Trend and Impact of Women Economics: A Macro-Economic Assessment

[1]**Suleiman T. H.,**

[2]**Abalaka, J. N. &**

[3]**Ajiteru, S. A. R**

[1&2]*Crown University Intl Chartered Inc, Faculty of Social Science, USA*
[3]*Department of Political Science & International Relations Achievers University,*
Owo, P.M.B.1030 Owo Ondo State Nigeria

Corresponding Author:
Suleiman T. H.

A b s t r a c t

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.

Background to the Study
Empowering women and youths are central to promoting quick and equitable economic growth and long-term stability in any country Ajiteru, (2020). Women make up a little over half the world's population, but their contribution to measured economic activity, growth, and well-being is far below its potential, with serious macroeconomic consequences. Despite significant progress in recent decades, labor markets across the world remain divided along gender lines, and progress toward gender equality seems to have stalled. They also face significant wage differentials vis-à-vis their male colleagues Abalaka, (2022). In many countries, distortions and discrimination in the labor market restrict women's options for paid work, and female representation in senior positions and entrepreneurship remains low Suleiman, (2021).

The challenges of growth, job creation, and inclusion are closely intertwined Ajiteru, (2020). This Staff Discussion Note examines the specific macro-critical features of women's participation in the labor market, the constraints preventing women from developing their full economic potential, and possible policies to overcome these obstacles Suleiman, (2021). Implementing policies that remove labor market distortions and create a level playing field for all will give women the opportunity to develop their potential and to participate in economic life more visibly. The analysis presented in this Staff Discussion Note is based on research undertaken in academia and by other international financial institutions, in addition to the IMF's own surveillance and research work Suleiman, (2021).

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 Ajiteru, (2020).

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, 2018; Giwa, 2019). The approach, apart from allowing covariates of different type to be included, is able to account for the hierarchical nature of the DHS data analyzed Suleiman, (2021). The objective of the study is to close the gender gap in Nigeria represents a major issue to be resolved if the country is to achieve the targets it set in its National Financial Inclusion Strategy (NFIS).

Macroeconomic Implications of the Labor Market Divide: Does Gender Matter?
There is ample evidence that when women are able to develop their full labor market potential, there can be significant macroeconomic gains. (Loko and Diouf, 2019; Dollar and

Gatti, 2019). GDP per capita losses attributable to gender gaps in the labor market have been estimated at up to 27 percent in certain regions (Cuberes and Teignier, 2021). Aguirre and others (2012) suggest that raising the female labor force participation rate (FLFPR) to country-specific male levels would, for instance, raise GDP in the United States by 5 percent, in Japan by 9 percent, in the United Arab Emirates by 12 percent, and in Egypt by 34 percent Ajiteru, (2020). Based on International Labour Organization (ILO) data, Aguirre and others (2021) estimate that of the 865 million women worldwide who have the potential to contribute more fully to their national economies, 812 million live in emerging and developing nations Abalaka, (2022).

Better opportunities for women to earn and control income could contribute to broader economic development in developing economies, for instance through higher levels of school enrollment for girls. Women are more likely than men to invest a large proportion of their household income in the education of their children. According to the ILO, women's work, both paid and unpaid, may be the single most important poverty-reducing factor in developing economies (Heintz, 2016). Accordingly, higher FLFP and greater earnings by women could result in higher expenditure on school enrollment for children, including girls, potentially triggering a virtuous cycle, when educated women become female role models (Aguirre and others 2012; Miller 2018). Stotsky (2016b) posits that women's relative lack of opportunities in developing countries inhibits economic growth, while at the same time, economic growth leads to improvements in their disadvantaged conditions Suleiman, (2021).

Equal access to inputs would raise the productivity of female-owned companies (Do, Levchenko, and Raddatz, 2021). Productivity differentials among companies owned by men and by women have been found to be mainly the result of differences in access to productive inputs (Blackden and Hallward-Driemeier 2018). A reduction of this productivity gap through equal access to productive resources could yield considerable output gains (World Bank, 2021).

The employment of women on an equal basis would allow companies to make better use of the available talent pool, with potential growth implications (Barsh and Yee, 2012; CAHRS 2021). While not uncontroversial, there is evidence of a positive impact of women's presence on boards and in senior management on companies' performance. Companies employing female managers could be better positioned to serve consumer markets dominated by women (Abalaka, (2022)) and more gender-diverse boards could enhance corporate governance by offering a wider range of perspectives (OECD, 2021; Lord Davies, 2012). Moreover, a larger share of women in decision-taking positions could reduce the share of high-risk financial transactions that are normally conducted by male traders (Coates and Herbert, 2018).

