Spatial Analysis of Women Employment Status in Nigeria

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This study considered the nature of employment that women engage in as a multi-categorical response. A multinomial logistic model with geo-additive predictors was used to examine the determinants and geographical variations using data from the 2008 Nigeria Demographic and Health Survey. Diffuse priors were assumed for modelling fixed effects, Bayesian p-spline for the nonlinear smooth functions and intrinsic conditional autoregressive prior for the spatial effects. Results showed that while a north-south divide existed in the likelihood of women engaging in all-year employment against not working, an east-west divide was found in seasonal/occasional jobs. Other important factors found to be significantly associated with employment status included women's age, educational level, marital status, sex of household head, and type of place of residence. Policymakers need to develop appropriate strategies to address the observed imbalance in the spatial distributions of women employment status in the country.

Keywords: Geo-additive model, spatial analysis, Bayesian, women employment.

JEL Classification: C11

1.0   Introduction

Empowering women and youths is central to promoting quick and equitable economic growth and long term stability in any country. Gender equity increases people's abilities to take advantage of opportunities and make informed choices. These abilities are essential for societal and national transformation. Expanding women's opportunity in public works, agriculture, finance and elsewhere accelerates economic growth. There is mounting evidence that women's ability to fully enjoy human rights - indeed, even to demand such rights - is integrally linked to their economic empowerment. Countries that invest in promoting the social and economic status of women tend to have lower poverty rates. Evidence has also shown that resources in women's hand result in household expenditure that benefit children (World Bank, 2014). On the other hand, wider gender gaps in education (at primary and secondary levels) and in labour force participation have been estimated to

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reduce economic growth by 0.4 percentage point annually, increase birth rates by about one child per woman, increase child deaths by 32 per year (per 1,000 live births) and raise by 2.5 percentage points the prevalence of underweight children (Abu-Ghaida & Klasen, 2004).

The Nigerian women have continued to prove their worth even in the midst of the male-dominated professional congregation. The steady advancement of women in contributing to the nation's economic development and their progressive prominence in the national scheme of affairs have, to a large extent, impacted on governance at all levels and government has responded positively in diverse ways. Though their contributions to agriculture and rural development are seldom noticed, rural women contribute 60-80 percent of labour force in this regard (Ogunlela & Mukhtar, 2009). Their overall involvement in labour force has attracted the attention of scholars (Baridam, 1996; Damisa & Yohanna, 2007; Okonjo, 1991; Rahman, 2008) but little has been put into examining the detailed geographical variations across states in Nigeria even though this has been intensively examined for other issues affecting them (Adebayo, Gayawan, Ujuju, & Ankomah, 2013; Gayawan, 2014; Kandala, Nwakeze, & Kandala, 2009; Uthman, 2008).

Data on women's socio-economic status measured by their employment, type of occupation, earning and continuity of employment have been included in many household surveys conducted in developing countries including Demographic and Health Surveys (DHS). Reports from such surveys are often presented on regional basis, which are habitually too coarse for a detailed inference at small geographical levels. Furthermore, survey data might not include sufficient sample sizes, at smaller geographic levels to allow accurate, local, and design-based estimation everywhere. In contrast, model-based approaches offer a mechanism to borrow strength across small areas to improve local estimates, resulting in the smoothing of extreme rates based on small local sample sizes.

Statistical inference based on classical regression methods have continued to suffer from methodological restraints making it difficult to detect nonlinear covariate effects adequately and it is impossible to recover small-scale district specific spatial effects with common linear regression or correlation analysis. Parametric approach has always been assumed for the continuous covariates but this has been found to be too restrictive in realistic situations as, a very

high number of parameters would be required for modelling purposes which may result in unstable estimates with high variances (Adebayo, 2004; Gayawan, 2014). Therefore motivated by the need to quantify spatial effects at state level, this study adopts structured additive regression (STAR) model for categorical responses to examine the determinants and geographical variation of the working status of women in Nigeria. The approach, apart from allowing covariates of different type to be included, is able to account for the hierarchical nature of the DHS data analysed.

