TRACING SPATIAL DIMENSION OF FOOD INSECURITY, A FIRST STEP TO A STRATEGIC MOVE TO COMBAT FOOD INSECURITY: THE CASE OF SOUTH AFRICA

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Abstract: a*vailable studies show that majority of households in South Africa are food insecure. However, these studies were not done in a manner that could assist policy planning at the national level. To address this, a survey matching technique was applied which helped develop a food security map for South Africa at various levels of disaggregation - province, District Municipality, and Local Municipality. In addition, results were used to analyze the socioeconomic characteristics of food insecure households. The results would assist policy planners to design location specific strategies; to coordinate resources better; to improve the targeting of interventions; and to lay the basis for further research that seeks to conduct an in-depth analysis of the socioeconomic characteristics of food insecure households, their coping strategies, and their responses to shocks.*

Keywords: food security, Logistic Regression, Monte Carlo Simulation, South Africa

1. INTRODUCTION

South Africa has for long been food secure as a nation. This being the case, however, food insecurity at the household level is becoming a challenge. The majority of South African households is food insecure (Altman, Hart, Jacobs, 2009). This is supported by the following estimates – 50% by National Department of Agriculture (2002), 52% by Labadarios, Davids, Mchiza, and Weir-Smith (2009), and 80% by Jacobs (2009).

The differences in the above national level estimates could be ascribed to the measurement used (under nutrition versus undernourishment) and the type of survey data relied on (Income and Expenditure Survey (IES) or General Household Survey (GHS) or the National Food Consumption Survey (NFCS)). The estimates, despite the differences, shed some light on the severity of food insecurity at the household level. However, their use for the purpose of national policy planning is limited as they are silent about the spatial dimensions of food insecurity. Spatial studies of food insecurity would facilitate evidence-based policy planning that relies on credible data to determine which areas, populations, and households are food insecure. By having this data available, policy planners could determine which programs would be suited to particular areas across a wide array of geographical spaces.

In addition, we came across a few other studies focusing in specific localities characterized by high level of poverty. Given that South Africa is made up of societies with heterogeneous socioeconomic characteristics, these studies offer little room to make generalizations for the whole country. This is notwithstanding methodological and statistical constraints. The former emanates from reliance on households income rather than their

actual expenditure on food. In general, there is lack of reliable information on the situation of food insecurity in the country. From the perspective of national planning, this is a recipe for ineffective targeting of interventions. It also hinders initiatives that aim at combating structural causes of food insecurity.

This paper takes cognizance of gaps left by existing studies. It attempts to address them by answering the following policy relevant questions - where do food insecure households live? And what are their socioeconomic characteristics? These would be done by producing a geo-referenced food insecurity map. In addition, it lays the basis for in-depth studies that seek to propose long-term solutions to challenges of food insecurity. These include analyses of identified food insecure households to understand their coping strategies and their degree of vulnerability to shocks.

2. LITERATURE REVIEW

This section reviews the literature on food security. This will be done in three sub-sections. Section 2.1 discusses the historical evolution of the definition of food security. In addition, where appropriate, attempt is made to highlight approaches that are in use to measure the status of food insecurity at individual/household levels. In section 2.2, much of the discussion will revolve around what the empirical literature has identified to be major causes of food insecurity. The last section, section 2.3, introduces the model.

2.1. Conceptual Issues

Attempts to coin a definition of food security and the lack thereof dates back to the Food and Agriculture Conference in 1943. The conference adopted the concept of a "secure, adequate and suitable supply of food for everyone". In response to this, bilateral organizations were created in developed countries to dispose of their surplus in the form of food aid (Weingartner, 2000).

In the 1960s, the World Food Program (WFP) was created. However, it was realized that food aid could harm food production in recipient countries. This led to the creation of conditionality to the way food aid should be distributed - the concept of food for development was introduced.

In the 1970s, instability in national and global food supplies and high prices became a problem due to population pressure and an occurrence of drought in major grain producing nations. This evoked global and national responses. Hence, the 1974 World Food Conference debated the need to increase food production through the creation of new international bodies- World Food Council, the FAO Committee on World Food Security and the International Fund for Agricultural Development (FAO, 1974). To address the problem at the national level, national governments formulated policies to ensure food availability and hence food self-sufficiency. Food availability is understood as the sum total of domestic food production, domestic food stock, commercial food import, and food aid.

In the 1980s, thanks to the green revolution in Asia, food production increased and made food availability less of a concern. This could not put a dent on the problem of food insecurity though. Much of the gains from increased production were siphoned by the elite. Therefore, issues of equity surfaced in the food security debate. In addition to this, Sen's (1981) seminal article on poverty and famine overshadowed the popular belief that food insecurity is caused by a lack of availability of foodstuffs. He showed that individuals' food

security could be compromised despite sufficient national food supplies. His work underscored that individuals' ability to establish entitlement to enough food also mattered.

This led to a shift in the emphasis towards both *physical and economic access to food*. Access implied not only own production but also households' ability to generate sufficient resources/income which could be made available to buy food in times of need. In general, access depends on household resources such as labor, land, capital, skills, prices, and all other factors which could inhibit or promote its ability to meet its food needs.

The definition was broadened to include utilization. This meant the inclusion of nutrition security to the broader definition of food security. For this to be achieved, the food which is available, through physical or economic means, has to be nutritious, and must be distributed among household members in a manner that does not discriminate against some members of the household.

The 1980s also saw further expansion in the definition to incorporate a fourth dimension to it - stability of access or vulnerability. It refers to the temporal dimension of food security. It means that households' status on food security should be compromised neither on an ongoing (chronic food insecurity) or temporary (transitory food insecurity) basis. See Maxwell & Frankenberger (1992) for an in-depth discussion on these.

Transitory food insecurity refers to individuals' lack of power to command resources on temporary basis. A person could be food secure now but this may not be true in the immediate future for various reasons; this is particularly evident in casual or seasonal labor. This could be as a result of exposure to the vagaries of nature, the nature of his/her work, his/her inability to call up on relations or friends when needed, or his/her limited access to available lines of credit. These are good examples of transitory food insecurity.

Currently, the FAO (2000) has developed a universally accepted definition for food security. It encompasses all the dimensions mentioned above in one way or another. According to this definition, food security is ascertained when "all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" (FAO, 2000).

The literature provides several methods to measure Individuals'/households' status on specific dimensions of food security. The most common are undernourishment and under-nutrition. Undernourishment refers to insufficiency of energy intake. Under-nutrition or malnutrition, on the other hand, is related to the health issue and considers deficiencies or imbalances in the intake of energy, protein and/or other nutrients. Both are related to poor households who cannot afford sufficient nutritional levels in their food baskets.

Undernourishment as a measure of food security is widely employed in empirical literature. It captures aspects of food availability and food accessibility, which are important dimensions of the operational definitions of food security. It estimates the proportion of people whose consumption levels are lying below the minimum levels of energy required. The latter is provided in terms of kilo calorie per person per day. Its magnitude falls in the ranges of 1800 and 2004 kilo calories per person per day. It takes into account, in its calculation, sex as well as age distribution of the population.

On the other hand, malnutrition handles the third dimension of the operational definition of food security - food utilization. It measures the proportion of people whose anthropometric measurements lie outside the ranges for healthy people. One advantage of this measurement over its counterpart is that it is outcome based. The outcome could be the result of not only inadequate food intake but also other important factors such as poor health and sanitation conditions, which prevent individuals from gaining full nutritional benefit from the food they eat. Again this is evident in isolated rural areas and becoming

more so in urban areas. The literature outlines several anthropometric indicators to measure levels of under-nutrition. These include Body Mass Index (BMI) for adults and measures such as stunting, underweight, and wasting for children under the age of five.

2.2. Empirical Literature

Food insecurity could be caused by several factors. Following the usual practice, we classify them into two broad categories- immediate and underlying community conditions. Under immediate conditions, we have low rates of agricultural production; low access to food resulting from low income; poor roads and infrastructure facilities. On the other hand, underlying community conditions include existing factors which could impinge availability, accessibility, utilization, and stability of food. For example, if a community is characterized by poor infrastructural conditions, productive capabilities of farmers could be hampered as they will have limited access to new technologies, to credit, and also to storage and transportation facilities for inputs and outputs. Subsistence farming is also characterized by low yield and growing levels of soil fatigue as people remain in one area for extended periods and become less peripatetic than in the past.

