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# Estimating multidimensional poverty in Zambia

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**Abstract:** In this paper, we apply the first-order dominance (FOD) approach to assessing multidimensional welfare to analyse multidimensional poverty in Zambia in 1996, 2006, and 2010. In addition to evaluating welfare across time and space, we extend the methodology to evaluate welfare by rural agricultural strata and urban housing cost areas. This modification allows a more detailed perspective on the evolution of rural poverty. Finally, we consider the sensitivity of FOD results to indicator definitions in a context where data prohibited the preferred definition.

**Keywords:** welfare, first-order dominance, Zambia, multidimensional poverty, growth
**JEL classification:** I32, D63, O10

**Figures and** Tables: at the end of the paper.

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# 1 Introduction

Throughout the 2000s, Zambia achieved robust economic growth with real gross domestic product (GDP) growing at an average annual rate of seven per cent making Zambia one of the fastest growing economies in southern Africa (Word Bank 2014; AFDB 2013) and boosting Zambia from low-income to middle-income country status. This economic achievement is remarkable in that it follows more than 20 years of economic decline whereby GDP per capita fell from USD1070 at independence to USD582 in 1994 (World Bank 2013), rural extreme consumption poverty peaked in 1993 at 84 per cent (CSO 2005), and life expectancy fell from 53 years in 1987 to 48 years in 1992 (Bonnick 1997). The growth rebound is thus broadly welcomed. Nevertheless, the re-emergence of sustained, strong macroeconomic performance has not proven to be inclusive. While urban consumption poverty rates have fallen from as high as 56 per cent in 1998 to 28 per cent in 2010,[1] rural rates have hovered near 80 per cent since 1996 (World Bank 2014).

In this paper, we continue the effort of Masumbu and Mahrt (2016) to understand better the nature of welfare dynamics during this period of high growth and relatively little rural consumption poverty reduction. Both analyses evaluate the evolution of nonmonetary welfare in Zambia through an application of the first-order dominance (FOD) methodology. FOD comparisons generate information about the relative welfare of the nine provinces of Zambia and their performance over time. Here, we focus on an extension of the methodology to compare household welfare by rural economic activity and urban housing cost areas. Analysis by rural household strata provides a more detailed perspective on rural welfare, which is particularly pressing in the Zambian context of only modest gains in rural consumption poverty. From the 1996, 2006, and 2010 Living Conditions Monitoring Surveys (LCMS), we define welfare in terms of five household level binary indicators measuring deprivations in five basic needs—water, sanitation, shelter, energy, and education.

With welfare defined in terms of binary indicators based on categorical data, careful and purposeful attention must be given to defining cut-offs that determine which outcomes are deemed deprived or not deprived. In this paper, we focus on cut-off levels to illustrate two points. First, data restrictions often prohibit indicator definitions from aligning with development and policy goals. Second, FOD results are sensitive to variable definitions, because not only outcomes across populations are likely to differ with alternative definitions, but also within a given set of definitions too much similarity or too many differences among indicators in each population could prevent meaningful comparisons.

The paper is structured as follows. Section 2 provides a brief contextual discussion of rural poverty. Section 3 presents the FOD methodology. Section 4 presents the data and addresses FOD indicator choices. Section 5 discusses spatial and temporal welfare comparisons for both provinces and rural and urban household strata, sensitivity to indicator choices, and indeterminate outcomes. Finally, section 6 concludes.

[1] The 2006 and 2010 poverty rates are not strictly comparable with earlier years. These rates were calculated using year specific Engel ratios to derive food shares while previous years used a fixed ratio.

## 2 Context

The Zambian government has prioritized poverty reduction since the 2002 adoption of the interim Poverty Reduction Strategy Paper (PSRP), and the subsequent Fifth and Sixth National Development Plans (FNDP and SNDP). Yet, despite targeted planning and robust growth, 2010 national monetary poverty lines indicate the Zambian population has not benefited equally. Figure 1 displays rural and urban poverty rates over the period 1996 to 2010. In 2010, 78 per cent of rural populations still lived in poverty compared to only 28 per cent in urban areas. Furthermore, 90 per cent of Zambians living below the extreme poverty line reside in rural areas (CSO 2010).

Table 1 disaggregates urban and rural poverty trends by urban housing cost areas and rural economic activities.[2] These figures pinpoint the modest reductions in rural poverty to a failure of agricultural households to achieve substantial gains. Between 1996 and 2010, rural non-agricultural consumption poverty fell 21 percentage points to 59 per cent compared to reductions of 8 and 3 percentage points to 80 and 70 per cent in small- and medium-scale farm households, respectively. However, as non-agricultural households comprise only six per cent of rural households and four per cent of all Zambian households, these significant gains had little impact on rural and overall poverty. On the other hand, small-scale farm households comprise 90 per cent of rural populations and account for 93 per cent of the rural poor; they comprise 59 per cent of Zambia's population, and 78 per cent of the nation's poor.

Given the high percentage of poor households engaged in small-scale farming, attention to the polarized socioeconomic structure of the Zambian economy remains central to poverty reduction efforts. The primary push to reduce rural poverty has occurred through large government agricultural programmes. Subsidized seed and fertilizer distributed via the Farmer Input Support Programme (FISP), formally the Fertilizer Support Programme, and price supports via the Food Reserve Agency (FRA) account for the majority of agricultural spending under the Poverty Reduction Strategy (Mason et al. 2013). However, such programmes have been less effective at reaching the poorest subset of the population, small-scale and medium-scale farms. Only 9, 11, and 30 per cent of Zambian small-scale and medium-scale households received subsidized fertilizer through FISP in 2002/3, 2006/7, and 2010/11, respectively, and only 1, 10, and 27 per cent sold maize to the FRA in the 2003/4, 2007/8, and 2011/12 maize marketing years, respectively (Mason et al. 2015; Mason and Tembo 2014). Furthermore, wealthier households and households farming larger plots of land were more likely to participate in FISP; wealthier households on average received greater shares of fertilizer (Mofya-Mukuka et al. 2013; Mason and Tembo 2014).

