0.003)	0.005* (0.003)	0.005 (0.003)
lnnpl	-0.013*** (0.003)	-0.016*** (0.004)	-0.013*** (0.002)	-0.013*** (0.002)	-0.012*** (0.002)
lnbsc	0.005 (0.009)	-0.012 (0.016)	0.005 (0.008)	0.005 (0.006)	0.004 (0.008)
lnbcd	-0.017 (0.011)	-0.002 (0.008)	-0.021** (0.008)	-0.018** (0.006)	-0.013 (0.008)
lnltrade	0.025** (0.010)	0.014 (0.009)	0.025** (0.011)	0.025*** (0.008)	0.025** (0.010)
lnlfdi	0.010*** (0.002)	-0.022*** (0.003)	0.011*** (0.002)	0.010*** (0.001)	0.013*** (0.002)
lnlsec	0.022 (0.012)	0.094*** (0.028)	0.029** (0.013)	0.022** (0.009)	0.015 (0.012)
lnlgfe	-0.013*** (0.004)	0.009*** (0.002)	-0.012*** (0.003)	-0.013*** (0.001)	-0.015*** (0.002)
lnlinf	-0.004** (0.002)	-0.006** (0.002)	-0.003 (0.002)	-0.004*** (0.002)	-0.005*** (0.002)
Long-run Impacts					
lnbsz	0.229	0.000	0.223	0.229	0.236
lnbsr	-0.184	0.000	0.000	-0.184	0.000
lnbla	0.000	0.000	0.000	0.053	0.000
lnnpl	-0.150	-0.240	-0.001	-0.149	-0.146
lnbcd	0.000	0.000	-0.234	0.000	0.000
AR2		0.190			
Hansen		0.105			

Robust standard errors are in parentheses. ***p<0. 01, **p<0. 05, *p<0.1. Year dummies are included.

Table 5 shows that the impact of banking system z-score on sustainable development as proxied by GDP per capita is the same (in the short-run but varies slightly in the long-run) for all countries – low and high sustainable development countries as depicted by the quantile regression and FE outputs. It shows that a 1% increase in the probability of default of the banking system leads to a 0.020% increase in sustainable development in the short-run but 0.223-0.236% increase in the long-run from countries on low to high sustainable development path. However, the result shows that banking system regulatory capital to risk-weighted assets only affects the sustainability of countries distributed around 50th quantiles. Thus, a 1% increase in capital adequacy of deposit takers reduces the sustainability of median sustainable development countries by 0.016% and 0.184% in the short-run and long-run respectively.

Surprisingly, the quantile regression shows that countries on low sustainable development path are affected by the changes in bank credit as percent of total bank deposits. Therefore, as the financial resources given to the private sector by domestic money banks as a share of total deposits increases by 1%, sustainability of countries on low sustainable development path reduces by 0.021% and 0.234% in the short-run and long-run respectively. It seem to suggest that the financial resources available to the private sector are not necessary geared towards sustainable development projects in these countries and as such more financial resources to the private sector means less financial resources available for sustainable development projects. Again, the quantile regression shows that the impact of non-performing loans on sustainable development varies across countries. Countries distributed across low sustainable development path are adversely affected by non-performing loans more than countries on a high sustainable development path. Generally, a 1% recovery in non-performing loans is associated with between sustainable development is expected to increase 0.012%-0.013% decrease in sustainable development. This finding is consistent with the findings of Jayakumar et al. (2018) and Jiang (2014) who revealed that banking system has significant impacts on long-term growth.

Figs. 1-3 show graphical representation of quantile regression and OLS results of the impacts of banking system on sustainable development with various proxies. The coefficients of ordinary least square OLS method (dotted line) remains constant in the selected distributional points while the quantile estimates (green line or in confidence interval term - gray area) around the coefficients vary significantly along the distributional points of the varies sustainable development proxies.