2.0   Method

2.1   Data

The data set used in this study came from the 2008 Nigeria Demographic and Health Survey (NDHS) conducted by the National Population Commission of the Federal Republic of Nigeria with funding from the United States Agency for International Development (USAID) through the DHS project. Using the sampling frame of the 2006 National Population Census, the survey utilized a two-stage sampling scheme. At the first stage, 888 clusters composed of 286 in urban areas and 602 in rural areas were selected, whereas a total of 36,298 households were selected at the second stage for interview. All women aged 15-49 years in the households were eligible for interview and a total of 34,596 women were identified. A response rate of 97% was recorded. Details of the sampling techniques adopted have been reported by National Population Commission and ICF Macro (2009).

The 2008 NDHS asked women detailed questions about their employment status in order to ensure complete coverage of employment in any of formal or informal sector. Women who reported that they were currently working and those who reported that they worked at some time during the 12 months preceding the survey were considered to have been employed. Additional information was collected on the type of work the women were doing, whether they worked continuously throughout the year or not, for whom they worked, and the form in which they received their earnings. Variables included in this study include: women's educational level, type of place of residence, sex of household head, household wealth index, religion, marital status, and age. Nigeria consists of 36 states and a Federal Capital Territory and these are geo-referenced.

2.2   Statistical Analysis

We used multinomial logit model within the framework of generalized linear model (Fahrmeir & Kneib, 2011; Fahrmeir & Lang, 2001b) to investigate women employment status in Nigeria. A categorical variable of women's employment status with three categories: did not work in the 12 months preceding the survey (unemployed), did a seasonal or occasional work (underemployed) and worked all year round (fully employed) was defined as Y_{ij} for the jth woman state i, $i = 1, 2, …, 37; j = 1, 2, …, n$, where

$$Y_{ij} = \begin{cases} 1 & \text{if respondent was unemployed} \\ 2 & \text{if respondent was underemployed} \\ 3 & \text{if respondent was fully employed} \end{cases} \qquad (1)$$

The response variable, Y_{ij}, is considered as a realization of some latent variable $U_{ij} = \eta_{ij} + \varepsilon_{ij}$, which the jth woman seeks to maximize by engaging in a particular employment type, where η_{ij} is the predictor and ε_{ij} is the error term. A woman chooses the rth employment type, $r = 1, 2, 3$, if it offers her the maximum benefits. Such benefits could be in the form of financial gains, time for children and household care, career pursuit or other similar opportunity costs.

The rth work category is modelled as the probability of selecting that category against a reference category, in this case, not-working. The influence of covariates is modelled using a multinomial logit model given by:

$$P\left(Y_{ij} = r\right) = \frac{exp\left(\eta_{ij}^{(r)}\right)}{1 + \sum_{t=2}^{4} exp\left(\eta_{ij}^{(r)}\right)} \qquad r = 2,3 \qquad (2)$$

where the predictor $\eta_{ij}^{(r)}$ is given by

$$\eta_{ij}^{(r)} = v'\gamma^{(r)} + f_{ij}^{(r)}\left(x_{ij}\right) + f_{spat}^{(r)}\left(s_i\right) + b_j. \qquad (3)$$

Not-working category that is, $r = 1$ is assigned as the reference category in order to compare it with the other employment types. The vector of the

categorical covariates is represented by v', and $\gamma^{(r)}$ is the corresponding vector of regression parameters for category r such that $exp(\gamma)$ is the odds ratio. $f_{ij}^{(r)}$ is the smooth function for the continuous covariates x_{ij}, say, woman's age, while $f_{spat}^{(r)}$ is the nonlinear effects of state i, where the woman resides, for $i = 1, 2, ..., 37$. The term b_j is a random effect component that controls for the hierarchical nature of data. In this case, the random effect was controlled using the enumeration areas.