Female Labor Force Participation: Stylized Facts
Average FLFP remains low at around 50 percent, with levels and trends varying across regions (Figure 1). While women now represent 40 percent of the global labor force (World

Bank, 2011), FLFPR have hovered around 50 percent over the past two decades. The average rate masks significant cross-regional differences in levels and trends: FLFPRs vary from a low of 21 percent in the Middle East and North Africa to over 63 percent in East Asia and the Pacific and sub-Saharan Africa Suleiman, (2021). While Latin America and the Caribbean experienced strong increases in FLFPR of some 13 percentage points over the past two decades, rates have been declining in South Asia. The rate in Europe and Central Asia has stayed broadly constant Ajiteru, (2020).

Variations in the gender gap are significant even among OECD countries. For instance, the gender gap in the Japanese labor market stands at 25 percentage points, compared to just over 10 percentage points on average in the major advanced economies and only 6 percentage points in Sweden. Across the OECD membership, female employment is concentrated in the services sector, which accounts for 80 percent of employed women, compared to 60 percent for men. Within this sector, women fill a disproportionally high share of occupations in health and community services, followed by education (OECD, 2012). An analysis by the ILO Abalaka, (2022) finds that women are overrepresented in sectors that are characterized by low status and pay Ajiteru, (2020).

FLFP varies with per capita income, with evidence pointing to a U-shaped relationship (Figures 3 and 4). At lower levels of per capita income, a high FLFPR reflects the necessity to work in the absence of social protection programs. With higher household income and increasing social protection, women can withdraw from the market in favor of household work and childcare. At advanced country income levels, labor force participation rebounds as a result of better education, lower fertility rates, access to labor-saving household technology, and the availability of market based household services (Duflo, 2022; Tsani and others, 2022; World Bank, 2021). The U-shaped relationship has been found to remain stable over time and to hold when controlling for country characteristics Ajiteru, (2020).

Gender gaps in education have been declining but literacy rates for women continue to lag those of men. Gender gaps in primary education have been largely closed, with the ratio of female to male primary enrollment rates reaching 94 percent even in the least developed countries (Figure 5). In secondary education, the ratio of female to male enrollment averages 97 percent, and women are now more likely to be enrolled in tertiary studies than men Suleiman, (2021). Nevertheless, literacy rates are still lower for women than for men, especially in South Asia and East and North Africa regions Ajiteru, (2020).

Gender-Specific Labor Market Characteristics
Women contribute substantially to economic welfare through large amounts of unpaid work, such as child-rearing and household tasks, which often remains unseen and unaccounted for in GDP. Women's ability to participate in the labor market is constrained by their higher allocation of time to unpaid work. On average, women spend twice as much time on household work as men and four times as much time on childcare (Duflo, 2012), thereby freeing up time for male household members to participate in the formal labor force. In the OECD countries, women spend about 2½ hours more than men on unpaid work (including

care work) each day, regardless of the employment status of their spouses (Aguirre and others, 2012). As a result, the gender difference in total working time the sum of paid and unpaid work, including travel time is close to zero in many countries (OECD, 2012). According to Heintz (2006), the gender division between market and household work, in combination with women's lower earnings potential, tends to reinforce established gender dynamics at the household level Ajiteru, (2020).

Moreover, there is a significant wage gap associated with gender, even for the same occupations and even when controlling for individual characteristics, such as education. Across OECD countries, the gender wage gap, defined as the difference between male and female median wages divided by male median wages, is estimated at 16 percent (OECD 2022). Occupational segregation and reduced working hours, in combination with differentials in work experience, explain around 30 percent of the wage gap, on average. While narrow for young women, the wage gap increases steeply during childbearing and childrearing years, pointing to an additional "motherhood penalty," estimated at 14 percent across the OECD countries Suleiman, (2021). Among emerging economies, wage gaps show a significant degree of variation, being relatively high in China, Indonesia, and South Africa. Comparatively narrow wage gaps in the Middle East and North Africa are explained by the small share of women in wage employment who are often more highly educated than their male colleagues Abalaka, (2022). In several countries, earnings differences are even more significant when comparing women and men with higher educational attainment (OECD, 2022).

The gender gap in earnings is even higher in self-employment than in wage employment, one explanatory factor being less time devoted by women to their business Ajiteru, (2020). On average, female-owned enterprises register lower profits and labor productivity than male-owned enterprises, also explained by the size of the enterprise, capital intensity, and more limited access to external finance and productive resources (OECD, 2022).

In many countries, the lack of basic necessities and rights inhibits women's potential to join the formal labor market or become entrepreneurs. In some emerging and developing economies, restrictions on women's independent mobility and participation in market work curtail their economic potential (World Bank, 2011). Women dominate the informal sector, characterized by vulnerability in employment status, a low degree of protection, mostly unskilled work, and unstable earnings (ILO, 2022a; Campbell and Ahmed, 2022). They often have limited property and inheritance rights and limited access to credit. In agriculture, particularly in Africa, women operate smaller plots of land and farm less remunerative crops than men, and they have more limited access to agricultural inputs (World Bank, 2021).