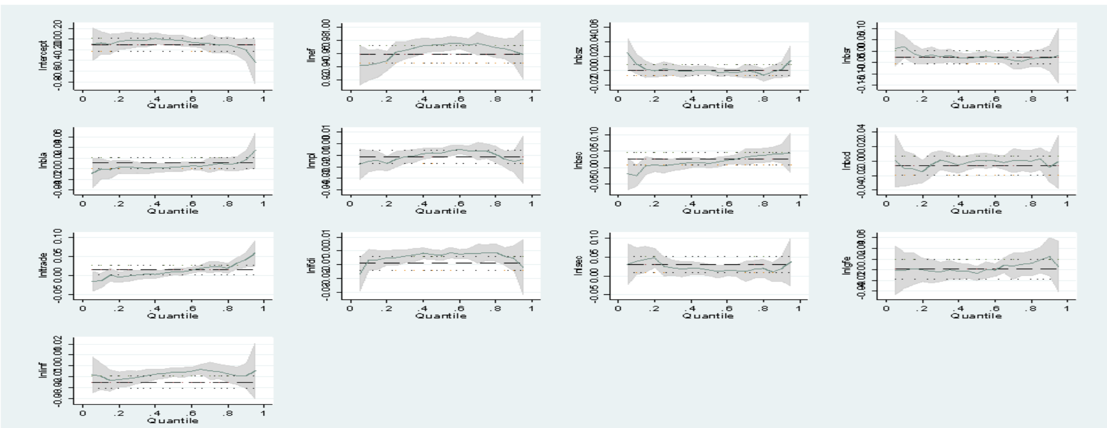

Fig. 1. Quantiles distributions of the impacts of banking system stability on sustainable development (Ecological Footprint).

Notes: 1. Green line represents 95% confidence level for the quantile regression estimates.

2. Dotted lines indicate the 95% significance level of the OLS coefficient.

3. The gray area denotes the confidence interval for quantile estimates.

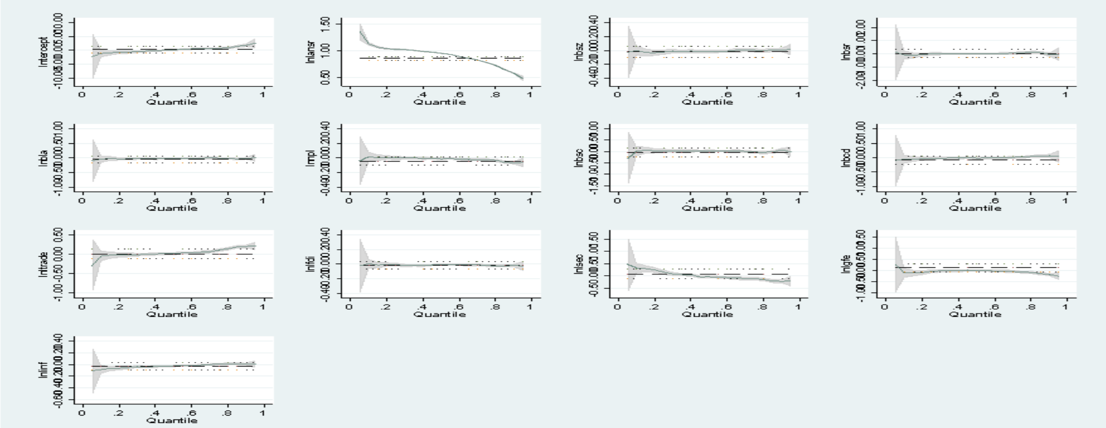

Fig. 2. Quantiles distributions of the impacts of banking system stability on sustainable development (Adjusted Net Savings rate)

