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Multidimensional poverty in Nigeria: First order dominance approach

Olu Ajakaiye,¹ Afeikhena T. Jerome,² Olanrewaju Olaniyan,³
Kristi Mahrt,⁴ and Olufunke A. Alaba⁵

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Abstract: This study appraises non-monetary multidimensional poverty in Nigeria using the novel first order dominance approach developed by Arndt et al. (2012). It examines five dimensions of deprivation: education, water, sanitation, shelter, and energy-using comparable datasets, the Nigeria Demographic and Health Surveys of 1999, 2003, and 2008 for national, regional, and zonal analysis, and the Harmonized Nigeria Living Standard Survey of 2008/09 as well as the Nigeria Living Standard Survey of 2003/04 for state analysis. The results are quite robust and lend support to the general view that poverty in Nigeria has not kept pace with the rapid economic growth attained in the last decade. The country registered only fewer gains in non-income poverty. There was a marginal change of -0.21 in the percentage of the population experiencing acute deprivation between 1999 and 2008 and only one of the indicators (sanitation) recorded a substantial positive change. The spatial first order dominance comparisons indicate that regional inequalities remain profound with huge disparities in states as shown by the bootstrap. Ten of the worst-ranked states are located in the northern part of the country.

Keywords: development, multidimensional poverty, ordinal dominance, welfare, well-being, Nigeria

JEL classification: I30, I31, I32, O12

¹African Centre for Shared Development Capacity Building, Ibadan, ajakaiye_olu@yahoo.com; ²Secretariat of Nigeria Governors' Forum, Abuja, ajerome4@hotmail.com; ³Department of Economics, University of Ibadan, lanreolaniyan@yahoo.co.uk; ⁴Development Economics Research Group, University of Copenhagen, kamahrt@gmail.com; ⁵School of Public Health and Family Medicine, University of Cape Town, olufunke.alaba@uct.ac.za

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UNU-WIDER, Katajanokanlaituri 6 B, 00160 Helsinki, Finland, wider.unu.edu

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1 Introduction

The latest consistent estimates of global poverty (World Bank 2012) indicate that 47.5 per cent of Sub-Saharan Africa's population, or 386 million people, lived below the poverty line of US\$1.25 a day in 2008, down from 51.5 per cent in 1981. About nine million fewer people lived on less than US\$1.25 a day in 2008 than in 2005. A number of factors have contributed to this trend prominent among which is sustained economic growth. Africa has indeed turned the corner, attaining more than 5 per cent annual gross domestic product (GDP) growth over the period 2001–10, thus becoming the second highest growing region in the world (Ajakaiye and Jerome 2014).

Nonetheless, there are marked disparities in the rate of decline in poverty between Africa and other regions of the world. Apart from lagging behind, the decline in both absolute and relative poverty in Africa is considered too slow and this issue has been of concern. In the quest to unravel the poor performance, which, to a large extent, is the result of lack of inclusiveness in African growth, Fosu (2011) and the African Development Bank (2012) estimated that the elasticity between growth and poverty was equal to -1.7 for the African continent compared with -2.0 and -3.1 for South Asia and Latin America and the Caribbean, respectively. The African Development Bank (2012) also noted that persistent inequalities might have impeded the responsiveness of poverty to economic growth.

Moreover, the wide disparities in poverty between African countries are equally of great concern. For instance, although Morocco, Gambia, Senegal, Cameroon, Ethiopia, and Ghana have made significant progress towards poverty reduction, other countries such as Côte d'Ivoire and Nigeria have experienced increases in the level of extreme poverty, reinforcing the interest on growth without development.

Nigeria, no doubt, typifies a country that has had rapid economic growth but worsening poverty. The Nigerian economy grew strongly at an average annual rate in excess of 6 per cent over the last decade, even during the global financial crisis (IMF 2013), ranking Nigeria as one of the fastest growing economies globally. The International Monetary Fund Staff Report on the 2012 Article IV Consultation also indicated a promising outlook for the Nigerian economy.

In spite of this strong growth performance, the poverty incidence has remained high, rising from 42.7 per cent in 1992 to 65.6 per cent in 1996, with an all-time high of 69 per cent in 2010, according to data from the National Bureau of Statistics (NBS 2012). Furthermore, the benefit of growth has not been equitably shared as income inequality increased from 0.42 per cent in 2004 to 0.45 per cent in 2010. Therefore, the theoretical arguments and empirical evidence from the literature that associate faster economic growth with poverty reduction seem to be failing in the Nigerian context. Not surprisingly, major issues in policy debates include how to proffer explanations and reconcile this paradoxical trend, and the need to investigate the key mechanisms through which growth can be translated into sustainable poverty reduction. This, no doubt, would require adequate measurement of poverty, an issue to which researchers and policy makers have given much prominence in recent years.

This paper seeks to contribute to the debate by estimating poverty in Nigeria using the multidimensional first order dominance (FOD) approach developed by Arndt et al. (2012). It makes a distinct contribution to the literature as few studies exist on multidimensional poverty in Nigeria.

This includes Oyekale et al. (2009) which used the fuzzy set approach to assess the poverty profile of rural households in Nigeria based on the 2006 Core Welfare Indicator Survey data and Adetola and Olufemi (2012) which employed the Alkire and Foster (2007) counting approach to examine child poverty in rural Nigeria using the 2008 Demographic and Health Survey data.

Poverty is increasingly being viewed as multidimensional (Ravallion 2011) because the poor suffer from a range of deficiencies including low levels of income and illiteracy, and relatively high levels of mortality, poor infrastructure, and poor access to basic needs such as food, shelter, and clothing (Mehta 2005). This complexity has thus led to recognition of the inability to capture the essence of poverty with a single indicator. As a result, the literature is converging to the fact that poverty is multidimensional in nature (Ferreira and Lugo 2012). This has also given rise to refinement in the methodology used, especially in addressing the issue of aggregating multiple dimensions.

Despite efforts to measure multidimensional poverty and social exclusion in many countries using a variety of approaches, no consensus has emerged about the best poverty measure that could, for example, allow for better targeting of the poor and suggest more effective poverty-reduction policies.

In this study, we intend to measure the evolution of poverty across time and space within Nigeria's 36 states and the Federal Capital Territory as well as the six geopolitical zones. Using the FOD method developed by Arndt et al. (2012), we are able to compare these sub-populations using multiple-ordinal, discrete measures of poverty without imposing weighting schemes or making assumptions about the preferences for each indicator. The FOD method allows multidimensional welfare comparisons based on the simple criterion that it is better to be non-deprived than deprived in any indicator. Furthermore, while the welfare indicators are ordinal in nature, the application of bootstrap sampling produces probabilities of one population performing better than another, which enables population ranking across time and space.

The remainder of the paper is structured as follows. Section 2 reviews the poverty and inequality situation in Nigeria, drawing on available data from the NBS, while Section 3 presents the methodology. The results are presented in Section 4 and Section 5 concludes.

2 Situation analysis of growth, poverty, and inequality in Nigeria

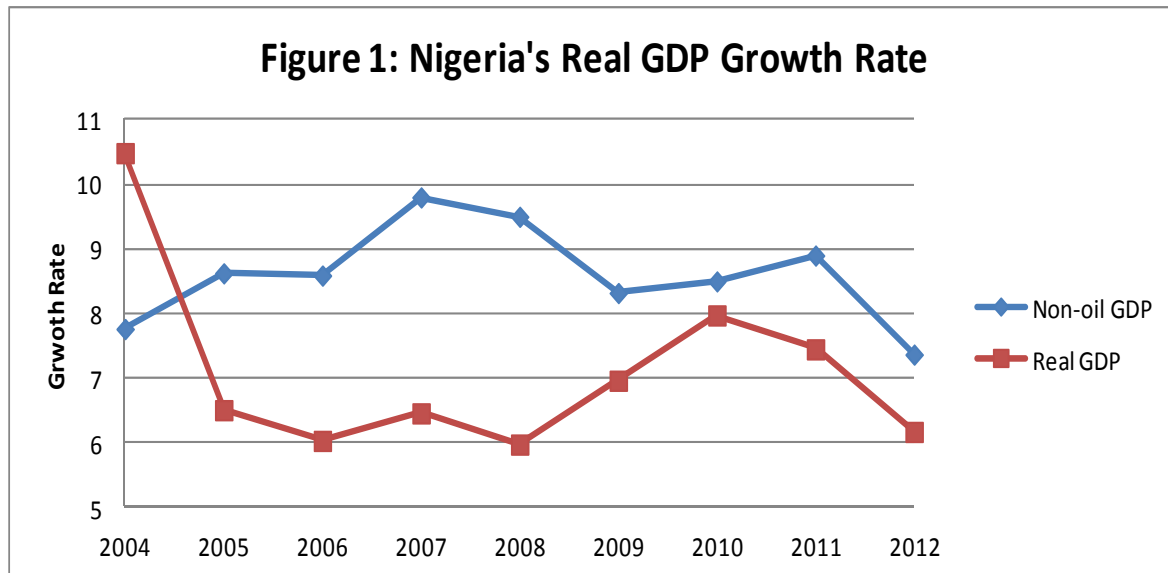
2.1 Economic growth

The depth and persistence of Nigeria's economic failure is well recognized. After a brief spurt of growth in the 1960s, the concurrence of political instability, an inert economic structure, and chronic levels of poverty despite huge hydrocarbon reserves have been recurrent decimals. Economic stagnation, declining welfare, and social instability have undermined development for most of the post-independence period despite generating about US\$500 billion as oil revenues in the past three decades (Ajakaiye and Jerome 2011).

Over the last ten years, Nigeria has turned the corner, implementing an ambitious reform agenda. Sound macroeconomic policies combined with structural reforms, aimed at increasing the supply

responsiveness of the economy, ushered in sustained high growth averaging 7.6 per cent over the last decade and one of the highest in Africa¹ (see Figure 1).

Figure 1: Nigeria's real GDP growth rate, 2004–12



Source: Underlying data based on Central Bank of Nigeria (2012).

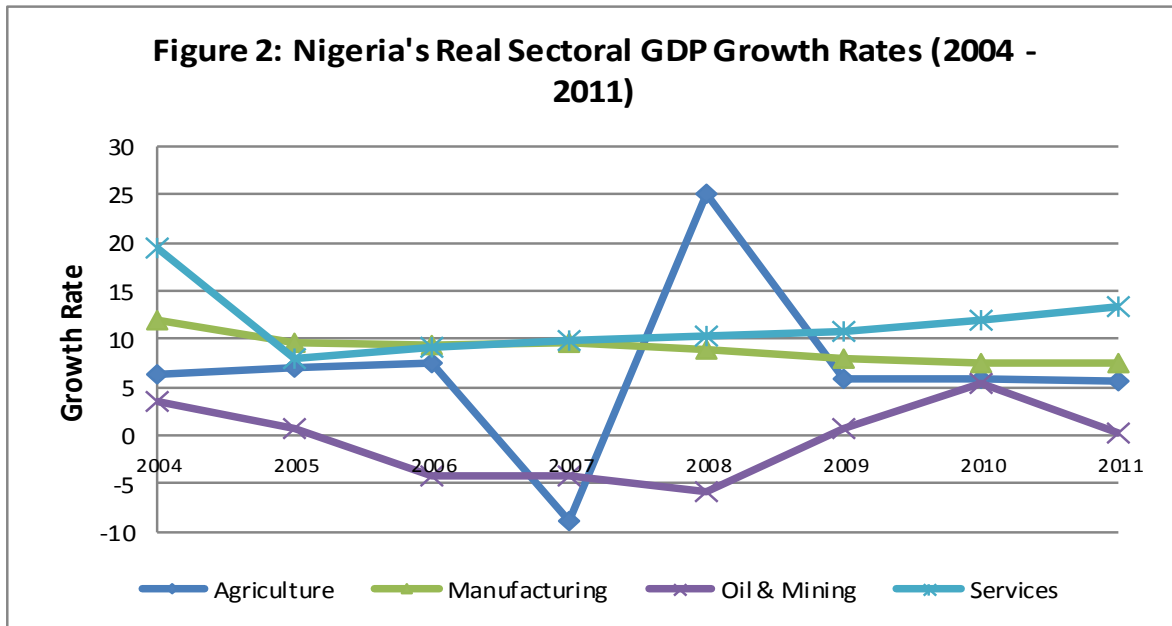
The profile of the Nigerian economy must consider the differential roles of the oil and non-oil sectors. The oil sector is the major export earner for the country as well as the largest revenue-earning sector for government. Figures 1 and 2 indicate that growth in the oil sector has been lagging behind growth in the non-oil sector in recent years. The drop in crude-oil production was a result of large-scale oil theft² and other operational constraints experienced by some of the oil-producing companies. Within the non-oil sector, agriculture and services, especially the communication sector, are the main growth drivers. Agriculture has maintained its dominant role in the Nigerian economy, though it is still essentially rain-fed, while farmers have suffered tremendous crop failure as a result of climate change.

While data on the geographic distribution of growth in Nigeria are still scanty, it does seem that growth has a very high geographic concentration and varies remarkably at the sub-national level as the World Bank (2013) rightly observes. Lagos state, for example, which accounts for about 35 per cent of the national GDP, is experiencing exceptionally rapid growth, which enabled it to reduce its poverty headcount from an estimated 44 per cent of the population to 23 per cent between 2004 and 2010.

¹ The rebasing of Nigeria's GDP in April 2014, to better reflect the structure of the economy, saw it surge after South Africa to become Africa's largest economy with a revised GDP estimate of US\$454 billion in 2012 and US\$510 billion in 2013 (compared with the US\$259 billion and US\$270 billion that were previously reported), confirming Nigeria's lead as the continent's largest economy.

² A recent study by Katsouris and Sayne (2013) estimated that an average of 100,000 barrels per day was stolen in the first quarter of 2013.

Figure 2: Nigeria's real sectoral GDP growth rates, 2004–11



Source: Underlying data based on Central Bank of Nigeria (2012) Statistical Bulletin.

2.2 Poverty

Poverty is widespread in Nigeria no matter the method used in computing it and the incidence has been on the rise over the last ten years.³ Using food-energy intake to measure poverty, the 2010 Nigeria Poverty Profile Report reveals that poverty incidence rose from 27.2 per cent in 1980 to 69.0 per cent in 2010 (NBS 2012).⁴ Urban poverty has been consistently lower than rural poverty; hence while 61.8 per cent of urban residents were considered poor in 2010, more than 73 per cent of rural dwellers fell into the same category (Table 1).