The food security status of the community could also be affected negatively by bad local and international market conditions which could result from ill-designed domestic and international trade policies. These could reduce access to food by the community from local as well as outside sources. In addition, the food security status of the community could be thwarted by HIV and AIDS and other pandemics that harm economically productive sections of the society.

Table 1 below gives a broad but not exhaustive category of factors from the literature with direct bearing on the food security status of households. They include household classification into rural and urban, factors related to issues of productivity, market, demographic characteristics of households, and infrastructure.

Table 1: Summary of Factors Affecting Food Security

Broad categories	**Variables**
Rural–urban dichotomy	Livelihood strategies, dietary patterns,
Productivity	Access to land, production implements, environmental sustainability (soil fertility), diseases, etc.
Markets	Physical access to markets, input and output prices, access to credit, market-related information.
Household	Size, gender of household head, education, dependency ratio, race, and total household income.
Infrastructure	Access to roads, access to basic services (health, water, and sanitation), information in general.

Source: authors' compilation based on a review of the literature

The first category, the rural-urban dichotomy refers to variables such as livelihood strategies pursued by households (i.e. whether they are agricultural-based or not), and their dietary patterns (i.e. whether they consume internationally traded staples or not). It is expected that agricultural-based households are more likely to be food secure. On the contrary, households that consume internationally traded staples are vulnerable to all sorts of shocks, compromising their food security status.

In Table 1, productivity encompasses all ranges of factors that enhance the capability of a household as a food producing entity. These include its access to vital production resources such as land and corresponding farm implements. Accesses to productive resources are hypothesized to help increase food production thereby enhancing food security status of households (Abebaw & Ayalneh, 2007; Shiferaw et al. 2005; Kidane, et al. 2005). Diseases such as HIV and AIDS, on the other hand, affect the productivity of the economically active sections of the society and expose affected households to food insecurity. Also, the availability of labor is affected by migration patterns in the household and geographic area. There may be periods when labor is readily available during off seasons while during seasonal employment, it is not available.

The notion of markets in Table 1 deals with a broad range of market-related factors having influence on the food security status of households. These, *inter alia*, include the cost of acquiring inputs from input markets; the price at which food producing households sell their produce in the product market; households' access to credits to produce food or to expand their existing food production operations; and their membership to marketing organizations to improve their physical access to markets and their collective bargaining power on a range of market-related issues. Except for prices, according to the literature, the effect others have on the food security status of households is less contested.

Studies show that food prices have increased sharply over the past five years. This has been attributed to a number of factors: rising energy prices and subsidized bio-fuel production; income and population growth; globalization and urbanization; land and water constraints underinvestment in rural infrastructure and agricultural innovation; and lack of access to inputs and water disruptions (IFPRI, 2008; FAO, 2008). This has made poorer households highly vulnerable to food insecurity by decreasing their purchasing power. Food constitutes the lion's share of poor households' expenditure or budget.

The food price surge is a global phenomenon. Its effect on the domestic food price depends on the degree of price transmission from the international to the domestic markets. Many governments have introduced policy instruments namely trade, tariffs, and subsidies to insulate their domestic markets to minimize the effect higher international food prices might have on their poor populations.

Studies show that price increases exert a negative influence on the food security status of households when households are net food buyers (IFPRI, 2008; FAO, 2008). The majority of households across the globe fall under this category. In Africa alone, close to 160 million people earn less than half a dollar a day. No question that they face the brunt of global food price hikes (IFPRI, 2008).

Food price increases could be viewed as an opportunity if households are net food sellers. Some even go deeper to argue that it could, in the medium term, positively affect the welfare (by implication food security status) of the poor in rural areas by creating more jobs (Brown, 1979; Lipton, 1984). The latter presupposes that food price elasticity of agricultural wage is elastic. On the contrary, findings by Ravallion (1990), Sah and Stiglitz (1987), and de Janvry and Subbarao (1986) see the issue in a different light. They contend that an increase in food prices would not be passed on to the agricultural wage rate. Therefore, much more research is needed to corroborate either one of the above findings.

Demographic factors also play a decisive role in households' food security status. For example, households whose heads or breadwinners are educated are often more likely to be food secure (Bartfeld & Dunifon, 2006; Kidane, Alemu, Khundhlande, 2005; Shiferaw, et al. 2005; Abebaw & Ayalneh, 2007); on the contrary, households with relatively more mouths to feed (i.e. with a higher dependency ratio) are more likely to face food insecurity

(Bartfeld & Dunifon, 2006; Shiferaw et al. 2005; Abebaw & Ayalneh, 2000); women-headed households face gender specific obstacles, adversely affecting their ability to produce food (FAO, 2008; Bartfeld & Dunifon, 2006). And even if they are employed, they don't earn as much as their male counterparts. They also spend much of their time doing unpaid work in the household; and chances are slimmer for households in affluent neighborhoods (higher income earners) to be food insecure (Bartfeld & Dunifon, 2006; Kidane, et al., 2005; Shiferaw, et al. 2005).

Infrastructure is another category with yet a huge potential to affect food security status of households. It could be presented as a collection of a multitude of sub-groupings namely, households' distance from an interconnecting road, their access to some basic services (health, water, and sanitation), their access to information vital to their wellbeing in general, etc.

2.3. Theoretical Model

The food security status of households is generally analyzed within the framework of households' demand for food. Modeling demand for food is a complicated exercise. This is more so when a household is not only a unit of consumption (as stipulated by the neoclassical economics) but also a unit of production, which is particularly true in much of the developing world.

A review of the literature provides several competing models. In this study, a framework based on a household-firm behavior model is used. It envisages that markets are competitive and households have the option of employing family or hired labor or some combination of the two. In addition, households are presumed to make decisions recursively. They decide first on the quantity of food to be produced. Thereafter, they decide how much of the food produced should be allocated between home consumption and sale in the market. For detailed description of the model, the reader is referred to the work by Strauss (1983).

The literature provides two approaches to calculate households' expenditure on food. The first is based on households' per capita expenditure obtained simply by dividing total household expenditure on food by the number of people living in the house. The second utilizes a relatively complex approach. In addition to size, it takes into account family composition i.e. age and gender of household members. In this study, we apply the former. This is because a study done by Statistics South Africa has revealed that family composition does not affect expenditure in poor households. This means that expenses to children and adults in poor households are similar (Statistics South Africa, 2007).

Households' status on food security is determined by the difference between per capita calorie availability and households' per capita calorie consumption needs. For example, to determine food security status for the i^{th} household, we apply a conversion factor to households' per capita expenditure on food to get an estimate for per capita calorie availability at the household level. We then proceed to determine an indicator for food security status of households. Next a logistic regression equation is estimated using a dummy variable measuring households' status on food security as a dependent variable and households' socio-economic and demographic factors as explanatory variable.

3. A REVIEW OF FOOD SECURITY STUDIES IN SOUTH AFRICA

In South Africa, the overwhelming majority of studies deal with poverty rather than food security. This could be because of the tendency by many to use poverty as a proxy for food insecurity. The two might follow similar procedures but the thresholds they employ as well as household specific estimates they consider, against which the thresholds are compared to seek answer to the incidence of poverty or food insecurity, are different.

The threshold used in poverty studies is commonly called a poverty line and comes in different breadths. An example of this is the UN threshold measure of $2 a day. Theoretically, it represents the minimum level of resources that individuals need to meet their *basic needs* (expenditure on essential food plus non food items). These measures are hugely controversial in that it is never clear who determines these lines and what the food basket looks like that meets those measurements. On the other hand, threshold used in food security studies should be limited merely to expenditure on food, which is the rand equivalent of recommended daily allowances. Again, there is space for controversy as who determines what is in that food basket as preferences are regionally, culturally and personally determined.

