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HOUSEHOLD AND CONTEXTUAL INDICATORS OF POVERTY IN THE GAUTENG PROVINCE OF SOUTH AFRICA: A MULTILEVEL ANALYSIS

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Abstract. This study aims to analyse the socio-economic factors contributing to poverty reduction in South Africa using time series data from 2006 to 2019. The stationarity of the variables will be assessed by applying the Augmented Dickey Fuller (ADF) test. The Autoregressive Distributed Lag (ARDL) analytical technique will be adopted to analyse the cointegration amongst variables pertaining to different orders of cointegration amongst lower bound [I(0)] and upper bound [I(1)]. The study will analyse the long-term and short-term effects of the socio-economic factors contributing to poverty reduction in South Africa. If the calculated F-statistic is greater than the upper bound [I(1)], the Error Correction Model will be adopted to assess the short-run effects. Diagnostic tests will be performed to test the robustness of the model. The tests will performed will include: (1) the Breusch-Godfrey test for serial correlation; (2) the Jarque-Bera test for normality; (3) the Breusch-Pagan-Godfrey technique to test for heteroscedasticity; and (4) the cumulative sum chart to detect deviation from the average associated with a subgroup.

Keywords: South Africa, poverty, Autoregressive Distributed Lag

INTRODUCTION

There is a long history of studying poverty in South Africa, while the socio-economic factors contributing to poverty reduction have not been so thoroughly explored. The early study of poverty in South Africa emerged in 1932, when the initial Carnegie inquiry (Carnegie one) was conducted to establish the causes and nature of poverty amongst the European settlers. During the 1970s, the Theron Commission of Inquiry conducted a study to identify the socio-economic factors contributing to poverty in 'black community' based in South Africa. In the 1980s, the Carnegie commission (Carnegie two) unleashed their second poverty study, which concentrated on the determinants of poverty amongst the black community (Francis & Webster 2019).

The findings from Carnegie poverty inquiries were that poverty is mainly associated with poor access to basic needs such as food, shelter, health, education and economic infrastructure. Furthermore, there are four challenges raised by early studies concerning poverty, indicating that the government needs to prioritise strategies to reduce it across the entire country. The challenges are as follows: (1) It imposes societal instability amongst community members. (2) It results in the country being inefficient in economic terms. For instance, a lack of healthy diets causes children not to perform properly at school. Furthermore, labourers who live under the food poverty line (FPL) are less productive. A country where the majority of the population is living under the FPL is susceptible to being a consumer of goods and services produced by developed countries. (3) The consequences of adverse poverty are that

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inequality starts to manifest and expand (Francis and Webster, 2019).

Eigbiremolen (2018: 692) argues that the fraction of the population that is experiencing poverty can be determined using a poverty line measurement. The adoption of a poverty line to measure poverty levels has been seen as a subjective decision, while it is the most crucial method of poverty measurement identified since 1925. The arbitrariness associated with the use of poverty lines has sparked controversy as some researchers have amended the threshold using different methods. Furthermore, the subjectivity regarding the setting of a poverty line can mean that a proportion of the poor population is left above the poverty line. Many studies in poverty literature have adopted existing poverty lines, such as the World Bank lines or the poverty lines adopted in various countries. Their adoption tends to be ineffective since such existing lines may not correctly point towards the minimum needs for basic living in a specific country in a given period. However, this study uses the South African poverty lines, which are administered by Statistics South Africa (StatsSA) and depend on actual prices as influenced by the Consumer Price Index (CPI).

Amara and Jemmali (2018: 114) posited that the socio-economic factors affecting poverty can be aggregated into two groups, namely the micro- and macrospheres. The micro-sphere encompasses factors such as age, gender, education level, marital status and access to nutritious food. The macro-sphere includes factors such as economic performance, employment rate, trade balance, wages, income distribution, foreign direct investment and average exchange rates. The current study adopts a multidimensional approach to poverty reduction since it uses both macro and micro variables to address the objective regarding the socio-economic factors contributing to poverty reduction in South Africa.

Attacking poverty and deprivation should be the priority of democratic government so that a society can flourish and survive the future (South Africa. National Planning Commission 2011: 1). South African governance went through a significant political transformation after 1994. The first democratically elected government, led by African National Congress (ANC), inherited a country that had significant inequality, with a Gini co-efficient of 0.58. The country was marked by widespread poverty, with almost half of the South African people classified as poor according to the national poverty line of R 354 (Mbuli, 2008: 01). In 2004, the country celebrated and reflected on how much progress has been achieved since the end of the apartheid era. A lot of socio-economic issues affecting poverty had been well researched. However, poverty is still widespread in most countries of the world including South Africa. This remains an obvious area of concern, even post-1994 (Mbuli, 2008: 01).

Various studies have tried to give estimates on the magnitude of poverty in South Africa but have yielded results that are at variance with each other. Available estimates regarding the occurrence of poverty in South Africa range from 45% to 57%, depending on the poverty line that has been used. What is also clear from the existing studies is that although they have produced estimates that are at variance, it appears that there are constant trends regarding 'where' and 'who' the poor are in South Africa. It is apparent from these studies that poverty in South Africa has, inter alia, race, age, gender, rural, regional, illiteracy and unemployment dimensions. In addition, the poor tend to experience inadequate access to basic services (Mbuli, 2008: 01).