³ The NBS periodically conducts the Harmonized Nigeria Living Standard Survey (HNLSS), which is used, among other things, to determine poverty and inequality trends in the country. The HNLSS uses four different approaches in the computation of poverty indicators: *relative poverty*, which is defined by reference to the living standards of the majority in a given society and separates the poor from the non-poor; *absolute poverty*, which reflects the minimal requirements necessary to afford minimal standards of food, clothing, healthcare, and shelter; the *basic needs approach*, which measures the proportion of those living on less than US\$1 per day poverty line; and *subjective poverty*, which is based on opinions from respondents on whether or not they consider themselves poor.

⁴ Concerns have been expressed about the comparability of surveys through time. The figures presented in Tables 1, 2, and 3 should be interpreted with this in mind.

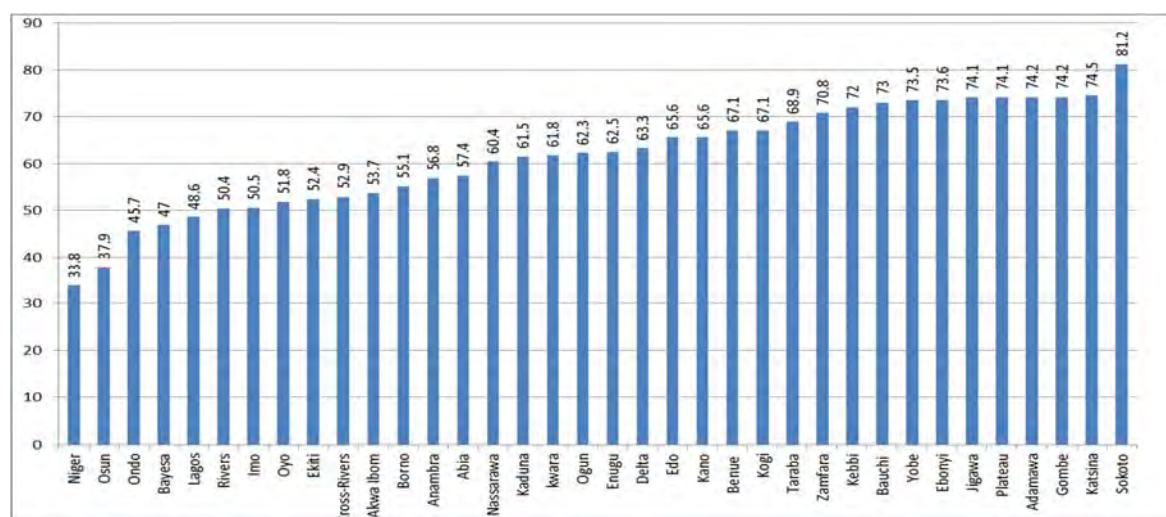
Table 1: Incidence of poverty by sector and zones, 1980–2010 (%)

Levels	1980	1985	1992	1996	2004	2010
National	27.2	46.3	42.7	65.6	54.4	69.0
Urban	17.2	37.8	37.5	58.2	43.2	61.8
Rural	28.3	51.4	46.0	69.3	63.3	73.2
Geopolitical zones						
North Central	32.2	50.8	46.0	64.7	67.0	67.5
North East	35.6	54.9	54.0	70.1	72.2	76.3
North West	37.7	52.1	36.5	77.2	71.2	77.7
South East	12.9	30.4	41.0	53.5	26.7	67.0
South South	13.2	45.7	40.8	58.2	35.1	63.8
South West	13.4	38.6	43.1	60.9	43.0	59.1

Source: NBS (2009, 2012).

Poverty also appears to be more prevalent in the northern part of the country with the highest rates hovering between the North East and North West zones. The high poverty rate had even become more pronounced by 2010 as virtually all the zones of the country had over 60 per cent poverty incidence (See Figure 3).

Figure 3: 2010 poverty rates by states of the Federation



Source: Adapted from estimates by NBS (2012).

As shown in Figure 3, Niger state had the lowest poverty rate followed by Osun and Ondo. On the other hand, Sokoto remained the poorest state in the country while all but one of the other states with a poverty rate of over 70 per cent were in the northern zones of the country. These were Katsina, Adamawa, Gombe, Jigawa, Plateau, Bauchi, Kebbi, and Zamfara. Ebonyi, in the South East zone, was the other state with a poverty rate exceeding 70 per cent.

In addition to poverty incidence, income inequality has been consistently high in the country although with some reduction in 1992 and 2004 (NBS2012). Using the Gini coefficient, income inequality in the country increased between 1985 and 2010. Although national income inequality fell between 1985 and 1992, it rose in 1996, declined in 2004, and rose again in 2010 (Table 2). With the exception of 1985 and 1996, inequality has been higher in the rural areas relative to the urban areas, which is probably accounted for by the structure of employment and income in the rural areas. The agricultural sector has consistently been neglected until recently due to the dominance of the oil sector in the economy. Faced with the inability to invest in skills acquisitions like those in the urban areas, the predominantly rural population has become more vulnerable to poverty. Considering zones, in 2010 income inequalities were highest in the North East and lowest in the North West and South West.

Table 2: Inequality trend by area of residence and zones, 1980–2010

Levels	1985	1992	1996	2004	2010
National	0.43	0.41	0.49	0.42	0.45
Urban	0.49	0.38	0.52	0.41	0.43
Rural	0.36	0.42	0.47	0.42	0.44
Geopolitical zones					
North Central	0.41	0.39	0.50	0.44	0.42
North East	0.39	0.40	0.49	0.41	0.45
North West	0.41	0.43	0.47	0.40	0.41
South East	0.44	0.40	0.39	0.38	0.44
South South	0.48	0.39	0.46	0.39	0.43
South West	0.43	0.40	0.47	0.41	0.41

Source: NBS (2009, 2012).

Income inequality is further demonstrated in the share of income held by the top richest and the bottom poorest in the country. As revealed in Table 3, there is a very high disparity between the income of the richest and poorest deciles of the population. In 1986, the income of the poorest 10 per cent of Nigeria's population was only 2.47 per cent, while that of the richest 10 per cent was 28.21 per cent. Curiously, the income share of the richest 10 and 20 per cent increased from 28.21 and 45.01 per cent, respectively in 1986 to 37.1 and 52.11 per cent in 1996, declined to 32.42 and 48.61 per cent in 2004, and then jumped to 38.23 and 54.01 per cent in 2010. This clearly defines Nigeria's paradoxical status as a rich country with poor people; a country whose richest 20 per cent controlled 54.01 per cent of income in 2010 while most of the remaining 80 per cent were poor and struggled to live. Apparently, a more equal distribution of Nigeria's income would assist greatly in curbing the increases in poverty rate.

Table 3: Income shares distribution, 1986–2010

Year	Income share held by the rich		Income share held by the poor	
	10%	20%	10%	20%
1986	28.2	45.0	2.5	6.0
1992	31.5	49.4	1.4	4.0
1996	37.1	52.1	1.9	5.0
2004	29.9	46.1	2.2	5.6
2010	32.8	48.9	2.2	5.4

Source: World Bank (2014).

3 Methodological issues

3.1 Introduction

Poverty has traditionally been measured in one dimension—usually income or consumption. The variable is typically assumed to be cardinal and identification typically proceeds by setting a poverty line corresponding to a minimum level below which one is considered poor. Aggregation is usually achieved through the use of a numerical poverty measure that determines the overall level of poverty in a distribution given the poverty line.

With a greater understanding of poverty as a complex phenomenon with multidimensional properties and effects (Sen 1973), there has been a shift from the conventional one-dimensional approaches to measuring poverty, inequality, and welfare using monetary values such as household income or expenditure per capita. These traditional, but still relevant approaches, including the much applied Foster-Greer-Thorbecke approach (Foster et al. 1984), determine poverty relative to a poverty line.

However, these single dimensional measures are being overtaken by a multidimensional concept where both monetary and non-monetary measures of deprivation are integrated. More advanced approaches have evolved over time to assess living standards and make comparisons within a multidimensional framework since the pioneering efforts of Tsui (2002) and Bourguignon and Chakravarty (2003). The challenge, however, has been to empirically define and aggregate relevant attributes as well as determine the minimum thresholds that can capture differences in levels of deprivation rather than choices and tastes (Layte et al. 2001).

The measurement of multidimensional poverty or welfare can be conceptualized as following two main steps: identification and aggregation. In order to select indicators, most analysts have gone with the basic needs approach (Streeten et al. 1981). Various social determinants are identified to define whether a person is poor or not, including health, education, shelter, clothing, and access to information. However, the identification and choice of dimensions, as Alkire (2008) argues, is a value judgement rather than a technical exercise and is more context specific.

The next step is the complex process of aggregation. The process is complex because great consideration is needed in valuing the various indicators to arrive at a multidimensional measure of poverty or well-being. The importance and weights to be ascribed to each dimension that contributes to the multidimensional poverty threshold is subjective and various weighting schemes have evolved over time.

Some approaches that have been adopted to handle the aggregation problem⁵ are axiomatic and extensions of uni-dimensional poverty indices (Tsui 2002; Atkinson 2003; Bourguignon and Chakravarty 2003). Other non-axiomatic approaches in the literature include the fuzzy set approach (Cerioli and Zani 1990; Cheli and Lemmi 1994; Chiappero-Martinetti 2006), the distance function method (Lovell et al. 1994; Anderson et al. 2005), the information theory approach (Maasoumi 1993; Deutsch and Silber 2005; Maasoumi and Lugo 2008), the inertia approach and factor analysis (Klasen 2000; Sahn and Stifel 2003), and methods from the psychometric literature (Wagle 2005; Di Tommaso 2007; Krishnakumar and Ballon 2008).

No matter the approach adopted, there are several methodological difficulties in implementing a truly multidimensional analysis of poverty. In performing such a task, a number of intrinsically arbitrary measurement assumptions are often made, consisting inter alia of choosing aggregation procedures across dimensions of well-being as well as across individuals and deciding on multidimensional poverty lines to separate the poor from the non-poor. Each of these choices raises concerns over the possible non-robustness of the results that are obtained (Batana and Duclos 2010).

Indeed, a controversy is raging in the literature.⁶ While there is a consensus that deprivations exist in multiple domains, and are often correlated, the disagreement is about how best to *measure* this multidimensional poverty in such a way that will be useful for analysts and policy makers. There is a debate as to whether the multiple indicators of deprivations should be brought together into a composite index or not. Some researchers like Alkire and Foster (2011) and Maasoumi and Lugo (2008), have proposed scalar indices that seek to combine, in a single number, information from those various dimensions. Others, such as Ravallion, have opted for a ‘dashboard approach’ whereby efforts and resources are focussed on developing the best possible set of ‘multiple indices’ with unique characteristics of the various dimensions rather than a single ‘multidimensional index’ (Ravallion 2011). Ferreira and Lugo (2012), on the other hand, argue that the single index, versus a ‘dashboard’, is a false dichotomy. Particularly, the dependency structure is lost entirely by the dashboard approach and often blurred by scalar indices and therefore what is needed is a middle-ground approach that considers the interrelationship among dimensions.

Arndt et al. (2012) apply the FOD approach to examine the distribution and evolution of child poverty in Vietnam and Mozambique using multiple-ordinal, discrete welfare indicators. This method is a significant contribution to the literature in that it does not impose a weighting scheme or ad hoc simplifying assumptions on the social welfare function. No assumptions are made about preferences for one indicator over another. The only criterion the method imposes is that it is better to be non-deprived than deprived in any indicator (Arndt et al. 2012; Sonne-Schmidt et al. 2008). This is the approach adopted in this study.

⁵ See Batana (2008) for a good overview and summary of the different applications.

⁶ The Forum section of the June 2011 edition of the *Journal of Economic Inequality* was dedicated to the debate on multidimensional poverty measurement with contributions from Alkire and Foster (2011); Ravallion (2011); and Lustig (2011).

3.2 Analytical framework – multidimensional first order dominance approach⁷

FOD⁸ is a simple form of stochastic ordering applied in decision situations characterized by a probability distribution over possible binary outcomes. The approach, which describes the criterion in which one distribution can be ranked unambiguously ‘better’ than another, allows us to make welfare comparisons between two populations on the basis of a series of discrete, ordinal welfare indicators without imposing arbitrary weighting schemes or conditions on the social welfare function (Arndt et al. 2012).

This approach is well established in the theory of one-dimensional⁹ and multidimensional FOD.¹⁰ Focussing on the multidimensional case, consider the welfare distribution of two populations as multidimensional probability mass functions f and g over a finite subset of outcomes X of R^n . Then f first order dominates g if any of the following equivalent conditions hold.¹¹

- i.* g can be obtained from f by definite number of shifts of density from one outcome to another that is less desirable.
- ii.* Social welfare is at least as high for f and g i.e. $\sum_{x \in X} f(x) w(x) \geq \sum_{x \in X} g(x) w(x)$ for every non-decreasing additively separable social function w .
- iii.* $\sum_{x \in Y} g(x) \geq \sum_{x \in Y} f(x)$ for any comprehensive set $Y \subseteq X$. [n.t. A set Y is comprehensive if $x \in Y, y \in X$ and $y \leq x$ implies $y \in Y$].

The most intuitive condition is (*i*) and it implies that if FOD is observed between two population distributions then the dominating population is unambiguously better than the other.

Given the strict criteria of FOD, the approach has several shortcomings. Because FOD analysis does not impose assumptions about the relative value of different indicators, it is possible the FOD criteria cannot determine whether one population dominates or is dominated by another population. The welfare ranking in this case is indeterminate. Furthermore, FOD does not provide information on the extent to which any population dominates another.

These shortcomings can be overcome through bootstrap sampling. In comparing repeated bootstrap samples, we obtain the empirical probability of domination, which provides an estimate of the extent to which one population dominates another. Furthermore, the probability of net domination (the probability a population dominates all other populations minus the probability that a population is

⁷ This section relies heavily on Arndt et al. (2012).

⁸ Note that FOD criterion differs from the Atkinson-Bourguignon class of robust welfare comparison criteria (Atkinson and Bourguignon 1982, 1987), which make stronger assumptions about the underlying welfare function than FOD criterion and are classified under Orthant stochastic orderings (see Arndt et al. 2012)

⁹ See Osterdal (2010) and Arndt et al. (2012) for detailed discussion

¹⁰ See Lehmann (1955), Strassen (1965), Levhari et al. (1975), Grant (1995) (cross ref from Arndt et al. 2012)

¹¹ See equivalence proofs in Lehmann (1955), Strassen (1965), Levhari et al. (1975), Osterdal (2010), Kamae et al. (1977) (cross ref from Arndt et al. 2012)

dominated by all other populations) can be interpreted as a cardinal measure of welfare, which provides the basis to rank populations.