These differences, by construction, make the threshold in a food security study much lower than that used in a poverty study, for the latter should represent only the food component of the poverty line. Hence attempts to proxy the incidence of food insecurity by a poverty line could misrepresent the true picture of food insecurity.

In addition to the thresholds, what goes into household level estimates, the value against which the threshold is compared, is important. In poverty studies, much emphasis is placed upon the wellbeing of households measured by their total level of income or consumption expenditure. But in food security studies it is households' expenditure on food which is important.

There are a small number of food security studies in South Africa. Those available are area specific. They concentrate on provinces perceived prone to poverty. These studies to some degree might shed light on the status of food security situations in these areas. But, their utility to inform policy making at the national level is suspect due to their apparent assumptions of heterogeneity characterizing food insecure areas. In addition, they use as their threshold a poverty line or, in cases where the threshold is measured correctly, it was compared against total household income or consumption expenditure instead of food consumption expenditure.

In contrast, there are a number of poverty-related studies. These studies have helped broaden our understanding of the concept of poverty. They have been used by some to predict the status of food insecurity in their respective study areas due to the apparent close association perceived to exist between poverty and food insecurity. These studies are not without problems. There is lack of consensus among researchers regarding the dimension of poverty that should feature in the poverty basket to measure poverty. This has led to a panorama of approaches and resulted in a number of headcount indices for poverty.

In the studies reviewed, the poverty line is compared against various indices coming from different poverty baskets[1]. Some of the poverty baskets included only income (e.g. Pauw & Mncube, 2007; Ngwane, Yadavalli & Stefens, 2001; Leibbrandt & Woolard, 1999), others only consumption expenditure (eg. Alderman, Babita, Demombynes, Makhata &

[1] This finding applies not only to South African studies. It applies to other studies as well.

Ozler, 2003), and still others included other dimensions of poverty i.e. food and nonfood items (eg. Hirschowitz, Orkin, & Alberts (2000) and Klasen (2000)).

Despite the enormity of the food security problem and the need at the national level to engage with the same; efforts to date are more strongly devoted to the study of poverty. Indicators of poverty could be used as proxies for food insecurity (food poverty) in the absence of reliable measures for food insecurity. However, generalizations made on the status of food security based on these indicators may distort the true picture of the food insecurity situation in the country.

4. MODELING STRATEGY

In this section we have two sub-sections. Section 4.1, discusses the type of data needed. Much of the discussion would revolve around how the various data sources could be utilized to estimate the model. This will be followed, in section 4.2, by an in-depth exposition of the procedures to be followed to achieve the objective set out in the introduction section of this paper.

4.1. The Data

The discussions hitherto outlined some important methodological challenges in food security studies. Equally challenging is the issue of data necessary to conduct an important study such as this one. We start off by looking at data required to estimate equation [2]. The dependent variable (φ_i) is households' status on food security. The vector of explanatory variables (Z_i) are socio-economic characteristics of households which presumably affect households' status on food security.

It is impossible to obtain all data needed to determine level of food insecurity at the local Municipality Level (LM) from a single source namely the Income and Expenditure Survey (IES) or the Community Survey (CS). Two factors are responsible for this. Firstly, the IES contains rich information about households' expenditure on food but it lacks representatives to do the analysis at the LM level. The IES is representative only for its stratum i.e. the province. Secondly, by relying on the Community Survey (CS), one could minimize the problem associated with representatives. But the CS is not rich enough to do the job as it lacks valuable information, such as households' expenditure on food, which is available only in the IES. Therefore, in this study we combine the 2005/06 IES and the 2007 CS to achieve our primary objective of determining food security status of households' at the LM level.

We estimate equation [2] below for the nine provinces using the IES by restricting the explanatory variables to those found in the IES and the CS. The following variables were used to match the two surveys - age group of household head, dependency ratio, dwelling type, education level of household head, family size, gender of household head, household income, location (urban versus rural), population group (black, colored, Asian, white), access to radio, access to services such as refuse collection and sanitation, district dummies, and interaction terms.

Parameters from this regression equation are next applied to the CS to determine headcount indices at the LM level. The practice of combining two or more data sets to fill in missing information is not new. It is gaining momentum in applied research. The reader

is refereed to Elbers, *et. al.* (2000) for a review of studies that combined different data sets to handle similar problems. For recent example on the same in South Africa, you may see Alderman *et. al*. (2003). They combined the 1995 IES, the October Household Survey (OHS), and the 1996 census to map poverty in South Africa.

4.2 The Model

After some manipulation into the theoretical model (see Straus, 1983), we get the following reduced demand for food equation:

$$\zeta_i = Z'_i\beta + \varepsilon_i \qquad [1]$$

Where, ζ_i is households per capital expenditure on food given by $log(\frac{1}{\nabla}\sum_{i=1}^{N} p_i x_i^c)$, ∇ stands for household size, p_i unit prices of food items, x_i^c is a matrix of food items consumed, Z_i is a vector of explanatory variables, β is vector of k+1 parameters to be estimated, and ε_i is the error term.

Households' status on food security is determined by the difference between per capita calorie availability (Ω_i) and households' per capita calorie consumption needs ($€_i$) both in logarithms. For example, to determine food security status for the i^{th} household, we apply a conversion factor to ζ_i to get an estimate for per capita calorie availability at the household level (Ω_i^*). We then proceed to determine an indicator for food security status of households (φ_i^*) as $\Omega_i^* - €_i = \varphi_i^*$. A household is food secured when φ_i^* >0.

Next, we write [1] in logistic regression format as:

$$\varphi_i = Z'_i\beta + \varepsilon_i \qquad [2]$$

Where, Z_i, β, and ε_i are as defined before, φ_i is a discrete variable taking a value of 0 if a household is food insecure ($\vartheta_i = 0\ for\ \varphi_i^*$ <0) and 1 otherwise ($\vartheta_i = 1\ for\ \varphi_i^*$>0). Equation [2] gives interaction between households' demand for food and a host of factors that affect their level of food insecurity.

The probability that a household is food secured is given by:

$$\emptyset_i = Prob(\vartheta_i = 1) = Prob\left(Z'_i\beta + \varepsilon_i > 0\right) \qquad [3]$$

Where, $\emptyset_i$is conditional probability of food security.

The log odds are given by:

$$\ln\left(\frac{\emptyset_i}{1-\emptyset_i}\right) = Z'_i\beta + \varepsilon_i \qquad [4]$$

Rearranging [4], we could derive a formula for conditional probability as:

$$\emptyset_i = \frac{e^{Z'_i\beta}}{1+e^{Z'_i\beta}} \qquad [5]$$

4.3. Measurement

In the literature, the discussion on the measurement of food insecurity centers around two distinct operations: identification and aggregation. The process of identifying the food insecure relies on the use of recommended dietary allowances (RDA) at a household level as a cut-off point or a threshold. This is similar to a poverty line in poverty studies. The RDA is given in kilocalorie per person per day *i*. According to the South African Medical Research Council (MRC), an average person requires 2261 kilocalories per day to meet his/her daily energy requirement. This in 2000 prices is equivalent to R211 per month per person (StatSA, 2007). In this study, the R211 is used as a threshold after adjustment for inflation.

In this study, households are treated as a unit of measurement. Therefore, we aggregate RDA to the level of households. Thereafter, RDA at household level is converted to monetary terms. Finally, the RDA is compared against per capita food consumption expenditure to determine the food security status of households.

Aggregation refers to constructing an index of food insecurity. Headcount ratio is one example. It gives the proportion of households whose spending on food is below the RDA. The headcount is widely criticized in the literature on two grounds. It fails to satisfy the monotonicity and transfer axioms (Sen 1979 & 1976; and Foster, Greer, and Thorbecke, 1984). Monotonicity assumes that a reduction in per capita food consumption expenditure of a household should increase the food insecurity measure. On the other hand, the transfer axiom establishes that the effect of a transfer of consumption expenditure from a food insecure to another household should result in an increase in the food insecurity measure.

The literature provides three measures that satisfy the two axioms. These include measures proposed by Foster, Greer, and Thorbecke (1984), Clark, Hemming, and Ulph (1981), and Thon (1979). Due to the nature of the model we estimate in this study (i.e. a logistic regression), we are unable to apply measures proposed by Foster, *et. al*. (1984).