In addition to agricultural supports, Zambia has made remarkable improvements in public service delivery in the last ten years. In 2005, the country benefited from substantial debt relief through the Heavily Indebted Poor Countries Initiatives that led to freeing of resources for poverty reduction programmes. The 2006 budgetary allocations to the social sectors stood at 30 per cent of the total budget, which was greater than any previous allocation (Zulu 2006), and has subsequently remained consistently high. Through the national development plans, the Government of Zambia has implemented a number of strategies to enhance public service delivery. As a result, Zambia has achieved significant gains in wellbeing as seen in its climb from

[2] Small-, medium- and large-scale farms are those achieving the greater of two criteria. Either households are cultivating less than five hectares, 5-20 hectares, and more than 20 hectares, respectively, or they own at least a specified number of livestock or poultry. To be classified as small-scale farms, households must own fewer than five exotic dairy cows and no beef cattle, exotic pigs, broilers, or layers. See CSO (1997) for specific details.

a low to a medium human development country in 2014 (UNDP 2014). Improvements have been recorded in dimensions such as infant mortality, under-five and maternal mortality rates, which have declined from 112,[3] 202,[4] and 650[5] in 1998 to 89, 93 and 440 (UNDP 2000, 2014). School enrolment has also increased over time; although the average schooling rate has remained stagnant at about six per cent by 2014 (UNDP 2014).

## 3 FOD methodology

This section provides an intuitive overview drawing from Arndt et al. (2013)[6]. In brief, the FOD criterion asserts that it is better to be not deprived than deprived in any dimension. Consider a set of three ordinal, binary welfare indicators such that '0' indicates deprived and '1' indicates not deprived in each dimension. Each combination of welfare indicators is said to dominate, be dominated by, or be indeterminate relative to other combinations. The outcome (1, 1, 1), clearly is better than or dominates (0, 0, 0), since it is superior in every dimension. Furthermore, the outcome (1, 1, 0), dominates (0, 1, 0) because it is better to be not deprived than deprived in the first dimension. However, (1, 1, 0) and (0, 0, 1) are indeterminate outcomes. Without imposing assumptions regarding the relative importance of or substitutability between each outcome, it cannot be determined if it is better to be not deprived in the first two dimensions or in the third dimension.[7]

Extending to two populations, A and B, consider the distribution of individuals falling into each combination of welfare indicators. The FOD criterion can be described as follows: population A first-order dominates population B if one can generate distribution B by transferring probability mass (i.e., moving individuals) from better to unambiguously worse outcomes within A, where better is defined as above.

Population groups are typically defined spatially to compare the welfare of geographic areas such as provinces or urban and rural areas. This study extends the FOD methodology to both compare welfare spatially and across household socioeconomic strata. The LCMS is stratified geographically and by rural household economic activity, and urban housing cost areas, which allows welfare comparisons to be made between household strata and for each stratum over time.

## 4 Data

### 4.1 LCMS surveys

FOD indicators are defined using the 1996, 2006, and 2010 Zambia LCMS conducted by the Central Statistical Office (CSO). These nationally representative surveys allow for welfare comparisons at the provincial and urban/rural levels. The sampling method also allows for analysis of households by urban housing cost areas (low, medium, and high cost), and rural agricultural activities (non-agricultural, small-scale farm, medium-scale farm, and large-scale farm households). The total number of households surveyed increased over the study period from

[3] Per 1,000 live births.

[4] Per 1,000 live births.

[5] Per 100,000 live births.

[6] See Arndt et al. (2012) for greater detail.

[7] See Mahrt and Nanivazo (2015) for a discussion of indeterminate outcomes.

11,787 in 1996 to 18,662 in 2006, and 19,397 in 2010. In urban areas, 65, 20, and 15 per cent of the 2010 sample resides in low, medium, and high cost areas, respectively. In rural areas, approximately 75, 10, and 15 per cent of the 2010 sample is engaged in small-scale farming, medium-scale farming, or non-agricultural activities, respectively. Fewer than 60 large-scale farming households were included in each sample, and therefore this stratum is excluded from analysis.

### 4.2 FOD indicators

We aimed to define welfare in terms of five indicators inspired by the national development goals as outlined in the Fifth and Sixth National Development Plans (GRZ 2011a,b) and Vision 2030 (GRZ 2006)—water, sanitation, housing, energy, and education. For each indicator, a cut-off level of welfare was selected, which defines whether a household is deprived or not. The Millennium Development Goals provided guidance in selecting these cut-offs.[8] Table 2 presents each indicator and the corresponding definition of deprived.

In general, two issues may arise in defining indicators from survey data preventing the line between deprived and not deprived from being drawn as preferred. First, the questionnaire's response options pertaining to a given indicator may not closely align with policy goals. For instance, regarding the source of drinking water, response options might only broadly encompass water from any well as opposed to more detailed options such as water from a covered well or water from an uncovered well. Development goals might focus on providing drinking water from a covered well or better. Second, though the questionnaire might identify useful categorizations, definitions may vary slightly or may not be interpreted similarly from year to year. For example, though the questionnaire distinguishes between covered and uncovered wells, the percentage of people responding that they obtain water from each source might be implausibly different from one year to the next. This chapter addresses the issue of response options defined more broadly than policy goals. The issue of seemingly unlikely changes in outcomes over time is addressed in terms of the sanitation indicator in Nigeria (Ajakaiye et al. 2015).

The 1996 and 2006 LCMS questionnaires do not provide responses that permit the sanitation indicator to align closely with poverty reduction goals. Ideally, we would define the sanitation indicator to be consistent with the internationally recognized definition of improved sanitation laid out for the MDGs. In this definition, improved sanitation includes latrines covered with a slab but not open latrines. The MDGs definition of improved sanitation further classifies all facilities shared among households to be unimproved. Unfortunately, the LCMS questionnaires prior to 2010 do not distinguish between covered and uncovered latrines. Though the LCMS distinguishes whether the household uses its own facilities, it does not identify if own facilities are shared. Given the data, the decision to define deprivation in sanitation as the lack of a flush toilet, covered latrine, or uncovered latrine was based on the more urgent priority of access to any latrine as opposed to access to flush toilets. Table 3 describes the sanitation indicator used in analysis and three alternative sanitation indicators. Section 5 will evaluate the sensitivity of FOD results to each sanitation indicator.

[8] MDG definitions of improved water and sanitation (WHO and UNICEF 2014) provided a framework for defining the water and sanitation indicators.

## 5 Results

This section presents an assessment Zambia's household welfare in 1996, 2006, and 2010.[9,10] We begin with a discussion of trends in each FOD indicator and then present temporal and spatial FOD results focusing on rural and urban welfare. Finally, we evaluate how each of the four sanitation definitions influences outcomes.