A fully Bayesian approach was adopted for estimating all parameters and functions. Within the Bayesian context, all parameters and functions are considered random variables and have to be supplemented with appropriate prior assumptions. Independent diffuse priors are assumed for the fixed effects parameters. For the unknown (smooth) functions, the Bayesian perspective of penalised spline (P-spline) proposed by Fahrmeir and Lang (2001a) and Lang and Brezger (2004) was adopted. The P-spline allows for nonparametric estimation of f as a linear combination of basis function (B-spline), that is, $p(z) = \sum_{j=1}^{J} \beta_j B_j(z)$, where $B_j(z)$ are B-spline. The coefficients, β_j, are further defined to follow a first or second order random walk smoothness prior. In this study, a second order random walk, that is, $\beta_j = 2\beta_{j-1} - \beta_{j-2} + \varepsilon_t$ with Gaussian error $\varepsilon_t \sim N\left(0, \tau_\varepsilon^2\right)$ was assumed. The variance τ_ε^2 controls for the smoothness of f and, assuming a weakly informative inverse gamma prior, it is estimated jointly with the basis function coefficients.

The random effect component was modelled by assuming exchangeable normal priors, $u_{ijk} \sim N\left(0, \tau_b^2\right)$, where τ_b^2 is a variance component that incorporates over-dispersion and heterogeneity for which an inverse gamma hyperprior was assigned. The spatial effect component (s_i), was modelled by assuming intrinsic conditional autoregressive prior (Besag, York, & Mollie, 1991; Fahrmeir & Lang, 2001a) which introduces a neighbourhood structure for the areas s_i, $i = 1, 2, ..., 37$. The prior defines areas as neighbours if they share a common boundary. Neighbouring areas are assumed to have similar patterns, such that the mean of area i is assumed to be an average of neighbouring areas, with variance as a function of neighbours and spatial variance. The spatial variance was also assigned an inverse gamma prior.

In order to be able to estimate the smoothing parameters for nonlinear and spatial effects simultaneously, highly dispersed but proper hyper-priors are assigned to them. Hence, for all variance components, an inverse Gamma distribution with hyperparameters *a* and *b* was chosen. Standard choices of hyperparameters are *a*=1 and *b*=0.005 or *a*=*b*=0.001. Fully Bayesian inference is based on the analysis of posterior distribution of the model parameters. In general, the posterior is highly dimensional and analytically intractable making direct inference almost impossible. This problem is circumvented using Markov chain Monte Carlo (MCMC) simulation technique whereby samples are drawn from the full conditional of parameters given the rest of the data. To implement the model, 20,000 iterations were carried out after a burn-in sample of 5,000 and every 10th iteration was thinned yielding 1,500 samples for parameter estimation. Sensitivity of the results to the choice of hyperparameters was investigated by varying the values of *a* and *b*. The results turned out to be less sensitive to the different choices. Hence, the results reported here are those of *a*=*b*=0.001.

In order to determine what would be gain or lost by assuming a nonparametric form for the continuous covariate age, three scenarios were considered for the variable. In the first, age was modelled as a nonparametric effect. In the second, the variable was categorized like other categorical variables, into three categories (less than 20 years; between ages 20 and 35 years and greater than 35 years) and the first made as reference while, in the third scenario, the variable was included as a linear effects. The models were implemented as follows:

Mode 1: $\eta_{ij}^{(r)} = v'\gamma^{(r)} + f_{ij}^{(r)}\left(age_{ij}\right) + f_{spat}^{(r)}\left(s_i\right) + b_j$

Model 2: $\eta_{ij}^{(r)} = v'\gamma^{(r)} + f_{spat}^{(r)}\left(s_i\right) + b_j$

Model 3: $\eta_{ij}^{(r)} = v'\gamma^{(r)} + age_{ij} + f_{spat}^{(r)}\left(s_i\right) + b_j$

Model performances were examined using the Deviance Information Criterion (DIC) (Spiegelhalter, Best, Carlin, & Van der Linde, 2002) given by

$DIC = \bar{D}(\theta) + pD$,

where $\bar{D}$ is the posterior mean of the deviance, measuring how well a model fits the data, and pD is the effective number of parameters measuring model complexity. Small values of $\bar{D}(\theta)$ indicate a good fit while small values of pD indicate a parsimonious model. The model with the lowest *DIC* is therefore considered as best.

3.0   Results

Table 1 presents the results of the model diagnostic statistics. Overall, the results show that model 1 that incorporates age as a nonlinear effect has the minimum DIC value and hence, outperformed the other models. Model 3, with age as a linear effect performs better than model 2. However, a close look shows that model 3 is less complex compared with the other two.