Refer to notes on Fig. 1 for interpretations

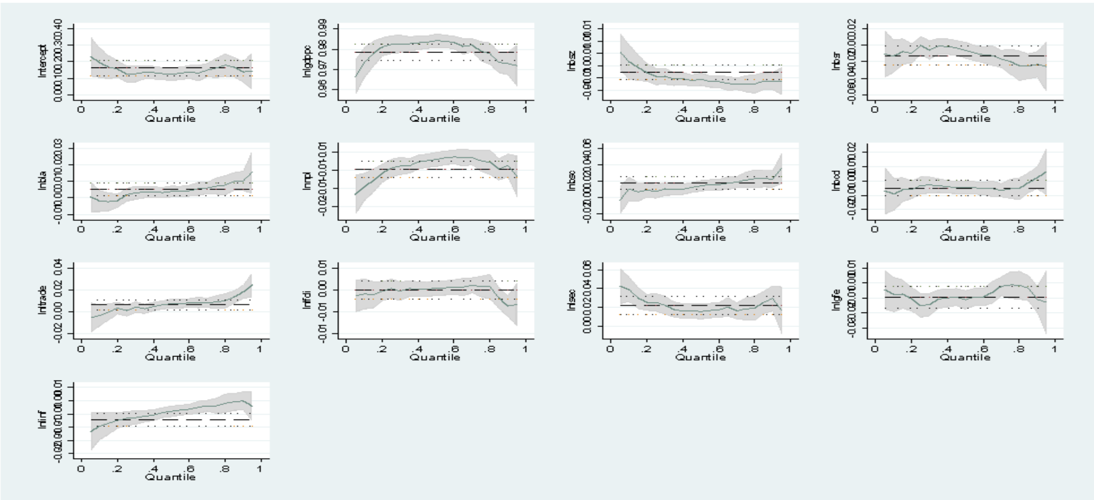

Fig. 3. Quantiles distributions of the impacts of banking system stability on sustainable development (GDP per Capita)

Refer to notes on Fig. 1 for interpretations

The second objective of this study investigated the impacts of banking system stability on sustainable development from two periods. The sample period are period 1 from 2000-2009 and period 2 from 2010 – 2016. We justify the breaking of the sample into these period based on a number of reasons. The first period marks the period that leading to the global financial crisis as well as the crisis period and its resulting impacts on sustainability of major countries. The second period (post crisis period) is the period that witness major banking system stability initiatives and regulatory activities (Vander Stichele, 2015; Wyman, 2015). We are motivated by the fact that groups, economies, and policy makers across that globe may find it prudent to lay hands on empirical evidence of the policy implications of the major financial soundness initiatives. Finally, we are convinced that

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country's distribution of sustainable development vary over the two periods and this may provide useful findings for policy implications.

Table 6: Impacts of banking system stability on sustainable development for two periods – Strong Sustainability Perspective (Ecological Footprint)

	FE		System GMM		Panel Quantile Regression with Fixed Effects					
	Period 1	Period 2	Period 1	Period 2	Period 1			Period 2		
					.25	.5	.75	.25	.5	.75
llnef	0.372*** (0.089)	0.478*** (0.081)	0.744*** (0.074)	0.859*** (0.097)	0.337*** (0.086)	0.375*** (0.072)	0.407*** (0.103)	0.460 (0.283)	0.477*** (0.167)	0.496*** (0.099)
lnbsz	0.026** (0.012)	-0.007 (0.007)	-0.002 (0.020)	0.001 (0.020)	0.029* (0.016)	0.026* (0.014)	0.023 (0.019)	-0.009 (0.021)	-0.007 (0.013)	-0.005 (0.008)
lnbsr	-0.072*** (0.024)	-0.023 (0.042)	-0.077 (0.072)	-0.134 (0.089)	-0.085** (0.033)	-0.070** (0.028)	-0.058 (0.039)	-0.018 (0.153)	-0.023 (0.090)	-0.029 (0.054)
lnbla	0.009 (0.012)	0.013 (0.019)	0.044 (0.039)	-0.040 (0.031)	0.013 (0.018)	0.009 (0.015)	0.006 (0.021)	0.008 (0.064)	0.012 (0.038)	0.018 (0.023)
lnnpl	-0.038*** (0.009)	-0.026** (0.012)	-0.050*** (0.015)	-0.049* (0.0250)	-0.042*** (0.010)	-0.037*** (0.008)	-0.033*** (0.012)	-0.027 (0.044)	-0.026 (0.026)	-0.026* (0.015)
lnbsc	0.021 (0.021)	-0.025 (0.050)	0.005 (0.052)	0.062 (0.056)	0.034 (0.029)	0.020 (0.024)	0.009 (0.035)	-0.042 (0.174)	-0.026 (0.103)	-0.009 (0.061)
lnbcd	0.049* (0.029)	-0.029 (0.031)	-0.009 (0.044)	-0.097* (0.053)	0.042 (0.038)	0.050 (0.032)	0.056 (0.046)	-0.005 (0.138)	-0.027 (0.082)	-0.052 (0.048)
lnltrade	-0.013*** (0.005)	0.005 (0.007)	0.014*** (0.004)	-0.056*** (0.007)	-0.017*** (0.002)	-0.013** (0.005)	-0.009 (0.005)	0.041*** (0.009)	0.007 (0.007)	-0.033*** (0.005)
lnlfdi	0.004 (0.005)	-0.003 (0.003)	-0.002 (0.012)	0.002 (0.010)	0.001 (0.007)	0.004 (0.006)	0.006 (0.008)	-0.006 (0.017)	-0.004 (0.010)	-0.004 (0.006)
lnlsec	0.093** (0.042)	-0.111 (0.085)	0.241** (0.106)	-0.045 (0.111)	0.154** (0.072)	0.088 (0.060)	0.032 (0.086)	-0.083*** (0.023)	-0.109*** (0.013)	-0.139*** (0.018)
lnlgfe	-0.062** (0.026)	0.060 (0.063)	-0.032 (0.161)	0.656*** (0.234)	-0.081** (0.031)	-0.060** (0.026)	-0.043*** (0.008)	0.044*** (0.016)	0.059*** (0.028)	0.076*** (0.007)
lnlinf	-0.007 (0.006)	-0.005 (0.005)	-0.026* (0.015)	0.004 (0.009)	-0.004 (0.008)	-0.007 (0.007)	-0.009 (0.010)	-0.003 (0.018)	-0.005 (0.011)	-0.007 (0.006)
Long-run Impacts										
lnbsz	0.041	0.000	0.000	0.000	0.044	0.041	0.000	0.000	0.000	0.000
lnbsr	-0.114	0.000	0.000	0.000	-0.128	-0.113	0.000	0.000	0.000	0.000
lnnpl	-0.060	-0.050	-0.196	-0.344	-0.063	-0.059	-0.056	0.000	0.000	-0.052
lnbcd	0.078	0.000	0.000	-0.688	0.000	0.000	0.000	0.000	0.000	0.000
AR2			0.232	0.123						
Hansen			0.219	0.788						