### 5.1 Levels of deprivation

Table 4 presents deprivations across urban housing cost areas, rural agricultural strata, and all areas of analysis. Overall deprivation in access to water, sanitation, and education significantly declined over the period while only modest declines were registered in deprivation in shelter and cooking fuel. In contrast to monetary poverty trends, the indicators provide evidence of improved welfare in rural areas whereas urban welfare essentially stagnated in all indicators except education. Substantial gains in rural areas were concentrated in small-scale farm and non-agricultural households. Over the study period, a great disparity persisted in deprivation levels of households residing in urban low-cost housing areas compared to medium- and high-cost areas. However, low-cost areas outperformed all rural strata in every indicator by a large margin. Though rural areas achieved notable gains, both the deprivation rates and the gap between urban and rural deprivation levels remained high.

### 5.2 Temporal FOD comparisons

Temporal FOD results are presented as the net probability of domination, which measures the probability that the welfare of an area or strata improves between two years net of any probability of regression. Positive values indicate the probability of advancement in welfare and negative values indicate the probability of regression.

Table 5 displays the net temporal FOD results for each aggregate area, province, and strata. At the national level, FOD comparisons indicate significant probabilities of advancement over time. National welfare advanced between 1996 and 2010 with a probability of 55 per cent and rural areas advanced with a probability of 87 per cent. Between 2006 and 2010, both urban and rural areas registered a 44 per cent probability of advancement. Provincial results also indicate rural advancement in that predominately-rural Central, Eastern, Northern, Northwestern, and Southern provinces exhibit notable probabilities of welfare improvements in 2010. The stronger evidence of rural compared to urban advancement stands in contrast to monetary trends over the same period indicating significant reductions in urban poverty compared to only modest reductions in rural poverty (Figure 1).

This contrast between trends in multidimensional welfare and monetary poverty holds when FOD comparisons are decomposed by urban household strata. Specifically, FOD results provide evidence that only low-cost housing areas improved with a probability of 30 per cent. However, welfare improvements in rural strata are more complex. Consistent with the 21 per cent decline in monetary poverty between 1996 and 2010 in non-agricultural households (Table 1), FOD results indicate an 86 per cent likelihood of welfare advancement between 2006 and 2010. Monetary poverty in medium-scale agricultural households stagnated at around 70 per cent over the study period, which is confirmed by the lack of evidence of advancement or regression in

[9] The use of updated 2010 weights resulted in slightly different figures than Masumbu and Mahrt (2016), however, overall trends and conclusions remain the same.

[10] Population weights are used throughout the analysis.

FOD comparisons. Despite a modest reduction in monetary poverty from 88 to 80 per cent, small-scale farms achieved a 68 per cent likelihood of advancement in the FOD indicators between 1996 and 2010.

## 5.3 Spatial FOD comparisons

In each year, FOD comparisons are made between all areas to determine the degree of domination of each aggregate area and province. In separate comparisons, the relative welfare of household strata is also evaluated. Spatial results are presented in two formats. First, spatial tables (Tables 6 and 7) present the FOD outcome of each area compared to every other area. Second, area and household stratum rankings are presented based on spatial bootstrap outcomes (Tables 8 and 9). While spatial tables provide more detail, ranking tables conveniently summarize the welfare performance of each population relative to other populations.

Tables 6 and 7 present spatial FOD results for 1996 and 2010. Row by row, values in the inner table represent the probability that a population dominates the corresponding column population.[11] Higher row averages are associated with relatively better off populations (populations likely to dominate) while higher column averages are associated with relatively worse off populations (populations likely to be dominated). Outer row values present row averages, which measure the probability the row population dominates all other populations. Reading down the columns, inner values represent the probability that a population is dominated by the row population and outer values represent the probability that the population is dominated by all other populations. In interpreting a population's relative wellbeing, both row and column averages should be considered.

Net domination measures the probability that an area dominates other areas (row averages) minus the probability that it is dominated by other areas (column averages). Net domination scores provide a basis for ranking provinces and conveniently presenting relative wellbeing. Table 8 presents area rankings and Table 9 presents urban and rural stratum rankings. It is worth noting that the difference in net domination scores is often insufficiently large to distinguish between differences in welfare outcomes and variability introduced through random bootstrapping. To avoid misinterpreting rankings within the tables, shading and lines identify clusters with similar net domination scores. Within these clusters, ranks cannot be established with confidence.

### *5.3.1 Area comparisons*

Tables 6 and 7 present 1996 and 2010 area spatial results. In all three years, row averages indicate that urban areas, Copperbelt, and Lusaka dominated all other areas with a high degree probability. Rural areas and Western province exhibit the highest average probability of being dominated (nearly 50 per cent or greater) in both 1996 and 2010. In all three years, virtually all FOD comparisons not involving one of the aforementioned areas result in indeterminate outcomes in the static case or low probabilities of domination in bootstrapping. In other words, nearly all FOD outcomes depend on the extent to which an area is dominated by urban areas, Lusaka, or Copperbelt, and the extent to which it dominates rural areas and Western province.

Table 8 presents provincial rankings based on net domination scores. Keeping in mind that small differences in net domination scores may not be robust, Table 8 shows that little change in

[11] Note that bootstrap sampling introduces a degree of randomness into the results and care must be taken in interpreting very small probabilities or small differences in probabilities.

ranking occurs between 1996 and 2010. As seen in the spatial tables, urban areas, Lusaka, and Copperbelt are ranked at the top and rural areas and Western provinces are ranked at the bottom, in all three years. Though temporal results suggest advancement in rural areas and many rural provinces, these gains were not sufficient to improve their rankings, as rural provinces remain dominated by urban areas and urban provinces. With the exception of Central province, rural areas and provinces remain persistently and in most cases severely deprived.

### *5.3.2 Household stratum comparisons*

The spatial FOD methodology applied to rural and urban household strata produces outcomes that are more or less as one would expect, and therefore FOD tables are not presented. In each year, all urban strata dominate all rural strata, rural areas, and the nation with probabilities at or near 100 per cent. Within urban strata, high and medium-cost areas dominate low-cost areas, but never dominate one another. Within the rural strata, both medium-scale agricultural households and non-agricultural households strongly dominate small-scale agricultural households in most cases but neither stratum ever dominates the other. These strata perform quite similarly in 1996 and 2006. However, in 2010 medium-scale agricultural households no longer dominate rural areas and dominate small-scale agricultural households to a much lesser degree while non-agricultural households dominate to a greater degree. This relative welfare improvement of non-agricultural households is consistent with temporal advancement between 2006 and 2010.

This reversal in the relative performance of medium-scale and non-agricultural households is the most notable trend in the ranking table (Table 9). High-cost and medium-cost households also reverse. The remaining net domination scores and the resulting rankings are quite stable. Despite temporal evidence of welfare advancement in small-scale agricultural households and rural areas between 1996 and 2010, and non-agricultural households between 2006 and 2010, these advancements were insufficient to change rankings relative to the nation and urban populations. Small-scale agricultural households remain severely deprived relative to all other household strata as evidenced by net domination scores near -.90 in 1996 and 2010.