Next, we demonstrate the procedures followed in this study to measure the headcount ratio (*H*). We estimate nine logistic regressions given by equation [2] for the nine provinces. We check for the robustness of the nine regression equations by examining goodness of fit. This was done in two stages – before and after regression. In stage one, we examine the correlation matrix of the determinants of food security to check for the presence of severe multicollinearity problem in the data. In stage two, we check for the significance of the parameter estimates using Likelihood Ratio Chi-Square statistic. In addition, we check for predictive efficiency of the models using Pesaran Timmermann test statistic and by computing estimates showing the number of times that the models make correct prediction using 0.5 as a threshold.

Having checked for robustness, we proceeded to impute the probability that a household is food secured using households' observable characteristics from the Community Survey. The values depend on variables such as households' observed characteristics and parameter estimates obtained from first stage regression. Therefore, the food insecurity estimates obtained at the end depend on the values of variables representing household socio, economic, and demographic characteristics and parameter estimates from the logistic regression. Due to space limitation, parameter estimates from first stage regression are not provided here. They can be made available upon request.

To compute headcount indices, we run simulation. We draw n-variate binomial distributions. The simulated disturbances together with the parameter estimates from the

logistic regression are used to estimate predicted odds ratio for each household in a local municipality. Predicted odds ratios are then manipulated to determine household status on food security. The procedure is replicated *r* times (r=100). Thereafter mean and variance values for each estimate are calculated over all the 100 simulations.

5. SUMMARY OF RESULTS

In this section results are analyzed. The analysis follows the following structure. In section 5.1, results from statistical relationships between the measure of food security and household characteristics are analyzed. Data on household characteristics are obtained from the 2005/06 Income and expenditure Survey (IES) of Statistics South Africa. The IES provides important data on household expenditure on food which cannot be obtained from other official sources. However, the representativeness of the IES data other than its sample strata (i.e. province) is questioned. This means that the analysis cannot be extended to the level of local municipality. To bridge this gap, in section 5.2, after the adequacy of the statistical relationships are confirmed, we subject the parameter estimates obtained in section 5.1 to the 2007 Community Survey (CS). The CS is larger in coverage as compared to the IES thus provides sufficient degree of maneuverability to conduct the analysis at the level of local municipality.

5.1. Estimation of Models of Food Security

Nine logistic regression equations were estimated for each province. Due to space limitations (over fifty variables in a single equation including interaction terms), regression results are not provided here. They could be made available upon request. All the variables were obtained from the IES. Except for the dependent variable, which provides data on food expenditure at the household level, attempt was made to consider only those variables which are available in both the IES and the CS. The dependent variable - a categorical variable which classifies a household into two as food secure and food insecure – is calculated from the IES data based on households expenditure on food using the method outlined in section 4.2.

The literature identifies a number of variables as important determinants of food security at the household level. We cluster them into different groups. This includes specific variables representing district councils (district dummies), geographical locations of households (rural versus urban), household characteristics (sex of household head, race of household head, dependency ratio, household size), health indicators such as households' access to refuse collection, asset of households (type of dwelling, education of household head, age of household head, income), information (access to radio), interaction terms to allow variation across clusters (district municipalities in our case).

Table 2: Goodness of fit of estimates of food security from first stage regression

Provinces	# of households	Goodness of fit
Western Cape	2404	77%
Eastern Cape	2797	84%
Northern Cape	1487	82%
Free State	1754	82%
Kwazulu-Natal	4645	87%
Northwest province	1446	84%
Gauteng	2312	74%
Mpumalanga	1495	82%
Limpopo	1868	86%

Source: Authors' computation

Table 2 shows the number of households covered by the IES survey. It ranged from 1487 in the Northern Cape Province to 4645 households in the Kwazulu-Natal province. The IES covered a total of 20, 208 households. Table 2 further shows the explanatory power of the food security models estimated using the IES data. This was calculated using 0.5 as the threshold. According to the results found, the explanatory power of the model ranges from 77% in the case of Western Cape Province to 87% in the Kwazulu-Natal province.

The models were further subjected to additional tests. This included tests on the direction as well as the level of significance of variables on the food security status of households. Overall, the variables have the expected sign. Households with higher levels of income, with educated household heads, with the age of household heads falling within higher age groupings, with household heads who are whites and Asians, with relatively better access to information, and located in urban areas experience a relatively lower level of food insecurity. On the contrary, results showed higher levels of food insecurity in households with larger family sizes, headed by females, and a higher dependency ratio. The dependency ratio was calculated for each household as a ratio of the number of household members aged less than 15 and above 65 to those that fall within the working age group of 15 to 65.

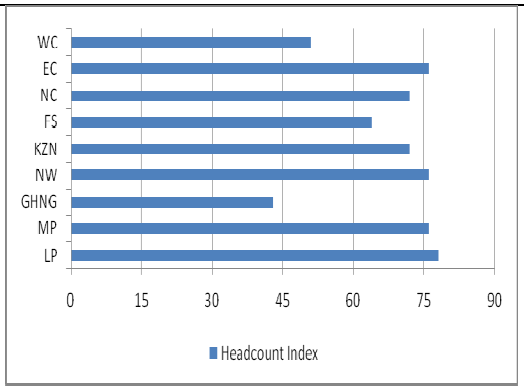
Results further indicate that, at the 5% level of significance, the effect of the variables mentioned above on food security status of households varies from one province to the other. For example, family size, income, education level of household heads, race of household heads, age of household heads, households' access to information, and sex of household heads are major determinants of the food security status of households in the majority of the provinces. On the other hand, household characteristics such as dependency ratios, location, dwelling, and access to refuse collection services do affect food security status of households but the effect is limited in fewer provinces. By implication, poorer households who live in poorer municipal areas have a high level of food insecurity. Due to space limitations detailed results could not be reported here. They can be made available upon request.

5.2. Imputed Probabilities of Food Insecurity

In this section we discuss results on imputed probability of food insecurity at the Provincial, District Municipality (DM), and Local Municipality levels (LM). The results are the combined outcome of regression coefficients (discussed in section 5.1) and the 2007 Community Surveys. The procedures followed to arrive at the results are outlined in section 4.2.

Table 3 gives summary estimates for food insecurity indices at the provincial level using imputed probabilities of food insecurity. It indicates that about 64% of households in South Africa are food insecure. This is different from the 50% estimate reported by the National Department of Agriculture (Table A1). The result underscores the widely held view that food insecurity is a challenge in South Africa. Except in the Gauteng Province, a highly urbanized province, where a relatively lower number of households (43%) are food insecure, concentration of food insecure households is much higher in the remaining eight provinces. Food insecurity is the highest in Limpopo (78%) followed by the Eastern Cape (76%), Mpumalanga (76%), and the North West (76%).

Table 3: Food Insecurity at Provincial level

Provinces	Level of food insecurity using monthly imputed expenditure on food (CS)	using *imputed* probabilities of food security (CS)
Western Cape (WC)		51 (0.158)
Eastern Cape (EC)		76 (0.119)
Northern Cape (NC)		72 (0.169)
Free State (FS)		64(0.171)
Kwazulu-Natal (KZN)		72(0.083)
Northwest Province (NW)		76 (0.182)
Gauteng (GHNG)		43 (0.113)
Mpumalanga (MP)		76 (0.171)
Limpopo (LP)		78 (0.122)

Headcount index is multiplied by 100. The food poverty (insecurity) line is R226 multiplied by family size

To have a better view over the spatial dimension of food insecurity, we next looked at estimates at the DM and the LM levels. Figure 1 gives spatial distribution of food insecurity at the DM level. It shows high levels of concentration of food insecure DMs in the Limpopo, KwaZulu-Natal, and the Eastern Cape provinces. Figure 1 further reveals that on the whole, concentration of food insecure DMs is the lowest in the Western Cape Province. It is also interesting to note that compared with other DMs, the Metros are home to a relatively small number of food insecure households by national standards. For example, 48% of households in Cape Town, 34% in Johannesburg, 39% in Pretoria, 44% in the East Rand, and 45% in the Durban metros are food insecure. Detailed results on the level of food insecurity at the DM level are provided in Table 1A.

