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Research article

Sociodemographic factors associated with informal sector activities in selected urban areas of Nigeria

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Abstract: The study examined the relationship between informal economic activities, geopolitical regions/ecological zones and other sociodemographic variables in Jos, Owerri, Port Harcourt and Sokoto in Nigeria. Data were collected from 7605 informal business operators in four urban areas by using a simple data collection form. The analysis was carried out with descriptive statistics, chi-squared test statistics, correlation statistics and multinomial logistic regression models. The results showed significant differences in the different regions in terms of engagement in informal activities, including the age of respondents (chi = 784.38; $p < 0.000$), gender (chi = 1400; $p < 0.000$), education (chi = 1700; $p < 0.000$), marital status (chi = 663; $p < 0.000$) and economic activity (chi = 1400; $p < 0.000$). Finally, the logistic models indicated that the region of residence and sociodemographic characteristics significantly predicted the likelihood of engaging in different informal activities. The study recommends taking the demographic, regional and ecological profiles of the informal sector operators into consideration in the formulation of new government policies and programs for the growth of the informal sector and the well-being of people engaged in it. Further, it recommends the sensitization of the various informal sector subgroups by governmental agencies, non-governmental organizations and international actors according to the types of informal activities in which each has a comparative advantage. Apart from the direct benefits of the investigation to the people in the four Nigerian cities, the study is expected to be of value to other urban areas in the country and their counterparts in developing countries.

Keywords: informal activities; geopolitical regions; demographic; economic; Nigeria

1. Introduction

Informal economic activities are the livelihood activities which operate outside state regulatory systems. While the informal sector contributes significantly to urban employment, it also provides income to the urban poor in most developing countries [1]. Poverty is a major global issue, and about 86% of the world's poor are found in developing countries where informal economic activities are prevalent. Thus, informal economic activities are recognized globally in poverty alleviation strategies in most developing countries such as Nigeria [2−5]. The International Monetary Fund noted that Nigeria's informal sector accounted for approximately 65% of Nigeria's 2017 gross domestic product (GDP) [6]. Most of the informal employments in Nigeria are non-manufacturing activities, namely, street trading, hair barbing, restaurant services and other informal economic activities. According to the National Bureau of Statistics, more than half (60%) of the population in Nigeria is engaged in street trading [7]. Thus, obtaining more information on the composition of the informal economy has sparked renewed interest among researchers in developing countries such as Nigeria.

Previous studies indicate that increases in age and education level are negatively correlated with more engagement in informal economic activities, and that females are more engaged in informal activities than their male counterparts [8−11]. Other studies also showed that married, high-income earners and white-collar employed individuals are less likely to be engaged in informal economic activities [10,11]. The literature also revealed that the type and nature of informal economic activities differ across regions and the rural-urban divide [12−16]. These findings buttress the fact that certain informal economic activities thrive more in certain locations than others due to ecological attributes. For instance, a study conducted in South Africa established a significant difference between spatial location and challenges faced by women in the informal sector and showed that a strong association exists between rural informal sustenance and ecological services [17]. Despite the myriad of studies on the informal economy, there is a paucity of studies on regional differences in the prevalence and predictors of informal economic activities in urban areas of the developing world.

In this present study, sociodemographic factors and economic activities are being considered within the context of human ecology theory, which captures succinctly the use of resources for human development. People are known to use the environment to survive and they can also regulate the environment [18]. Sociodemographic characteristics have the potential to shape human actions toward the ecosystems for economic growth and sustainable development. In this context, it has also been shown that cultural evolution is needed by humans to reshape behavior for sustainable development [18]. Accordingly, it has been noted that the human ecology theory reaches well beyond a particular class of phenomena and generates a host of questions about the relationships between population and their environment. The theory specifically interrogates the character of the interactions among subpopulations or species, as well as the relationships that arise from those interactions in the developmental process. In summary, the human ecology theory deals with two lines of investigation, namely, the form and development of an urban organization, and how human social systems of whatever kind develop in different environmental settings [19]. Therefore the theory seeks to interrogate the issues of how populations ensure their survival in any given environment, improve their quality of life and sustain their natural resources [20].

Literature on informal sector activities indicates that the termed "informal economy" was a study

in Accra, Ghana [21] and subsequently adopted in report of the International Labour Organization (ILO), which was presented in Kenya. The ILO report described the formal sector as consisting of enumerated, large-scale, capital-intensive firms, while the informal sector was seen as comprising the unremunerated and self-employed, mainly providing a livelihood for new entrants into the cities [22]. In addition, studies conducted in Lagos, Nigeria were also part of the ILO city studies conducted in the 1970s [23,24]. Other studies in other parts of Nigeria opined that the informal sector's expansion was a result of rural-urban migration; these studies noted the duality in the Nigerian economy and provided theoretical evidence of the dual economy framework and the dependence therein [25,26]. Despite these explanations, most scholars have used certain characteristics of the informal sector to distinguish it from the formal. For instance, several scholars were of the view that the informal sector refers to the groups of enterprises with relatively little capital investment, produce in small quantities, and as a result, control (individually) a small share of the market, employing less than 10 people, and wherein the management, marketing and entrepreneurial functions are vested in the proprietor [27−31].