## 5.4 Indicator sensitivity

In this section, we explore the sensitivity of temporal and spatial FOD outcomes to indicator definitions by exploring the impact of each of the four sanitation definitions presented in Table 3. This discussion is not intended to dig deeper into the sanitation indicator per se, but rather to illustrate the sensitivity of FOD outcomes to indictor definitions. We will also show that in some circumstances a single indicator choice can lead to a high degree of indeterminate outcomes rendering FOD analysis much less effective.

Beginning with a look at descriptive statistics for each sanitation indicator, Table 10 highlights how different definitions can tell quite different stories about the level and degree of change in welfare. For instance, the percentage of households that do not use a *flush toilet or any* latrine declined significantly in rural areas but held steady in urban areas. Though the *own* indicator also suggests improvements in rural areas, urban areas backslid. Finally, the *flush* indicator suggests persistently high rural deprivation and significantly deteriorating conditions in urban areas. In addition, patterns of deprivation differ with the *own* indicator driven by the prevalence of communal facilities in Lusaka. Compared to the large gap between urban and rural deprivation exhibited by other sanitation indicators, in 2010, own sanitation deprivation in the nation, rural areas, and urban areas is quite similar. Furthermore, deprivation in own sanitation is higher in Lusaka than the rural provinces of Central, Lupuala, Northern, and North-Western. Three of the poorest provinces, Lupuala, Northern, and North-Western, outperform almost all areas, including the urban area aggregate in many cases. Given the clear differences in the levels and

dynamics of each sanitation indicator, it would be expected that FOD outcomes would also be sensitive to sanitation indicator choice.

Table 11 presents a comparison of temporal FOD outcomes using each sanitation indicator. Temporal results are sensitive to the sanitation indicator and generally mirror each indicator's pattern of deprivation. Temporal FOD comparisons using the *flush/any latrine* indicator point to a strong probability that national and rural welfare improved between 1996 and 2010. When the own indicator is used instead, only rural areas are likely to have improved over time. Finally, welfare is unlikely to have improved in any aggregate area with the *flush* indicator.

As with temporal FOD outcomes, spatial comparisons differ according to which sanitation indicator is included. In this discussion, we will also consider the *flush/covered* latrine indicator, which was preferred but not used due to data limitations prior to 2010. Evaluating areas based on 2010 spatial net domination scores suggests that rankings do not differ substantially with the *flush/any latrine*, *flush/covered latrine*, and the *flush* indicators (Table 12). *Flush/covered latrine* and *flush* results are remarkably similar. The *flush/any latrine* and *flush/covered* latrine results are similar once potential differences due to bootstrapping variation are taken into account. In contrast, the *own* indictor produces quite different outcomes. Most notably, Lusaka has a net domination score of only .25 compared to scores of at least .76 with the other three definitions.

### 5.5 Indeterminate outcomes

Whether a household has its own facility does not necessarily correspond to the quality of the facility. As noted, introducing a measure of shared sanitation generates patterns of deprivation quite different from those of the other sanitation indicators. These patterns of deprivation also differ substantially from the water, shelter, fuel, and education indicators and thus lead to a high degree of indeterminate outcomes. Recall that the combination (1, 0, 0) is indeterminate compared to (0, 1, 1) because no assumptions are made whether it is better to be not deprived in the first dimension or not deprived in all other dimensions. Relatively high deprivation in own sanitation in Lusaka and low deprivation in all other indicators creates an analogous scenario where Lusaka fails to dominate or be dominated by most areas. Table 13 illustrates the extent of the resulting indeterminacy compared to the flush/any latrine results reported in Table 7. Using the original set of indicators, as would be expected, Lusaka and urban areas dominated the nation, rural areas, and Central, Copperbelt, Lupuala, Northern, and North-Western provinces with probabilities near 50 per cent or more and in most cases, close to 100 per cent. Using the *own* indicator in spatial FOD comparisons, Lusaka dominates none of these areas with probabilities greater than five per cent. Similarly, urban areas no longer dominate Central, Copperbelt, Lupuala, and Northern provinces.

It should be noted that extensive indeterminate outcomes are certainly not always the result of indicator definitions. Indeterminacy may also result simply because areas have extremely different deprivation levels among the FOD indicators. Mahrt and Nanivaso (2015) find a great degree of indeterminacy in FOD analysis of the provinces of the DRC. In this case, the inability to compare conclusively welfare between provinces is more likely due to erratically different welfare profiles over time and space.

## 6 Discussion

Zambia has made strides in revitalizing its economy over the last 20 years. The country rebounded from low and even negative growth in the 1980s and 1990s to a high average annual growth rate of seven per cent in the 2000s. Despite strong growth, structural changes over the

last twenty years have brought little social transformation or employment creation (Resnick and Thurlow 2014). Though agricultural productivity rose in recent years, productivity remains low with agriculture's contribution to GDP steadily declining. Furthermore, policy attempts in the 2000s to reduce rural poverty through farm input subsidies and price supports largely failed to reach the poorest subset of rural households, small-scale farmers (Mason et al. 2015; Mason and Tembo 2014). Ultimately, impressive economic growth did not translate to substantial monetary poverty reduction for rural agricultural households compared to rural non-agricultural and urban households.

In contrast, strong growth and government efforts to increase spending on poverty reduction programmes and the delivery of public services appear to have had an impact on multidimensional poverty. FOD results provide evidence of broad based gains in rural welfare in Zambia between 1996 and 2010—gains driven by small-scale farm and non-agricultural rural households. FOD also suggests urban welfare gains between 2006 and 2010 driven by gains in urban low-cost housing areas. While these results are not robust to all choices of sanitation indicators, access to any sanitation facility is a general and broadly accepted goal. Despite these welfare gains, rural households, particularly small-scale farm households, continue to lag significantly behind their urban counterparts. Nevertheless, the results indicate that, in terms of the multidimensional indicators employed, some of the fruits of the improved government investments and growth performance have been translated into real progress in important development indicators on the ground.

Finally considering the sensitivity of FOD outcomes to indicator definitions, temporal results varied considerably using alternative sanitation indicators, while spatial results were robust to the use of the *flush*, *flush/covered*, and *flush/any latrine* indicators. However, the *own* indicator produced quite different results, including a high degree of indeterminate outcomes, as patterns of sanitation quality and patterns of own facility usage differ significantly. When indicators follow vastly different patterns among populations over time or space, FOD comparisons are likely to result in indeterminate outcomes and provide less information regarding relative welfare.