3.3 Choice of welfare indicators

Poverty can be reflected in various broad dimensions and, as Sen (2004) suggested, the judgement and selection of relevant indicators should be driven by two underlying factors. These are: context specificity, i.e. indicators that are special to the society in question; and indicators that could focus appropriately on public policy by way of external influence.

The selection of the indicators should be in line with internationally accepted criteria and studies on multidimensional basic-needs poverty outcomes such as the UN Human Development Indicators as well as the relevant measurement indicators of the United Nations' Millennium Development Goals (MDGs). The choice of appropriate indicators is further restricted by the availability of data. The five relevant indicators used in this study are education, water, sanitation, shelter, and energy.

Education

Education acts as a proxy for the level of literacy, knowledge, and understanding that household members possess. The proxy used to measure education is whether someone in *the household has three years of schooling*. Since basic education in Nigeria begins at the age of six, a household is considered deprived if no family member aged nine years and above has completed three years of schooling. Although years of schooling may not capture completion of school or quality of education, it has been found to be a robust proxy and it follows the effective literacy idea of Basu and Foster (1998); all household members benefit from the abilities of a literate individual in the household, regardless of each person's actual level of education.

Apart from the fact that the country is committed to the achievement of universal basic education as one of the MDGs, it should be noted that education is a shared responsibility of the Nigerian federal, state, and local governments. However, primary education is largely the responsibility of local government.

Energy/power

The second indicator is electricity. Electricity is essential to quality of life. Availability of electric power enables people to independently pursue a wide range of economic activities that could generate income and sustain livelihood of the household; it is thus related indirectly to the first MDG. Furthermore, availability of government-supplied electricity is known to be a safer means of lighting and the supply can be used as a government performance indicator. However, electric power supply in Nigeria does not meet the needs of its citizens. The cost of failure in electricity supply does not affect households' socio-economic status alone, but also the growth path of the nation (Akinlo 2012). Thus a household without access to main government electricity or a generator is assumed to be energy-power deprived.

Water, sanitation, and shelter

In addition, there are three important and often applied indicators of welfare, namely safe drinking water, access to good sanitation facilities, and appropriate dwellings (shelter). They are core drivers of health and standards of living, as well as the MDGs, which provides a strong basis for their inclusion

in the MDG indices. Although they can be integrated, this study chose to apply them individually in its analysis.

The responsibility for providing these three important drivers of health and welfare are shared between governments and private individuals. The responsibility for water supply is shared among the three levels of government. The federal government is in charge of water resource management; the state is responsible for urban water supply; and local government for rural water supply. Water supply remains one of the core measures of performance of government. Yet, access to improved water sources remains a challenge in Nigeria. In the case of improved sanitation, even though the responsibility is not well defined, it is expected that the states would create an appropriate sewage system. While maintaining consistency among years and surveys, we tried as much as possible to align our definition of deprivation in water and sanitation with the WHO/UNICEF Joint Monitoring Programme's definitions of improved sanitation and water sources.¹²

Even though shelter is an individual rather than governmental responsibility, the lack of adequate shelter is an indicator of limited income. Also, inadequate shelter contributes to low life-expectancy and health and effective intervention in the housing/shelter capability of the population will impact on labour productivity.

A household with no good flooring material is classified as shelter-deprived, which includes flooring material made of dirt, sand, or dung.

3.4 Data sources

Two data sources provided five datasets that were used in this study. The Harmonized Nigeria Living Standard Survey (HNLSS) of 2008/09 and the Nigeria Living Standard Survey (NLSS) of 2003/04, both from the NBS, were used in the state-level analysis. The Nigeria Demographic Health Surveys (DHS) of 1999, 2003, and 2008 were used for national, zonal, and sectoral analysis.

The 1999, 2003, and 2008 DHS are nationally representative surveys covering both urban and rural households. The surveys follow a stratified cluster sampling design. Details of the research design can be found in the final reports (NPC and ORC Macro 1999, 2004, and NPC and IFC Macro 2009). As indicated in the surveys, 7,647, 7,225, and 34,070 households were surveyed in 1999, 2003, and 2006, respectively. Due to the removal of missing values, 7,354, 7,121, and 32,896 households in 1999, 2003, and 2008 were utilized for the analysis.

Although, the DHS would have been used for all the analysis, the sample strata and clusters were different in the three datasets. In the 1999 and 2003 DHS, the strata were regions and urban/rural sectors whereas in 2008 they were states and urban/rural sectors. Consequently, several of the states had an insufficient number of clusters in 1999 and 2003 to give meaningful results. This implied that we had to merge states and due to structural differences within states this idea was rejected. Therefore, to maintain consistency the 2008/09 HNLSS and the 2003/04 NLSS were used for the state analysis.

The HNLSS and the NLSS are both nationally representative datasets covering the 36 states of the Federation and the Federal Capital Territory. Both surveys used the National Integrated Survey of Household framework and employed multi-stage sampling, stratified by states. Each of the surveys

¹² A detailed description can be found at <http://www.wssinfo.org/definitions-methods/watsan-categories/>

was conducted by the NBS and the comparability between them was high even though the HNLSS had a greater scope than the NLSS. The HNLSS is the combination of the NLSS and the Core Welfare Indicators Questionnaire (NBS2012).

In the 2003/04 NLSS, clusters of 120 housing units called enumeration areas (EA) were randomly selected from each state and the Federal Capital Territory (FCT, Abuja) for the first stage. The second stage involved random selection of five housing units from the selected EAs. A total of 600 households were randomly chosen in each of the states and 300 from the FCT, summing up to 21,900 households.

In the case of the 2008/09 HNLSS, the welfare component was conducted in 77,400 households, which is an average of 100 households per local government area. In addition to the household questionnaires, a consumption module was also included and covered 50 households in each local government area, which means 38,700 households were interviewed. Both the household welfare questionnaire and the consumption module were linked together to produce the Nigeria Poverty Profile.

The final sample sizes used for analysis were 19,158 households from the NLSS and 70,534 households from the HNLSS. The observed differences between the original and the final figures were due to missing information.

From the two sets of surveys, five binary welfare indicators were identified with careful attention to define the variables as consistently as possible across surveys. The indicators are defined as follows:

Water: a household is not deprived if the household's water source is piped water, well water, or rainwater.

Sanitation: a household is not deprived if the household uses a flush toilet, an improved, ventilated pit latrine, or a composting toilet.

Access to electricity: in the DHS, a household is not deprived if the household has access to electricity. In the HNLSS and NLSS, a household is not deprived in electricity if the household's main source of lighting is electricity from mains electricity or electricity from a generator.¹³

Shelter: a household is not deprived if the household has flooring made of a material other than dirt, sand, or dung.

Education: a household is not deprived if any household member has completed three or more years of schooling at the primary level or above.

3.5 Analysis

With the indicators chosen, the FOD approach allows comparison between populations over time, on the basis of a series of binary ordinal welfare indicators. Therefore, the binary variables were created

¹³ In the HNLSS a main source of lighting and an additional source of lighting were identified whereas in the NLSS only one source was identified. For consistency, in the HNLSS the indicator is defined using only the main source of lighting.

for each indicator, where ‘1’ is the good outcome (non-deprived) and ‘0’ is the bad outcome (deprived). Therefore, the outcome (0,0,0,0,0) indicates deprivation in all indicators of well-being while the outcome (1,1,1,1,1) means non-deprivation in all of the dimensions.

FOD operates through the principles of the linear programming. To overcome the possibility of indeterminate outcomes of dominance, the bootstrapping approach was applied and the final output can be empirically interpreted as the probability that population A dominates population B or vice-versa. Bootstrapping is a computational non-parametric technique for re-sampling and enables conclusions to be drawn based on the characteristics of the population. We ran the bootstrap analysis with 100 replicates.

The analyses were conducted using Stata 12 (Stata Corp. Inc. TX, USA) and for the linear programming, the algorithm written by Arndt et al. (2012) using CONOPT solver (Drud 2008) in the General Algebraic Modelling System (GAMS Development Corp., Washington, DC, USA) was utilized.

The analysis captured both spatial and temporal welfare domination for states, geopolitical zones, and sectors. Temporal FOD analysis measures domination of one time period over another in the same population. For each population (states, geopolitical zones, and sectors) due to the availability of three datasets, we defined three possibilities of temporal domination as follows:

- 0: neither 2003 FOD 1999 nor 1999 FOD 2003
 neither 2008 FOD 1999 nor 1999 FOD 2008
 neither 2008 FOD 2003 nor 2003 FOD 2008
- 1: 2003 FOD 1999
 2008 FOD 1999
 2008 FOD 2003
- 1: 1999 FOD 2003
 1999 FOD 2008
 2003 FOD 2008

These possible outcomes are averaged over all bootstrap iterations for each of the three combinations of years to obtain a net domination score.

4 **Results and discussion**

The analyses were conducted at the national, zonal, sectoral (rural and urban), and state levels. Five binary indicators were selected as mentioned above, and the number of possible welfare combinations we arrived at is $2^5=32$, giving us 32 comparator sub-groups. The national, zonal, and sectoral results are based on the 1999, 2003, and 2008 DHS datasets while the state results are from the 2003/04 NLSS and 2008/09 HNLSS datasets.

4.1 **Households according to welfare indicators**

Table 4 presents the proportion of Nigerian households that are not deprived by the five different welfare indicators at national, zonal, and sectoral levels based on the 1999, 2003, and 2008 DHS datasets. It also reports the percentage change of households not deprived by welfare indicators over

the three periods. Nationally, the table indicates a positive change in welfare indicators between 1999 and 2008 with the exception of education, which had a small negative change of -0.01 per cent. However, the proportion of Nigerian households that had access to electricity declined from 51.08 per cent in 2003 to 47.76 per cent in 2008 and a similar decrease can be observed for shelter (64.38 per cent in 2003 and 61.78 per cent in 2008).

The change in deprivation levels from 1999 to 2008 varies across welfare indicators and areas. Both the urban and rural sectors experienced deterioration in two indicators between 1999 and 2008—water and electricity for urban populations and shelter and education for rural areas. The North Central zone performed the worst with negative changes in all welfare indicators except sanitation.

Table 4: Proportion and percentage change of households not deprived, by welfare indicator and year

	Water				Sanitation				Electricity			
	1992	2003	2008	Change	1992	2003	2008	Change	1992	2003	2008	Change
National	68.9	70.0	73.5	0.07	18.6	15.8	40.2	1.16	44.6	51.1	47.8	0.07
Rural	59.9	64.9	68.1	0.14	9.6	7.4	30.2	2.16	28.0	34.5	29.8	0.06
Urban	90.9	80.0	84.7	-0.07	40.7	32.5	60.6	0.49	85.3	83.9	84.6	-0.01
NC	66.3	50.7	60.5	-0.09	18.6	10.1	32.6	0.75	50.9	47.2	32.3	-0.37
NE	76.7	68.8	71.9	-0.06	10.7	5.6	25.3	1.37	23.1	34.4	24.7	0.07
NW	89.6	84.3	87.5	-0.02	8.1	5.8	48.4	4.99	30.7	45.0	38.3	0.25
SE	44.5	73.7	70.8	0.59	18.6	37.1	44.2	1.37	44.0	66.0	64.4	0.46
SS	47.0	59.6	67.1	0.43	21.2	28.3	35.3	0.66	48.4	55.9	56.9	0.18
SW	74.6	76.2	72.5	-0.03	34.5	31.4	46.4	0.35	67.3	80.7	71.2	0.06

Table 4: Proportion and percentage change of households not deprived, by welfare indicator and year (cont.)

	Shelter				Education			
	1992	2003	2008	Change	1992	2003	2008	Change
National	61.3	64.4	61.8	0.01	79.6	78.4	79.1	-0.01
Rural	50.3	52.6	48.5	-0.04	74.9	73.1	72.4	-0.03
Urban	88.1	87.6	88.9	0.01	90.9	88.9	92.9	0.02
NC	73.9	69.3	62.4	-0.15	86.5	88.3	84.9	-0.02
NE	32.5	39.4	30.8	-0.05	60.1	62.1	57.9	-0.04
NW	43.0	56.1	39.1	-0.09	52.9	61.4	59.4	0.12
SE	76.7	85.4	84.4	0.10	95.8	96.2	95.8	0.00
SS	67.5	76.0	79.5	0.18	96.3	96.8	97.0	0.01
SW	77.3	87.4	85.9	0.11	94.4	93.7	92.4	-0.02

Source: Authors' calculations based on the 1999, 2003, and 2008 Nigeria DHS.

Appendix Table A2 presents the percentage change of households not deprived by welfare indicator by states between 2004 and 2009 using the 2003/04 NLSS and 2008/09 HNLSS. The table indicates that 12 of Nigeria's 36 states and the FCT recorded improvements in access to water, two states had no change, and the rest had a negative change. For electricity, it is disappointing to note that in 2009 only nine states had more than 50 per cent of their population non-deprived. However, it was not surprising that only five states improved over the five years. The change in performance ranged from

-67 per cent for Zamfara to 189 per cent for Jigawa albeit from a very low base of only 8.63 per cent coverage in 2004.

4.2 Share of households in multidimensional welfare combinations

The share of households at the national level that fall in each combination of welfare indicator and the change in this share over time are presented in Table 5 for the nation, Appendix Table A1a, for rural and urban sectors, and Appendix Table A1b for zones. The first row of the tables shows the share of the households characterized by deprivation in all dimensions (0,0,0,0,0), which we called acute-deprivation while the bottom row illustrates non-deprivation in any dimension (1,1,1,1,1), which is called zero-deprivation. Between the two extremes are the various combinations of welfare indicators. However, our discussion will only consider the two extremes, i.e. acute-deprivation (topmost row) and zero-deprivation (bottom row).

Nationally, acute-deprivation was 3.34 per cent in 1999, fell to 2.42 per cent in 2003, but increased to 3.09 per cent in 2008, although it remained below the 1999 level. Substantial improvement can be observed in the percentage of households with no deprivation (the last row), with a 5.51 per cent national improvement from 13.37 to 18.88 per cent over the ten-year period.