The main objective of this study, therefore, is to determine the socio-economic factors contributing to poverty reduction in South Africa between 2006 and 2019. The study differs significantly from other studies within the poverty literature. Firstly, the study uses the ARDL bound test to assess cointegration amongst the regressand and regressors, prior to estimating the long-run and short-run effects of regressors on poverty reduction in South Africa. Secondly, the study adopts the Granger Causality test to establish the relationship between poverty and various independent variables. The current study contributes to the poverty literature gap by determining socio-economic factors contributing to poverty alleviation using modern time series data. Therefore, the research question to be addressed is: Which socio-economic variables lead to poverty reduction in South Africa?

The remainder of the paper is set out as follows: Section 2 outlines a brief review of the existing theoretical and empirical literature; Section 3 provides the study's methodology, covering data sources and model specifications; Section 4 discusses the findings from the ARDL technique and the Granger Causality test; and Section 5 outlines the conclusion and recommendations.

LITERATURE REVIEW

Freeman (2018:01) stipulates that there is no 'one size fits all' in terms of factors contributing to economic growth. There is no single recipe that can be adopted to foster growth and improve the poverty reduction of a country. Yet various studies have been conducted to investigate the general correlation between poverty as a dependent variable and other independent variables such as employment, income, foreign direct investment (FDI) and gross domestic product (GDP). The aim of this section is to review the literature on how various factors can positively impact poverty reduction in South Africa, as several variables can play a significant role in alleviating poverty within the country.

Theoretical framework

The meaning, determinants and understanding of poverty are crucial in framing poverty reduction strategies. Poverty is conceptualised in economic terms and often measured by means of economic values. The World Bank defines poverty as 'the incapacity to reach a minimum standard of living' and has formed a 'universal poverty line', which is 'consumption based' and contains two elements: 'the expenditure necessary to buy a minimum standard of nutrition and other necessities'. The definition is frequently used for inter-country comparisons, and does not necessarily depict what happens at the community and household levels. According to the income perspective, one is living under the poverty line if one's income falls under US$ 1.25 a day. The economic definition of poverty has received considerable criticisms from poverty scholars because it fails to consider the holistic and humanistic perspectives. The World Bank's work on the voices of the poor together with Amartya Sen's philosophical works on ability and development as freedom have broadened our understanding of what poverty signifies, and what poverty reduction interventions should focus on in order to produce desired outcomes (Adjei and Adjei, 2016: 273).

According to these more recent perspectives, poverty is conceptualised in terms of social norms, lack of participation and political voice, inadequate human development opportunities, vulnerability, and economic and social assets. Adjei and Adjei (2016: 273) postulate that poverty is characterised as a 'capability deprivation', where one lacks 'subsistence freedom'. Furthermore, freedom has two facets: opportunity and security. Opportunity entails education and a variety of political and economic freedoms, whereas security is seen as a consequence of the effective utilisation of the opportunities afforded to an individual or household. Hence, poverty is not merely a state of existence but also a process with numerous dimensions and complexities characterised by vulnerability (low capacity to cope with risks), powerlessness and deprivation. In actual fact, poverty is not only a lack of income (Adjei and Adjei, 2016: 273).

According to the literature, the definition and measurements of poverty must consider its multidimensional attributes that include the social and cultural context in which people live and work. Thus, the success of interventions is dependent on their ability to endorse multidimensional poverty reduction and human well-being on a sustainable basis. Furthermore, these abilities to address the multidimensional poverty of South African communities also depend on the extent to which the country's developmental agenda is holistic and humanistic, the extent to which the actors are all included within the national poverty definition and participate in the entire reduction process and the extent to which the strategies and actions are integrated and transformative (Adjei and Adjei, 2016: 273).

Over the past decades, extensive resources have been committed to the cause of poverty reduction, which is currently the primary dominant goal of the international development community. However, much of the global effort towards attaining poverty reduction has been expressed through the neoliberal approach driven by market reforms and a shift towards enhancing and promoting the economic competitiveness of the supply side of the economy (Adjei and Adjei, 2016: 273). The economic paradigm entrenched in the neoliberal discourse is rooted in the classical economics of utilitarianism, which observe low economic growth and less productivity as the most structural cause of poverty. In line with the neoliberal approach, market-based strategies such as the Poverty Reduction Strategy Programmes in the early 2000s have most commonly been the policy preferences to achieve poverty reduction and eliminate socio-economic challenges. The adoption and implementation of these policy strategies over the years have resulted in a drop in the number of people who live in poverty (Adjei and Adjei, 2016: 273). Furthermore, growth-enhancing policies have benefitted poor populations, especially in the less developed and developed countries.

Other recent studies have reported that the number of poor people dropped from 403 million in 1970 to 152 million by 2006 (Adjei and Adjei, 2016: 273).

While these policy strategies have made some moderate improvements in relation to the growth of the economy, evidence is increasing on the growing levels of poverty and inequality in the countries that implemented these strategies, which cannot be overemphasized. Even with different enterprise interventions in rural Ghana, a number of people still find themselves in the midst of poverty, and within the region poverty rose from 227 million to 314 million between 1990 and 2001 as a result of the implementation of SAPs (Adjei and Adjei, 2016: 273). These figures were expected to rise from 314 million in 2001 to 366 million by 2015. In some Latin American countries, such as Argentina, the unemployment rate increased from 6.5% to over 17%, while simultaneously the number of people living in conditions of income poverty soared from 22% to over 27% between 1991 and 1995 due to the implementation of the adjustment and stabilisation policies of the World Bank and IMF (Adjei and Adjei, 2016: 273). Even though developing countries have made incredible progress in improving living standards, globally, an estimated 1.2 billion people live in deep poverty and about 850 million are malnourished.