Given the sensitivity of results to indictor definitions, further analysis is warranted. Applying FOD analysis to the 2010 and 2013 Zambia Demographic and Health Surveys would permit the use of the more relevantly defined sanitation indicator, *flush/covered*, and provide a brief glimpse of access to covered latrines over time. Furthermore, considering alternative indicators measuring aspects of welfare such as health, nutrition, or access to information would better our understanding of the sensitivity of results to indicator selection as well as deepen our knowledge of the evolution of welfare in Zambia.

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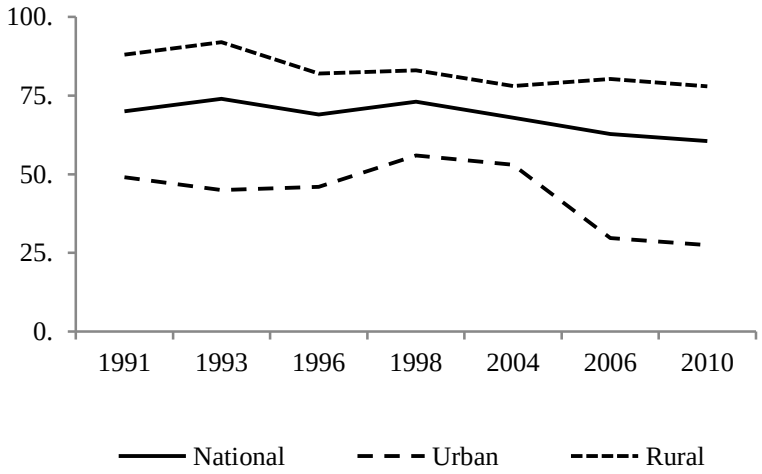
## Figures

Figure 1: Urban and rural poverty, 1996-2010




Note: The 2006 and 2010 poverty rates are not strictly comparable with earlier years. These rates were calculated using year specific Engel ratios to derive food shares while previous years used a fixed ratio.

Source: World Development Indicators (World Bank 2014).

## Tables

Table 1: Consumption poverty headcount rates by strata (per cent), 1996-2010

| | 1996 | 1998 | 2004 | 2006* | 2010* | 2010 Population share | 2010 Contribution to national poverty |
|---|---|---|---|---|---|---|---|
| Low cost housing | 58 | 61 | 58 | 35 | 35 | 26 | 15 |
| Medium cost | 43 | 50 | 46 | 14 | 9 | 6 | 1 |
| High cost housing | 36 | 33 | 30 | 5 | 5 | 3 | < 1 |
| Small-scale farms | 88 | 84 | 79 | 82 | 80 | 59 | 78 |
| Medium-scale farms | 73 | 72 | 73 | 70 | 70 | 2 | 3 |
| Large-scale farms | 22 | 16 | 37 | 33 | 25 | < 1 | < 1 |
| Non-agricultural | 80 | 80 | 69 | 68 | 59 | 4 | 4 |

Notes: * The 2006 and 2010 poverty rates are not strictly comparable with earlier years. These rates were calculated using year specific Engel ratios to derive food shares while previous years used a fixed ratio.

Source: CSO (2005, 2012).

Table 2: FOD indicators

| Indicators | Definitions |
|---|---|
| Water | Deprived if the main source of drinking water is not supplied by a tap, pipe, protected well or spring, rainwater, or water kiosk. |
| Sanitation | .The use of communal or a neighbour's facilities is not considered a deprivation. |
| Housing | Deprived if the main flooring material is mud. |
| Fuel | Deprived if the household's cooking fuel source is firewood, charcoal, or crop/livestock material. |
| Education | Deprived if the household head has not completed primary school. |

Source: Author's own definitions.

Table 3: Sanitation indicators

| Indicators | Definitions |
|---|---|
| Flush/any latrine | Deprived if the household does not use a flush toilet or a covered or uncovered latrine. |
| Own | Deprived if the household does not have a flush toilet or a covered or uncovered latrine. The use of a communal or a neighbour's facility is considered a deprivation. Sharing the household's own facilities with others is not a deprivation. |
| Flush | Deprived if the household does not use a flush toilet. |
| Flush/covered latrine | Deprived if the household does not use a flush toilet or a covered latrine. This definition is only possible with the 2010 LCMS. |

Source: Author's own definitions.

Table 4: Household deprivation by indicator (per cent)

| | Water | | | Sanitation | | | Shelter | | | Fuel | | | Education | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1996 | 2006 | 2010 | 1996 | 2006 | 2010 | 1996 | 2006 | 2010 | 1996 | 2006 | 2010 | 1996 | 2006 | 2010 |
| National | 48 | 42 | 34 | 22 | 13 | 12 | 57 | 61 | 56 | 85 | 84 | 84 | 43 | 36 | 31 |
| Rural | 70 | 58 | 48 | 33 | 19 | 17 | 82 | 84 | 78 | 99 | 98 | 98 | 56 | 48 | 41 |
| Urban | 11 | 12 | 8 | 2 | 2 | 1 | 13 | 19 | 14 | 60 | 58 | 57 | 21 | 14 | 14 |
| Central | 47 | 39 | 31 | 16 | 5 | 4 | 62 | 71 | 56 | 87 | 91 | 89 | 42 | 37 | 26 |
| Copperbelt | 27 | 28 | 22 | 2 | 1 | 1 | 25 | 29 | 29 | 68 | 62 | 67 | 27 | 19 | 20 |
| Eastern | 56 | 41 | 24 | 43 | 22 | 26 | 79 | 79 | 72 | 97 | 97 | 96 | 60 | 57 | 52 |
| Luapula | 89 | 87 | 69 | 6 | 2 | 2 | 76 | 86 | 75 | 97 | 98 | 98 | 50 | 41 | 42 |
| Lusaka | 4 | 4 | 4 | 2 | 3 | 2 | 10 | 13 | 8 | 58 | 54 | 48 | 22 | 16 | 14 |
| Northern | 86 | 71 | 68 | 10 | 1 | 1 | 87 | 82 | 75 | 98 | 96 | 96 | 52 | 41 | 34 |
| N.-Western | 80 | 59 | 44 | 7 | 3 | 4 | 85 | 85 | 77 | 96 | 97 | 94 | 58 | 44 | 38 |
| Southern | 40 | 28 | 23 | 61 | 34 | 28 | 64 | 62 | 57 | 93 | 89 | 88 | 50 | 33 | 31 |
| Western | 68 | 57 | 50 | 63 | 56 | 42 | 84 | 88 | 84 | 97 | 97 | 98 | 55 | 52 | 35 |
| Low cost | 12 | 13 | 10 | 3 | 2 | 1 | 16 | 22 | 18 | 71 | 66 | 67 | 25 | 16 | 16 |
| Medium cost | 6 | 5 | 2 | 0 | 1 | 0 | 5 | 6 | 2 | 27 | 27 | 34 | 9 | 5 | 9 |
| High cost | 3 | 3 | 3 | 1 | 1 | 0 | 2 | 2 | 3 | 22 | 12 | 21 | 5 | 3 | 5 |
| Small-scale farms | 73 | 59 | 49 | 34 | 19 | 18 | 84 | 85 | 80 | 99 | 98 | 98 | 57 | 49 | 42 |
| Medium-scale farms | 52 | 47 | 50 | 28 | 15 | 17 | 60 | 62 | 62 | 97 | 97 | 97 | 40 | 33 | 31 |
| Non-agricultural | 43 | 42 | 28 | 25 | 14 | 11 | 58 | 72 | 61 | 97 | 91 | 86 | 50 | 42 | 30 |