Furthermore, literature showed that the urban informal sector is the main provider of employment and income to the unemployed, that the proportion is highest in Africa [32], and that the informal sector activities generated 90% of employment while contributing about 38% of the GDP in other countries in sub-Saharan Africa [33]. In addition, other studies noted about 95% of the urban labor force are employed in the urban informal sector in the United Republic of Tanzania, even as 61% of the total households in urban areas have informal sector activities [34,35]. In Nigeria, the informal economy has a 65.4% participation rate, contributes an equivalent of 52–53% of official GDP and provides cheap and easily accessible goods/services to members of the public, as well as job, income and poverty reduction for informal participants [36]. In addition, another study revealed that urban informal business largely contributed to the urban economy and much more, including to the economy of Ibadan, Nigeria via its job provision to many job-seeking migrants [37].

Elsewhere, in other parts of the world, the literature indicates that sociodemographic factors affect the size of the informal sector [38,39]. While some studies focused on the influence of certain demographic characteristics on the growth of specific subsectors of the informal economy [40−43], other studies found a negative association between income and the level of participation in the informal sector [44−46]; and another study indicated that there is a positive association between the income and growth of informal sector activities [47].

In summary, the myriad of studies in developing countries have focused on the various perspectives of the informal economy. Previous studies have dwelled on the benefits, negative impacts, policies and strategies of informal sector activities to ensure their growth and its regulations. There appears to be an insufficiency or paucity of studies on locational aspects of the informal sector activities and regional differences in the prevalence and predictors of informal sector activities. The very few previous studies on this topic were either marred by underrepresented samples or overlooked certain variables. For example, a study in Nigeria was limited to only studying the marital status, age, religion and sex of operators in Nigeria by using a sample size of 641 from five geopolitical zones; the number of respondents in the study grossly underrepresents the teeming population of informal sector operators (ISOs) throughout Nigeria [36]. Also, a study which was limited to the urban areas in Tanzania (a single-country study) established that the types of businesses found in municipal wards are significantly influenced by location because of the fact that people who do not want to cook tend to patronize food vendors in their neighborhoods, and those who do not want to wash their clothes tend

to patronize laundry services in their neighborhoods [48]. The influence of area of residence on participation in informal sector activities was also studied by some scholars, but it was limited to western market economies [49]. Even though an earlier referenced study found a significant regional difference in informal sector participants' income and educational levels, as well as correlations of region with age, level of education, income, savings and business age, it did not consider other key sociodemographic variables such as gender, marital status and specific subgroups of informal economic activity [36]. Therefore, the association that informal sector activities have with various factors, namely, the geopolitical region /ecological zone, marital status, subtypes of informal economic activities and gender, is not clear. Therefore, the review of literature above shows that no previous study has captured the aforementioned sociodemographic variables in the study of the informal economy in Nigeria. This therefore creates a gap in literature, as it becomes necessary to investigate the relationship between the informal sector and a wide range of sociodemographic variables, especially as research is focusing more on informal sector segmentation as a tool for appropriate policy interventions.

The goal of this study was to ascertain the relationship between informal sector activities, geopolitical region/ecological zone and other key sociodemographic variables. Therefore, the objectives of this study were as follows: (1) examine the distribution of sociodemographic characteristics of the respondents; (2) determine the degree of association between informal sector activities, geopolitical regions/ecological zones and other sociodemographic characteristics; (3) examine the influence of geopolitical regions/ecological zones and other sociodemographic characteristics on informal sector activities. The null hypotheses for the study are that (i) there is no significant association between the sociodemographic characteristics of the respondents, geopolitical region/ecological zones and informal sector activities; (ii) there is no significant correlation between sociodemographic characteristics of respondents, geopolitical regions/ecological zones and informal sector activities; and (iii) geopolitical regions/ecological zones are not likely to influence informal sector activities, even after controlling for the sociodemographic characteristics of respondents.

The study will help in the defining of different subgroups of the population involved in informal economic activities in cities located in different geopolitical regions/ecological zones, revealing what they have in common and showing how they respond to the different resource endowments attributable to their ecological settings. The study is expected to help identify informal economic activities that exhibit comparative advantage relative to other forms of informal sector activities for different regions. This will guide the development and implementation of policies and strategies that will maximize the potential of the informal sector activities which exhibit a comparative advantage for each of the regions and maximize the developmental impact of the informal economy for different regions of the country.

2. Methods and data sources

Nigeria has been ranked top on the list of African countries with a high prevalence of informal sector activities in sub-Saharan Africa as a result of decades of economic recession [7]. The literature has also revealed that Nigeria's most informalized cities, in proportion to its population to regulated services, are Lagos, Port Harcourt, Kano, Sokoto, Enugu, Owerri, Ibadan, Kaduna, Jos, Benin and Aba [50,51]. Thus, the selection of the four towns for the study, i.e., Sokoto, Jos, Owerri and Port Harcourt, was based on these towns being part of the most informalized cities in Nigeria. In addition, they were selected to balance the north-south divide of the country. Quantitative data were collected

from a total 7605 respondents in the four cities by using a simple data collection form administered by trained research assistants. The demographic variables were analyzed by using a squared test and logistic regression. These statistical tools were used to check dependence and association for the attribute data, and to estimate the influences of the independent variables on the dependent variable.