Basically, market-based strategies have achieved less in reducing poverty because they mostly reward the rich and leave the poor behind. Hence, there are high levels of vulnerability and social inequality. For example, the Ghana Living Standard Survey Report IV shows that about 85.7% of people in Ghana are poor. Prolonged mismanagement, macro-economic instability and corruption have undermined Ghana's attempts to reduce multidimensional poverty (Adjei and Adjei, 2016: 273). Women are amongst those who are most affected. As a result of the failure of the market-based strategies of trade liberalisation, privatisation and reduction in government expenditure towards reducing poverty, there have been increasing calls for more direct social policy enterprises and human development interventions that can address poverty within the developing countries, where the majority of poor people are marginalised (Adjei and Adjei, 2016: 273).

In the South African context, efforts to eradicate poverty have been part of the development agenda since the country became a democracy. Over the past decade, there has been progress observed in improving the socio-economic status of South Africa in areas such as education, healthcare and basic services from various adopted policies and frameworks. Attempts to improve the poverty situation include partnering with United Nations–Sustainable Development Goals (SDG), the adoption of National Developmental Goals (NDP) 2030 and the Poverty Strategy (Mbuli, 2008: 132).

The seventeen identified SDG of agenda 2030 aim to improve the socio–economic well-being of all the United Nations Member States that have adopted it. Notably, some of these goals target poverty-related issues, such as no poverty; zero hunger; quality education; decent work and economic growth; and good health and well-being. In addition, NDP vision 2030 aims to accelerate the development in South Africa of an economy that creates more job opportunities; gives everyone an equitable share of the economy; ends segregation; improves infrastructure; and includes an integrated and inclusive rural economy, underpinned by great quality education, healthcare, improved basic services and job creation (Mbuli, 2008: 170).

Furthermore, the national strategy on poverty reduction launched in 2008 intends to broaden the programmes dealing with poverty alleviation. This strategy has numerous pillars such as the creation of economic opportunities, ensuring that poor households are able to improve their earnings through jobs or self-employment, and investment in human capital by providing training and educational opportunities and healthcare services. It aims to establish income security, which ensures the safety of vulnerable poor households by providing assistance such as social grants to those who are disabled, ill and aged. It targets the provision of basic services and other non-financial transfers such as: social grants; subsidised housing; electricity; sanitation; and refuse removal. It includes the provision of healthcare by ensuring that poor children grow up healthy through access to quality and sufficient curative care, while providing equitable access to assets such as land, housing and capital in order to improve social security and economic engagement in the long term. It incorporates social inclusion, which promotes an inclusive and integrated society across all classes and races, and seeks to provide a sustainable environment, where adopted programmes and strategies are meant to increase economic opportunities for poor communities by rehabilitating the ecosystem, reversing the degradation of the environment and promoting eco-tourism. A final goal of the strategy is good

governance that is accountable, informative, and promotes participatory citizens and sound macroeconomic management and pro-poor policies (Mbuli, 2008: 170).

Empirical evidence

Globally the concepts of poverty and unemployment are intertwined. Some of the sub-Saharan African countries like Nigeria diagnose poverty to be caused by mismanagement of public funds and political instability, which adversely affect the population (Muhammad and David, 2019: 72). Barahona (2018: 601) stipulates that poverty is caused by variables that have monetary, human rights and geographical aspects. Moreover, poverty can be measured, while influencing the understanding of its analysis and adopted policies. Due to space limitations, only the best-known measures of poverty are discussed, as a thorough list of all existing multidimensional measures will be displayed in the results section.

The causal relationship between poverty and unemployment is indisputable, even in South Africa, from both dynamic and static perspectives. However, it remains possible that some of the unemployed are those who leave employment voluntarily and choose not to work again (Zizzamia, 2020: 11). The study of Muhammad and David (2019) investigated the relationship between poverty and unemployment and found that these variables are twin challenges of the economy, even though it is not clear which causes the other.

According to Kheir (2018: 41), the poverty reduction revolution in Egypt resulted from increased job creation. The creation of about 40% of these jobs was catalysed through oil revenues, which created employment opportunities even for unskilled workers.

According to Masukwa and Odhiambo (2019: 56) the causal relationship between FDI and poverty is still growing, most especially in African countries. A few studies have attempted to investigate this relationship and the results reflect bidirectional causality, while some have found a unidirectional causal relationship and others have found no causal relationship between FDI and poverty. These discrepancies indicate that the causal relationship between these variables depends on the measurement of poverty, sample period and domain. The lack of uniformity in the results precludes any generalisations about causality. Magombeyi and Odhiambo (2017: 2) stipulate that the impact of FDI on poverty reduction is not clear as these variables have not yet been fully explored.

However, the literature reflects that FDI can also be utilised to improve poverty. FDI allows the country to participate in a global economy. The policies adopted in South Africa aim to increase the inflows of FDI to boost economic growth by entering into multilateral and bilateral investment agreements. Furthermore, FDI improves market access for a receiving country and triggers regional integration initiatives (Magombeyi and Odhiambo 2017: 2). Therefore, the FDI inflow plays a vital role in poverty alleviation and improved standards of living.