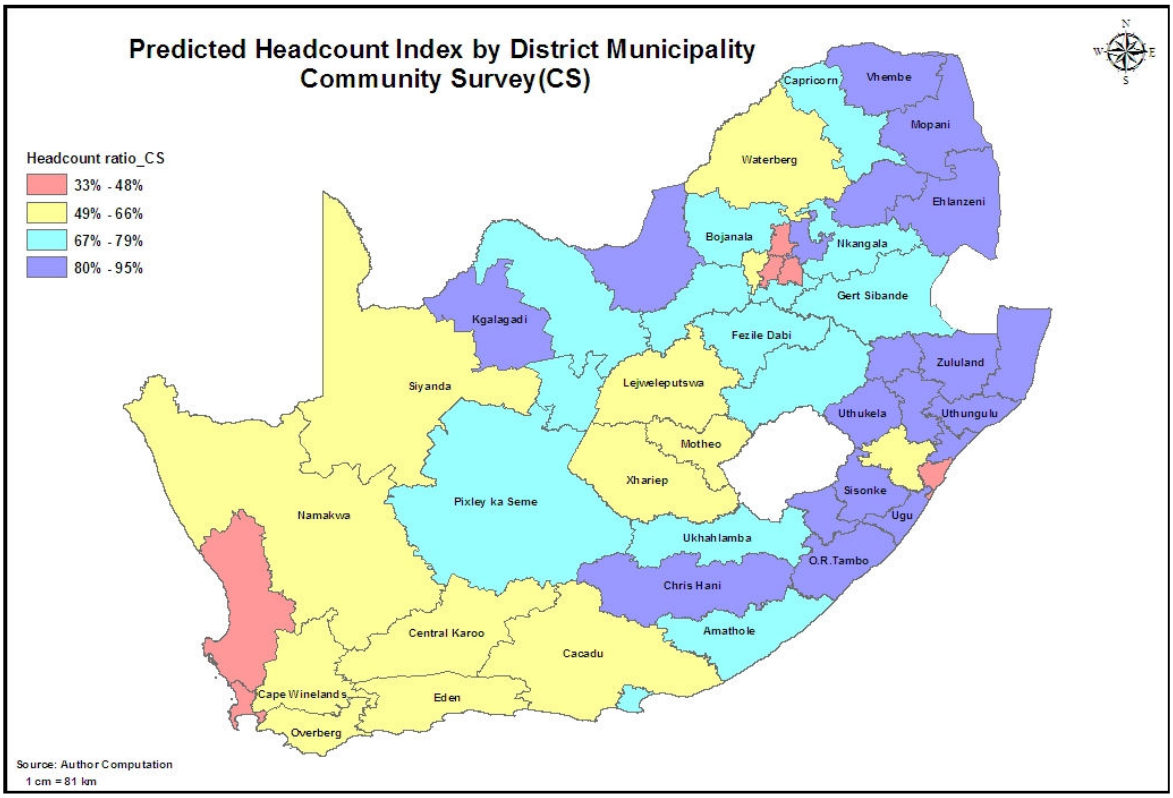


Figure 1: Predicted headcount index by district municipality

The mapping exercises add more value to efforts that attempt to achieve efficient geographical targeting of anti-food insecurity efforts if welfare data that are available at higher level of aggregation such as province could be disaggregated into smaller geographical units such as LMs. This study was designed to achieve just that. Results on these are presented in Figure 2. Similar estimates but in table formats together with their respective standard errors are provided in Tables B1 through B9 in the appendix section of this paper. It is evidenced by Figure 2 that the majority of local municipalities with headcounts more than 74% are located in provinces such as the Eastern Cape, KwaZulu-Natal, Limpopo, and Mpumalanga. It is also clear that municipalities that border Swaziland, Lesotho and Mozambique also have high headcounts of food insecurity, which would have a significant impact on lifestyles and health in those areas due to overstretched municipalities who have to deal with high levels of migration into their areas.

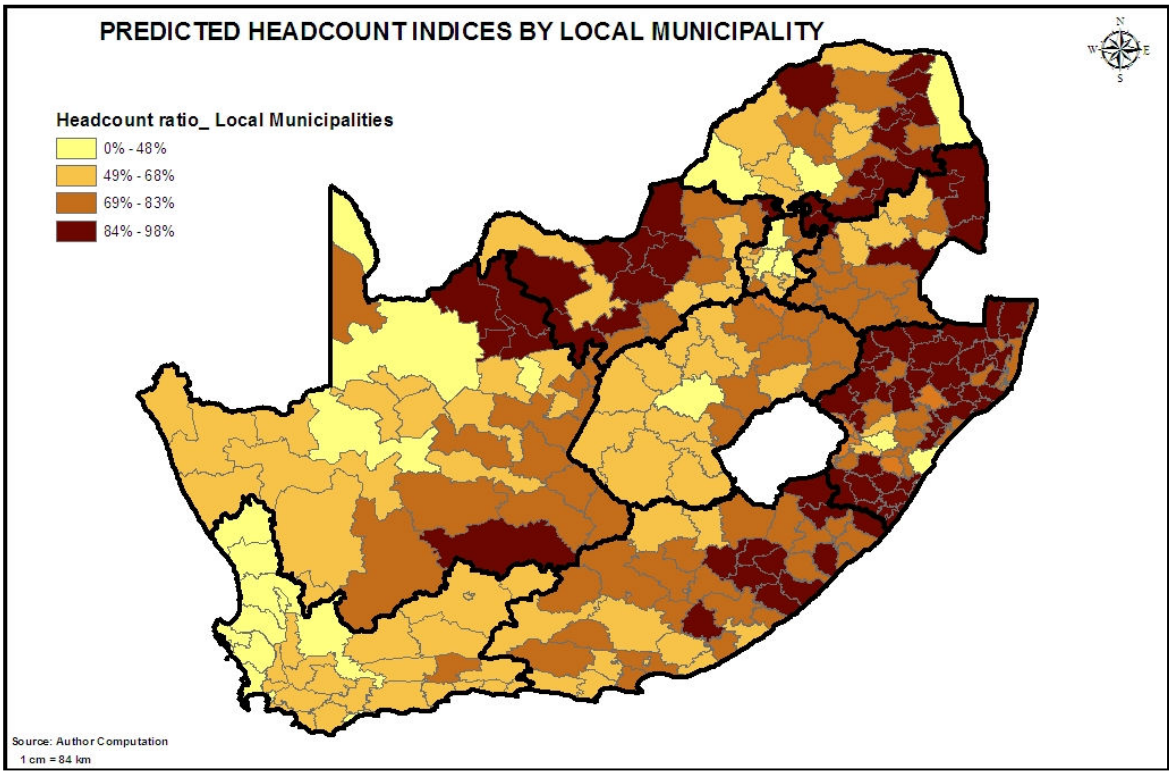
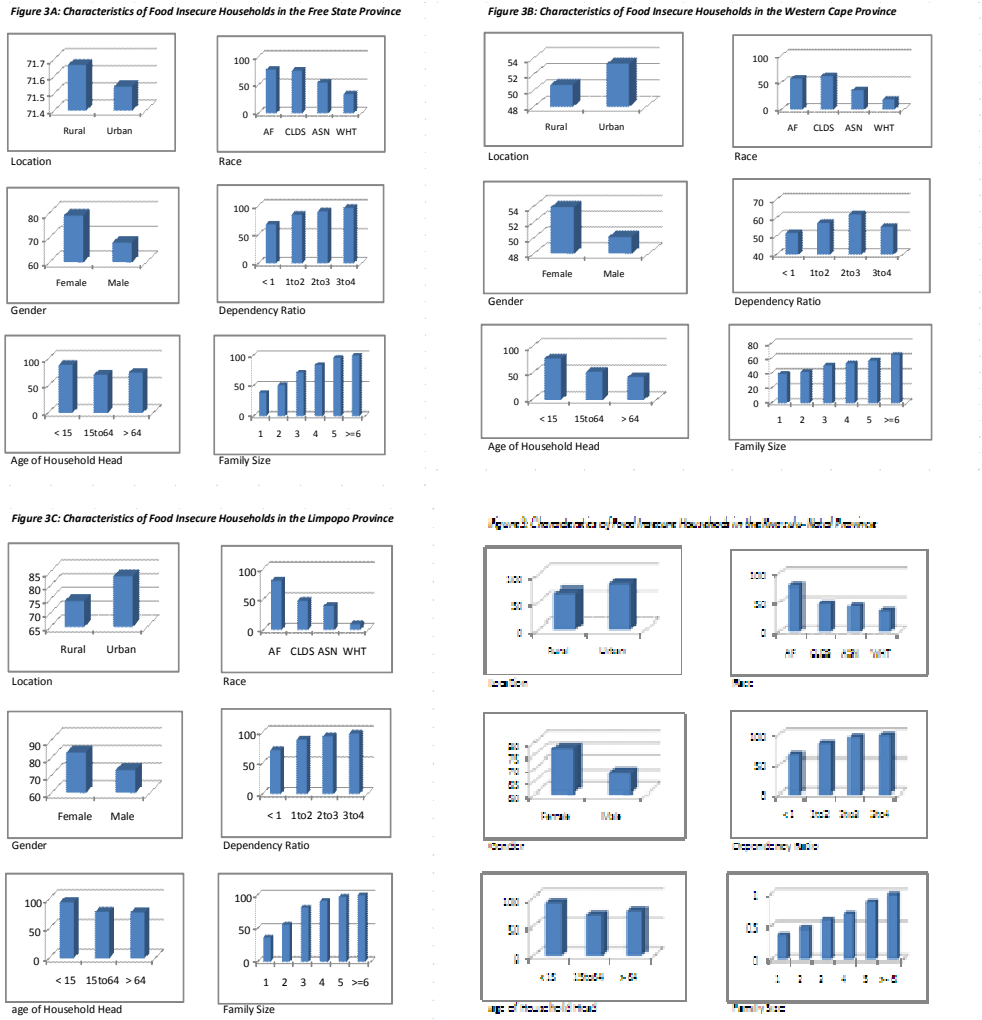