The study was conducted in four state capitals: Sokoto in the North-West region/the Savanna ecological zone, Jos in the North-Central region/Montane ecological zone, Owerri in South-East region/Rainforest ecological zone and Port Harcourt in South-South region/Swamp forest ecological zone (Figures 1 and 2). These capitals were purposively selected because they are the commercial nerve centers of their various states and are towns with a thriving informal economy. They are located in regions that have abundant natural resources, major infrastructure and large markets that have potential for rapid growth of micro-enterprises.

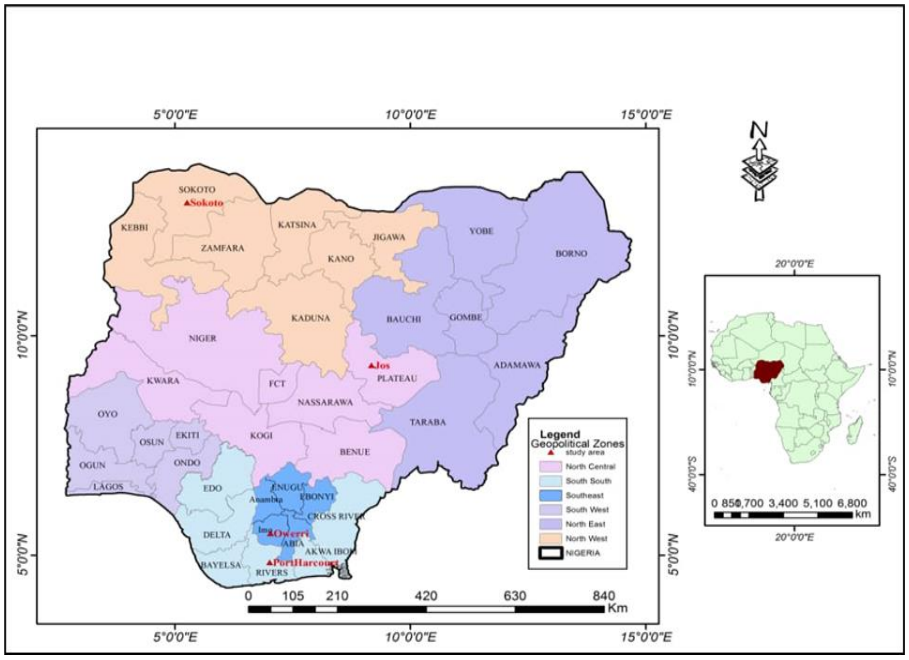

Figure 1. Geopolitical regions in Nigeria with location of the towns.

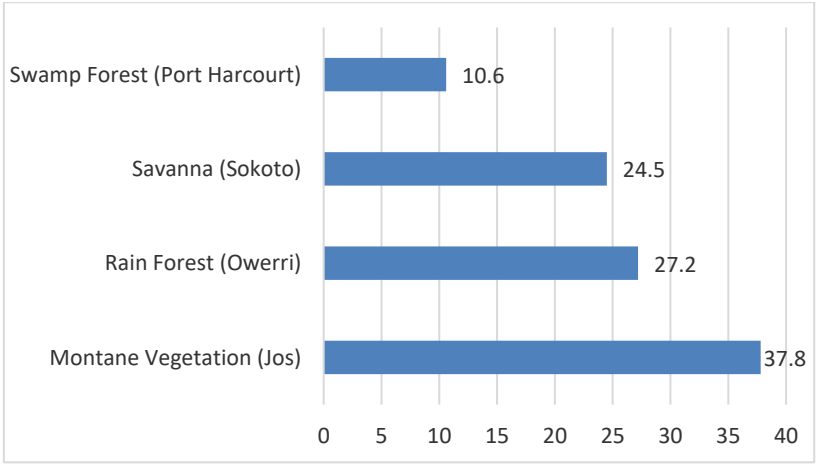

Figure 2. Ecological zones/towns.

The study employed a correlational research design. It depended heavily on field survey data, as there are no current official documents or databases on ISOs in Nigeria. Field workers enumerated and collected primary data from ISOs engaged in the six selected activities (i.e., automobile service, general dressmaking, livestock trading, market roadside petty trading and sachet water vending, welding and metal works, and woodwork and furniture making) in the four studied cities. This was based on the decision to avoid making inferences from any sample due to the absence of an established population figure of ISOs. It is an approach that is similar to the "random walk" described by Lau and Bobashev [52]. This approach is justified since the creation of a high-quality sampling frame of businesses in those cities will not only be too time-consuming, but would also be too expensive.

The reconnaissance survey and the pilot survey preceded the data collection exercise. It involved the identification and compilation of a sampling frame of existing informal sector activities and the locations where those involved in them agglomerated in large numbers. Letters were issued to the operators to officially seek their participation and collaboration in the investigation. The reconnaissance and pilot survey commenced in Sokoto town in August 2017, in Owerri town in September 2017 and in Port Harcourt town in March 2018. The enumeration and data collection exercise ended in April 2018, while the data analysis was completed at the end of October 2020.