FDI inflows in South Africa were depressed between 1980 and 1994, and displayed an upward trend from 1994. However, between 1994 and 2014 the average share of FDI to GDP was 0.9%. The incidence of poverty measured by poverty headcount with a daily rate of $1.90 reflected a decrease from 31.9% in 1993 to 16.6% in 2011. Overall, South Africa has since experienced a decrease in poverty evident from other measures such as the poverty gap and human development index. Further studies conducted by Musakwa and Odhiambo (2019: 57) investigated the FDI and poverty reduction in Botswana using a multivariate causality test. The study applied the autoregressive distributed lag bounds testing approach and ECM-based Granger causality model in a stepwise manner to analyse the link. The study concluded that there is a sensitive relationship between FDI and poverty based on the proxy used to measure poverty levels. The study conducted by Magombeyi and Odhiambo (2017: 2) investigated the causal relationship between FDI and poverty reduction in South Africa. The ARDL bounds testing method for cointegration and ECM-base connection test was adopted, and the findings revealed that the causal relationship between FDI and poverty reduction is sensitive to the proxy set to measure the level of poverty reduction. The results found in this study are consistent with those found in the study of Musakwa and Odhiambo (2019: 57).

MATERIALS AND METHODS

Dataset

This study used data sourced from the fifth quality of life survey which was conducted in 2017/18 for the Gauteng City-Region Observatory (GCRO). The survey questionnaire was constructed by GCRO, with comments and inputs from various stakeholders. Table 1 shows that the survey was based on a random sample of 24,890 individuals representing 0.20% of the total population

Table 1. Distribution of population sampled per Gauteng regions

Region	Total population	Sample size households	Sample percent (%)
Johannesburg	4,435,000	9,119	0.21
Ekurhuleni	3,178,000	6,456	0.20
Tshwane	2,931,000	5,995	0.20
Emfuleni	722,000	1,326	0.18
Mogale City	384,000	728	0.19
Rand West	261,000	497	0.19
Merafong	198,000	355	0.18
Lesedi	112,000	203	0.18
Midvaal	95,000	211	0.22
Total	12,316,000	24,890	0.20

Source: Gauteng City-Region Observatory (GCRO).

in the Gauteng city region. Furthermore, the majority of sampled individuals in terms of head count were based in the City of Johannesburg, which has a population of 4.4 million. However, in terms of percentages, the sample size is equally spread amongst the nine regions of Gauteng province. The questionnaire was comprised of 248 close-ended questions, which were divided into 15 sections. The study area comprised the regions within Gauteng province, which are as follows: City of Johannesburg; City of Ekurhuleni; Emfuleni; Lesedi; Merafong City; Midvaal; Mogale City; Randfontein; City of Tshwane and Westonaria.

Amara and Jemmali (2017: 118) posited that individuals are regarded as poor if they live under the minimum level of the poverty line. The World Bank describes three measures that can be used to construct poverty lines, which are: nutritious food intake, the cost of basic needs and subjective evaluations. Nutritious food intake is the most widely adopted method for various countries including South Africa. The poverty line used for Gauteng province is the national poverty line, described by the Statistics South Africa (StatsSA) as a measure of poverty in South Africa.

The poverty line estimates take into consideration the food poverty line, signifying the cost of a basket of food items. However, the definition by the World Bank incorporates a non-food poverty line in order to attain an inclusive measure. The non-food poverty line represents essential non-food items such as clothing, shelter and other basic needs.

The regressor variable for this study is a binary measure reflecting an individual's poverty status. The study adopted two proxy variables to measure poverty: unemployment and missed meal. Intuitively, when applying these two proxies for poverty, an individual is poor when unemployed and missing one meal in a day (Amara and Jemmali, 2018: 120–121). The independent variables included in the study are: migration; income; gender; household size; business ownership; number of dependents; education level; and debt. The choice of covariates was directed by the theoretical and empirical studies of Barahona (2018); Freeman (2018); Gnangnon (2021); Magombeyi and Odhiambo (2017); Thompson and Dahling (2019); and Muhammad and David (2019).

Methodology

The study adopted a multilevel logit analytical technique that takes into consideration the structure of the dataset

Table 2. Summary description of the variables

Variables	Type	Mean	SD (range)
Dependent variables			
Unemployment	Dichotomous	0.51	
Missed meal	Dichotomous	0.21	
Log of the unemployment	Continuous	0.64	0.32
Log of monthly expenditure on food	Continuous	0.41	0.18
Independent variables			
Migration	Categorical	4.80	3.03
Income	Categorical	0.51	0.50
Gender	Categorical	1.49	0.50
Household size	Continuous	3.16	1.80
Business ownership	Categorical	0.13	0.33
Number of dependents	Continuous	1.78	1.74
Level of education	Continuous	3.81	1.08
Debt	Categorical	0.35	0.48

Source: variables included in the study are from survey conducted by Gauteng City-Region Observatory.

in order to analyse the relationship amongst the regressand and regressor variables. Furthermore, the model was applied to analyse the binary variable y_{ij} in relation to various dependent variables which highlight whether a household is poor or not. The model found that the regressand, y_{ij}, takes a binary direction with conditional variance var($y_{ij} \mid p_{ij}$) = $p_{ij}(1 - p_{ij})$, where p_{ij} represents the possibility that a household member i from specific region j is experiencing poverty

The initial stage is to estimate a null model where the regressor is based on the intercept as well as random effects at every level. This empty model offers the possibility that an individual household is poor, putting forward the intuition that the households do not vary according to individual or regional characteristics. Furthermore, the null model permits the fragmentation of the entire variance of the model into various variance components for each structural level.