Robust standard errors are in parentheses. ***p<0. 01, **p<0. 05, *p<0.1. Year dummies are included.

Compared to earlier result over the whole sample period, we found little evidence of the impacts of banking system stability on sustainable development as depicted in Table 6. The quantile regression result shows that there exist positive impact of banking system z-scores on sustainable development among countries on low and median sustainable development path in the first period but no significant impact can be said in the second period. The same can be said about the impact of banking system regulatory capital to risk-weighted assets but in adverse manner. This seem to suggest that there exist

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vanishing effects of banking system stability on sustainable development within the post-crisis period.

A very important revelation is the impact of non-performing loans on sustainable development. The result revealed a negative impact of non-performing loans on sustainability of countries on high sustainable development path for both periods. However, the impact is stronger for the first period than the second period with a 1% loans unrecovered result in 0.033% and 0.026% reduction in sustainable development for countries on high sustainable development path for the first and second period respectively within the short-run. The long-run impact resulting from 1% loans unrecovered leads to 0.056% and 0.052% for the same countries in periods one and two respectively. It can be deduced that the post crisis regulatory activities have minimized the adverse effect of non-performing loans on the sustainability of these countries. Again, the result provides evidence of vanishing adverse effect of the impact of non-performing loans on sustainable development. This study validate the studies of Samargandi et al (2015), Rousseau, and Wachtel (2011) regarding vanishing effects within finance and long-term growth nexus.

Table 7: Impacts of banking system stability on sustainable development for two periods – Weak Sustainability Perspective (Adjusted Net Savings rate)