A total of 7605 ISOs were enumerated and used for the study: 2065 from Owerri, 806 from Port Harcourt, 1860 from Sokoto and 2874 from Jos. The observed inequality in the number of respondents per city is a limitation because it was only those informal business owners who were willing to be a part of the study that became respondents. Another constraint worthy of mention is the prevalent weather during the time of data collection. The heavy rains in Port Harcourt from May to August 2018 impeded the participation of ISOs in the survey and, hence, the small numbers of operators that participated in that city.

During the field survey, a simple data collection form was designed according to the Kozinetz [53] and Meade and Richardson [54] guidelines and subsequently employed to elicit the needed data. The instrument was designed to provide answers to the research questions. It is highly recommended because it saves time and reduces biases. The form had columns for the following information: the name of the operator, gender, age, marital status, level of education attained, city and region of business enterprise, a specific informal economic activity in which the participant is engaged, date of data collection and name and signature of the person that collected the data.

The demographic data collected during the survey were quantitative. The independent variables collected were age in years (less than 11, 11–20, 21–30, 31–40, 41–50, 51–60, 61 and over), marital status (single, currently married), gender (male, female), educational attainment (non-formal/Arabic, primary, secondary, tertiary) and geopolitical region/ecological zone (South-South region/Swamp forest, South-East region/Rainforest, North-Central region/Montane and North-West region/Savanna). The dependent variable collected was the informal economic activities (automobile services, general dressmaking, livestock trading, petty trading and sachet water vending, welding and metal work, and woodwork and furniture-making). The dependent variable is a categorical variable.

The chi-squared test and logistic regression were used to analyze the data. Stata version 14 was employed for the statistical operations. The chi-squared analysis was used to check dependence and association for the attribute data; specifically, it was used to examine whether there is a significant difference in the informal economic activities being carried out in different geopolitical regions. Finally, multinomial logistic regression analysis was used to estimate the influences of the region of residence and the sociodemographic factors on informal economic activity. The study had two multinomial logistic models. Model 1 is the unadjusted model of only the regions of residence as the predictors of engagement in the different informal economic activities. On the other hand, Model 2

represents the adjusted model of the regions and the demographic characteristics as the predictors of engagement in the various informal economic activities. The results of these models are expressed as odd ratios at a 95% confidence level.

3. Testing of the research hypotheses

Table 1 shows the percentage distribution of the respondents' demographic and economic characteristics. The table shows that more than half of the respondents (informal economic operators) were male (74.6%), while 25.4% were female. It can be seen from Table 1 that about 30.4% and 25.3% were aged 31–40 years and 21–30 years, respectively. It is obvious from Table 1 that most of the operators in the informal sector were within the age range of 21–50 years. About half of the respondents (54.6%) had a secondary school education (see Table 1). Table 1 also reveals that about 43.7% and 30.9% of the informal economic operators were into petty trading and water vending and automobile services, respectively, and that most of the respondents were married (66.9%).

Table 1. Percentage distribution of the respondents' sociodemographic characteristics.

	Variable	Frequency	Percentage (%)
Gender/Sex	Male	5677	74.6
	Female	1928	25.4
Age	≤ 10 yrs	66	0.9
	11–20 yrs	973	12.8
	21–30 yrs	1925	25.3
	31–40 yrs	2314	30.4
	41–50 yrs	1550	20.4
	51–60 yrs	563	7.4
	≥ 61 yrs	214	2.8
Education	Non-formal/Arabic	928	12.2
	Primary	1808	23.8
	Secondary	4152	54.6
	Tertiary	717	9.4
Marital status	Single	2517	33.1
	Currently married	5088	66.9
Ecological zone/town	Rainforest (Owerri)	2065	27.2
	Swamp forest (Port Harcourt)	806	10.6
	Savanna (Sokoto)	1860	24.5
	Montane vegetation (Jos)	2874	37.8
Informal economic activity	Automobile service	2348	30.9
	General dressmaking	470	6.2
	Livestock trading	628	8.3
	Petty trading & sachet water vending	3324	43.7
	Welding and metal work	396	5.2
	Woodwork and furniture-making	439	5.8
	Total	7605	100.0

The results of the chi-squared analysis in Table 2 show that there exist significant differences in the sociodemographic characteristics of the respondents across the four regions.

Table 2. Chi-squared test statistics of sociodemographic characteristics and informal sector activities.