Stage 1: Caters for a household i in relation to the specific region; the logit representing the probability of $y_{ij} = 1$ observation, is captured as follows:

$$\log\left(\frac{p_{ij}}{1-p_{ij}}\right) = \text{logit}\left(y_{ij}\right) = \beta_{0j} \tag{1}$$

Stage 2: This represents the household at the second regional level, in which the equation is expressed as follows:

$$\beta_{0j} = \gamma_{00} + \mu_{0j} \tag{2}$$

Therefore, the combined model for household poverty is as follows:

$$\log\left(\frac{p_{ij}}{1-p_{ij}}\right) = \text{logit}\left(y_{ij}\right) = \gamma_{00} + \mu_{0j} \tag{3}$$

In this regard, γ_{00} represents the entire average log-odds, while μ_{0j} denotes the random disparities in the first level constant terms across regions. The second phase is when households' log-odds are a function of individual household and regional features. Therefore, equation three can be stretched to include $P(p = 1, ..., P)$, other household variables (x_{pij}), and $Q(q = 1, ..., Q)$, regional regressors (z_{qj}).

Stage 1 extension:

$$\log\left(\frac{p_{ij}}{1-p_{ij}}\right) = \text{logit}\left(y_{ij}\right) = \beta_{0j} + \sum_{p=1}^{P}\beta_{pj}x_{pij} \tag{4}$$

Stage 2 extensions:

$$\beta_{0j} = \gamma_{00} + \sum_{q=1}^{Q}\beta_{0q}z_{qj} + \mu_{0j} \text{ and } \beta_{pj} = \gamma_{p0} + \sum_{q=1}^{Q}\beta_{pq}x_{qj} \tag{5}$$

Therefore, the household poverty model can be amalgamated as follows:

$$\log\left(\frac{p_{ij}}{1-p_{ij}}\right) = \text{logit}\left(y_{ij}\right) = \gamma_{00} + \sum_{p=1}^{P}\beta_{p0}x_{pij} + \sum_{q=1}^{Q}\beta_{0q}z_{qj} + \sum_{p=1}^{P}\sum_{q=1}^{Q}\beta_{pq}x_{pij}z_{qj} + \mu_{0j} \tag{6}$$

Where β_{pj}, captured in equation four, denotes the model coefficient of the p^{th} household feature in the specific region which is permitted to randomly differ across regions by including the Q regional variables. Therefore, the model assumes fixed estimation slopes and the estimation is represented as variance component regression. It is evident that equation six caters for possible cross-level relationships amongst regressors at different levels.

RESULTS AND DISCUSSIONS

Null model results

The analysis commences with the estimation of the two-level null model called the intercept-only or random intercept-model. Table 3 shows that the null model estimates the single intercept of the regressand as a random effect of the secondary phase containing various covariates. Notably, the primary aim of this phase is to assess the level of significant intercept variance, which is an assessment of the need for multiple estimations. When the intercept variance is insignificant, it is possible to hold it constant in the future.

Table 3 displays the findings of the null model for two identified proxy regressors for poverty, which are unemployment and missed meal. The results from the log likelihood (LR) test for both models show that the multilevel logit model is more relevant than the simple logit model, since the LR assessment is statistically significant at the 1% level. The group variance between the dependent variables (unemployment and missed meal)

Table 3. Null model results

Parameters	Unemployment	Missed meal
	Empty model	
Intercept (γ_{00})	0.051*	–2.307***
Standard error	0.030	0.583
$\sigma^2_{\mu 0}$	0.001*	1.673
Standard error	0.003	1.127
Odds ratio = exp (γ_{00})	0.053	0.100
Probability (P_{ij})	0.086	0.169
Intraclass correlation coefficient (ICC)	0.185	0.313
LR test	72.847***	730.802***

The interclass correlation coefficient (ICC) denotes the proportion of the variance of the group-level random effect from the entire variance.

Notably, the findings from ICCs shows that approximately 0.185% and 0.313% of the entire variance in unemployment and missed meal respectively is accounted for by the multilevel effects of the identified regressors. Therefore, the grouping effect revealed by the null model shows that households living in a specific region are prone to experience poverty, while households residing in other regions might avoid poverty. As depicted in Table 3, the average unemployment rate (the first proxy for poverty) across city regions of Gauteng province is approximately 5.3%, whereas the average missed meal rate (the second proxy for poverty) within Gauteng is equivalent to 10%.

The estimated average probability of unemployment within Gauteng province is equivalent to 0.086, while it is approximated at 0.169 for missed meal. Figures 1 and 2 represent the differences amongst city regions as a random constant term for both unemployment and