Table 1: Model Diagnostic Statistics

Model	$\bar{D}(\theta)$	pD	DIC
Mode 1	49431.204	1231.115	51893.435
Model 2	49988.110	1218.927	52425.963
Model 3	49930.517	1216.819	52364.155

Results presented are restricted to those of the model that has the best fit. Table 2 presents the results of the fixed effects parameters. Presented are the odds ratio and 95% credible intervals for the two categories: all-year round and seasonal/occasional employment against not working. Findings show that, comparing with women who had no education, women with primary education were about 40% [OR=1.395; CI: 1.299, 1.496] more likely to have worked all-year round and this is significant. Women with higher education were about 19% [OR=0.810; CI: 0.743, 0.890] less likely to have worked all-year round and this is also significant. Estimates for women with secondary education are not significant. Women from households headed by females were significantly more likely to have worked all-year round when compared with those from male-headed households. Results based on wealth quantum show that compared with women from the poorest households, those from the

other wealth strata were more likely to have worked all-year but only significant for women in the middle wealth stratum.

Table 2: Posterior means of the fixed effect parameters and the 95% credible intervals

Variable	All-year vs. Not working	Seasonal/occasional vs. Not working
Education		
No education	1	1
Primary	1.395 (1.299, 1.496)	1.482 (1.369, 1.614)
Secondary	0.987 (0.931, 1.052)	0.908 (0.842, 0.979)
Higher	0.810 (0.743, 0.890)	0.692 (0.601, 0.805)
Place of residence		
Rural	1	1
Urban	1.054 (0.985, 1.127)	0.862 (0.790, 0.941)
Sex of household head		
Male	1	1
Female	1.165 (1.116, 1.218)	1.074 (1.014, 1.138)
Wealth Index		
Poorest	1	
Poorer	1.047 (0.972, 1.124)	1.463 (1.339, 1.587)
Middle	1.069 (1.001, 1.143)	1.074 (0.992, 1.164)
Richer	1.043 (0.973, 1.122)	0.773 (0.704, 0.852)
Richest	1.056 (0.965, 1.156)	0.600 (0.521, 0.691)
Religion		
No/Traditional	1	1
Christians	1.154 (1.035, 1.286)	1.297 (1.151, 1.459)
Islam	0.932 (0.836, 1.045)	0.520 (0.457, 0.589)
Marital Status		
Single	1	1
Married	1.429 (1.330, 1.532)	1.203 (1.103, 1.310)
Widow/Divorced	1.668 (1.487, 1.878)	1.497 (1.311, 1.703)

Women from the Christian religious group were about 15% more likely to have worked all-year round compared with those from no/traditional religious group. Results for those of Moslem religious group are not significant. Married women were about 43% more likely to have worked all-year round when compared with single women while the widowed/divorced women were about 67% more likely. These are all significant. Results based on place of residence do not indicate difference in the likelihood of engaging in all-year round jobs between women who dwell in rural areas and those in urban.

Findings on seasonal/occasional works show that, instead of not engaging in any work activities, women with primary education were more likely to have worked on seasonal/occasional basis while those with secondary and higher education were significantly less likely to have engaged in such works when compared with women having no education. Women from urban areas were less likely to have engaged in seasonal/occasional jobs when put side by side with women from rural areas. Those from households headed by females were more likely to have been engaged in seasonal/occasional jobs compared with their counterparts from male-headed households. Findings further show that, compared with women from the poorest household, those from the poorer ones were more likely to have worked on seasonal/occasional basis while those from richer and richest households were less likely. However, results for women belonging to the middle index are not significant. While women from household that practise Christianity were significantly more likely to have engaged in seasonal/occasional works, those from Islamic religious group were significantly less likely to have engaged in such works when compared with women from no/traditional religious group. Comparing with the single women, the married and those who were divorced or widowed were more likely to have worked on seasonal/occasional basis and these are significant.

Results for the nonlinear effect of woman's age for all-year round employments against not working and seasonal/occasional employments against not working are presented in Figure 1(a & b). Shown are the posterior means and 95% credible intervals. Findings show similar pattern for all-year employments and seasonal/occasional employments against not working. As women increase in age, the chance that they would be engaged in all-year round or seasonal/occasional employments increase steadily to level off after around age 35 years.