	Variables	Automobile service	Petty trading & sachet water vending	General dressmaking	Livestock trading	Welding & metal work	Woodwork & furniture-making	Total	χ^2 (P-value)
Regions	North-West (Sokoto) Savanna	278 (11.8)	1,292, (42.0)	170 (39.9)	37 (5.8)	168 (24.4)	120 (27.3)	2,065 (27.1)	$\chi2 = 1400$ $p = 0.000$
	South-South (Port Harcourt) Swamp	232 (9.8)	429 (13.9)	27 (6.3)	17 (2.7)	64 (9.3)	37 (8.4)	806 (10.6)	
	South-East (Owerri) Rainforest	953 (40.6)	374 (12.2)	0 (0.0)	295 (46.9)	125 (18.2)	113 (25.7)	1,860 (24.5)	
	North-Central (Jos) Montane	885 (37.6)	981 (31.9)	229 (53.8)	279 (44.4)	331 (48.1)	169 (38.5)	2,874 (37.8)	
Sex/gender	Male	2.282 (97.2)	1,615 (52.2)	257 (60.3)	624 (99.4)	558 (81.1)	341 (77.68)	5,67 (74.6)	$\chi2 = 1700$
	Female	66 (2.8)	1,461 (47.5)	169 (39.6)	4 (0.6)	130 (18.9)	98 (22.3)	1,928 (25.4)	$p = 0.000$
Age	30 yrs	458 (19.5)	1,673 (54.4)	188 (44.1)	230 (36.6)	273 (39.7)	142 (32.4)	2,964 (38.9)	$\chi2 = 727.13$
	30–40 yrs	903 (38.5)	735 (23.9)	139 (32.6)	181 (28.8)	232 (33.7)	124 (28.2)	2,314 (30.4)	$p = 0.000$
	40 +	987 (42.0)	668 (21.7)	99 (23.2)	217 (34.6)	183 (26.6)	173 (39.4)	2,327 (30.6)	
Educational attainment	None	162 (6.9)	352 (11.4)	13 (3.1)	161 (25.6)	25 (3.6)	39 (8.9)	752 (9.9)	$\chi2 = 522.31$
	Primary	627 (26.7)	782 (25.4)	50 (11.7)	211 (33.6)	188 (27.3)	126 (28.7)	1,984 (26.1)	$p = 0.000$
	Secondary	1,429 (60.9)	1,604 (52.2)	262 (61.5)	244 (38.8)	386 (56.1)	227 (51.7)	4,152 (54.6)	
	Tertiary	130 (5.5)	338 (11.0)	101 (23.7)	12 (1.9)	89 (12.9)	47 (10.7)	717 (9.4)	
Marital status	Single	506 (21.5)	1,280 (41.6)	195 (45.8)	183 (29.1)	260 (37.8)	93 (21.2)	2,517	$\chi2 = 312.45$
	Currently married	1,842 (78.5)	1,796 (58.4)	231 (54.2)	445 (70.9)	428 (62.2)	346 (78.8)	5,088 (66.9)	$p = 0.000$

*$p < 0.01$; **$p < 0.001$; ***$p < 0.000$.

The chi-squared statistics confirmed the existence of significant association, as reflected in the values for informal economic activities and geopolitical regions/ecological zones (chi = 1400, $p < 0.000$) and other sociodemographic characteristics of respondents: age (chi = 727.13; $p < 0.000$), gender (chi = 1700; $p < 0.000$), education (chi = 522.31; $p < 0.000$), and marital status (chi = 312.45; $p < 0.000$). For instance, 42% of the respondents in Sokoto were into petty trading, compared to 14% and 12% of respondents from Port-Harcourt and Owerri, respectively. On the other hand, the major informal work in Owerri was automobile repair services (40.6%), while livestock trading activities were more pronounced in Owerri and Jos, respectively accounting for 46.9% and 44.4% of the respondents.

Table 3. Chi-squared test statistics of respondents' sociodemographic characteristics and geopolitical regions/ecological zones in Nigeria.

		North-West (Sokoto) Savanna	South (Port Harcourt) Swamp forest	South-East (Owerri) Rainforest	North-Central (Jos) Montane	Chi-squared ($\chi 2$)
Gender	Male	982 (47.6)	561 (69.6)	1832 (98.5)	2302 (80.1)	$\chi 2 = 1400$,
	Female	1083 (52.4)	245 (30.4)	28 (1.5)	572 (19.9)	$p < 0.01$
Age of	< 30 yrs	663 (32.1)	551 (68.4)	440 (23.7)	1310 (45.6)	$\chi 2 = 620.77$,
respondent	30–40 yrs	714 (34.6)	179 (22.2)	620 (33.3)	801 (27.9)	$p < 0.01$
	40 +	688 (33.3)	76 (9.4)	800 (43.0)	763 (26.6)	
Highest	None	19 (0.9)	15 (1.9)	590 (31.7)	128 (4.4)	$\chi 2 = 1700$,
level of	Primary	377 (18.3)	325 (40.3)	420 (22.6)	862 (30.0)	$p < 0.01$
education	Secondary	1304 (63.2)	441 (54.7)	779 (41.9)	1628 (56.6)	
	Tertiary	365 (17.6)	25 (3.1)	71 (3.8)	256 (8.9)	
Marital	Not married	584 (28.3)	517 (64.1)	297 (15.9)	1119 (38.9)	$\chi 2 = 663.20$,
status	Currently married	1481 (71.7)	289 (35.8)	1563 (84.0)	1755 (61.1)	$P < 0.01$
	Total	2,065	806	1,860	2,874	

Furthermore, there exist significant differences in the socioeconomic characteristics of the respondents across the four geopolitical zones/ecological zones. These significant differences are reflected in the values for the age of respondents (chi = 620.77; $p < 0.000$), gender (chi = 1400; $p < 0.000$), education (chi = 1700; $p < 0.000$) and marital status (chi = 663.20; $p < 0.000$). For instance, 32.1% of respondents in Sokoto were aged < 30 years, compared to 68.6% and 45.6% of the respondents from Port-Harcourt and Jos, respectively. On the other hand, 63.2% of the respondents from Sokoto had a secondary education, compared to 41.9% and 56.6% from Owerri and Jos, respectively (see Table 3).

Table 4. Correlation matrix of the main variables.