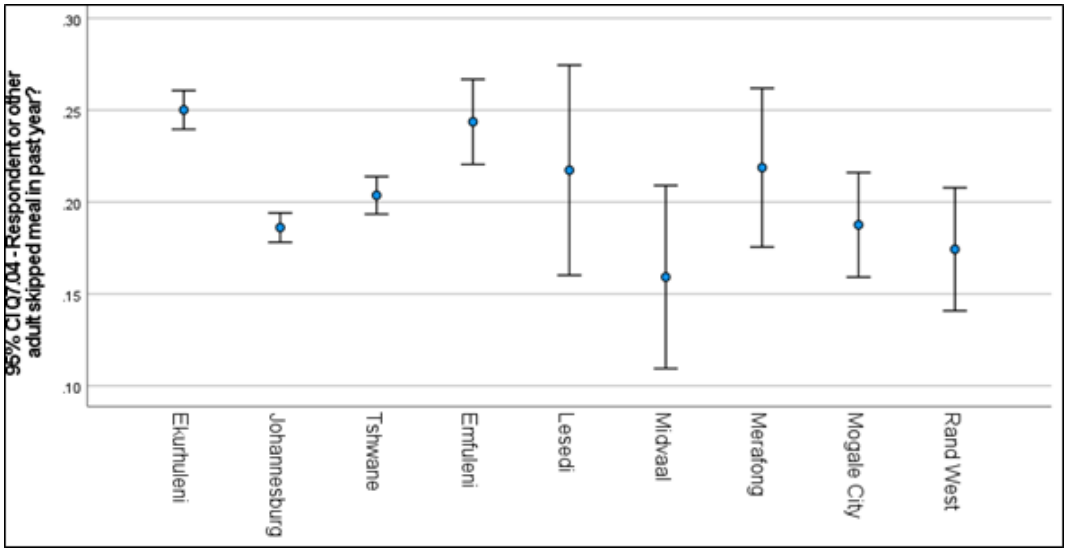

Fig. 1. Random intercept forecasts and estimated 95% confidence intervals for unemployment in the city regions of Gauteng province
Source: own elaboration.

is non-zero, which confirms the adoption of a multilevel logit analytical technique. Furthermore, the results are anchored by the intra-class correlation coefficients (ICCs) that highlight a substantial clustering of households within different regions.

missed meal. Regions which are not metropolitan, such as Emfuleni, Lesedi, Merafong and Midvaal, experience more poverty than regions within metropolitan areas, such as the City of Johannesburg, the City of Pretoria and the City of Ekurhuleni.

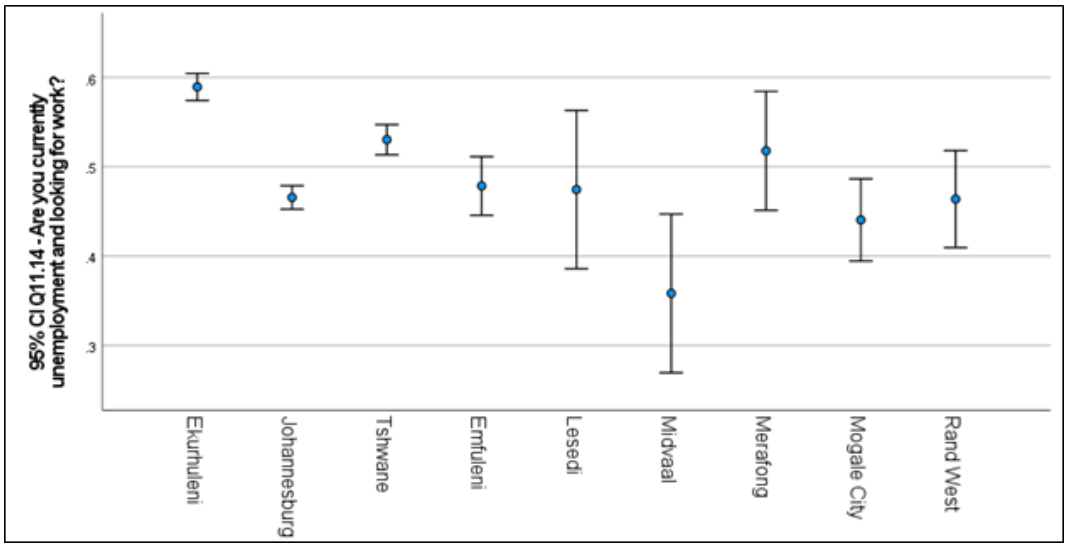

Fig. 2. Random intercept forecasts and estimated 95% confidence intervals for missed meal in the city regions of Gauteng province
Source: own elaboration.

Fixed effects findings with poverty household characteristics only

This section presents the findings concerning the effects of poverty household characteristics on the sampled population within the city regions of Gauteng province. This stage includes an estimation of four models, in which the first model only estimates the fixed effects of household variables related to unemployment status. The second model includes poverty household factors to estimate the log-odds of an individual household being affected by poverty. The findings indicate that five covariates in the first model (unemployment) are statistically significant, while six independent variables are statistically significant in the second model (missed meal).

Figure 2 shows that poverty (assessed by means of unemployment and missed meal) is more prevalent in non-metropolitan regions such as Lesedi, Merafong and Midvaal, while metropolitan regions are less likely to be affected by poverty. The results can be attributed to the fact that non-metropolitan regions feature less economic activity than metropolitan regions. Most industries employing the majority of people are situated in the metropolitan regions of Gauteng province. These findings are compatible with those of Amara and Jemmali (2017), which highlight that remote regions are susceptible to poverty due to poor infrastructure and inadequate access to basic services such as education, water, nutritious food and employment opportunities. The provincial government of Gauteng province, in collaboration with local government, should prioritise relevant policy instruments (providing enabling infrastructure, promoting inward investment and allows the donation of edible nutritious food to less privilege communities) in order to eliminate poverty in non-metropolitan regions. Failure to execute such policies will result in the migration of households towards affluent regions, while others will participate in informal activities.

The covariates, such as gender, household size, business ownership, number of dependents (number of people depending on household heads) and level of education, are statistically significant. The significant variables are likely to have an impact on the poverty status of households residing in the city regions of Gauteng province. The relationship between immigration and unemployment is insignificant with a negative sign, while it is statistically significant at 1% for missed meal. The implication is that when immigration increases by one unit point, the odds of experiencing poverty through missed meal will increase by 7.8%. The income of a household is insignificant for unemployment, while it is statistically significant for missed meal.