Table 5: Households by combination of welfare indicators, national figures (%)

Education	Welfare indicator combination				National			
	Water	Floor	Sanitation	Electricity	1999	2003	2008	Change
0	0	0	0	0	3.34	2.42	3.09	-0.25
0	0	0	0	1	0.13	0.56	0.05	-0.08
0	0	0	1	0	0.06	0.01	0.59	0.53
0	0	0	1	1	0.00	0.00	0.07	0.07
0	0	1	0	0	0.80	0.84	0.77	-0.03
0	0	1	0	1	0.32	0.57	0.16	-0.15
0	0	1	1	0	0.09	0.02	0.17	0.08
0	0	1	1	1	0.03	0.08	0.13	0.10
0	1	0	0	0	10.28	10.69	6.68	-3.59
0	1	0	0	1	0.66	1.24	0.44	-0.21
0	1	0	1	0	0.56	0.03	3.89	3.33
0	1	0	1	1	0.05	0.01	0.92	0.87
0	1	1	0	0	2.43	2.62	1.73	-0.70
0	1	1	0	1	1.33	2.23	0.92	-0.40
0	1	1	1	0	0.16	0.05	0.57	0.42
0	1	1	1	1	0.19	0.20	0.67	0.47
1	0	0	0	0	9.43	7.05	6.59	2.84
1	0	0	0	1	0.69	1.71	0.56	-0.13
1	0	0	1	0	0.25	0.00	0.91	0.66
1	0	0	1	1	0.05	0.11	0.20	0.14
1	0	1	0	0	8.11	6.95	5.18	-2.93
1	0	1	0	1	5.87	7.85	3.27	-2.60
1	0	1	1	0	0.68	0.22	1.04	0.36
1	0	1	1	1	1.24	1.63	3.69	2.44
1	1	0	0	0	9.51	8.85	7.14	-2.37
1	1	0	0	1	2.75	2.74	1.58	-1.17
1	1	0	1	0	0.61	0.05	3.40	2.79
1	1	0	1	1	0.31	0.14	2.11	1.80
1	1	1	0	0	8.12	8.59	7.56	-0.56
1	1	1	0	1	17.64	19.26	14.10	-3.54
1	1	1	1	0	0.93	0.53	2.93	1.99
1	1	1	1	1	13.37	12.73	18.88	5.51

Source: Authors' calculations based on the 1999, 2003, and 2008 Nigeria DHS.

Households by the number of deprivations in welfare indicators are presented in Table 6 for the nation, zones, and sectors from the 1999, 2003, and 2008 DHS surveys, while the state results from the 2004 NLSS and the 2009 HNLSS are presented in Table 7. In the tables, the number of deprivations range from 0 to 5 where 0 signifies zero-deprivation and 5 implies acute-deprivation, i.e. deprivation in all welfare dimensions. In the urban sector, only 0.36 per cent of households experienced acute-deprivation in 2008 compared to 4.42 per cent in the rural sector. Also of note is the fact that only 4.06 per cent of rural households had zero-deprivation in 1999, and this marginally improved by 3.25 percentage points to 7.31 per cent over the ten-year period.

Among the zones, acute-deprivation ranged from 0.96 per cent in the South East to 5.47 per cent in the North East zone in 1999. The proportion of households in the North East experiencing acute-deprivation increased by over one-half from 5.47 per cent in 1999 to 8.27 per cent in 2008, while zero-deprivation declined by almost one-half in the same period, 7.23 per cent and 4.28 per cent in 1999 and 2008, respectively. Generally, the northern zones are characterized by a higher share of acute-deprivation and a marginal share in zero-deprivation compared to the southern zones.

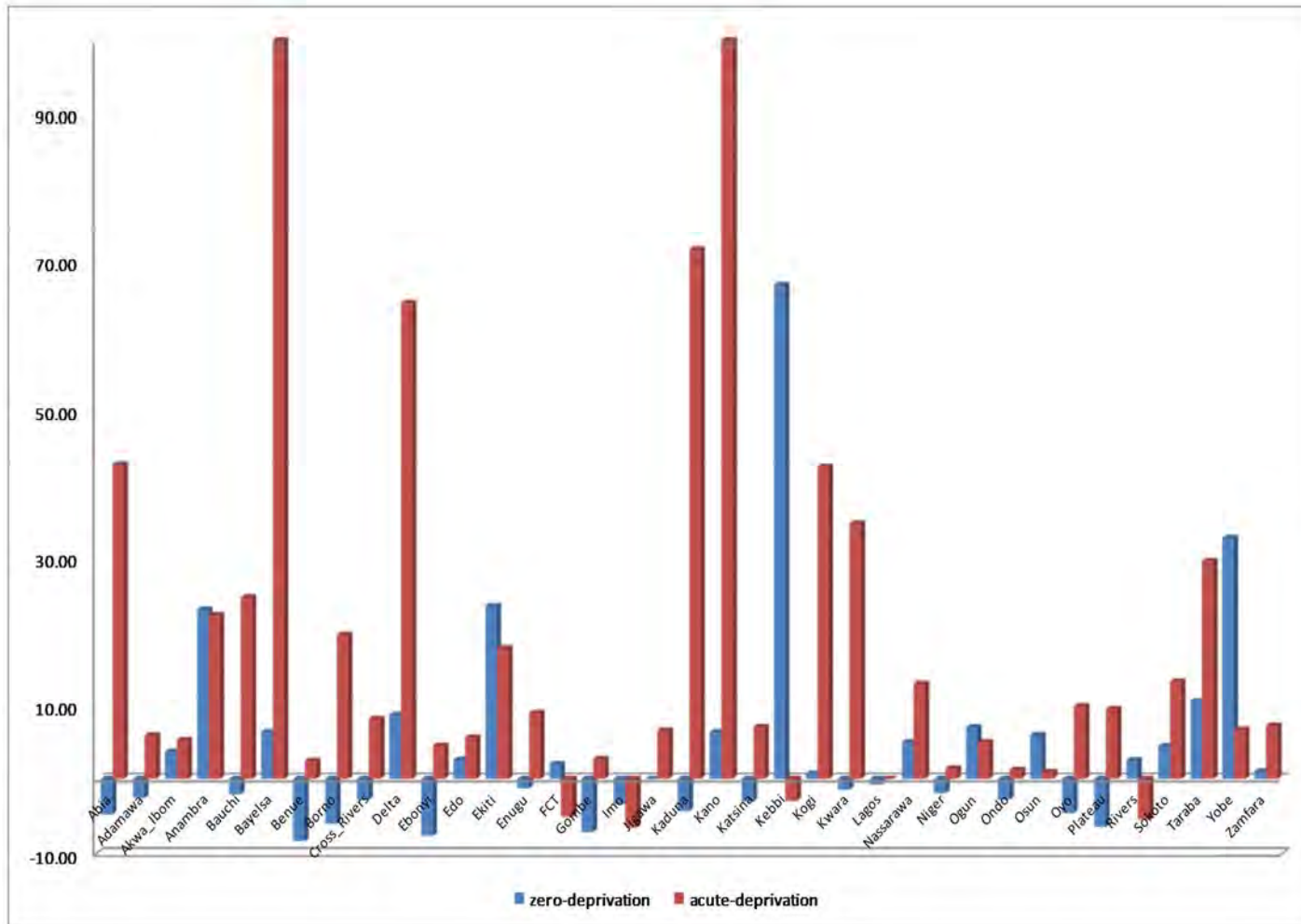
Table 6: Households by number of deprivations in welfare indicators (%)

	National	Urban	Rural	NC	NE	NW	SE	SS	SW
1999									
0	13.4	36.1	4.1	9.9	7.2	3.7	11.9	16.5	30.8
1	20.3	38.5	12.9	29.3	7.6	16.0	15.2	18.6	30.2
2	19.7	14.1	21.9	25.9	14.1	19.9	28.6	18.9	12.9
3	22.6	7.9	28.6	20.0	28.7	26.8	30.3	23.5	10.8
4	20.7	3.2	27.9	11.9	37.0	28.8	13.1	20.0	12.9
5	3.3	0.2	4.6	3.0	5.5	4.9	1.0	2.5	2.4
2003									
0	12.7	27.3	5.4	6.7	3.9	4.5	31.0	24.2	25.9
1	21.8	40.1	12.5	18.0	10.9	21.4	27.5	18.8	45.8
2	21.9	17.8	24.0	30.9	19.9	24.5	18.5	20.6	11.5
3	22.0	9.0	28.6	25.4	27.0	23.5	15.8	23.5	7.7
4	19.2	4.4	26.6	16.7	33.5	23.9	6.5	11.8	6.9
5	2.4	1.3	3.0	2.3	4.8	2.2	0.7	1.1	2.2
2008									
0	18.9	42.5	7.3	14.7	4.3	9.8	27.2	23.8	35.5
1	23.5	36.6	17.1	16.7	13.7	20.4	30.9	27.5	32.0
2	19.6	13.5	22.6	22.0	17.1	23.4	22.9	20.1	12.2
3	20.3	5.1	27.7	24.9	26.6	27.3	13.0	18.5	8.7
4	14.7	1.9	20.9	16.5	30.1	17.0	5.2	9.3	9.2
5	3.1	0.4	4.4	5.1	8.3	2.1	0.8	0.7	2.4

Source: Authors' calculations based on the 1999, 2003, and 2008 Nigeria DHS.

Figure 4 shows the observed change in acute-deprivation and zero-deprivation between 2004 and 2009 at the state level. Note that a positive change in zero-deprivation is good and negative change in acute-deprivation is bad. Only four states (FCT, Imo, Kebbi, and Rivers) had a reduction in the proportion of households experiencing acute-deprivation over the five years, ranging from 0.30 per cent in Kebbi to 0.65 per cent in Imo. Lagos state recorded zero per cent of people lacking in all the dimensions in both periods but there was a drop in zero-deprivation by 0.08 per cent. Abia, Anambra, Bayelsa, Kaduna, Kano, Kogi, Kwara, Taraba, and Delta experienced an increase in the proportion of households experiencing acute-deprivation in 2009 ranging from a change of 2.23 per cent in Anambra and up to 121.84 per cent in Kano.

Figure 4: Percentage change in acute- and zero-deprivation between 2004 and 2009 by states



Source: Authors' calculations based on the 2004 and 2009 H/NLSS.

4.3 First order domination comparisons

FOD comparisons across time and space were carried out across the states, sectors, zones, and the nation. Spatial bootstrapped FOD comparisons from the 1999, 2003, and 2008 DHS for the nation, zones, and sectors are reported in Tables 7, 8, and 9, respectively while the static results are in Appendix Tables A3a to A3c. The bootstrap results from the 2004 NLSS and 2009 HNLSS for states are reported in Tables 10 and 11, and the static results are in Appendix Tables A4a and A4b. In each bootstrapped table, the row (column) averages indicate the probability that a constituency dominated (is dominated by) all other constituencies.

4.4 First order domination over other constituencies

In Tables 7, 8, 9, 10, and 11, row values indicate the probability over 100 bootstraps that the row constituency dominated the column constituency. Row averages indicate the average probability that the row constituency dominated all others and higher values indicate greater welfare. It is expected, therefore, that areas with lower poverty should have a higher level of dominance with higher row averages. The nation as a whole dominated rural areas in all three years with a probability at or near 100 per cent. The only other area the nation dominated was the North East zone with a probability of dominance near zero in 1999 but solid probabilities in 2003 and 2008 at 61 and 67 per cent, respectively. The urban sector consistently had the highest probability of dominating in all the three periods and strongly dominated the nation, rural areas, and the North Central and North East zones in all three years. In addition, urban areas had a significant probability of dominating the North West zone in 1999 (79 per cent), and the South West zone in 2008 (60 per cent). Performance among the zones indicated that southern zones had higher probabilities of dominating compared to the northern zones. Notably, the South West zone almost doubled its probability of dominating over the ten-year period.

Table 7: 1999 DHS bootstrap spatial FOD comparisons (probabilities)

Area	National	Rural	Urban	NC	NE	NW	SE	SS	SW	Avg.
National		1			0.02					0.13
Rural										0.00
Urban	1	1		0.9	1	0.79			0.01	0.59
NC	0.01	0.6			0.04					0.08
NE										0.00
NW					0.03					0.00
SE										0.00
SS		0.02								0.00
SW	0.26	0.83		0.12	0.22		0.01	0.06		0.19
Average	0.16	0.43	0.00	0.13	0.16	0.10	0.00	0.01	0.00	0.11

Source: Authors' calculations based on the 1999 Nigeria DHS.

Table 8: 2003 DHS bootstrap spatial FOD comparisons (probabilities)

Area	National	Rural	Urban	NC	NE	NW	SE	SS	SW	Avg.
National		0.94			0.61					0.19
Rural					0.09					0.01
Urban	0.94	0.94		0.42	0.98	0.09				0.42
NC		0.01			0.01					0.00
NE										0.00
NW					0.2					0.03
SE	0.59	0.84		0.87	0.7	0.01		0.14		0.39
SS	0.02	0.13		0.29	0.11		0.01			0.07
SW	0.56	0.79		0.48	0.86	0.01	0.01			0.34
Average	0.26	0.46	0.00	0.26	0.45	0.01	0.00	0.02	0.00	0.16

Source: Authors' calculations based on the 2003 Nigeria DHS.

Table 9: 2008 DHS bootstrap spatial FOD comparisons (probabilities)

Area	National	Rural	Urban	NC	NE	NW	SE	SS	SW	Avg.
National		1			0.67					0.21
Rural					0.03					0.00
Urban	1	1		1	1	0.1			0.6	0.59
NC										0.00
NE										0.00
NW					0.68					0.09
SE	0.09	0.83		0.97	0.32					0.28
SS		0.23		0.71	0.1					0.13
SW	0.17	0.97		0.98	0.54					0.33
Average	0.16	0.50	0.00	0.46	0.42	0.01	0.00	0.00	0.08	0.18

Source: Authors' calculations based on the 2008 Nigeria DHS.

Spatial bootstrap analysis by states in 2004 (Table 10) shows that 27 states including FCT had less than a 10 per cent chance of ever dominating any other state; however, in 2009 15 states had more than 10 per cent probability of dominating other states (Table 11). Lagos maintained high economic dominance and confirmed its status as the main economic engine in Nigeria with a 73 per cent per cent and 68 per cent chance of dominating other states including FCT in 2004 and 2009 respectively.