Correlation	Area/region	Marital status	Informal activities	Age	Education level
Area/region	1				
Marital status	−0.130	1			
Informal activities	0.385*	−0.030	1		
Age	−0.093	0.406*	−0.190	1	
Education level	0.244*	−0.026	0.028	−0.030	1

The values of the numerical variables were ordered and the transformed data were analyzed by using Spearman's rank-order correlation statistics. The results are presented in Table 4. The correlation matrix shows the diagnostic analysis of the main variables. There is a positive correlation between geopolitical regions/ecological zones and informal economic activities ($r = 0.385$, $p < 0.05$), as well as a negative correlation between age and informal economic activities ($r = -0.190$, $p < 0.05$). Other significant correlations were found between geopolitical regions/ecological zones and education ($r = 0.244$, $p < 0.05$), marital status and age ($r = 0.406$, $p < 0.05$).

Table 5. Unadjusted model of regions/ecological zones as predictors of informal activities.

Variables	Automobile service	General dressmaking	Livestock trading	Welding & metal work	Woodwork & furniture-making
Sokoto (North-West)	1.00	1.00	1.00	1.00	1.00
Port harcourt (South-South)	2.51 (2.04–3.08)***	0.47 (0.31–0.73)***	1.38 (0.77–2.48)	1.14 (0.84–1.56)	0.92 (0.63–1.36)
Owerri (South-East)	1.84 (9.92–14.12)***	0.00 (0.0–1.0)	27.54 (19.20–39.50)***	2.57 (1.98–3.32)***	3.25 (2.45–4.31)***
Jos (North-Central)	4.19 (3.57–4.91)***	1.77 (1.43–2.20)***	9.93 (6.97–14.13)***	2.59 (2.11–3.18)	1.85 (1.44–2.37)***

*p < 0.01; **p < 0.001; ***p < 0.000.

Model 1 of the multinomial logistic regression with roadside petty trading/sachet water vending as the relative category to other informal economic activities is shown in Table 5. The results showed that multinomial logit models for being resident in South-South region (Swamp forest), South-East region (Rainforest) and North-Central region (Montane), relative to being resident in the North-West region (Savanna), were significant at 2.51, 1.84 and 4.19 units respectively. Therefore, the multinomial logit is significantly higher for engagement in automobile repairs service relative to roadside petty trading while all other predictor variables in the model is constant. In other words, relative to the residents of the North-West region (Savanna), a resident of the North-Central region (Montane) was 4.19 times more likely to engage in automobile repair activities than to engage in roadside petty trading, all other factors being constant. Other results showed that North-Central residents were 1.77 times more likely to engage in dressmaking than roadside petty trading, while the South-East residents, relative to the residents of the North-West, were 27.54 times more likely to engage in livestock trading than roadside petty trading.

In the adjusted model which included the geopolitical regions/ecological zones of residence and sociodemographic factors, the pattern observed in Model 1 for the geopolitical regions/ecological zones of residence persists, although there are variations in the odds ratios (Table 6).

Table 6. Adjusted model of regions and sociodemographic characteristics as predictors of informal activities.

Variables	Automobile service	General dressmaking	Livestock trading	Welding & metal work	Woodwork & furniture-making
Sokoto (North-West)	1.00	1.00	1.00	1.00	1.00
Port Harcourt (South-South)	4.17 (3.23–5.40)***	0.69 (0.45–1.09)***	1.19 (0.65–2.20)***	1.41 (1.01–1.98)***	1.62 (1.07–2.47)***
Owerri (South-East)	11.51 (9.08–14.61)***	00 (0.00)***	13.22 (8.85–19.75)***	3.56 (2.61–4.86)***	4.06 (2.86–5.77)***
Jos (North-Central)	4.14 (3.43–4.98)***	2.08 (1.64–2.64)***	6.63 (4.61–9.61)***	2.54 (2.04–3.18)***	2.13 (1.63–2.80)***
Male	1.00	1.00	1.00	1.00	1.00
Female	0.05 (0.04–0.07)***	0.62 (0.50–0.77)***	0.01 (0.01–0.04)***	0.3 (0.24–0.37)***	0.39 (0.30–0.51)***
Age (< 30 yrs)	1.00	1.00	1.00	1.00	1.00
Age (30–40 yrs)	4.71 (3.96–5.62)***	1.84 (1.44–2.38)***	1.95 (1.54–2.49)***	2.24 (1.81–2.78)***	1.82 (1.38–2.40)***
Age (40 +)	5.59 (4.67–6.71)***	1.72 (1.30–2.29)***	2.14 (1.68–2.72)***	2.01 (1.60–2.54)***	2.65 (2.03–3.48)***
Education (one)	1.00	1.00		1.00	
Primary	7.8 (5.91–10.30)***	0.84 (0.44–1.59)***	2.24 (1.65–3.03)***	7.64 (4.75–12.28)***	4.12 (2.66–6.39)***
Secondary	11.07 (8.48–14.46)***	2.21 (1.22–4.00)***	1.58 (1.18–2.13)***	8.85(5.58–14.08)***	4.32 (2.83–6.60)***
Tertiary	6.36 (4.47–9.05)***	4.14 (2.22–7.73)***	0.48 (0.25–0.92)***	11.21 (6.70–18.78)***	4.72 (2.82–7.89)***
Single	1.00	1.00	1.00	1.00	1.00
Currently married	1.63 (1.40–1.92)***	0.73 (0.59–0.92)***	1.23 (0.99–1.53)***	1.00 (0.83–1.22)***	2.08 (1.60–2.72)***
Constant	0.011 (0.01–0.02)***	0.06 (0.03–0.12)***	0.027 (0.02–0.04)***	0.01 (0.01–0.03)***	0.11 (0.01–0.02)***

*p < 0.01; **p < 0.001; ***p < 0.000.