Table 4. Multilevel Logit model with random constant term and household covariates

Covariates	Model (1) unemployment	Odds ratio (OR)	Model (2) with missed meal	Odds ratio (OR)
Intercept	–1.750*	(0.174)	–0.934***	(0.393)
$Immigration_i$	–0.009	(0.091)	–0.016***	(0.078)
$Income_i$	–0.280	(0.756)	–0.644***	(0.525)
$Gender_i$	0.639**	(0.089)	0.014	(1.015)
$Household\ size_i$	0.904***	(2.468)	0.881***	(2.431)
$Business\ ownership_i$	–0.698***	(0.049)	–0.217***	(0.080)
$Number\ of\ dependents_i$	0.434***	(0.055)	0.063**	(0.093)
$Level\ of\ education_i$	–1.881*	(0.056)	–0.089**	(0.091)
$Debt_i$	0.352	(0.428)	0.270	(1.310)
Log likelihood	4 418.06		5 624.15	
LR test	0.77***		0.74***	

Odds ratio in parentheses.
* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.
Source: own elaboration.

Gender is statistically significant at a level of 5% for unemployment, while it is statistically insignificant for missed meal. The findings of the unemployment model show that the gender of the household head is a significant factor linked with the odds of being poor. More particularly, male-headed households are 8.9% less likely to be in poverty than female-led households. The household size is statistically significant for both unemployment and missed meal at a 1% level of significance. The implication is that bigger households are more susceptible to poverty than smaller households. When holding all other covariates constant, business ownership is negative as well as statistically significant for both unemployment and missed meal. If business ownership increases by one unit, the odds of being poor as measured by unemployment decrease by 4.9% and the odds of being poor as measured by missed meal decrease by 8%. The implication is that households that own businesses are less prone to poverty than those without businesses. When controlling for other regressors and estimating the number of dependents, the odds of experiencing poverty increase by 5.5% as measured by unemployment and by 9.3% as measured by missed meal. The effect of level of education was shown to be negative and statistically significant for both unemployment and missed meal. Holding all other variables constant, a one-unit increase in the level of education decreases the odds of experiencing poverty through unemployment by 5.6% and the odds of experiencing poverty through missed meal by 9.1%. The debt associated with the sampled households in the Gauteng city regions was statistically insignificant for both unemployment and missed meal.

Fixed effects findings with both household characteristics and multiple covariates

The estimations in Table 5 include household-specific and multiple covariates in order to estimate the likelihood that a household will be in poverty as measured by unemployment and missed meal. Immigration was found to be statistically significant and positively associated with both proxies of poverty (unemployment and missed meal). More particularly, a one-unit increase in immigration appears to increase a household's odds of being in poverty as measured by unemployment by at least 1.4% and by 9.7% for missed meal.

Household income is statistically significant, while negatively associated with poverty for both unemployment and missed meal. The implication is that a one-unit increase in income results in a 4.2% decrease in a household's odds of being in poverty when using

Table 5. Fixed multilevel Logit model with random constant term and household covariates

Covariates	Model (1) unemployment	Odds ratio (OR)	Model (2) with missed meal	Odds ratio (OR)
Intercept	2.457***	(0.025)	–0.419**	(0.065)
$Immigration_i$	0.273**	(0.014)	–0.022**	(0.097)
$Income_i$	–9.180*	(0.042)	–1.040***	(0.035)
$Gender_i$	0.123*	(0.060)	0.023	(1.023)
$Household\ size_i$	1.617**	(0.097)	0.136***	(0.014)
$Business\ ownership_i$	–0.001	(1.843)	–0.288***	(0.750)
$Number\ of\ dependents_i$	0.179*	(1.715)	0.048**	(1.050)
$Level\ of\ education_i$	–0.242**	(0.452)	–0.290***	(0.748)
$Debt_i$	0.277*	(0.042)	0.397***	(1.487)
Log likelihood	–4 215.09		–5 719.13	
LR test	0.76***		0.071***	

Odds ratio in parentheses.
* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.
Source: own elaboration.

unemployment as a proxy and a 3.5% decrease when using missed meal. The association of the gender of the household with poverty appears to be positive, and it is statistically significant for unemployment and insignificant for missed meal. In a nutshell, one additional unit in household size leads to at least a 9.7% increase in poverty when the proxy variable is unemployment and an increase of 1.4% when the proxy variable is missed meal.

Table 5 shows that business ownership tends to be negatively linked to poverty in terms of unemployment and missed meal. However, number of dependents was positive and statistically significant for both unemployment and missed meal. The implication is that when the number of dependants rises by one unit for both unemployment and missed meal, unemployment increases by 17.9% and the chances of missing a meal increase by at least 4.8%. These findings are compatible with expectations.

The level of education is positive and statistically significant for both proxies of poverty. The results shows that when the level of education rises by at least one unit point for both unemployment and missed meal, poverty decreases significantly. The inference is that when level of education increases by one unit point, unemployment decreases by 24.2% and missed meal decreases by at least 29%. The debt level of the household is positively and significantly related to both unemployment and missed meal. The interpretation is that when debt increases by one, unemployment and missed meal increase by 27.7% and 39.7%, respectively. It is fascinating to find that poverty (as measured by unemployment and missed meal) is high in non-metropolitan regions of Gauteng province. The findings conform to common intuitions. Mazenda et al. (2022) posited that education, health status, household size, indigency, income and unemployment are key determinants of food insecurity in Gauteng City-Region.