	FE		System GMM		Panel Quantile Regression with Fixed Effects					
	Period 1	Period 2	Period 1	Period 2	Period 1			Period 2		
					.25	.5	.75	.25	.5	.75
llnansr	0.490*** (0.126)	0.431*** (0.095)	0.598*** (0.193)	0.754*** (0.103)	0.498 (0.311)	0.489 (0.406)	0.484 (0.632)	0.369 (0.406)	0.437* (0.254)	0.505* (0.263)
lnbsz	0.099 (0.151)	0.097 (0.077)	0.106 (0.105)	-0.092 (0.173)	0.232 (0.471)	0.086 (0.616)	-0.017 (0.956)	0.123 (0.305)	0.094 (0.190)	0.065 (0.197)
lnbsr	0.319 (0.326)	-0.329 (0.479)	0.053 (0.349)	-0.345 (0.511)	0.363 (1.542)	0.315 (2.017)	0.281 (3.134)	-0.293 (1.596)	-0.332 (0.994)	-0.371 (1.030)
lnbla	-0.025 (0.111)	-0.146 (0.201)	-0.097 (0.156)	-0.193 (0.306)	-0.109 (0.422)	-0.017 (0.552)	0.048 (0.858)	-0.186 (0.774)	-0.142 (0.482)	-0.099 (0.499)
lnnpl	-0.064 (0.103)	-0.120 (0.115)	-0.039 (0.059)	-0.171* (0.101)	-0.075 (0.304)	-0.063 (0.397)	-0.055 (0.618)	-0.131 (0.484)	-0.119 (0.302)	-0.107 (0.312)
lnbsc	0.356 (0.329)	-0.515 (0.556)	-0.150 (0.214)	-0.262 (0.304)	-0.073 (1.136)	0.397 (1.483)	0.728 (2.304)	-0.574 (1.917)	-0.509 (1.194)	-0.445 (1.237)
lnbcd	-0.226 (0.336)	0.418 (0.364)	-0.189 (0.182)	-0.121 (0.172)	-0.503 (0.989)	-0.199 (1.293)	0.014 (2.008)	0.335 (1.415)	0.426 (0.882)	0.517 (0.913)
lnltrade	0.917*** (0.081)	0.571*** (0.038)	0.168* (0.076)	-0.143** (0.061)	0.903*** (0.072)	0.918*** (0.055)	0.929*** (0.194)	0.563*** (0.025)	0.572** (0.262)	0.581* (0.307)
lnlfdi	0.040*** (0.005)	0.060*** (0.009)	0.023*** (0.008)	0.144** (0.066)	-0.064** (0.026)	0.010 (0.096)	0.062 (0.059)	0.076 (0.086)	0.059*** (0.016)	0.041** (0.020)
lnlsec	-0.081 (0.585)	0.771 (0.547)	-0.215 (0.385)	-0.220 (0.787)	0.156 (1.677)	-0.103 (2.193)	-0.286 (3.408)	0.952 (2.954)	0.753 (1.841)	0.554 (1.906)
lnlgfe	0.403*** (0.023)	-0.497*** (0.012)	0.764*** (0.028)	0.682*** (0.061)	-0.097* (0.054)	0.451*** (0.025)	0.838*** (0.078)	-0.630*** (0.074)	-0.484*** (0.079)	-0.338*** (0.077)
lnlinf	0.043 (0.069)	0.040 (0.043)	0.055 (0.088)	-0.016 (0.097)	0.026 (0.218)	0.045 (0.285)	0.058 (0.443)	0.013 (0.209)	0.043 (0.131)	0.074 (0.135)
AR2			0.733	0.620						
Hansen			0.177	0.166						

Robust standard errors are in parentheses. ***p<0. 01, *p<0.1. Year dummies are included.

From Table 7, we found no evidence of the impact of banking system stability on sustainable development as proxied by adjusted net savings rate for the two periods in all the estimations. Largely, adjusted net savings rate depended on its initial values. Thus, this finding corroborate with the studies of Tongurai and Vithessonthi (2018) and Ayadi et al. (2015) who found weak or no relationship among banking system-long-term growth nexus. As indicated earlier, even though adjusted net savings indicator has emerged as a useful weak sustainability indicator its relationship among certain variables including the variables of interest in this study is weak in magnitude (Gnegne, 2009; Ferreira, et al., 2008).

Table 8: Impacts of banking system stability on sustainable development for two periods – Traditional Index (GDP per Capita)