4. Case studies

4.1. Case of North-West (Savanna)

The North-West region is heavily endowed with resources that favor commerce/retail and, most especially, petty trade. It has some major rivers and Sokoto town lies at the intersection of the Sokoto River and Rima River. This makes Sokoto one of the main fish-producing areas of the country. The region has a semi-arid climate (Koppen climate classification *BSh*) and is dominated by sand and

isolated hills. It is very hot and dry due to its maximum daytime temperatures, which are generally less below 40 ℃ (104.0 ℉) most of the year, but which can exceed 40 ℃ from February to April. The rainy season is from June to October. The floodplains of the Sokoto-Rima river system, which are covered with rich alluvial soil, make the cultivation of crops possible. The main crops cultivated are beans, millet, guinea corn, maize, rice, cotton, kola nuts and sesame, apart from onions, tomatoes, groundnuts, peppers, garden egg, lettuce and cabbage. A large number of the inhabitants are farmers and food crop traders. However, local crafts such as blacksmithing, weaving, dyeing, carving and leather works (tannery) also play an important role in the economic life of the people. Some important mineral resources, such as kaolin, gypsum, limestone, laterite and phosphate, are available in commercial quantities. A cement factory for example exists in Sokoto. Sokoto also has hospitals, airports, schools and several tertiary educational institutions, as well as four major markets (Kara market, Central market, Marna market and Anyichi market). With a population figure of 641249, the potential for grain markets exists in Sokoto town, for instance. The results show that, relative to males, females in other geopolitical regions/ecological zones, using the North-West (Savanna) as a reference category, are significantly less likely to engage in all of the other informal economic activities than to engage in roadside petty trading. In other words, using the North-West (Savanna) as a reference category, women are more likely to engage in roadside petty trading than to engage in automobile repair services, dressmaking, livestock trading, metal works and woodworking informal activities. In addition, the results indicated that older respondents have significantly higher odds of engaging in informal economic activities that are not roadside petty trading, using the North-West (Savanna) region as a reference category. These findings have policy implications. Knowing that female ISOs in Sokoto in the North-West region/ Savanna ecological zone are more likely to be inclined to petty trade than other subtypes of informal economic activities, specific policy interventions toward the growth of crop production and the creation of more foodstuff markets will be necessary. In the same vein, since older ISOs are likely to have a preference for informal economic activities that are not petty trading, it would be inappropriate to target this subgroup of the population while creating programs that promote petty trading.

4.2. Case of South-East (Rainforest)

Owerri town is in the South-East region which is situated in the rainforest region that produces many agricultural products, such as yams, cassava, local spices, corn, rubber and palm products. It has a land mass of 100 km^2 and the Nworie River. The region has a tropical wet climate. The average annual temperature is 26.4 ℃. The economy of the place depends primarily on agriculture and commerce, and that is why the livestock trade is a prominent activity. There are several natural resources, including crude oil, natural gas, lead, calcium carbonate and zinc in the town and its surroundings. Owerri has infrastructure such as chemical plants, agro-processing plants, stadiums, schools, universities, polytechnics, a dense road transport network and a palm produce industry. It is served by a cargo airport located at Obiangwu in the Aboh Mbaise Local Government Area. The following markets are in Owerri: Eke Ukwu market, Egbeada International Modern market, Relief market, Naze Allied Timber and Buiding Materials market and Amakohia market. The estimated population of Owerri is 1,401,873. This very large population implies that the city has a large consumer base and is a ready market for raw materials, numerous manufactured products and services.