Source: Authors' own calculations based on the CSO 1996, 2006, and 2010 LCMS datasets.

Table 5: Temporal net FOD comparisons by area and strata (probabilities)

| | 2006 FOD 1996 | 2010 FOD 2006 | 2010 FOD 1996 |
|---|---|---|---|
| National | 0.20 | 0.45 | **0.55** |
| Rural | 0.09 | **0.44** | **0.87** |
| Urban | | **0.44** | 0.35 |
| Central | 0.02 | **0.51** | 0.22 |
| Copperbelt | 0.22 | -0.04 | 0.40 |
| Eastern | 0.43 | 0.03 | **0.47** |
| Luapula | | 0.07 | 0.20 |
| Lusaka | 0.06 | 0.19 | 0.29 |
| Northern | **0.80** | -0.02 | **0.93** |
| Northwestern | 0.18 | 0.01 | **0.63** |
| Southern | **0.63** | 0.38 | **0.70** |
| Western | 0.07 | 0.32 | 0.22 |
| Urban Low Cost Housing | | 0.30 | 0.13 |
| Urban Medium Cost Housing | | 0.03 | |
| Urban High Cost Housing | | | |
| Small Scale Farms | 0.03 | 0.13 | **0.68** |
| Medium Scale Farms | 0.05 | -0.04 | 0.02 |
| Rural Non-Agricultural | | **0.86** | 0.30 |

Note: Values in bold indicate domination in the static case (FOD without bootstrapping).

Source: Authors' own calculations based on the CSO 1996, 2006, and 2010 LCMS datasets.

Table 6: 1996 Bootstrap spatial FOD comparisons (probabilities)

| Areas | National | Rural | Urban | Central | Copperbelt | Eastern | Luapula | Lusaka | Northern | North- Western | Southern | Western | Avg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| National | | **1** | | | | **0.89** | | | | | 0.01 | **0.99** | 0.26 |
| Rural | | | | | | | | | | | | 0.02 | 0.00 |
| Urban | **1** | **1** | | **0.99** | 0.44 | **1** | **0.95** | | **1** | **0.99** | **1** | **1** | 0.85 |
| Central | 0.05 | **1** | | | | **0.84** | | | 0.02 | 0.01 | 0.13 | **0.99** | 0.28 |
| Copperbelt | **1** | **1** | | **0.96** | | **0.98** | **0.96** | | **1** | **0.96** | **0.98** | **1** | 0.80 |
| Eastern | | 0.01 | | | | | | | | | | 0.08 | 0.01 |
| Luapula | | | | | | | | | 0.14 | | | | 0.01 |
| Lusaka | **1** | **1** | 0.01 | **1** | 0.27 | **1** | **0.94** | | **1** | **0.99** | **1** | **1** | 0.84 |
| Northern | | 0.01 | | | | | | | | | | 0.01 | 0.00 |
| N.-Western | | | | | | | | | 0.04 | | | 0.01 | 0.00 |
| Southern | | | | | | | | | | | | **0.60** | 0.05 |
| Western | | 0.01 | | | | | | | | | | | 0.00 |
| Average | 0.28 | 0.46 | 0.00 | 0.27 | 0.06 | 0.43 | 0.26 | 0.00 | 0.29 | 0.27 | 0.28 | 0.52 | 0.26 |

Note: Values in bold indicate domination in the static case (FOD without bootstrapping).

Source: Authors' own calculations based on the CSO 1996, 2006, and 2010 LCMS datasets.

Table 7: 2010 Bootstrap spatial FOD comparisons (probabilities)

| Areas | National | Rural | Urban | Central | Copperbelt | Eastern | Luapula | Lusaka | Northern | N.- Western | Southern | Western | Avg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| National | | **1** | | | | | | | | | | **0.95** | 0.18 |
| Rural | | | | | | | | | | | | 0.06 | 0.01 |
| Urban | **1** | **1** | | **0.99** | **0.81** | **1** | **0.99** | | **0.98** | **1** | **1** | **1** | 0.89 |
| Central | 0.06 | **1** | | | | | 0.04 | | | 0.28 | 0.01 | **0.99** | 0.22 |
| Copperbelt | **1** | **1** | | **0.73** | | **0.96** | **0.75** | | **0.50** | **0.97** | **0.90** | **0.99** | 0.71 |
| Eastern | | | | | | | | | | | | | 0.00 |
| Luapula | | | | | | | | | | | | | 0.00 |
| Lusaka | **1** | **1** | 0.03 | **0.91** | 0.27 | **1** | **0.72** | | 0.46 | **0.97** | **1** | **1** | 0.76 |
| Northern | | | | | | | 0.15 | | | | | | 0.01 |
| N.-Western | | 0.31 | | | | | 0.01 | | | | | **0.58** | 0.08 |
| Southern | | 0.01 | | | | 0.32 | | | | | | **0.89** | 0.11 |
| Western | | | | | | | | | | | | | 0.00 |
| Average | 0.28 | 0.48 | 0.00 | 0.24 | 0.10 | 0.30 | 0.24 | 0.00 | 0.18 | 0.29 | 0.26 | 0.59 | 0.25 |

Note: Values in bold indicate domination in the static case (FOD without bootstrapping).

Source: Authors' own calculations based on the CSO 1996, 2006, and 2010 LCMS datasets.