	FE		System GMM		Panel Quantile Regression with Fixed Effects					
	Period 1	Period2	Period 1	Period 2	Period 1			Period 2		
					.25	.5	.75	.25	.5	.75
lnlgdppc	0.801*** (0.021)	0.847 (0.023)	0.826*** (0.219)	0.974*** (0.009)	0.763*** (0.041)	0.803*** (0.035)	0.839*** (0.051)	0.858*** (0.027)	0.846*** (0.021)	0.835*** (0.030)
lnbsz	0.015** (0.006)	0.008 (0.003)	0.003 (0.013)	0.002 (0.004)	0.013 (0.010)	0.015* (0.008)	0.016 (0.012)	0.007 (0.005)	0.008** (0.004)	0.008 (0.005)
lnbsr	-0.035*** (0.013)	-0.018 (0.026)	-0.051 (0.040)	0.015 (0.015)	-0.030* (0.018)	-0.035** (0.016)	-0.040* (0.023)	-0.011 (0.027)	-0.018 (0.020)	-0.025 (0.030)
lnbla	0.003 (0.003)	0.012 (0.007)	0.033 (0.028)	-0.002 (0.005)	0.003 (0.005)	0.003 (0.004)	0.003 (0.006)	0.011 (0.009)	0.012* (0.007)	0.013 (0.010)
lnnpl	-0.030*** (0.003)	-0.009 (0.005)	-0.044*** (0.007)	-0.007** (0.003)	-0.034*** (0.005)	-0.030*** (0.004)	-0.026*** (0.006)	-0.011* (0.005)	-0.009** (0.004)	-0.007 (0.006)
lnbsc	0.002 (0.009)	0.017 (0.036)	-0.048 (0.050)	-0.001 (0.008)	0.006 (0.013)	0.002 (0.012)	-0.002 (0.017)	0.006 (0.034)	0.017 (0.026)	0.028 (0.038)
lnbcd	-0.011 (0.018)	0.002 (0.024)	0.025 (0.037)	0.006 (0.006)	-0.017 (0.020)	-0.011 (0.017)	-0.005 (0.025)	0.005 (0.021)	0.002 (0.016)	-0.001 (0.023)
lnltrade	0.043*** (0.013)	0.026 (0.014)	0.021 (0.030)	0.011 (0.006)	0.044* (0.026)	0.043* (0.022)	0.043 (0.033)	0.035** (0.017)	0.026** (0.013)	0.016 (0.019)
lnlfdi	0.004** (0.002)	-0.002 (0.002)	-0.002 (0.005)	0.002 (0.003)	0.005* (0.003)	0.004 (0.002)	0.003 (0.003)	-0.001 (0.002)	-0.002 (0.002)	0.001 (0.003)
lnlsec	0.074*** (0.017)	0.009 (0.022)	0.268*** (0.082)	0.043 (0.024)	0.094*** (0.032)	0.073*** (0.027)	0.054 (0.040)	0.013 (0.025)	0.008 (0.019)	0.004 (0.028)
lnlgfe	-0.012 (0.010)	0.018 (0.019)	-0.034 (0.085)	-0.036 (0.013)	0.002 (0.021)	-0.012 (0.018)	-0.025 (0.026)	0.003 (0.028)	0.018 (0.021)	0.035 (0.031)
lnlinf	-0.009*** (0.002)	-0.009 (0.002)	-0.012** (0.005)	-0.007 (0.003)	-0.010*** (0.004)	-0.009*** (0.003)	-0.008* (0.005)	-0.007*** (0.003)	-0.009*** (0.002)	-0.011*** (0.003)
Long-run Impacts										
lnbsz	0.074	0.000	0.000	0.000	0.000	0.075	0.000	0.000	0.050	0.000
lnbsr	-0.177	0.000	0.000	0.000	-0.128	-0.180	-0.249	0.000	0.000	0.000
lnbla	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.080	0.000
lnnpl	-0.149	0.000	-0.250	-0.248	-0.144	-0.150	-0.159	-0.074	-0.059	0.000
AR2			0.187	0.183						
Hansen			0.156	0.982						

Robust standard errors are in parentheses. ***p<0. 01, **p<0. 05, *p<0.1. Year dummies are included.

In Table 8, impact of banking system z-scores on sustainable development as proxied by GDP per capita exist among only countries on median sustainable development path for the two sample periods for both short-run and long-run. However, the impact is stronger for the period leading to the crisis than period after the crisis. The quantile regression result shows that there is a negative yet varied impacts of banking system regulatory capital to risk-weighted assets on sustainable development among countries on low and high sustainable development path for the period leading to the crisis but similar thing cannot be said for post crisis period. However, the result revealed a negative impact of non-performing loans on sustainability of countries on high sustainable development path for both periods. The impact is stronger for the period leading to the crisis than the post crisis period with a 1% increase in non-performing loans resulting in 0.033% and 0.026% (0.150% and 0.059%) decrease in sustainable development in the short-run (long-run) for countries on high sustainable development path for the two periods respectively. The results further confirms the studies of Arcand et al. (2012) and Rousseau and Wachtel (2011) who found vanishing effects of banking system variables. This implies the regulatory activities to stabilize the banking system to some extent have minimized the adverse effect of non-performing loans on sustainability of these countries.