Results of the spatial effects are presented in Figures 2(a-d). The results for all-year round employments against not working are presented in Figures 2(a & b) while those of seasonal/occasional employments are shown in Figure 2(c & d). The left panel of the figure shows the posterior means while the right panel shows maps of 95% credible intervals used in assessing the significance of the posterior means. From the maps of credible intervals, white shading signifies significantly higher effect, black, significantly lower effect. The effects for states in gray shading are not significant. Findings show a north-south divide in the likelihood of all-year work as oppose to not working while

a west-east divide is observed for seasonal/occasional work against not working.
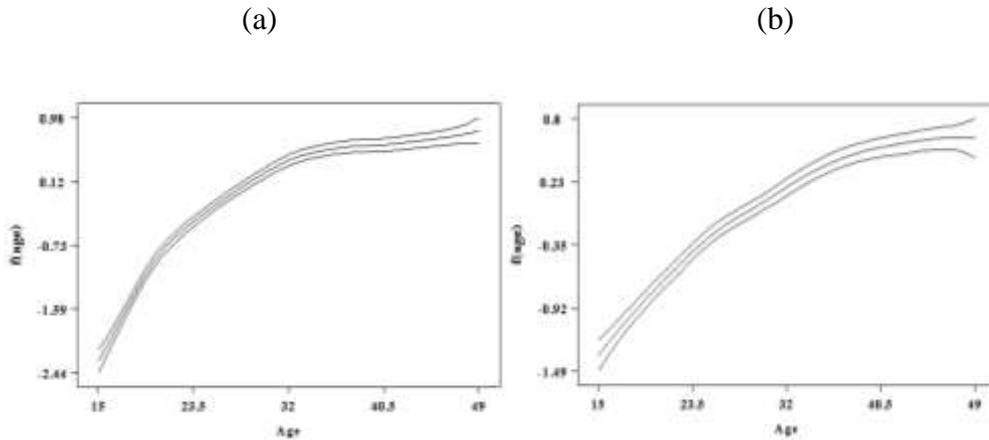
Figure 1: Nonlinear effects of age for (a) working all-year round against not working, and (b) seasonal/occasional works against not working

Specifically, women from Kwara, Oyo, Ogun, Lagos, Osun, Ekiti, Ondo, Edo, Kogi, Benue, Ebonyi, Cross Rivier, Akwa Ibom, and Rivers states were significantly more likely to have been engaged in all-year round employments instead of not working. Those from Borno, Yobe, Gombe, Bauchi, Plateau, Kaduna, Jigawa, Katsina, Zamfara, Nasarawa, Enugu, and Imo states were significantly less likely to have been engaged in all-year employments instead of not working. On the other hand, the likelihood that the women would have been engaged in seasonal/occasional jobs against not working was significantly higher in Borno, Adamawa, Taraba, Bauchi, Benue, Cross River, and Ekiti states while it was significantly lower in Jigawa, Sokoto, Kaduna, Plateau, Lagos, Ogun, Oyo, Osun, Edo, Delta, and Akwa Ibom states. Estimates for the remaining states as shown on the maps, are not significant.

4.0   Discussion

In this study, a multinomial logistic model with geoadditive predictors; a technique that incorporates individual characteristics and spatially distributed random effects in a unified framework while, at the same time, controlling for the hierarchical nature of the DHS data set was employed to model women employment status in Nigeria. The method permits detail geographical

variations at state level, and relationship among continuous variables to be examined.

(a)   (b)