Table 8: Area rankings by probability of net domination

| 1996 | | | 2006 | | | 2010 | | | 1996-2010 Change |
|---|---|---|---|---|---|---|---|---|---|
| | Domination | Rank | | Domination | Rank | | Domination | Rank | |
| Urban | 0.85 | 1 | Copperbelt | 0.73 | 1 | Urban | 0.89 | 1 | 0 |
| Lusaka | 0.84 | 2 | Urban | 0.68 | 2 | Lusaka | 0.76 | 2 | 0 |
| Copperbelt | 0.74 | 3 | Lusaka | 0.58 | 3 | Copperbelt | 0.61 | 3 | 0 |
| Central | 0.01 | 4 | Central | -0.01 | 4 | Central | -0.02 | 4 | 0 |
| National | -0.01 | 5 | Northern | -0.01 | 5 | National | -0.10 | 5 | 0 |
| Southern | -0.23 | 6 | National | -0.05 | 6 | Southern | -0.15 | 6 | 0 |
| Luapula | -0.25 | 7 | N.-Western | -0.14 | 7 | Northern | -0.16 | 7 | -2 |
| N.-Western | -0.26 | 8 | Southern | -0.14 | 8 | N.-Western | -0.21 | 8 | 0 |
| Northern | -0.29 | 9 | Luapula | -0.22 | 9 | Luapula | -0.24 | 9 | 2 |
| Eastern | -0.42 | 10 | Eastern | -0.37 | 10 | Eastern | -0.30 | 10 | 0 |
| Rural | -0.46 | 11 | Rural | -0.47 | 11 | Rural | -0.48 | 11 | 0 |
| Western | -0.52 | 12 | Western | -0.58 | 12 | Western | -0.59 | 12 | 0 |

Note: Areas grouped in shaded cells have net domination scores too close to distinguish between differences in welfare and differences in bootstrap variation. Therefore, shaded rankings must be interpreted with caution.

Source: Authors' own calculations based on the CSO 1996, 2006, and 2010 LCMS datasets.

Table 9: Area rankings by probability of net domination

| 1996 | | | 2006 | | | 2010 | | | 1996-2010 Change |
|---|---|---|---|---|---|---|---|---|---|
| | Domination | Rank | | Domination | Rank | | Domination | Rank | |
| Medium cost housing | 0.86 | 1 | High cost housing | 0.96 | 1 | High cost housing | 0.87 | 1 | -1 |
| High cost housing | 0.79 | 2 | Medium cost housing | 0.65 | 2 | Medium cost housing | 0.86 | 2 | 1 |
| Urban | 0.55 | 3 | Urban | 0.55 | 3 | Urban | 0.51 | 3 | 0 |
| Low cost housing | 0.31 | 4 | Low cost housing | 0.35 | 4 | Low cost housing | 0.27 | 4 | 0 |
| National | -0.23 | 5 | National | -0.20 | 5 | National | -0.21 | 5 | 0 |
| Medium-scale farms | -0.30 | 6 | Medium-scale farms | -0.30 | 6 | Non-agricultural | -0.22 | 6 | -1 |
| Non-agricultural | -0.35 | 7 | Non-agricultural | -0.33 | 7 | Medium-scale farms | -0.55 | 7 | 1 |
| Rural | -0.71 | 8 | Rural | -0.70 | 8 | Rural | -0.63 | 8 | 0 |
| Small-scale farms | -0.90 | 9 | Small-scale farms | -0.97 | 9 | Small-scale farms | -0.89 | 9 | 0 |

Note: Rankings within shaded groups are highly sensitive to small perturbations and should be interpreted with caution.

Source: Authors' own calculations based on the CSO 1996, 2006, and 2010 LCMS datasets.

Table 10: Household deprivation by sanitation indicator (per cent)

| | Flush toilet or any latrine | | | Own flush toilet or any latrine | | | Flush toilet | | | Flush or covered latrine |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1996 | 2006 | 2010 | 1996 | 2006 | 2010 | 1996 | 2006 | 2010 | 2010 |
| Nation | 22 | 13 | 12 | 33 | 26 | 31 | 79 | 85 | 87 | 67 |
| Rural | 33 | 19 | 17 | 42 | 29 | 33 | 98 | 98 | 99 | 85 |
| Urban | 2 | 2 | 1 | 18 | 20 | 26 | 46 | 62 | 64 | 33 |
| Central | 16 | 5 | 4 | 24 | 14 | 20 | 84 | 88 | 90 | 68 |
| Copperbelt | 2 | 1 | 1 | 10 | 7 | 13 | 42 | 51 | 58 | 42 |
| Eastern | 43 | 22 | 26 | 56 | 35 | 46 | 97 | 98 | 98 | 87 |
| Luapula | 6 | 2 | 2 | 18 | 15 | 17 | 96 | 96 | 99 | 86 |
| Lusaka | 2 | 3 | 2 | 25 | 34 | 41 | 60 | 76 | 75 | 28 |
| Northern | 10 | 1 | 1 | 21 | 9 | 12 | 97 | 96 | 96 | 85 |
| N.-Western | 7 | 3 | 4 | 18 | 13 | 29 | 95 | 96 | 97 | 81 |
| Southern | 61 | 34 | 28 | 67 | 49 | 49 | 90 | 89 | 91 | 65 |
| Western | 63 | 56 | 42 | 69 | 62 | 54 | 93 | 97 | 96 | 92 |
| Urban Low Cost Housing | 3 | 2 | 1 | 22 | 24 | 32 | 55 | 71 | 78 | 41 |
| Urban Medium Cost Housing | 0 | 1 | 0 | 4 | 8 | 11 | 21 | 26 | 25 | 10 |
| Urban High Cost Housing | 1 | 1 | 0 | 6 | 4 | 10 | 10 | 12 | 21 | 9 |
| Small Scale Farms | 34 | 19 | 18 | 43 | 29 | 33 | 98 | 98 | 99 | 86 |
| Medium Scale Farms | 28 | 15 | 17 | 30 | 20 | 32 | 96 | 97 | 98 | 74 |
| Rural Non-Agricultural | 25 | 14 | 11 | 43 | 35 | 36 | 95 | 94 | 94 | 68 |

Source: Authors' own calculations based on the CSO 1996, 2006, and 2010 LCMS datasets.