Figure 2: Predicted headcount indices by local municipality

The food insecurity maps given by Figures 1 and 2 dealt with spatial dimensions of food insecurity. The results from the exercise could also be used to study additional characteristics of food insecure households. We demonstrate this using the Free State, Western Cape, Limpopo, and KwaZulu-Natal Provinces. The household characteristics selected for the analysis were location, sex of household head, age of household head, dependency ratio, and family size. As shown by Figure 3, a higher percentage of food insecure households reside in urban areas except in the Free State Province. Figure 3 also shows that food insecure households are headed by females, the youth and the elderly, and Africans. In addition, Figure 3 depicts that food insecure households are characterized by higher dependency ratio and larger family sizes.

Figure 3: Characteristics of food insecure households in selected Provinces



Source: Authors' calculation

The food insecurity map provided by Figure 2 could be regarded of less value if municipal level estimates of food insecurity are not statistically different from each other and from provincial estimates. In such cases, the IES alone could be a valid source of information. To check this, we conducted two types of precision tests. The first test looked into the proportion of municipalities with headcount indices that are significantly different from their respective provincial level estimates. The test was conducted at 5% level of significance. According to the results (Table 4), headcount indices at the level of LM are significantly different from their provincial counterparts'. For example, for the Gauteng Province, 100% of the LMs have headcount indices that are statistically different from provincial level estimates. In addition, results reveal that 82% (18%) of the LMs in the

Gauteng province have headcount indices that are significantly higher (lower) than provincial level estimates.

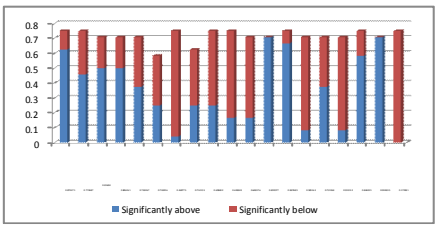
Table 4: Local Municipalities with Headcount indices Significantly Different from Provincial Headcount estimates at 5% level of significance

Provinces	Significantly higher than provincial estimates %	Significantly lower than provincial estimates %	Significantly different from provincial estimates %
Western Cape	53	30	83
Eastern Cape	50	38	88
Northern Cape	34	34	68
Free State	45	35	80
Kwazulu-Natal	88	8	96
Northwest province	62	28	90
Gauteng	82	18	100
Mpumalanga	37	52	89
Limpopo	50	38	88

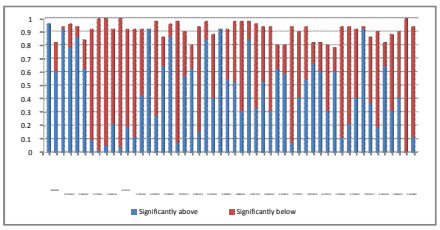
Source: Authors' calculation

In addition, we conducted additional test to check whether headcount indices of LMs in the same province are significantly different from each other. This is done using municipal level estimates and their respective standard errors. For example, the KwaZulu-Natal province is home to 52 LMs. This leaves us with a 51×51 pairs of estimates of headcount indices that should undergo the test. We conducted the test to check whether estimates in a pair are statistically different from each other. The test was conducted at the 5% level of significance. Results for selected provinces are reported in Figures 4. According to the results found, headcount estimates at the level of LM are different from each other.

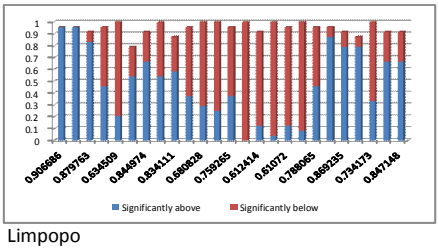
Figure 4: Fraction of Local Municipality Significantly Different from Point Estimates



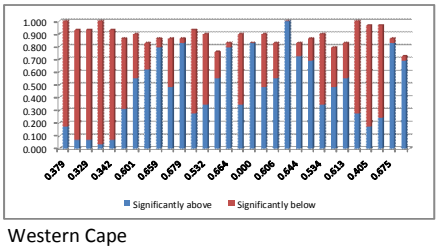
Mpumalanga



Kwazulu-Natal



Limpopo



Western Cape

We also computed correlation coefficients between headcount indices computed using the IES and the imputed CS. This was done using a simple correlation coefficient and spearman rank coefficient. Results are reported in Table 5. Results show that provincial and DC level estimates are correlated at 5% level of significance.

Table 5: Simple and Rank Correlation Coefficient between Imputed CS and IES data

	No. of Observations	Headcount index	
		Simple correlation coefficient	Spearman rank correlation coefficient
Provinces (CS *imputed* & IES)	9	0.935 (0.000)*	0.752 (0.019)**
District councils (CS *imputed* & IES)	52	0.861 (0.000)*	0.841 (0.000)*

Significance levels are in parenthesis. *significant at 1% level, ** significant at 5% level

6. SUMMARY AND CONCLUSION

There are food security studies for South Africa. However, they provide very little information to assist planning processes at the national level. This is because they are area specific and concentrate in areas perceived to be prone to poverty. Since food insecure areas are heterogeneous in terms of their socioeconomic characteristics, it makes it difficult to extrapolate their findings to make generalizations for the whole country. In addition, the studies are characterized by a lack of methodological clarity attributable in part to limited access to important data such as households' actual expenditure on food.

To fill the gap left by existing studies, we adopted a methodology by Elbers, Lanjouw, Lanjouw (2003) which we slightly modified to align it to the overall intent of the exercise - to estimate levels of food insecurity across the country at a local municipal level. The estimates were then used to develop a geo-referenced food insecurity map for South Africa. In essence, the map will assist policy planning to design location specific intervention strategies, to coordinate and enhance allocation of resources, and to evaluate the impact of targeted interventions.