(c)   (d)
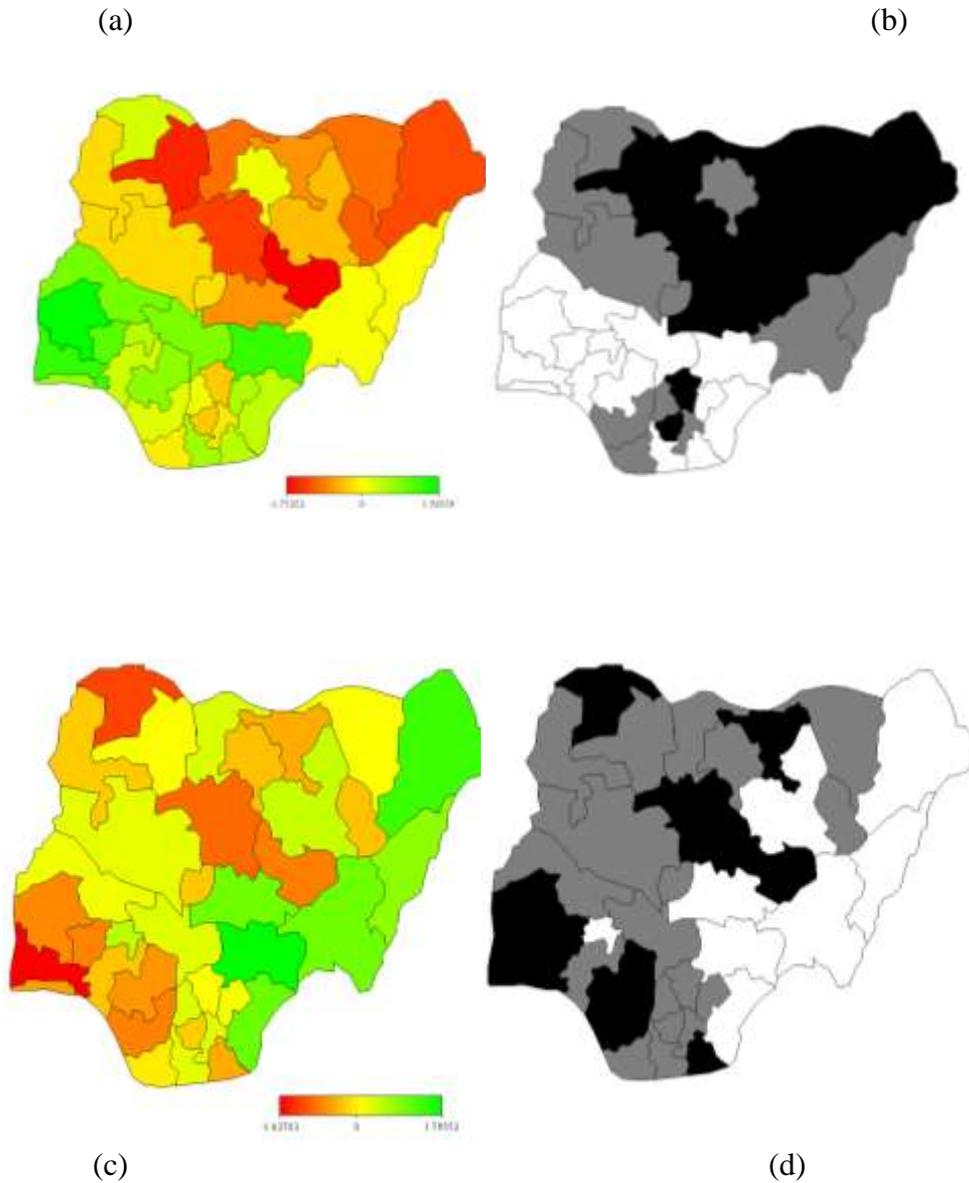
Figure 2: Maps of Nigeria showing spatial effects of (a) working all-year against not working (b) 95% credible interval for working all-year round; and (c) seasonal/occasional works against not working (d) 95% credible interval for seasonal/occasional works against not working.

Knowledge of geographical variation is an important factor that can aid the design of effective intervention programmes to address the imbalance in women engagement in labour force across the nation.

The fact that huge geographical variation exists in the rate of women involvement in labour force in Nigeria has been established in this study. Interestingly, a north-south divide in women engagement in all-year round employments as against not working and an east-west divide for seasonal/occasional employments were obtained. The observed spatial pattern do not, however, have direct causal effect but a careful interpretation can help to find socio-economic and other unobserved factors that directly reflect the level of women involvement in labour force in each states. It has been reported that the pattern of distribution of manufacturing industries at the city level in Nigeria indicates a marked concentration of industries in the southern part of the country, especially in Lagos, Ibadan, Enugu, Port Harcourt, and Benin with Kano in the northern fringe (Ajayi, 2007). These industries would no doubt engage the services of people around, including women resulting in the significantly higher likelihood of all-year round employments for women in the southern part of the country. It is noteworthy that while other states around Kano had significantly lower effects for all-year round employments, the state had non-significant effects. The level of industries in the state might have accounted for these findings.