Table 10: 2003/04 NLSS bootstrap spatial FOD comparisons (probabilities), by state

State	Abia	Adamawa	Akwalbom	Anambra	Bauchi	Bayelsa	Benue	Borno	Cross Rivers	Delta	Ebonyi	Edo	Ekiti	Enugu	FCT	Gombe	Imo	Jigawa	Kaduna
Abia		0.75	0.56				0.99	0.03	0.73		0.60		0.01	0.46	0.39	0.22	0.03		
Adamawa																			
Akwalbom																			
Anambra		0.01	0.17				0.20		0.30		0.02			0.12		0.11			
Bauchi																0.04			
Bayelsa																			
Benue																			
Borno																0.06			
Cross Rivers																			
Delta		0.84	0.21		0.01		0.66	0.23	0.37		0.49		0.12	0.04		0.73	0.02		
Ebonyi		0.02					0.01												
Edo		0.93	0.53				0.98	0.01	0.90		0.86		0.06	0.47	0.20	0.85			
Ekiti		0.05					0.02									0.38			
Enugu							0.01												
FCT		0.09					0.04												
Gombe																			
Imo		0.06	0.10				0.31		0.18		0.06			0.02		0.03			
Jigawa																			
Kaduna		0.85			0.99		0.06	0.86								0.99		0.11	
Kano		0.01			0.06		0.01									0.61			
Katsina																0.03			
Kebbi																			
Kogi							0.02		0.02										
Kwara		0.94			0.32		0.27	0.59							0.04	0.99			
Lagos	0.71	1.00	0.93	0.71	0.71		1.00	1.00	0.93	0.28	0.92	0.53	0.75	0.86	1.00	1.00	0.63		0.01

Nassarawa																				
Niger					0.02															
Ogun	0.70						0.25												0.63	
Ondo	0.61	0.01					0.71	0.01		0.05						0.02			0.04	
Osun	0.23				0.05		0.02													0.85
Oyo	0.98				0.22		0.53	0.04			0.01					0.10			0.99	
Plateau	0.26						0.06													
Rivers	0.56	0.25					0.74	0.06	0.34		0.86			0.01					0.12	
Sokoto																				0.14
Taraba																				
Yobe																				
Zamfara					0.01															
Average	0.02	0.25	0.08	0.02	0.07	0.00	0.19	0.08	0.11	0.01	0.11	0.01	0.03	0.06	0.05	0.24	0.02	0.01	0.00	

Table 10: 2003/04 NLSS bootstrap spatial FOD comparisons (probabilities) by state, (cont.)

State	Kano	Katsina	Kebbi	Kogi	Kwara	Lagos	Nassarawa	Niger	Ogun	Ondo	Osun	Oyo	Plateau	Rivers	Sokoto	Taraba	Yobe	Zamfara	Avg.
Abia				0.96			0.98	0.01		0.08			0.16			1.00			0.22
Adamawa			0.01													0.12			0.00
Akwalbom							0.02									0.26			0.01
Anambra				0.60			0.21									0.51			0.06
Bauchi			0.79															0.05	0.02
Bayelsa																			0.00
Benue																0.40			0.01
Borno			0.08																0.00
Cross Rivers																0.07			0.00
Delta		0.29	0.24	0.61			1.00	0.28		0.11	0.03		0.58			1.00		0.10	0.22
Ebonyi																0.34			0.01
Edo		0.05	0.06	0.46			0.98	0.04	0.20	0.25	0.02		0.44			1.00		0.01	0.26
Ekiti		0.17	0.19	0.02			0.47	0.01								0.91		0.05	0.06
Enugu																0.03			0.00
FCT							0.03									0.30			0.01
Gombe																			0.00
Imo				0.10			0.30									0.84			0.06
Jigawa			0.02																0.00
Kaduna		1.00	1.00				0.04	0.91								0.89	0.65	1.00	0.26
Kano		0.34	0.43				0.06	0.01								0.54		0.12	0.06
Katsina			0.33															0.05	0.01
Kebbi																			0.00
Kogi							0.04									0.09			0.00
Kwara		0.91	0.87				0.42	0.90	0.03		0.15	0.03	0.06			0.97	0.02	0.61	0.23
Lagos	0.15	1.00	0.99	1.00	0.80		1.00	1.00	1.00	0.99	0.98	0.89	1.00	0.34		1.00	0.13	0.88	0.73

Nassarawa																			0.36	0.01			
Niger			0.34																		0.01		
Ogun		0.15	0.15																	0.98	0.05	0.09	
Ondo				0.04																0.99		0.10	
Osun		0.54	0.51																	0.93	0.25	0.10	
Oyo		0.83	0.82		0.02															0.99	0.62	0.21	
Plateau			0.01																	0.73		0.03	
Rivers		0.06	0.18	0.01																1.00	0.07	0.13	
Sokoto			0.53																		0.04	0.01	0.02
Taraba																							0.00
Yobe			0.18																				0.01
Zamfara			0.49																				0.01
Average	0.00	0.15	0.23	0.11	0.02	0.00	0.21	0.11	0.04	0.04	0.04	0.03	0.08	0.01	0.00	0.45	0.02	0.11					

Source: Authors' calculations based on the 2003/04 NLSS.

Table 11: 2008/09 NLSS bootstrap spatial FOD comparisons (probabilities) by state

State	Abia	Adamawa	Akwa_Ibom	Anambra	Bauchi	Bayelsa	Benue	Borno	Cross_Rivers	Delta	Ebonyi	Edo	Ekiti	Enugu	FCT	Gombe	Imo	Jigawa	Kaduna
Abia		1.00	0.57		0.21	0.73	1.00	0.02	0.98		0.53			0.07		0.87			
Adamawa																			
Akwa_Ibom		0.21					0.07									0.01			
Anambra		0.81	0.31			0.94	1.00		0.99	0.74			0.99	0.02	0.79				
Bauchi																			
Bayelsa							0.24		0.23	0.03									
Benue																			
Borno																			
Cross_Rivers							0.01												
Delta		1.00	0.08		0.71		0.21	0.47					0.05	0.02		1.00			0.01
Ebonyi		0.01					0.02												
Edo		0.98	0.58		0.11	0.37	1.00	0.03	0.55	0.26			0.07	0.25		0.99			
Ekiti		1.00			0.30		0.66	0.05						0.02		0.96			
Enugu						0.01	0.48				0.01								
FCT		0.56	0.03		0.05	0.26	0.79	0.03	0.45	0.01	0.26		0.04	0.20		0.54			
Gombe																			
Imo		0.81	0.56		0.15	0.03	1.00	0.41	0.13		0.56					0.01			
Jigawa																			
Kaduna		0.95			0.99			0.94								0.90			
Kano		0.01			0.15											0.48			
Katsina																			
Kebbi																			
Kogi							0.02												
Kwara		0.89			0.52			0.13								0.92			
Lagos	0.97	1.00	1.00	0.99	0.75	1.00	1.00	0.51	1.00	0.55	0.99	0.96	0.93	1.00	0.84	1.00	0.53		0.03

Nassarawa	0.13																		
Niger	0.01			0.04														0.17	
Ogun	1.00	0.04		0.92	0.06	0.96		0.01			0.02							1.00	0.06
Ondo	0.96	0.20		0.02	0.13	0.98		0.15		0.12				0.06				0.29	
Osun	1.00	0.10		0.34		0.55	0.06						0.03	0.01				0.97	
Oyo	1.00			0.85			0.64											0.99	
Plateau	0.07					0.03													
Rivers	1.00	1.00		1.00	0.94	1.00	0.99	0.99		0.92				0.26				0.98	0.49
Sokoto																			
Taraba																			
Yobe																			
Zamfara																			
Average	0.03	0.40	0.12	0.03	0.20	0.12	0.28	0.15	0.15	0.02	0.12	0.03	0.03	0.08	0.02	0.36	0.01	0.00	0.02

Table 11: 2008/09 NLSS bootstrap spatial FOD comparisons (probabilities) by state, cont.

State	Kano	Katsina	Kebbi	Kogi	Kwara	Lagos	Nassara wa	Niger	Ogun	Ondo	Osun	Oyo	Plateau	Rivers	Sokoto	Taraba	Yobe	Zamfara	Avg.
Abia	0.06			0.57			0.99	0.78		0.09			1.00			1.00		0.04	0.29
Adamawa																0.34			0.01
Akwa Ibom							0.03						0.01			1.00			0.04
Anambra				1.00			0.80	0.07		0.21			0.93			1.00			0.29
Bauchi																			0.00
Bayelsa				0.07												0.24			0.02
Benue																0.05			0.00
Borno																			0.00
Cross_Rivers																0.02			0.00
Delta	0.51	0.02		0.56	0.50		0.94	0.97			0.03	0.16	0.66			1.00	0.01	0.51	0.26
Ebonyi																0.10			0.00
Edo	0.06			1.00	0.03		0.74	0.21		0.07	0.06	0.01	1.00			1.00		0.05	0.26
Ekiti	0.10			0.81	0.02		0.68	0.14			0.05	0.04	0.92			1.00		0.11	0.19
Enugu				0.01			0.01									0.71			0.03
FCT	0.07			0.74	0.03		0.62	0.22		0.03	0.04		0.52			1.00		0.02	0.18
Gombe																			0.00
Imo		0.01					0.71						0.76			1.00		0.47	0.18
Jigawa																			0.00
Kaduna	0.92	0.37	0.09					0.01								0.97	0.01	0.93	0.20
Kano																0.44			0.03
Katsina																			0.00
Kebbi																			0.00
Kogi																0.24			0.01
Kwara	0.20	0.01						0.08								1.00		0.24	0.11
Lagos	0.96	0.04	0.01	1.00	0.53		1.00	1.00	0.08	1.00	0.92	0.22	1.00			1.00	0.02	0.57	0.68

Nassarawa																		0.90	0.03	
Niger																		0.48	0.02	
Ogun	0.97	0.21	0.04	0.32	0.96		0.94	1.00			0.02	0.63	0.54				1.00	0.04	0.88	0.32
Ondo				0.87			0.73	0.11					0.99				1.00			0.18
Osun	0.03			0.88			0.75	0.28					0.94				1.00		0.07	0.19
Oyo	0.25	0.11	0.04				0.25	0.52					0.02				1.00		0.59	0.17
Plateau																	0.97			0.03
Rivers	0.92	0.76	0.52	0.78			1.00	1.00		0.33		0.05	1.00			1.00	0.12	0.99	0.50	
Sokoto																				0.00
Taraba																				0.00
Yobe																				0.00
Zamfara																				0.00
Average	0.14	0.04	0.02	0.24	0.06	0.00	0.28	0.18	0.00	0.05	0.03	0.03	0.29	0.00	0.00	0.57	0.01	0.15		

Source: Authors' calculations based on the 2008/09 NLSS.

4.5 First order domination *by other* constituencies

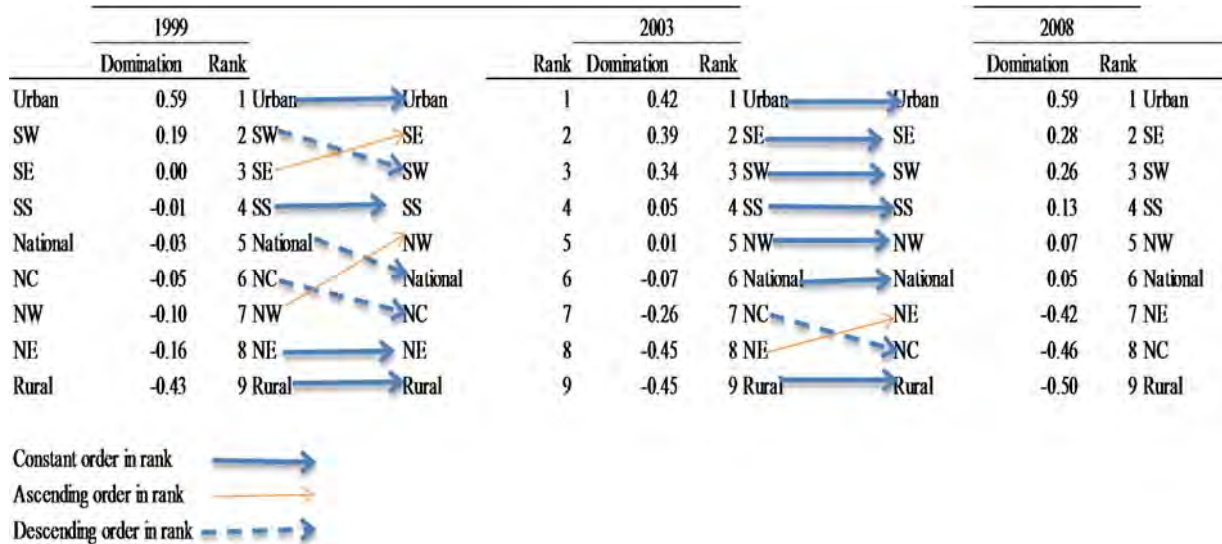
Column values in Tables 7, 8, 9, 10 and 11 provide the probability over 100 bootstraps that the column constituent is dominated *by* the row constituent while column averages provide the average probability of being dominated *by* all others. With this metric, it is expected that relatively poor constituents should have relatively high column averages. The nation on average had a probability of being dominated of 16, 26, and 16 per cent in 1999, 2003, and 2008, respectively (Tables 7, 8, and 9). Urban areas had a significant probability of dominating the nation with probabilities at or near 100 per cent in every year. The nation had a 26, 56, and 17 per cent probability of being dominated by the South West in 1999, 2003, and 2008 respectively and a 59 per cent chance of being dominated by the South East in 2003. The probability of the rural sector being dominated steadily increased from 43 per cent in 1999 to 50 per cent in 2008. The nation, urban areas, and the South South and South West zones solidly dominated rural areas in every year. Furthermore, the South East increasingly dominated rural areas over time, though the probability remains low. In comparison, the urban sector had zero probability of being dominated in any year, which indicates no area dominated urban areas in any of the bootstraps in any year. From the zones, the North West and all southern zones had essentially no probability of being dominated in any year. The probability of the North Central and North East zones being dominated increased considerably from 13 and 16 per cent in 1999 to 46 and 42 per cent in 2008.

In 2004, 12 states had more than a 10 per cent chance of being dominated by others with all but two of the states in northern zones (Table 10). This increased to 16 in 2009 with all but three of these states in northern zones (Table 11). In both 2004 and 2009, Taraba state stands out as performing significantly worse than all other areas with a 45 and 57 per cent chance of being dominated in each year respectively.

4.6 Net dominance and inequality

Probability of net dominance is the difference between the average probability of dominating and being dominated by all other areas, i.e. the column average minus the row average. Net dominance is an indicator of the strength of domination over others and allows constituencies to be ranked. Positive figures indicate a high dominancy level and negative figures show low dominancy. While Figure 5 presents the result for national, zonal, and sectoral levels from the 1999, 2003, and 2008 DHS surveys, Figure 6 reports the results for states from the 2003/04 NLSS and 2008/09 H/NLSS surveys. The two figures present the change in dominance and ranks of the constituencies across time.