Table 11: Temporal net FOD comparisons by sanitation indicator (probabilities)

| | Flush toilet or any latrine | | | Own flush toilet or any latrine | | | Flush toilet | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2006 FOD 1996 | 2010 FOD 2006 | 2010 FOD 1996 | 2006 FOD 1996 | 2010 FOD 2006 | 2010 FOD 1996 | 2006 FOD 1996 | 2010 FOD 2006 | 2010 FOD 1996 |
| National | 0.20 | 0.45 | **0.55** | 0.15 | | 0.16 | 0.03 | 0.24 | |
| Rural | 0.09 | **0.44** | **0.87** | 0.07 | 0.01 | **0.67** | 0.04 | 0.02 | 0.18 |
| Urban | | **0.44** | 0.35 | | | | | 0.15 | |
| Central | 0.02 | **0.51** | 0.22 | 0.02 | | 0.14 | -0.01 | 0.29 | 0.05 |
| Copperbelt | 0.22 | -0.04 | 0.40 | 0.23 | -0.03 | 0.05 | 0.10 | 0.12 | 0.03 |
| Eastern | 0.43 | 0.03 | **0.47** | 0.43 | | **0.38** | -0.01 | 0.20 | 0.10 |
| Luapula | | 0.07 | 0.20 | | 0.02 | 0.12 | | 0.01 | 0.06 |
| Lusaka | 0.06 | 0.19 | 0.29 | | -0.04 | | | 0.08 | |
| Northern | **0.80** | -0.02 | **0.93** | **0.79** | -0.01 | **0.88** | **0.66** | 0.25 | **0.64** |
| Northwestern | 0.18 | 0.01 | **0.63** | 0.17 | | | 0.11 | 0.15 | 0.22 |
| Southern | **0.63** | 0.38 | **0.70** | **0.61** | 0.25 | **0.68** | 0.41 | 0.32 | 0.40 |
| Western | 0.07 | 0.32 | 0.22 | 0.06 | 0.31 | 0.22 | -0.03 | 0.29 | 0.05 |
| Urban Low Cost Housing | | 0.30 | 0.13 | | | | | | |
| Urban Medium Cost Housing | | 0.03 | | | -0.01 | | 0.11 | 0.01 | 0.02 |
| Urban High Cost Housing | | | | | -0.02 | -0.01 | 0.08 | -0.01 | -0.07 |
| Small Scale Farms | 0.03 | 0.13 | **0.68** | 0.02 | | **0.53** | 0.01 | | 0.02 |
| Medium Scale Farms | 0.05 | -0.04 | 0.02 | 0.03 | -0.06 | | 0.02 | -0.08 | 0.02 |
| Rural Non-Agricultural | | **0.86** | 0.30 | | 0.14 | 0.01 | | **0.59** | 0.06 |

Note: Values in bold indicate domination in the static case (FOD without bootstrapping).

Source: Authors' own calculations based on the CSO 1996, 2006, and 2010 LCMS datasets.

Table 12: 2010 Area rankings for each possible sanitation definition by probability of net domination

| Flush toilet or pit latrine of any kind | | | Flush toilet or covered latrine | | | Flush toilet | | | Own flush toilet or own pit latrine of any kind | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Domination | Rank | | Domination | Rank | | Domination | Rank | | Domination | Rank |
| Urban | 0.89 | 1 | Lusaka | 0.92 | 1 | Urban | 0.82 | 1 | Copperbelt | 0.72 | 1 |
| Lusaka | | 2 | Urban | 0.89 | 2 | Lusaka | 0.82 | 2 | Urban | 0.51 | 2 |
| Copperbelt | 0.61 | 3 | Copperbelt | 0.51 | 3 | Copperbelt | 0.79 | 3 | Lusaka | 0.25 | 3 |
| Central | -0.02 | 4 | Southern | 0.24 | 4 | Southern | 0.20 | 4 | Central | 0.20 | 4 |
| National | -0.10 | 5 | Central | 0.20 | 5 | Central | 0.17 | 5 | National | 0.00 | 5 |
| Southern | -0.15 | 6 | National | 0.16 | 6 | National | 0.14 | 6 | Northern | -0.01 | 6 |
| Northern | -0.16 | 7 | Eastern | -0.29 | 7 | Eastern | -0.32 | 7 | Luapula | -0.11 | 7 |
| Northwestern | -0.21 | 8 | Northwestern | -0.43 | 8 | Northwestern | -0.41 | 8 | Southern | -0.16 | 8 |
| Luapula | -0.24 | 9 | Northern | -0.51 | 9 | Northern | -0.50 | 9 | Northwestern | -0.19 | 9 |
| Eastern | -0.30 | 10 | Western | -0.53 | 10 | Western | -0.55 | 10 | Eastern | -0.28 | 10 |
| Rural | -0.48 | 11 | Rural | -0.57 | 11 | Rural | -0.55 | 11 | Rural | -0.37 | 11 |
| Western | -0.59 | 12 | Luapula | -0.57 | 12 | Luapula | -0.61 | 12 | Western | -0.56 | 12 |

Note: Rankings within shaded groups are highly sensitive to small perturbations and should be interpreted with caution.

Source: Authors' own calculations based on the CSO 1996, 2006, and 2010 LCMS datasets.

Table 13: 2010 Bootstrap spatial FOD comparisons (probabilities) with sanitation defined to be not deprived if the household uses its own flush toilet or any latrine

| Areas | National | Rural | Urban | Central | Copperbelt | Eastern | Luapula | Lusaka | Northern | N.- Western | Southern | Western | Avg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| National | | **0.97** | | | | | | | | 0.07 | | **0.94** | 0.18 |
| Rural | | | | | | | | | | | | 0.02 | 0.00 |
| Urban | **0.97** | **0.97** | | | | **1** | | | | **0.71** | **1** | **1** | 0.51 |
| Central | 0.06 | **1** | | | | | 0.11 | | | **0.92** | 0.01 | **0.99** | 0.28 |
| Copperbelt | **1** | **1** | | **0.88** | | **0.96** | **0.96** | | 0.2 | **1** | 0.9 | **0.99** | 0.72 |
| Eastern | | | | | | | | | | | | | 0.00 |
| Luapula | | | | | | | | | | | | | 0.00 |
| Lusaka | | 0.01 | | | | **0.89** | | | | | **0.89** | **0.99** | 0.25 |
| Northern | | | | | | | 0.12 | | | | | | 0.01 |
| N.-Western | | 0.13 | | | | | | | | | | **0.52** | 0.06 |
| Southern | | | | | | 0.28 | | | | | | **0.73** | 0.09 |
| Western | | | | | | | | | | | | | 0.00 |
| Average | 0.18 | 0.37 | 0.00 | 0.08 | 0.00 | 0.28 | 0.11 | 0.00 | 0.02 | 0.25 | 0.25 | 0.56 | 0.18 |

Note: Values in bold indicate domination in the static case (FOD without bootstrapping).

Source: Authors' own calculations based on the CSO 1996, 2006, and 2010 LCMS datasets.