The analysis was carried out in two stages. In stage one, the 2005/06 Income and Expenditure Survey was used to determine statistical relationships between empirical variables representing food security status of households and a set of explanatory variables which are expected to correlate with the food security status of households. The dependent variable (a measure for the food security status of households) was computed by comparing households' actual expenditure on food with recommended daily energy intakes. Recommended daily energy requirement per person per day was obtained from the South African Medical Research Council (MRC). In stage two, simulations (100 times for each household) were conducted by combining the estimated regression coefficients from stage one with the Community Survey (CS) to conduct a more disaggregated analysis of food insecurity at the local municipality level.

The following were major findings of the study. Although some macro level estimates attest to the fact that the country is food self-sufficient at the national level

(measured in terms of availability), the majority of households accounting for about 64% are food insecure (measured in terms of access). Food insecurity has also a spatial dimension. The majority of food insecure households live in the provinces such as Limpopo (78%), Mpumalanga (76%), Eastern Cape (76%), and Kwazulu-Natal (72%). On the other hand, relatively small percentages of food insecure households are found in the Metros such as Johannesburg (34%), Pretoria (39%), Cape Town (48%), and Durban (43%). The results also allowed zooming in to see the level of food insecurity at the lowest level of administration possible (i.e. local Municipality). This helped uncover the severity of food insecurity. It was found that a large number of local municipalities with headcount indices as high as 98% are found in the KwaZulu-Natal province.

In addition to the spatial nature of food insecurity discussed, it is also interesting to note that inter-household disparities in access to resources, racial makeup of households, and demographic characteristics of households appeared to be major determinants of food security. For example, African headed households are more food insecure compared with households headed by other races; and households with large family size, with higher dependency ratio, and households headed by females, are more food insecure.

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Appendix: Predicted headcount indices

Table B1: Predicted headcount indices by local municipality in the Western Cape

Province	Local Municipality	Headcount ratio	standard errors
Western Cape	WC011: Matzikama	37.90	1.12
	WC012: Cederberg	32.42	1.07
	WC013: Bergrivier	32.93	1.00
	WC014: Saldanha Bay	26.13	0.89
	WC015: Swartland	34.24	0.94
	WCDMA01: West Coast	40.52	1.97
	WC022: Witzenberg	51.44	1.10
	WC023: Drakenstein	60.13	0.80
	WC024: Stellenbosch	62.39	1.06
	WC025: Breede Valley	65.94	0.99
	WC026: Breede River/Winelands	58.36	1.17
	WCDMA02: Breede River	45.68	1.68
	WC031: Theewaterskloof	67.93	1.24
	WC032: Overstrand	49.48	1.19
	WC032: Overstrand	53.23	1.25
	WC034: Swellendam	61.95	1.42
	WCDMA03: Overberg	0.00	0.00
	WC041: Kannaland	66.40	1.27
	WC042: Langeberg	52.28	1.14
	WC043: Mossel Bay	58.37	0.98
	WC044: George	60.58	1.06
	WC045: Oudtshoorn	71.42	0.96
	WC047: Plettenberg Bay	64.41	1.23
	WC048: Knysna	63.54	1.09
	WCDMA04: South Cape	67.50	1.48
	WC051: Laingsburg	53.45	1.89
	WC052: Prince Albert	59.35	1.38
	WC053: Beaufort West	61.29	1.02
	WCDMA05: Central Karoo	65.51	1.90
	Cape Town: City of Cape Town	47.72	0.22

Source: Authors' calculation

Table B2: Predicted headcount indices by local municipality in the Eastern Cape

Province	Local Municipality	Headcount ratio	Standard errors
Eastern Cape	EC101: Camdeboo	70.34	1.13
	EC102: Blue Crane Route	62.32	1.16
	EC103: Ikwezi	79.80	1.33
	EC104: Makana	65.81	0.96
	EC105: Ndlambe	64.52	1.19
	EC106: Sunday's River Valley	69.60	1.18
	EC107: Baviaans	70.34	1.12
	EC108: Kouga	59.62	0.93
	EC109: Kou-Kamma	59.93	1.00
	ECDMA10: Aberdeen Plain	58.67	1.76
	EC121: Mbhashe	90.06	0.35
	EC122: Mnquma	87.09	0.46
	EC123: Great Kei	77.04	1.08
	EC124: Amahlathi	82.10	0.72
	EC125: Buffalo City	57.02	0.39
	EC126: Ngqushwa	71.51	1.16
	EC127: Nkonkobe	83.77	0.70
	EC128: Nxuba	75.32	0.94
	EC131: Inxuba Yethemba	71.56	1.20
	EC132: Tsolwana	82.37	1.36
	EC133: Inkwanca	80.55	1.44
	EC134: Lukanji	82.60	0.66
	EC135: Intsika Yethu	86.24	0.73
	EC136: Emalahleni	85.96	0.80
	EC137: Engcobo	84.67	0.73
	EC138: Sakhisizwe	85.63	1.12
	EC141: Elundini	76.61	0.71
	EC142: Senqu	76.16	0.87
	EC143: Maletswai	63.14	1.14
	EC144: Gariep	57.60	1.20
	EC151: Mbizana	82.75	0.62
	EC152: Ntabankulu	80.31	0.79
	EC153: Qaukeni	81.14	0.66
	EC154: Port St Johns	79.12	0.75
	EC155: Nyandeni	87.40	0.57
	EC156: Mhlontlo	80.57	0.69
	EC157: King Sabata Dalindyebo	76.30	0.51
	EC05b2: Umzimvubu	85.62	0.35
	KZ5a3: Matatiele	86.15	0.23
	Port Elizabeth: Nelson Mandela	70.56	0.36

Source: Authors' calculation

Table B3: Predicted headcount indices by local municipality in the Northern Cape

Province	Local Municipality	Headcount ratio	Standard errors
Northern Cape	NC061: Richtersveld	62.43	1.11
	NC062: Nama Khoi	53.38	1.26
	NC064: Kamiesberg	56.46	1.20
	NC065: Hantam	67.60	1.38
	NC066: Karoo Hoogland	74.79	1.31
	NC067: Kh?i-Ma	59.18	1.23
	NCDMA06: Namaqualand	51.38	2.32
	NC071: Ubuntu	83.61	1.17
	NC072: Umsombomvu	78.32	0.95
	NC073: Emthanjeni	77.81	0.95
	NC074: Kareeberg	72.14	1.37
	NC075: Renosterberg	77.54	1.39
	NC076: Thembelihle	75.90	0.91
	NC077: Siyathemba	81.54	1.16
	NC078: Siyancuma	75.65	1.03
	NCDMA07: Bo Karoo	64.96	1.90
	NC081: Mier	71.35	1.49
	NC082: Kai !Garib	51.51	1.14
	NC083: ||Khara Hais	67.77	0.97
	NC084: !Kheis	67.55	0.85
	NC085: Tsantsabane	66.14	1.10
	NC086: Kgatelopele	45.63	0.87
	NCDMA08: Benede Oranje	43.27	1.76
	NC091: Sol Plaatje	74.26	0.67
	NC092: Dikgatlong	69.51	1.09
	NC093: Magareng	79.87	0.72
	CBLC7: Phokwane	75.94	0.70
	NCDMA09: Diamondfields	56.66	1.93
	NC01B1: Gamagara	89.97	0.61
	NW1a1: Moshaweng/NW391:Kagisano	90.83	0.43
	CBLC1: Ga-Segonyana	88.96	0.49
	NCDMACB1: Kalahari	89.71	0.78

Source: Authors' calculation

Table B4: Predicted headcount indices by local municipality in the Free State province

Province	Local Municipality	Headcount ratio	Standard errors
Free State	FS163: Mohokare	63.18	1.33
	FS162: Kopanong	54.96	1.24
	FS163: Mohokare	74.25	1.24
	FS171: Naledi	67.19	0.89
	FS172: Mangaung	61.74	0.35
	FS173: Mantsopa	72.22	0.93
	FS181: Masilonyana	40.82	0.87
	FS182: Tokologo	50.03	1.18
	FS183: Tswelopele	57.57	0.87
	FS184: Matjhabeng	49.50	0.46
	FS185: Nala	64.46	1.13
	FS191: Setsoto	75.58	0.88
	FS192: Dihlabeng	66.14	1.00
	FS193: Nketoana	74.88	1.08
	FS194: Maluti a Phofung	81.55	0.43
	FS195: Phumelela	72.01	1.00
	FS201: Moqhaka	58.23	0.80
	FS203: Ngwathe	75.48	0.83
	FS204: Metsimaholo	78.83	0.76
	FS205: Mafube	81.36	1.00