4.3. Case of North-Central (Montane)

Jos city is located on the Jos Plateau (elevation 1295 m) in the North-Central region of Nigeria. The climate of the region is the wet and dry tropical type that is favorable for livestock. To expand this market, it would be necessary to consider the establishment of ranches and grazing reserves. The region is characterized by a mean annual rainfall of 1250 mm, peaking between July and August. The mean annual temperature is about 22 ℃, but the mean monthly values vary between 19 ℃ in the coolest month of December and 25 ℃ in the hottest month, i.e., April. Jos city has several tourist sites and it is a trading hub with several markets (Katako market, Terminus market, Railway market, Faringada market, GSM market and the Jos main market, which is being rebuilt). It lies on the Delimi River. In 1905, tin mining began at Jos, attracting large numbers of outsiders, including Hausa, Igbo, Yoruba and Europeans. The city has a lot of developmental activities and infrastructure, namely, industries, breweries, stadiums, golf courses, airports, museums, hospitals, a wildlife, national institutions, schools and several tertiary educational institutions. Considering that ISOs in Jos in the North-Central region/Montane ecological zone are likely to be inclined toward automobile repairs and livestock trading, policies should be targeted at the development of ranches/grazing reserves, the building of more abattoirs and the creation of more mechanic cluster villages. Solution-driven policy actions are most appropriate to avoid policy failure. In this regard, government policies and programs for the growth of the informal sector and the well-being of people engaged in informal economic activities should take into serious consideration the ISOs' demographic, regional and ecological profiles. Again, earlier studies found that more educated people are less likely to engage in informal economic activities. However, the results of this study indicated that increasing numbers of educated people are engaged in informal economic activities. As noted earlier, the high rate of unemployment in the country forces graduates to engage in various livelihood activities to survive and help their families, who spent a lot of money training them in school. Furthermore, this study found that more married people engage in informal activities, and this finding contradicts earlier findings [10,11]. This is because the majority of single people in Nigeria are still in school and are being cared for by their parents and guardians. When these people complete their training in school and get married, they will become engaged in informal activities in the absence of formal employment. Therefore, in the face of this anticipated steady flow of new entrants into the informal labor market, the results of the predictors of informal economic activities are that the residents of the North-Central region (Montane) are more likely to engage in automobile repair activities and dressmaking than to engage in roadside petty trading, particularly for those residents in the region or hoping to reside in the region.

4.4. Case of South-South (Swamp forest)

Port Harcourt is a port town along the Bonny River, an eastern tributary of the Niger River. It is geographically situated within 4.8156 °N and 7.0498 °E, and it lies 66 km upstream from the Gulf of Guinea. Port Harcourt is the capital and largest city of Rivers State, Nigeria. It has a tropical wet climate characterized by a long rainy season with heavy rains and a very short dry season in the months of December and January. Port Harcourt's heaviest precipitation occurs in September, with a monthly average of 367 mm. December is the driest month of the year, with an average of 20 mm. The temperature varies throughout the year in the city, averaging between 27 ℃ and 18 ℃. Port Harcourt is one of Nigeria's leading industrial centers and manufactures aluminum products, glass bottles, paper, steel structural products, corrugated tin, paints, plastics, enamelware, wood and metal furniture, cement and concrete products, among other goods. Port Harcourt is the site of boat building and fishing

industries and has fish-freezing facilities. Petty trading is a dominant informal sector activity, as indicated by the respondents from Port-Harcourt. Many ISOs have goods manufactured in the city of Port Harcourt to sell to the residents. The markets in Port Harcourt are the Oil Mill market, Rumuokoro market, Creek Road market, Mile 1 market, Mile 3 market, Ikokwu spareparts market, Borikiri market and Choba market, among others. The population figure for Port Harcourt city was 1005904 according to the national population commission (NPC) 2006 census figure**.** However, from 1005904, which is the 2006 national census figure it grew; and the estimated population of the greater Port Harcourt metropolis became 1148665 in 2020. Of this populace, there are more males than females engaged in the informal sector. This finding is not consistent with previous studies, which found that many of the informal business operators in most developing countries are female [23,55]; another study concluded that about 90.0% of the workers in the informal sector in Ghana are female. This is because more males now resort to informal activities in the absence of formal employment for them to be able to sustain their families.

Generally, there were significant differences in the informal activities carried out by respondents across the four regions/ecological zones. In other words, there are spatial variations, like informal activities in the different regions/zones. This finding is supported by studies which reported variations in informal activities in different spatial/geographical regions [11,15,17,56]. These variations are due to the geographic and environmental differences observed in the different regions, which promote and encourage people to engage more in some activities over others in a way that differs from other regions with different environmental situations. In this context, the study found that engagement in livestock trading activities is more pronounced in Owerri (rainforest) and Jos (Montane) because of the weather and pastures in these two regions that differ from the relatively unfavorable environmental factors existing in the very humid swamp forest region and the much drier/arid savanna region, which is facing climate change, and the Sahara desert's southward drift.

5. Conclusion

The study sought to establish the relationship between informality and key sociodemographic variables such as location, age, gender, educational level and marital status in four select cities in four regions of Nigeria. There are significant variations in informal activities in the different regions primarily due to different social and environmental conditions. Most importantly, and as noted earlier in this study, Nigeria's informal sector accounted for approximately 65% of Nigeria's 2017 GDP while more than half of the population, or about 60% of Nigeria's over 200 million people, are engaged in street trading. In addition, most of the informal employment options in Nigeria are non-manufacturing activities, namely, street trading, hair barbing, restaurant services and other informal economic activities. This reality that over 100 million Nigerians depend on the informal sector for their survival and sustenance makes it imperative that adequate attention be paid to the sector, as it remains the most significant employer of labor and source of livelihoods for millions of Nigerians. Subsequently, interventions and programs for the enhancement of the informal economy based on the outcome of this study should be location-specific and on the basis of comparative advantages of this informal sector activities, especially with regard to the sociodemographic and environmental factors. It is also expected that governmental agencies and non-governmental organizations will educate the various subgroups of the informal sector population on the types of informal activities that offer them a comparative advantage within their regions, as well as provide some funding and other incentives for them. Furthermore, the government should provide a conducive business environment for the informal

economy actors to thrive, pull more millions of Nigerians out of poverty and, more importantly, contribute more to the socioeconomic development of the country.

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Conflict of interest

There is no conflict of interest regarding this study.

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