This study has also shown that women's level of education and their marital status, place of residence, sex of household head, household wealth index and religion are strong determinants of women participation in labour force in Nigeria. In line with Babalola and Akor (2013) observation that the majority of married women who engage in labour force in Nigeria work in the informal sector (self-employed), involving in petty jobs, and are characterized by low level education of primary and secondary certificates or even none in some cases, results from this study show that women with primary education were more likely to have worked either all-year round or engaged in seasonal/occasional works instead of not working. Contrary to expectations, results show that women with higher education were less likely to have participated in gainful employments. The view of other scholars on this is that, apart from self-employment, women tend to be concentrated, in large proportion, in the lowest levels of public sector employment, where layoffs were most common while those in rural areas, mostly illiterates, engage in

small scale agriculture (Baridam, 1996; Rahman, 2008). Educated women, who mostly reside in urban areas would often shy away from these types of work, preferring to wait for white-collar jobs which are seldom available. The resulting effect is the underutilization of manpower in the country as this set of women have received training in the formal education sector and thus, a negative returns to investment in human resources.

Though the demand for child rearing and general household care consume the attention of women who have been ever-married, we found that these women were more likely to have been engaged in labour force whether in all-year round or in seasonal/occasional employments than women who were not married. This findings contradicts the opinion of (Baridam, 1996) who held that married women were less likely to participate in labour force compared with the single women. Further, women from households headed by females were found to be more likely to engage in labour force than their counterparts in households headed by males. This is obvious because women from such households assume the role of men and hence, have no option than to engage in any available job. In Uruguay, the odds that a woman from a female-headed household would engage in labour force was found to be 66% higher than for those from male-headed households (Psacharopoulos & Winter, 1992). The fact that the odds for seasonal/occasional employments was found to be significantly lower among women residing in urban areas when compared with those in rural areas shows that rural women are more likely to participate in agricultural activities, which is a seasonal occupation in Nigeria. Ogunlela and Mukhtar (2009) have reported that these women form up to 80% of the labour force in agricultural sector in rural areas but mostly engaging in subsistence farming.

Results of the nonlinear effect of age underscore the importance of relaxing the strict parametric assumption in assessing the effect of continuous covariates in any regression analysis. This approach allows for any hidden relationship, such as bumps, among the variables to be clearly established. For instance, the steep rise in the likelihood of women taking all-year round employments from age 15 to around age 35 years before a gentle rise for the rest of the reproductive age would not have been so clearly established. The STAR model, which has continued to receive attention in applied demography and epidemiology analyses, has been used to explain complex relationships and most of the results have shown that strict parametric assumptions could

lead to spurious conclusions (Adebayo et al., 2013; Fahrmeir & Lang, 2001a; Gayawan, 2014; Kazembe, 2009).

This study suffers from some setbacks and need to be mentioned. It might have been difficult, during the survey, to measure employment status accurately because some works, especially work on family farms, in family businesses, or in the informal sector, are often not perceived as employment by women and hence, there is the likelihood that such works were not reported. This might have led to underestimation of the working women. Also, the multinomial logistic approach adopted can lead to difficulties in estimating and interpreting results when the number of levels increases resulting in a rapid expansion of the number of categories to be estimated. The multivariate spatial approach may serve as advantage in this regard. But far and above these limitations, data analysed is national in scope and contain enough coverage to permit spatial analysis at state level.

5.0   Conclusion

In summary, the veiled geographical patterns in women labour force participation both on all-year and seasonal/occasional basis in Nigeria has been identified. In particular, women engagements portray a north-south and a west-east divide for all-year round and seasonal/occasional works respectively. Though the observed patterns do not have direct causal effect, careful interpretations of the maps could generate hypotheses as to the factors explaining the residual spatial variability observed. The results could aid policymakers in identifying potential risk factors of employment status of women thereby seek how to effectively engage them.

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