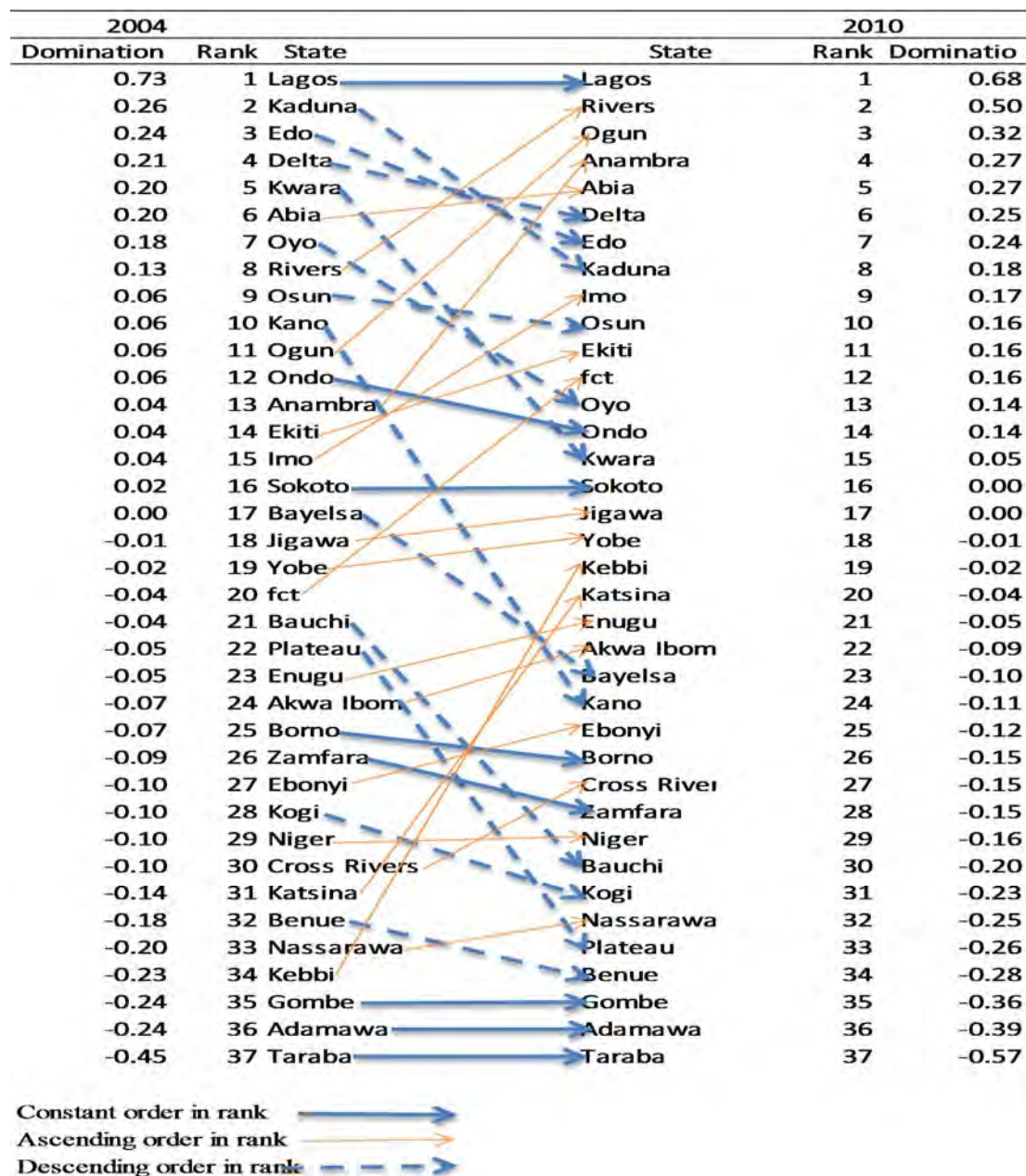
Figure 5: Spatial FOD ranking and probability of net domination for national, sectoral, and zonal levels in 1999, 2003, and 2008



Source: Authors' calculations based on the 1999, 2003, and 2008 Nigeria DHS.

The national probability of net domination was -0.03, -0.07, and 0.05 and ranked fifth, sixth, and sixth position within the nine constituencies in 1999, 2003, and 2008, respectively. In other words the nation had essentially equal probability of dominating and of being dominated. While the urban sector consistently maintained the highest ranking, the rural sector maintained the lowest ranking through the ten years. A significant change in rankings could be observed within the nine constituencies between 1999 and 2003, but between 2003 and 2008, the movement was not dramatic with North East moving up by one point to the seventh position and North Central falling in ranking to the eighth position in 2009 (Figure 5).

Figure 6: Net dominance and ranks by state in 2004 and 2009



Source: Authors' calculations based on the 2003/04 NLSS and the 2008/09 HNLSS.

The state rankings presented in Figure 6 show Lagos state to have the highest net dominance and ranking in 2003/04 and 2008/09. States like Rivers, Ogun, and Anambra had a significant improvement in well-being and moved to second, third, and fourth highest ranks in 2009 from eighth, 11th and 13th position in 2004. However, states like Kaduna, Kano, and Niger lost their strength by 2009, indicating a relative loss in well-being.

4.7 Temporal comparisons

The net temporal domination score is the average of the three possible outcomes in comparing one year to another, i.e. the average that one year dominates (1), neither dominates nor is dominated by (0), or is dominated by (-1) another year over all bootstraps. Net domination scores for the nation, zones, and sectors are presented in Table 12. State results are presented as maps in Figure 7(c).

Table 12: Temporal net FOD comparisons, DHS (probabilities)

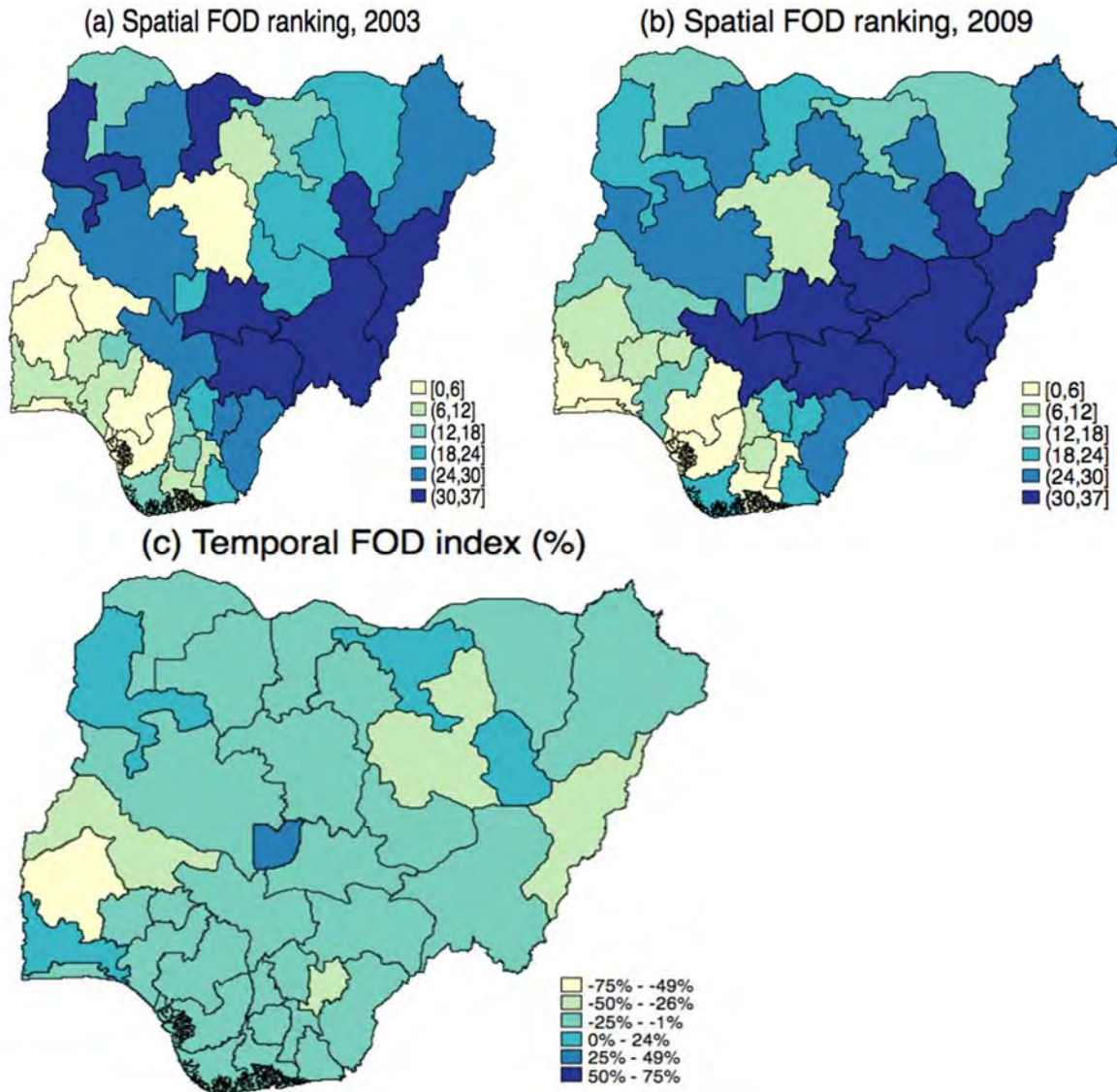
	2003 FOD 1999		2008 FOD 1999		2008 FOD 2003	
	Static	Boot	Static	Boot	Static	Boot
NC		-0.04				
NE		-0.01				
NW		0.02		0.07		
National		0.01		0.15		
Rural		0.03		0.04		
SE	1	0.36		0.38		0.05
SS	1	0.4	1	0.6		0.24
SW				0.03		0.01
Urban	-1	-0.37			1	0.45

Source: Authors' calculations based on the 1999, 2003, and 2008 Nigeria DHS.

Nationally, the temporal results show that 2003 dominated 1999 by a very low probability of 0.01; a slightly higher probability of 0.15 net domination can be observed between 2008 and 1999; and neither 2008 dominates 2003 nor 2003 dominates 2008. However, these are very low probabilities indicating little evidence of advancement over the years. Among the zones, North Central and North East experienced 1999 dominating 2003 while South East, South South and South West experienced positive probability of dominance between 2008 and 2003 with the highest chance in the South South (0.24). In the sectors, the urban sector displays some probability of decline between 1999 and 2003 but had a high probability of 2008 dominating 2003 with 0.45.

Figure 7 presents the spatial FOD index for the two years 2003 and 2009—panels (a) and (b)—and the temporal FOD index—panel (c). It should be noted that the FOD index levels in panels (a) and (b) are not comparable because they are respectively relative to the situations prevailing in 2004 and 2009 while the temporal FOD index (c) measures whether the 2009 welfare distribution dominates the welfare distribution of the same state in 2004, or whether 2009 is dominated by 2004.

Figure 7: Spatial FOD ranking by state



Source: Authors' calculations based on the 2003/04 NLSS and the 2008/09 HNLSS.

Therefore, for each state, the three possible results are: 0: neither 2009 FOD 2004 nor 2004 FOD 2009; 1: 2009 FOD 2004; and -1: 2004 FOD 2009. The map indicates that more than half of the states, mostly the northern states recorded regression over time and only Abuja had between a 29 per cent and a 45 per cent chance that 2008/09 FOD 2003/04.

5 Concluding remarks

This study set out to appraise non-monetary multidimensional poverty in Nigeria using the FOD approach, which is novel in the literature. While the theoretical underpinning of FOD has developed considerably and the method has been applied to child poverty in Vietnam and Mozambique by Arndt

et al. (2012), this is the first application of this methodology to non-monetary multidimensional poverty in Nigeria. As demonstrated by the different experimentations in this paper, the methodology is quite robust and lends credence to the general observation that the distribution of positive economic performance has not translated positively to improvements in welfare/poverty in the country. This is consistent with the observed lack of pro-poor growth observed by Ichoku et al. (2012).

The results indicate that Nigeria registered fewer gains in non-income poverty over the decade from 1999 to 2008. While there was a decrease in the percentage of the population experiencing acute-deprivation between 1999 and 2003, an increase was observed between 2003 and 2008, which resulted in a total decline of merely -0.25per cent between 1999 and 2008.

A cursory examination of the performance of the five indicators over the decade indicate that only sanitation recorded a substantial positive change; education had a negative change; and the rest had an improvement of less than 10 per cent. Furthermore, the results for states indicate that the country has not achieved broad-based progress across a number of welfare indicators for the majority of the states especially in indicators like water, education, and electricity that are directly accruable from public expenditure.

The spatial FOD comparisons indicate that regional inequalities remain profound with huge disparities among the states. We observed that most of the worst-ranked states are located in the northern zones of the country. The ten worst-ranked states in 2003/04 are Kogi, Niger, Cross Rivers, Katsina, Benue, Nassarawa, Kebbi, Gombe, Adamawa, and Taraba. In 2008/09, they were Zamfara, Niger, Bauchi, Kogi, Nassarawa, Plateau, Benue, Gombe, Adamawa, and Taraba. The worst states are similar to the states with more than 65 per cent poverty rates in 2012 (NBS2012).

The FOD temporal results indicate that the probability of experiencing welfare improvement between any two years was quite low and in some cases negative. South East, South South, South West and the urban sector were the only areas with positive probability of advancement between 1999 and 2008; however, the probabilities for South South and South West were virtually zero. Within states, there was evidence of regress in the majority of the states over time.

It is imperative that Nigeria finds a recipe for making growth inclusive while alleviating poverty in a larger part of the country, recognizing that poverty rates appear to be geographically concentrated in some states and rural areas.