There is a positive alignment amongst various socioeconomic factors, such as age, education and gender, as well as marital status and household food security (Masuku et al., 2017). Furthermore, Arndt et al. (2020) posited that low-educated households which rely on income from labour or have no stable income are more likely to suffer from poverty. Despite these findings, further studies focusing on geopolitical areas are required to address issues related to poverty (Gulati et al., 2013; Dharmasena et al., 2016).

Further robustness checks

The article adopted the multilevel logistic analytical technique to assess the log odds of being in poverty

Table 6. Robustness checks: Multilevel mixed linear model with both household, group and interaction effects

Covariates	Log of unemployment	Standard error	Log of missed meal	Standard error
Intercept	–0.419**	(0.181)	–2.459***	(0.915)
$Immigration_i$	–0.022*	(0.011)	–0.040	(0.039)
$Income_i$	–1.040***	(0.072)	–2.522***	(0.315)
$Gender_i$	0.023	(0.069)	–0.110	(0.215)
$Household\ size_i$	0.136***	(0.020)	–0.934***	(0.067)
$Business\ ownership_i$	–0.288***	(0.105)	–1.392***	(0.273)
$Number\ of\ dependents_i$	0.048***	(0.020)	0.078	(0.067)
$Level\ of\ education_i$	–0.290***	(0.034)	–0.291***	(0.049)
$Debt_i$	0.397***	(0.071)	0.531	(0.228)
Log likelihood	3 562		12 875	
LR test	705		1 620	

Standard error in parentheses
* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.
Source: own elaboration.

by applying a binary regressand. The assessment of robustness includes the estimation of a mixed linear model by adopting the welfare ratio, which is a ratio associated with a household's expenditure on region-specific unemployment and missed meal in relation to the cost-of-living differences in various regions in Gauteng province. The findings presented in Table 6 represent the two robustness check results shown in Table 5. The study adopted the estimation of mixed linear analytical technique by grouping specific intercepts applying logarithms of the unemployment and missed meal. Furthermore, it estimates an assorted linear model including grouped random constant term using the logarithm of both unemployment and missed meal. All variables carry the correct signage for unemployment and missed meal, hence the robustness test supports the results. Households consisting of many people are more likely to be affected by poverty as compared to households with fewer members. Inbound migration into Gauteng province is negative and statistically significant for unemployment, while it is negative and statistically insignificant for missed meal.

The effect of household income is negative and statistically significant for both unemployment and missed meal, which is compatible with findings from the multilevel logit model that low earners are more susceptible to poverty than high earners. The ratio associated with small household size is larger than the welfare ratio of a bigger household, while it shrinks sharply with large households earning less income. The effect of business ownership on both proxies of poverty was negative and statistically significant. The implication is that when business ownership increases both unemployment and missed meal decrease significantly. The number of dependents carries a positive sign for both unemployment and missed meal, while only unemployment is statistically significant at 1%. The coefficients associated with the logarithms of level of education are negative and statistically significant for unemployment and missed meal. The inference is that a one-unit increase in the level of education leads to at least a 29% decrease in unemployment, while it leads to a 29.1% decline in missed meal. The effect of debt is positive for both poverty proxies included in the study, while is only statistically significant for unemployment since a one-unit increase in debt results in a 39.7% increase in unemployment.

CONCLUSION AND POLICY IMPLICATIONS

This paper has analysed empirical evidence for the occurrence of poverty as multiple effects on the log-odds of experiencing poverty using unemployment and missed meal as proxies in different regions of Gauteng province. The findings from the multilevel logit model show that immigration, income, gender, household size, business ownership, number of dependents, level of education and debt are statistically significant variables when determining the log-odds of households being in poverty (as defined using the proxies of unemployment and missed meal). Therefore, variables such as income, gender, household size, business ownership, number of dependants, level of education and debt are positively associated with poverty in Gauteng province of South Africa. Furthermore, households living outside metropolitan regions are more prone to unemployment and missed meal. The article covers variables at both macro- and micro-levels to analyse the existence of poverty in the city regions of Gauteng province. Macro-level variables include unemployment rate and immigration, while micro-level variables include income, gender, household size, business ownership, number of dependents, level of education and debt. Notably, the associations of variables such as income and level of education with the two proxies of poverty are negative and statistically significant, which conforms to the intuition that adding one year to an individual's education reduces poverty. Furthermore, poverty is reduced when the level of income increases. The findings indicate that it is necessary to use multilevel interaction effects to clarify levels of household poverty when using unemployment and missed meal as proxies for poverty.

The multilevel arrangement of the household survey as well as the contextual-level, micro-level and cross interaction effects can assist policy makers seeking to ascertain the main determinants of household poverty. Expansionary public policy may be a catalytic vehicle to minimise household poverty by creating sustainable manufacturing activities, maintaining good education and health systems and strengthening investment opportunities throughout all city regions in Gauteng province. South Africa became a democracy in 1994 and managed to equally provide basic services to the majority; however, the effects of these achievement have not been felt by most people living in non-metropolitan city regions. It is pivotal to reiterate that both policy makers and researchers need to refrain from treating poverty as a micro-level issue, but craft policy that addresses poverty holistically. Poverty-minimisation policy in Gauteng province should incorporate a regional element whereby region-specific programmes are crafted and implemented.

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