Conclusion

This study investigated the impacts of banking system stability on sustainable development. We explored the impacts of banking system stability on sustainable development for the period 2000-2016 as well as the period leading to global financial crisis (2000-2009) and the period after the financial crisis (2010-2016) to provide empirical evidence of vanishing effects within the relationship. We investigated this phenomenon by employing econometrics frameworks of dynamic fixed effects, system GMM and panel quantile regression with fixed effects to provide robust results from the conditional mean-based and heterogeneous responses (parameter heterogeneity) approaches.

Based on the results, we conclude that, conditioning on other sustainable development determinants, banking system stability have significant impacts on sustainable development (indexed by ecological footprint and GDP per capita). Furthermore, the results provide empirical evidence of parameter heterogeneity response of sustainable development to banking system z-score, bank liquid assets to deposits and short-term funding, non-performing loans as percent of all bank loans and bank credit. Thus, the magnitude in which sustainable development responds to the impacts of these variables varies among countries on low and high sustainable development path with stronger impacts on low sustainable development path.

In addition, there exist vanishing adverse effects of banking system stability on sustainable development for post-financial crisis period compared to the period leading to global financial crisis. Thus, banking system z-score and bank liquid assets to deposits and short-term funding were contributing factors to sustainability of countries on low and median sustainable development path for the period leading to the crisis period but disappears after the crisis period where a number of regulations and initiatives have been put in place to stabilize the banking system. More importantly, the adverse effects of non-performing loans on sustainable development diminished after the crisis period compared to the period leading to crisis than especially for countries on high sustainable development path. This implies that the post crisis initiatives to some extent accounted for the vanishing adverse effects of non-performing loans on sustainable development.

In terms of policy recommendations, we advocates that countries at low sustainable development path especially developing countries could benefits more from aligning stable banking system with sustainable development agenda. For instance, a national agenda for banks and other financial institutions embracing green banking in their stabilization policies can help promote sustainable development. As a result, these countries stand to gain most (increase sustainable development) from stable banking system in the long-run. Secondly, we recommend new banking system stability initiatives including post crisis initiatives, which can go a long way to increase their sustainable development especially new initiatives to recover non-performing loans. In addition, banks especially in the developing economies should have comprehensive assessment policies and guidelines that will guide their lending behavior for projects in order to fund economically viable projects and minimize risky projects. Finally, future research could focus on establishing how stability in the banking system influence sustainability of developing or regional economies.

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Appendix

Table 1: Summary of Variables, Data Sources and Description

Variable	Description (we used log values of all the variables)
Dependent (SD)	
Adjusted Net Savings rate (ANSr)	ANSr (lnansr) is a useful measure of sustainability. It make available a useful measure of sustainability by determining the change in comprehensive wealth for a specified period. The study used inverse hyperbolic sine (IHS)-transformation
Ecological footprint	EF measures how much nature we have and how much nature we use.
Gross Domestic Product per Capita (GDPpc)	GDPpc (lngdppc) is gross domestic product divided by midyear population.
Independent (BSS)	
Non-performing loans as percent of all bank loans (NPL)	NPL (lnnpl) refers to a loan on which the borrower is not making any interest payments or repaying any principal.
Banking system z-scores (BSZ)	BSZ (lnbsz) captures the probability of default of a country's banking system.
Banking system capital percent of assets (BSC)	BSC (lnbsc) is the ratio of bank capital and reserves to total assets.
Bank credit as percent of bank deposits (BCD)	BCD (lnbcd) includes the financial resources given to the private sector by domestic money banks as a share of total deposits.
Bank liquid assets to deposits and short-term funding (BLA)	BLA (lnbla) refers the ratio of the value of liquid assets (easily altered to cash) to total deposits and short-term funding.
Banking system regulatory capital to risk-weighted assets (BSR)	BSR (lnbsr) is simply the capital adequacy of deposit takers.
Controlling (CV)	
Foreign direct investment (FDI)	FDI (lnlfdi) are the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor.
General government final consumption expenditure (GFE)	GFE (lnlgfe) includes all government current expenditures for purchases of goods and services (including compensation of employees).
Inflation, consumer prices (INF)	INF (lnlinf) measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services.
School enrollment, secondary (SES)	SES (lnlsec) is the total enrollment in secondary education, regardless of age, expressed as a percentage of the population of official secondary education age.
Trade Openness (TRADE)	TRADE (lnltrade) is the sum of exports and imports of goods and services measured as a share of gross domestic product.
Lagged Dependent Variables	The lagged dependent variables used in the study are the initial values of adjusted net savings rate (lnlansr), ecological footprint (llnef), GDP per capita (lnlgdppc).