Appendix

Appendix Table A1a: Population by combination of welfare indicators by urban and rural sector (%)

Welfare Indicator Combination					Urban				Rural			
Edu.	Water	Floor	Sanit.	Elect.	1999	2003	2008	Change	1999	2003	2008	Change
0	0	0	0	0	0.18	1.30	0.36	0.18	4.64	2.99	4.42	-0.21
0	0	0	0	1	0.06	0.38	0.03	-0.03	0.16	0.66	0.05	-0.11
0	0	0	1	0	0.00	0.00	0.08	0.08	0.09	0.01	0.84	0.75
0	0	0	1	1	0.00	0.00	0.04	0.04	0.00	0.00	0.09	0.09
0	0	1	0	0	0.15	0.68	0.11	-0.04	1.06	0.93	1.09	0.03
0	0	1	0	1	0.39	0.71	0.23	-0.16	0.28	0.50	0.13	-0.15
0	0	1	1	0	0.14	0.04	0.02	-0.12	0.06	0.00	0.24	0.18
0	0	1	1	1	0.05	0.11	0.20	0.15	0.03	0.07	0.10	0.07
0	1	0	0	0	1.53	1.61	0.87	-0.67	13.86	15.29	9.53	-4.33
0	1	0	0	1	0.92	1.11	0.20	-0.72	0.55	1.31	0.56	0.02
0	1	0	1	0	0.15	0.00	0.55	0.40	0.73	0.05	5.53	4.80
0	1	0	1	1	0.11	0.02	0.89	0.78	0.03	0.00	0.94	0.91
0	1	1	0	0	1.48	1.53	0.72	-0.76	2.82	3.18	2.22	-0.60
0	1	1	0	1	3.25	3.22	1.30	-1.96	0.54	1.73	0.74	0.20
0	1	1	1	0	0.04	0.10	0.27	0.22	0.20	0.02	0.72	0.52
0	1	1	1	1	0.61	0.30	1.27	0.65	0.02	0.15	0.38	0.35
1	0	0	0	0	1.45	1.77	0.81	-0.64	12.70	9.72	9.41	-3.29
1	0	0	0	1	0.28	1.06	0.31	0.03	0.85	2.04	0.69	-0.17
1	0	0	1	0	0.00	0.00	0.09	0.09	0.35	0.00	1.31	0.96
1	0	0	1	1	0.18	0.07	0.25	0.08	0.00	0.13	0.17	0.17
1	0	1	0	0	1.49	2.25	0.96	-0.54	10.82	9.33	7.25	-3.58
1	0	1	0	1	2.60	7.83	3.51	0.91	7.22	7.86	3.16	-4.06
1	0	1	1	0	0.07	0.28	0.30	0.23	0.93	0.19	1.41	0.47
1	0	1	1	1	2.07	3.53	7.99	5.92	0.90	0.67	1.58	0.68
1	1	0	0	0	3.02	2.33	2.01	-1.01	12.17	12.15	9.65	-2.52
1	1	0	0	1	3.36	2.49	1.38	-1.98	2.50	2.87	1.67	-0.83
1	1	0	1	0	0.09	0.02	0.98	0.89	0.82	0.07	4.58	3.77
1	1	0	1	1	0.53	0.25	2.23	1.69	0.22	0.09	2.05	1.83
1	1	1	0	0	4.39	3.71	4.40	0.01	9.65	11.06	9.11	-0.54
1	1	1	0	1	34.76	35.57	22.19	-12.57	10.62	11.00	10.14	-0.48
1	1	1	1	0	0.53	0.51	2.93	2.40	1.10	0.54	2.92	1.82
1	1	1	1	1	36.09	27.25	42.55	6.45	4.06	5.38	7.31	3.25

Source: Authors' calculations based on the 1999, 2003, and 2008 Nigeria DHS.

Appendix Table A1b: Population by combination of welfare indicators by zones (%)

Welfare Indicator Combination					South East				South South			
Edu.	Water	Floor	Sanit.	Elect.	1999	2003	2008	Change	1999	2003	2008	Change
0	0	0	0	0	0.96	0.72	0.77	-0.19	2.49	1.12	0.73	-1.76
0	0	0	0	1	0.08	0.04	0.04	-0.04	0.06	0.30	0.02	-0.04
0	0	0	1	0	0.00	0.00	0.13	0.13	0.06	0.00	0.05	-0.01
0	0	0	1	1	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00
0	0	1	0	0	0.63	0.53	0.34	-0.29	0.26	0.44	0.33	0.07
0	0	1	0	1	0.28	0.13	0.18	-0.10	0.16	0.07	0.13	-0.03
0	0	1	1	0	0.00	0.00	0.04	0.04	0.02	0.01	0.03	0.01
0	0	1	1	1	0.00	0.03	0.25	0.25	0.00	0.00	0.03	0.03
0	1	0	0	0	1.60	0.99	0.60	-1.00	0.25	0.55	0.42	0.18
0	1	0	0	1	0.08	0.01	0.08	0.00	0.03	0.11	0.13	0.10
0	1	0	1	0	0.16	0.00	0.17	0.01	0.00	0.01	0.01	0.01
0	1	0	1	1	0.00	0.00	0.01	0.01	0.00	0.02	0.03	0.03
0	1	1	0	0	0.08	0.33	0.74	0.67	0.06	0.17	0.45	0.39
0	1	1	0	1	0.29	0.82	0.37	0.08	0.20	0.21	0.47	0.27
0	1	1	1	0	0.05	0.02	0.22	0.17	0.03	0.02	0.06	0.03
0	1	1	1	1	0.02	0.15	0.29	0.27	0.03	0.15	0.15	0.11
1	0	0	0	0	10.80	4.94	4.08	-6.72	19.40	10.53	8.48	-10.92
1	0	0	0	1	1.96	0.14	0.56	-1.39	1.17	3.14	1.54	0.38
1	0	0	1	0	0.17	0.00	0.36	0.18	0.58	0.00	0.82	0.24
1	0	0	1	1	0.00	0.00	0.21	0.21	0.00	0.09	0.16	0.16
1	0	1	0	0	21.36	7.89	4.92	-16.44	16.79	14.68	9.81	-6.98
1	0	1	0	1	15.05	6.49	7.15	-7.89	9.46	7.96	6.92	-2.54
1	0	1	1	0	0.56	0.00	1.51	0.95	1.24	0.67	1.24	-0.01
1	0	1	1	1	3.68	5.36	8.63	4.95	1.26	1.38	2.62	1.36
1	1	0	0	0	6.18	7.32	5.92	-0.26	4.70	5.30	5.62	0.92
1	1	0	0	1	0.94	0.43	1.27	0.32	3.24	2.38	1.48	-1.76
1	1	0	1	0	0.38	0.02	0.91	0.53	0.56	0.04	0.30	-0.26
1	1	0	1	1	0.00	0.00	0.48	0.48	0.00	0.37	0.70	0.70
1	1	1	0	0	11.32	10.72	11.04	-0.29	4.17	9.20	9.42	5.24
1	1	1	0	1	9.77	21.45	17.69	7.92	16.33	15.49	18.76	2.42
1	1	1	1	0	1.72	0.53	3.85	2.13	0.96	1.38	5.31	4.35
1	1	1	1	1	11.89	30.95	27.19	15.30	16.47	24.21	23.78	7.31

Appendix Table A1b: Population by combination of welfare indicators by zones (%), (cont.)

Welfare Indicator Combination					South West				North Central			
Edu.	Water	Floor	Sanit.	Elect.	1999	2003	2008	Change	1999	2003	2008	Change
0	0	0	0	0	2.43	2.19	2.41	-0.02	3.00	2.31	5.13	2.13
0	0	0	0	1	0.06	0.00	0.05	-0.01	0.03	0.00	0.08	0.05
0	0	0	1	0	0.00	0.05	0.04	0.04	0.15	0.00	0.23	0.08
0	0	0	1	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	1	0	0	0.43	0.35	1.26	0.84	1.94	1.45	1.52	-0.42
0	0	1	0	1	0.29	0.34	0.21	-0.08	0.38	0.93	0.07	-0.31
0	0	1	1	0	0.00	0.00	0.06	0.06	0.24	0.00	0.11	-0.13
0	0	1	1	1	0.00	0.07	0.06	0.06	0.10	0.38	0.17	0.07
0	1	0	0	0	0.42	0.75	0.75	0.33	3.18	3.81	2.57	-0.61
0	1	0	0	1	0.10	0.07	0.11	0.02	0.08	0.15	0.20	0.13
0	1	0	1	0	0.00	0.00	0.00	0.00	0.73	0.00	1.53	0.80
0	1	0	1	1	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.45
0	1	1	0	0	0.38	0.45	1.01	0.63	2.33	0.93	1.53	-0.80
0	1	1	0	1	1.02	1.93	0.95	-0.06	0.47	1.35	0.54	0.07
0	1	1	1	0	0.05	0.01	0.05	0.00	0.50	0.00	0.41	-0.09
0	1	1	1	1	0.44	0.06	0.64	0.20	0.36	0.40	0.54	0.18
1	0	0	0	0	11.95	5.71	7.13	-4.81	6.61	11.42	12.13	5.52
1	0	0	0	1	0.21	0.46	0.17	-0.05	0.85	3.10	0.36	-0.48
1	0	0	1	0	0.11	0.00	0.08	-0.03	0.24	0.00	1.29	1.05
1	0	0	1	1	0.07	0.00	0.04	-0.03	0.02	0.00	0.13	0.11
1	0	1	0	0	4.96	3.42	4.77	-0.19	7.73	12.36	10.40	2.66
1	0	1	0	1	3.15	6.03	3.31	0.16	8.93	16.17	2.43	-6.50
1	0	1	1	0	0.35	0.04	0.41	0.06	1.88	0.17	2.87	1.00
1	0	1	1	1	1.41	5.11	7.51	6.10	1.61	0.97	2.63	1.03
1	1	0	0	0	4.73	2.99	2.34	-2.40	7.43	7.91	9.43	2.00
1	1	0	0	1	2.02	0.34	0.67	-1.35	2.63	1.61	0.95	-1.69
1	1	0	1	0	0.09	0.00	0.10	0.02	0.86	0.28	2.20	1.34
1	1	0	1	1	0.51	0.00	0.16	-0.35	0.34	0.08	0.87	0.53
1	1	1	0	0	6.16	3.12	6.57	0.41	10.52	10.96	11.87	1.34
1	1	1	0	1	27.20	40.45	21.82	-5.38	25.26	15.40	8.16	-17.10
1	1	1	1	0	0.65	0.20	1.84	1.18	1.72	1.17	4.52	2.79
1	1	1	1	1	30.84	25.86	35.47	4.63	9.90	6.70	14.69	4.79

Appendix Table A1b: population by combination of welfare indicators by zones (%), (cont.)

Welfare Indicator Combination					North East				North West			
Edu.	Water	Floor	Sanit.	Elect.	1999	2003	2008	Change	1999	2003	2008	Change
0	0	0	0	0	5.47	4.84	8.27	2.81	4.88	2.18	2.09	-2.80
0	0	0	0	1	0.31	0.82	0.09	-0.22	0.24	1.25	0.02	-0.22
0	0	0	1	0	0.19	0.00	0.67	0.48	0.01	0.00	1.68	1.67
0	0	0	1	1	0.00	0.00	0.06	0.06	0.00	0.00	0.23	0.23
0	0	1	0	0	0.81	1.15	0.58	-0.23	0.68	0.84	0.51	-0.17
0	0	1	0	1	0.09	0.61	0.27	0.17	0.55	0.86	0.15	-0.41
0	0	1	1	0	0.03	0.00	0.16	0.13	0.16	0.05	0.42	0.26
0	0	1	1	1	0.00	0.01	0.17	0.17	0.07	0.04	0.14	0.08
0	1	0	0	0	26.83	22.41	19.00	-7.83	26.16	19.63	13.34	-12.82
0	1	0	0	1	0.91	2.57	0.75	-0.16	2.16	2.47	1.01	-1.14
0	1	0	1	0	0.52	0.00	6.13	5.61	1.51	0.11	10.88	9.37
0	1	0	1	1	0.00	0.00	0.99	0.99	0.22	0.01	2.78	2.56
0	1	1	0	0	3.08	3.18	2.09	-0.99	6.67	6.27	3.35	-3.32
0	1	1	0	1	1.62	2.10	1.14	-0.48	3.40	4.59	1.50	-1.90
0	1	1	1	0	0.00	0.00	1.07	1.07	0.22	0.14	1.25	1.03
0	1	1	1	1	0.00	0.23	0.64	0.64	0.18	0.18	1.24	1.06
1	0	0	0	0	8.81	9.10	9.74	0.93	1.70	2.15	1.43	-0.27
1	0	0	0	1	0.19	2.33	1.16	0.97	0.30	0.59	0.12	-0.17
1	0	0	1	0	0.44	0.00	1.40	0.96	0.05	0.00	1.36	1.31
1	0	0	1	1	0.31	0.11	0.27	-0.04	0.00	0.26	0.33	0.33
1	0	1	0	0	4.18	5.68	2.44	-1.75	0.59	1.25	1.49	0.89
1	0	1	0	1	2.11	5.19	1.36	-0.75	0.94	6.12	0.93	-0.01
1	0	1	1	0	0.04	0.36	0.54	0.50	0.00	0.00	0.41	0.41
1	0	1	1	1	0.34	0.94	0.87	0.53	0.22	0.12	1.21	0.99
1	1	0	0	0	19.25	12.58	12.15	-7.10	14.79	11.93	8.26	-6.54
1	1	0	0	1	3.29	5.84	1.94	-1.34	3.56	3.12	2.63	-0.94
1	1	0	1	0	0.86	0.00	4.13	3.28	0.82	0.00	9.06	8.24
1	1	0	1	1	0.15	0.04	2.40	2.25	0.60	0.21	5.67	5.07
1	1	1	0	0	5.84	6.29	5.46	-0.38	10.68	10.25	4.35	-6.33
1	1	1	0	1	6.53	9.72	8.30	1.77	14.60	20.70	10.46	-4.15
1	1	1	1	0	0.59	0.00	1.48	0.89	0.37	0.16	1.86	1.49
1	1	1	1	1	7.23	3.89	4.28	-2.94	3.65	4.52	9.83	6.18

Source: Authors' calculations based on the 1999, 2003, and 2008 Nigeria DHS.