Source: Authors' calculation

Table B5: Predicted headcount indices by local municipality in the Gauteng Province

Province	Local Municipality	Headcount ratio	Standard errors
Gauteng	GT411: Mogale City	53.46	0.64
	GT412: Randfontein	52.48	1.00
	GT414: Westonaria	51.55	1.06
	GT421: Emfuleni	71.48	0.40
	GT422: Midvaal	62.23	0.95
	GT423: Lesedi	66.70	1.05
	GT02b1: Nokeng tsa Taemane	76.46	1.11
	CBLC2: Kungwini	82.24	0.68
	East Rand: Ekurhuleni Metro	43.77	0.23
	Johannesburg: City of Johannesburg Metro	33.92	0.19
	Pretoria: City of Tshwane Metro	38.82	0.24

Source: Authors' calculation

Table B6: Predicted headcount indices by local municipality in the North West Province

Province	Local Municipality	Headcount ratio	Standard errors
North West	NW371: Moretele	84.72	0.92
	NW372: Madibeng	79.33	0.76
	NW373: Rustenburg	64.85	0.70
	NW374: Kgetlengrivier	76.72	1.35
	NW375: Moses Kotane	78.81	0.85
	NW381: Setla-Kgobi	88.88	0.94
	NW382: Tswaing	88.71	0.86
	NW383: Mafikeng	84.64	0.55
	NW384: Ditsobotla	87.40	0.57
	NW385: Zeerust	87.42	0.75
	NW391: Kagisano	84.57	0.92
	NW392: Naledi	62.70	0.73
	NW393: Mamusa	86.24	1.01
	NW394: Greater Taung	89.59	0.60
	NW395: Molopo	67.16	1.18
	NW396: Lekwa-Teemane	82.08	1.08
	NW401: Ventersdorp	75.48	0.93
	NW402: Potchefstroom	62.45	0.89
	NW403: City Council of Klerksdorp	67.42	0.51
	NW404: Maquassi Hills	80.10	0.78
	CBLC8: Merafong City	66.85	0.61

Source: Authors' calculation

Table B7: Predicted headcount indices by local municipality in the Mpumalanga Province

Province	Local Municipality	Headcount ratio	Standard errors
Mpumalanga	MP301: Albert Luthuli	87.05	0.53
	MP302: Msukaligwa	77.27	1.04
	MP303: Mkhondo	81.60	0.90
	MP304: Seme	80.63	1.04
	MP305: Lekwa	73.83	1.02
	MP306: Dipaleseng	71.80	1.23
	MP307: Highveld East	46.98	0.66
	MP311: Delmas	71.42	1.22
	MP312: Emalahleni	69.87	0.60
	MP313: Middelburg	61.88	0.94
	MP314: Highlands	64.84	1.85
	MP315: Thembisile	89.96	0.53
	MP316: Dr JS Moroka	88.77	0.60
	MP321: Thaba Chweu	58.52	1.01
	MP322: Mbombela	73.20	0.50
	MP323: Umjindi	59.31	1.02
	MP324: Nkomazi	84.69	0.53
	CBLC6: Bushbuckridge	90.48	0.32
	CBDMA4: Kruger Park	17.24	5.57

Source: authors' calculation

Table B8: Predicted headcount indices by local municipality in the Northern Province

Province	Local Municipality	Headcount ratio	Standard errors
Northern Province	NP331: Greater Giyani	90.67	0.52
	NP332: Greater Letaba	89.90	0.54
	NP333: Greater Tzaneen	87.98	0.47
	NP334: Ba-Phalaborwa	78.92	1.01
	NP04A1: Maruleng	87.41	0.76
	NP341: Musina	63.45	0.85
	NP342: Mutale	83.11	0.88
	NP343: Thulamela	84.50	0.33
	NP344: Makhado	81.97	0.40
	NP351: Blouberg	83.41	0.56
	NP352: Aganang	76.44	0.78
	NP353: Molemole	68.08	1.12
	NP354: Polokwane	65.37	0.42
	NP355: Lepele-Nkumpi	75.93	0.57
	NP361: Thabazimbi	37.04	1.00
	NP362: Lephalale	61.24	1.28
	NP364: Mookgopong	47.87	1.58
	NP365: Modimolle	61.07	1.01
	NP366: Bela-Bela	58.23	0.93
	NP367: Mogalakwena	78.81	0.63
	NP03A2: Makhuduthamaga	88.74	0.41
	NP03A3: Fetakgomo	86.92	0.68
	CBDMA3: Schuinsdraai Nature Reserve	90.00	0.00
	CBLC3: Greater Marble Hall	73.42	0.51
	CBLC4: Greater Groblersdal	84.46	0.42
	CBLC5: Greater Tubatse	84.71	0.39

Table B9: Predicted headcount indices by local municipality in the Kwazulu-Natal

Province	Local Municipality	Headcount ratio	Standard errors
Kwazulu-Natal	KZ211: Vulamehlo	98.40	0.42
	KZ212: Umdoni	92.06	0.60
	KZ213: Umzumbe	97.37	0.44
	KZ214: uMuziwabantu	93.66	0.47
	KZ215: Ezingoleni	96.45	0.54
	KZ216: Hibiscus Coast	92.38	0.56
	KZ221: uMshwathi	75.22	0.88
	KZ222: uMngeni	46.73	0.86
	KZ223: Mooi Mpofana	65.81	1.11
	KZ5a1: Ingwe	80.38	0.89
	KZ225: Msunduzi	54.12	0.45
	KZ226: Mkhambathini	78.82	0.90
	KZ227: Richmond	76.34	1.09
	KZ232: Emnambithi/Ladysmith	87.60	0.58
	KZ233: Indaka	97.67	0.52
	KZ234: Umtshezi	80.82	0.56
	KZ235: Okhahlamba	92.49	0.39
	KZ236: Imbabazane	96.35	0.47
	KZ241: Endumeni	72.95	1.03
	KZ242: Nqutu	91.15	0.62
	KZ244: Msinga	92.66	0.62
	KZ245: Umvoti	77.57	0.86
	KZ266: Ulundi	84.63	0.48
	KZ252: Newcastle	95.54	0.32
	KZ253: Utrecht	87.45	0.70
	KZ254: Dannhauser	98.08	0.41
	KZ261: eDumbe	90.41	0.62
	KZ262: uPhongolo	88.82	0.57
	KZ263: Abaqulusi	83.63	0.49
	KZ265: Nongoma	95.12	0.41
	KZ266: Ulundi	84.63	0.48
	KZ271: Umhlabuyalingana	89.63	0.71
	KZ272: Jozini	84.40	0.52
	KZ273: The Big 5 False Bay	92.59	0.65
	KZ274: Hlabisa	91.63	0.68
	KZ275: Mtubatuba	73.79	0.97

Table B9: Continued

Province	Local Municipality	Headcount ratio	Standard errors
Kwazulu-Natal	KZDMA27: St Lucia Park	71.22	0.85
	KZ281: Mbonambi	87.15	0.78
	KZ282: uMhlathuze	90.18	0.57
	KZ283: Ntambanana	93.71	0.88
	KZ284: uMlalazi	91.80	0.62
	KZ285: Mthonjaneni	85.59	1.12
	KZ286: Nkandla	92.51	0.73
	KZ291: eNdondakusuka	75.34	0.60
	KZ292: KwaDukuza	79.45	0.63
	KZ293: Ndwedwe	86.65	0.45
	KZ294: Maphumulo	97.56	0.38
	KZ5a1: Ingwe	86.36	0.84
	KZ5a2: Kwa Sani	79.65	1.17
	KZ5a4: Greater Kokstad	92.83	0.58
	KZ5a5: Ubuhlebezwe	85.07	0.82
	EC05b1: Umzimkhulu	87.10	0.68
	Durban: Ethekwini	44.55	0.21

Source: Authors' computation