Table 2: Mean and Standard Deviation

	Full Sample				Period 1 (2000-2009)				Period 1 (2010-2016)		
Variable	Obs	Mean	SD		Obs	Mean	SD		Obs	Mean	SD
lnef	1554	1.144	0.667		910	1.145	0.689		644	1.143	0.636
llnef	1462	1.145	0.670		818	1.146	0.694		644	1.144	0.638
lnansr	1552	2.307	1.805		908	2.372	1.747		644	2.217	1.880
llnansr	1460	2.307	1.799		826	2.397	1.740		634	2.198	1.864
lngdppc	1574	9.523	1.048		923	9.441	1.070		651	9.638	0.993
lnlgdppc	1481	9.512	1.051		830	9.430	1.083		651	9.617	0.999
lnbsz	1576	2.395	0.718		930	2.362	0.717		646	2.442	0.717
lnbsr	1574	2.722	0.265		923	2.678	0.290		651	2.781	0.214

lnbla	1581	3.359	0.553		930	3.432	0.575		651	3.254	0.501
lnnpl	1556	1.431	1.057		913	1.470	1.119		643	1.377	0.960
lnbsc	1523	2.151	0.397		902	2.108	0.417		621	2.215	0.356
lnbcd	1549	4.568	0.453		914	4.547	0.478		635	4.597	0.413
lnltrade	1481	4.337	0.519		830	4.310	0.513		651	4.371	0.524
lnlfdi	1429	1.077	1.176		805	1.107	1.228		624	1.037	1.104
lnlsec	1478	4.411	0.404		859	4.358	0.453		619	4.480	0.318
lnlgfe	1479	2.749	0.347		828	2.724	0.363		651	2.781	0.323
lnlinf	1440	1.255	1.012		830	1.382	0.995		610	1.083	1.011

Table 3: Correlations Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
lnef	1																
lnansr	0.15	1															
lngdppc	0.92	0.23	1														
lnbsz	0.02	0.14	0.05	1													
lnbsr	-0.13	-0.09	-0.16	-0.05	1												
lnbla	0.19	-0.05	0.13	-0.03	0.17	1											
lnnpl	-0.49	-0.30	-0.48	-0.17	0.10	-0.08	1										
lnbsc	-0.36	-0.24	-0.42	-0.07	0.63	-0.11	0.24	1									
lnbcd	0.23	0.02	0.26	-0.12	-0.22	-0.15	-0.15	-0.06	1								
llnef	0.99	0.15	0.92	-0.01	-0.13	0.19	-0.48	-0.37	0.24	1							
lnlansr	0.15	0.87	0.23	0.150	-0.10	-0.05	-0.30	-0.24	0.03	0.15	1						
lnlgdppc	0.92	0.23	1.00	0.05	-0.16	0.13	-0.47	-0.43	0.26	0.92	0.23	1					
lnltrade	0.35	0.11	0.25	-0.03	0.17	0.12	-0.14	-0.03	-0.02	0.34	0.11	0.24	1				
lnlfdi	0.21	0.02	0.15	0.03	0.05	0.13	-0.24	-0.02	0.05	0.22	0.02	0.15	0.40	1			
lnlsec	0.74	0.18	0.78	-0.08	-0.01	0.09	-0.36	-0.23	0.33	0.74	0.17	0.77	0.24	0.22	1		
lnlgfe	0.56	0.08	0.48	-0.04	-0.05	0.14	-0.19	-0.19	0.28	0.57	0.05	0.48	0.31	0.15	0.53	1	
lnlinf	-0.36	-0.17	-0.43	-0.23	0.15	-0.08	0.21	0.33	-0.12	-0.34	-0.16	-0.43	-0.12	0.05	-0.28	-0.30	1

1.lnef, 2.lnansr, 3.lngdppc, 4.lnbsz, 5.lnbsr, 6.lnbla, 7.lnnpl, 8.lnbsc, 9.lnbcd, 10.llnef, 11.lnlansr, 12.lnlgdppc