Appendix Table A2: Households not deprived by welfare indicator by state and year (%)

	Water			Sanitation			Electricity		
	2004	2009	Change	2004	2009	Change	2004	2009	Change
Abia	73.25	75.32	0.03	42.61	51.12	0.20	60.60	31.82	-0.47
Adamawa	68.19	61.19	-0.10	12.25	6.48	-0.47	25.13	16.49	-0.34
Akwalbom	59.97	69.02	0.15	5.39	14.45	1.68	27.35	17.87	-0.35
Anambra	53.75	66.16	0.23	16.12	50.98	2.16	68.98	61.03	-0.12
Bauchi	91.21	79.25	-0.13	5.22	4.26	-0.18	27.21	19.62	-0.28
Bayelsa	27.59	34.89	0.26	85.62	17.12	-0.80	13.52	25.34	0.87
Benue	56.82	40.03	-0.30	14.57	8.15	-0.44	23.72	9.38	-0.60
Borno	77.36	79.87	0.03	8.55	9.79	0.15	37.23	13.18	-0.65
Cross Rivers	48.34	30.39	-0.37	12.32	12.97	0.05	29.68	21.85	-0.26
Delta	82.40	81.39	-0.01	26.39	40.47	0.53	60.42	59.31	-0.02
Ebonyi	62.25	51.91	-0.17	17.82	6.85	-0.62	15.05	5.40	-0.64
Edo	77.14	73.80	-0.04	28.69	44.03	0.53	79.50	72.93	-0.08
Ekiti	81.40	77.01	-0.05	8.29	23.18	1.80	47.67	53.43	0.12
Enugu	40.96	41.01	0.00	19.79	26.25	0.33	40.81	37.25	-0.09
FTC	59.62	62.04	0.04	37.14	54.26	0.46	59.79	68.00	0.14
Gombe	57.67	64.18	0.11	3.72	6.92	0.86	39.64	26.52	-0.33
Imo	60.75	80.41	0.32	15.56	26.44	0.70	40.08	19.04	-0.52
Jigawa	98.31	98.30	0.00	1.51	15.36	9.15	4.76	13.74	1.89
Kaduna	96.91	86.37	-0.11	18.50	27.32	0.48	60.76	30.62	-0.50
Kano	85.66	76.91	-0.10	5.62	21.73	2.87	57.90	26.38	-0.54
Katsina	85.08	86.28	0.01	4.03	9.89	1.45	29.02	17.22	-0.41
Kebbi	85.61	88.27	0.03	1.82	12.08	5.65	8.63	23.79	1.76
Kogi	50.44	35.99	-0.29	8.30	13.47	0.62	39.15	31.69	-0.19
Kwara	90.88	80.79	-0.11	24.13	24.82	0.03	78.27	54.00	-0.31
Lagos	92.83	81.07	-0.13	60.66	70.14	0.16	96.68	88.87	-0.08
Nassarawa	60.39	59.75	-0.01	6.55	9.12	0.39	30.81	15.98	-0.48
Niger	84.26	72.26	-0.14	11.18	14.59	0.30	44.18	24.88	-0.44
Ogun	79.21	85.54	0.08	16.23	37.21	1.29	72.70	65.06	-0.11
Ondo	70.85	69.23	-0.02	25.75	23.20	-0.10	56.09	34.75	-0.38
Osun	85.97	77.63	-0.10	9.17	20.53	1.24	67.10	52.72	-0.21
Oyo	89.38	84.61	-0.05	26.49	21.50	-0.19	76.74	41.49	-0.46
Plateau	74.18	59.27	-0.20	21.05	11.86	-0.44	26.81	14.15	-0.47
Rivers	81.27	88.89	0.09	44.92	35.33	-0.21	29.34	35.44	0.21
Sokoto	99.12	98.37	-0.01	3.47	22.54	5.50	24.26	19.11	-0.21
Taraba	54.27	38.86	-0.28	4.84	6.07	0.25	8.92	7.27	-0.18
Yobe	95.60	88.73	-0.07	2.18	8.46	2.88	23.57	17.91	-0.24
Zamfara	88.40	81.11	-0.08	4.98	16.97	2.41	21.47	7.16	-0.67

Appendix Table A2: Households not deprived by welfare indicator by state and year (%), (cont.)

	Shelter			Education		
	2004	2009	Change	2004	2009	Change
Abia	94.79	89.61	-0.05	97.47	96.15	-0.01
Adamawa	45.30	42.23	-0.07	81.13	70.75	-0.13
Akwalbom	73.65	70.27	-0.05	96.62	88.93	-0.08
Anambra	94.05	92.79	-0.01	97.19	96.52	-0.01
Bauchi	49.16	37.63	-0.23	62.14	52.55	-0.15
Bayelsa	71.63	78.44	0.10	94.00	95.22	0.01
Benue	56.55	47.79	-0.15	91.54	91.82	0.00
Borno	71.72	37.06	-0.48	55.85	45.97	-0.18
Cross Rivers	62.07	60.17	-0.03	95.99	94.99	-0.01
Delta	91.56	87.46	-0.04	95.81	90.73	-0.05
Ebonyi	44.32	30.05	-0.32	95.25	95.85	0.01
Edo	90.10	81.04	-0.10	97.92	95.01	-0.03
Ekiti	88.59	87.02	-0.02	93.38	92.29	-0.01
Enugu	85.43	83.00	-0.03	97.05	93.14	-0.04
FTC	80.22	90.29	0.13	88.52	94.26	0.06
Gombe	48.96	36.87	-0.25	65.12	60.49	-0.07
Imo	95.85	92.19	-0.04	95.87	95.86	0.00
Jigawa	25.98	20.94	-0.19	54.59	52.44	-0.04
Kaduna	78.45	65.64	-0.16	88.06	75.81	-0.14
Kano	65.81	41.66	-0.37	90.01	66.14	-0.27
Katsina	47.16	35.66	-0.24	73.61	46.96	-0.36
Kebbi	24.03	27.83	0.16	45.60	41.45	-0.09
Kogi	81.14	72.84	-0.10	94.30	90.69	-0.04
Kwara	89.98	74.55	-0.17	89.65	80.16	-0.11
Lagos	98.23	98.64	0.00	98.07	97.97	0.00
Nassarawa	66.69	73.31	0.10	87.65	86.51	-0.01
Niger	62.91	73.94	0.18	54.58	64.87	0.19
Ogun	89.59	92.26	0.03	90.52	90.39	0.00
Ondo	89.55	85.73	-0.04	93.86	94.18	0.00
Osun	86.10	84.08	-0.02	88.96	91.95	0.03
Oyo	90.04	81.93	-0.09	91.44	86.09	-0.06
Plateau	49.43	62.36	0.26	91.83	90.03	-0.02
Rivers	89.85	86.27	-0.04	97.19	97.38	0.00
Sokoto	30.51	22.86	-0.25	55.44	36.74	-0.34
Taraba	42.58	36.63	-0.14	82.73	64.89	-0.22
Yobe	34.90	29.42	-0.16	48.84	46.09	-0.06
Zamfara	41.05	46.30	0.13	63.49	35.59	-0.44

Source: Authors' calculations based on the 2003/04 NLSS and the 2008/09 HNLSS.

Appendix Table A3a: 1999 DHS static spatial FOD comparisons

Area	National	Rural	Urban	NC	NE	NW	SE	SS	SW	Avg.
National		1								0.13
Rural										0.00
Urban	1	1		1	1	1				0.63
NC		1								0.13
NE										0.00
NW										0.00
SE										0.00
SS										0.00
SW		1								0.13
Average	0.13	0.50	0.00	0.13	0.13	0.13	0.00	0.00	0.00	0.11

Source: Authors' calculations based on the 1999 Nigeria DHS.

Appendix Table A3b: 2003 DHS static spatial FOD comparisons

Area	National	Rural	Urban	NC	NE	NW	SE	SS	SW	Avg.
National		1			1					0.25
Rural										0.00
Urban	1	1		1	1					0.50
NC										0.00
NE										0.00
NW										0.00
SE	1	1		1	1					0.50
SS										0.00
SW	1	1		1	1					0.50
Average	0.38	0.50	0.00	0.38	0.50	0.00	0.00	0.00	0.00	0.19

Source: Authors' calculations based on the, 2003 Nigeria DHS.

Appendix Table A3c: 2008 DHS static spatial FOD comparisons

Area	National	Rural	Urban	NC	NE	NW	SE	SS	SW	Avg.
National		1			1					0.25
Rural										0.00
Urban	1	1		1	1				1	0.63
NC										0.00
NE										0.00
NW					1					0.13
SE		1		1						0.25
SS				1						0.13
SW		1		1	1					0.38
Average	0.13	0.50	0.00	0.50	0.50	0.00	0.00	0.00	0.13	0.19

Source: Authors' calculations based on the 2008 Nigeria DHS.

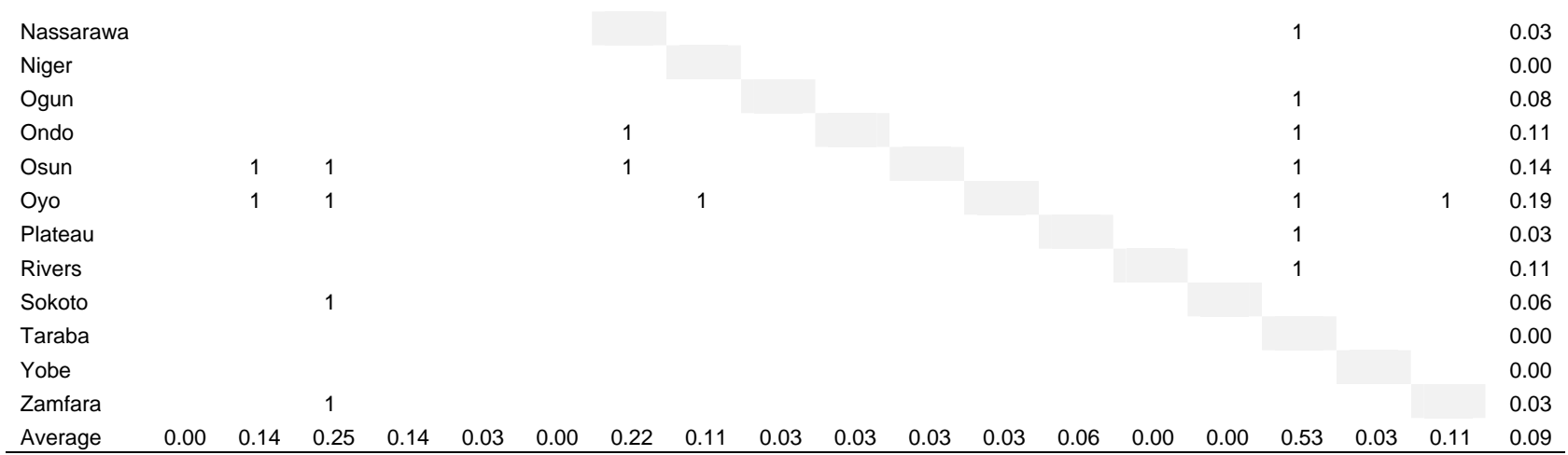
Appendix Table A4a: 2003/04 NLSS static spatial FOD comparisons by state

State	Abia	Adamawa	Akwa Ibom	Anambra	Bauchi	Bayelsa	Benue	Borno	Cross_River	Delta	Ebonyi	Edo	Ekiti	Enugu	FCT	Gombe	Imo	Jigawa	Kaduna	
Abia	1																			
Adamawa		1																		
Akwabom			1																	
Anambra				1																
Bauchi					1															
Bayelsa						1														
Benue							1													
Borno								1												
Cross Rivers									1											
Delta		1								1										
Ebonyi											1									
Edo		1	1									1								
Ekiti													1							
Enugu														1						
FCT															1					
Gombe																1				
Imo																	1			
Jigawa																		1		
Kaduna		1			1			1											1	
Kano																				1
Katsina																				
Kebbi																				
Kogi																				
Kwara		1						1												1
Lagos	1	1	1	1	1		1	1	1		1	1	1	1	1	1	1			

Nassarawa																				
Niger																				
Ogun	1																		1	
Ondo	1						1													
Osun																			1	
Oyo	1																		1	
Plateau																				
Rivers	1						1			1										
Sokoto																				1
Taraba																				
Yobe																				
Zamfara																				
Average	0.03	0.28	0.08	0.03	0.06	0.00	0.17	0.08	0.08	0.00	0.14	0.03	0.03	0.06	0.06	0.28	0.03	0.03	0.00	

Appendix Table A4a: 2003/04 NLSS static spatial FOD comparisons by state, (cont.)

State	Kano	Katsina	Kebbi	Kogi	Kwara	Lagos	Nassarawa	Niger	Ogun	Ondo	Osun	Oyo	Plateau	Rivers	Sokoto	Taraba	Yobe	Zamfara	Avg.
Abia				1			1									1			0.25
Adamawa																			0.00
Akwa_Ibom																1			0.03
Anambra				1															0.03
Bauchi			1																0.03
Bayelsa																			0.00
Benue																1			0.03
Borno																			0.00
Cross_Rivers																			0.00
Delta				1			1						1			1			0.22
Ebonyi																1			0.03
Edo				1			1									1			0.28
Ekiti							1									1			0.08
Enugu																			0.00
FCT																			0.00
Gombe																			0.00
Imo																1			0.03
Jigawa																			0.00
Kaduna		1	1					1								1	1	1	0.28
Kano			1													1			0.08
Katsina																			0.00
Kebbi																			0.00
Kogi																			0.00
Kwara		1	1				1	1								1		1	0.25
Lagos		1	1	1	1		1	1	1	1	1	1	1			1		1	0.78



Source: Authors' calculations based on the 2003/04 NLSS.

Appendix Table A4b: 2008/09 NLSS static spatial FOD comparisons by state

State	Abia	Adamawa	Akwa_Ibom	Anambra	Bauchi	Bayelsa	Benue	Borno	Cross_River	Delta	Ebonyi	Edo	Ekiti	Enugu	FCT	Gombe	Imo	Jigawa	Kaduna
Abia	1																		
Adamawa		1																	
Akwa_Ibom			1																
Anambra		1		1															
Bauchi					1														
Bayelsa						1													
Benue							1												
Borno								1											
Cross_Rivers									1										
Delta		1			1			1		1									
Ebonyi											1								
Edo		1	1				1		1			1							
Ekiti		1					1						1						
Enugu							1							1					
FCT		1					1								1				
Gombe																1			
Imo		1	1				1				1						1		
Jigawa																		1	
Kaduna		1			1			1											1
Kano																			1
Katsina																			
Kebbi																			
Kogi																			
Kwara		1			1														1
Lagos	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Nassarawa																			
Niger																			
Ogun	1				1				1									1	
Ondo	1							1											
Osun	1							1											1
Oyo	1				1				1										1
Plateau																			
Rivers	1	1			1	1		1	1	1			1					1	1
Sokoto																			
Taraba																			
Yobe																			
Zamfara																			
Average	0.03	0.42	0.14	0.03	0.19	0.11	0.31	0.17	0.17	0.00	0.14	0.03	0.03	0.06	0.03	0.36	0.03	0.00	0.03

Source: Authors' calculations based on the 2008/09 HNLS.

Appendix Table A4b: 2008/09 NLSS static spatial FOD comparisons by state, (cont.)

State	Kano	Katsina	Kebbi	Kogi	Kwara	Lagos	Nassaraw ^a	Niger	Ogun	Ondo	Osun	Oyo	Plateau	Rivers	Sokoto	Taraba	Yobe	Zamfara	Avg.
Abia				1			1	1					1			1			0.33
Adamawa																1			0.03
Akwa_Ibom																1			0.03
Anambra				1			1						1			1			0.31
Bauchi																			0.00
Bayelsa																			0.03
Benue																			0.00
Borno																			0.00
Cross_Rivers																			0.00
Delta	1			1	1		1	1					1			1			0.31
Ebonyi																			0.00
Edo				1			1						1			1			0.25
Ekiti				1			1						1			1			0.19
Enugu																1			0.06
FCT				1			1						1			1			0.17
Gombe																			0.00
Imo							1						1			1			0.19
Jigawa																			0.00
Kaduna	1															1	1		0.19
Kano																1			0.06
Katsina																			0.00
Kebbi																			0.00
Kogi																			0.00
Kwara																1			0.11
Lagos	1			1	1		1	1		1	1		1			1	1	1	0.72

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