Policies in Support of Higher Female Labor Force Participation
Providing women with equal economic opportunities and unleashing the full potential of the female labor force, with significant prospective growth and welfare implications, will require an integrated set of policies to promote and support female employment (Sen, 2021). Research suggests that well-designed, comprehensive policies can be effective in boosting

women's economic opportunities and their actual economic participation (Revenga and Shetty, 2018; Aguirre and others, 2017; Duflo, 2017). A. Fiscal Policies

Replacing family income taxation with individual income taxation would boost FLFP
Empirical studies indicate that the female labor supply is more responsive to taxes than the male labor supply (IMF, 2017d). Hence, reducing the tax burden for (predominantly female) secondary earners by replacing family taxation with individual taxation can potentially generate large efficiency gains and improve aggregate labor market outcomes Ajiteru, (2020). Countries with potential to reduce the secondary earner tax wedge significantly include France, Portugal, and the United States Abalaka, (2022).

Tax credits or benefits for low-wage earners can be used to stimulate labor force participation, including among women. These so called "in-work" tax credits reduce the net tax liability or even turn it negative for low-wage earners thereby increasing the net income gain from accepting a job, and are usually phased out as income rises Suleiman, (2021). In countries that emphasize the income support objective, credits are generally phased out with *family* income and are often conditional on the presence of children in the household. However, the phasing out of the credit with family income results in high marginal tax rates for both the primary and the secondary earner in a family, creating strong adverse labor supply effects among secondary earners. By contrast, in countries that emphasize labor force participation, credits are usually phased out with *individual* income, the preferable policy to increase FLFP, as the marginal tax rate applied to the secondary earner will generally remain lower Ajiteru, (2020).

Properly designed family benefits can help support female FLFP (Jaumotte, 2018). Publicly financed parental leave schemes can help parents reconcile work and family life, and maintain their connection to the labor market through a guaranteed return to their job. The average duration of paid parental leave in advanced economies is 26 weeks, and all OECD countries except the United States and Korea currently offer paid parental leave (see Appendix Table 2.2 in Appendix 2). However, long periods outside the labor market also risk reducing skills and earnings (Ruhm, 2018). Policies that provide and encourage greater parity between paternity and maternity leave could support a more rapid return to work among mothers and help shift underlying gender norms (World Bank, 2017a). Iceland and Norway have introduced mandatory paternity leave, while in Sweden one part of parental leave is earmarked for the father and forfeited in case he opts not to take it Abalaka, (2022).

Reform of child support and other social benefits could increase the incentives to work. If too high, such support can reduce the incentives for women to enter the labor market, especially those with low earnings capacity (Jaumotte, 2018). Linking benefits to labor force participation ("in-work" benefits), participation in job training, or other active labor market programs can increase the incentives for women to rejoin the labor market Suleiman, (2021).

Expenditure on the education of women and improvements in rural infrastructure can boost FLFP in emerging and developing countries. Empirical evidence suggests that educational

attainment correlates positively with FLFP. In Turkey, for example, only 17 percent of illiterate women participate in the labor force, while the participation rate exceeds 70 percent among women holding a graduate degree (Ercan, Hoşgör, and Yimlaz, 2020). Beyond increases in overall education spending, policymakers should consider measures that increase the incentives to send girls to school, for example by making cash transfers to poor family's conditional on their daughters' school attendance, as in Bangladesh and Cambodia (World Bank, 2021). Furthermore, boosting the quality of infrastructure in rural areas, for example by making clean water more accessible and improving transportation systems, can reduce the time women spend on domestic tasks and facilitate their access to markets (Koolwal and van de Walle, 2018).

Policies to Increase Demand for Female Labor
Implementing policies that remove labor market distortions and create a level playing field for all would help boost the demand for women's labor. Discrimination artificially restricts the demand for women's labor. The norms that apply to women's participation in the labor market have a tangible impact on labor demand, FLFP, and thereby on macroeconomic outcomes Ajiteru, (2020). These social norms that influence FLFP cut across the IMF's membership. In some countries, women's participation in the labor market is affected by legal constraints that limit women's participation to specific sectors of the economy and restrict their access to credit and property rights. In many other economies, tradition and unwritten rules curtail women's economic opportunities.

Despite significant progress in advanced market economies, evidence of gender-based discrimination persists. Changes in legislation and social norms in recent decades have supported the increasing demand for female labor and have made it possible for women to seek employment outside their homes Suleiman, (2021). However, while anti-discrimination provisions have been adopted legally within all OECD countries, some measures have proven difficult to enforce (OECD, 2018).

Social norms evolve over time. While the traditional intra-household division of labor implies that women still do most household work, and while social norms and legislation in some countries curtail women's opportunities to engage in formal employment, attitudes toward working women are changing. Analyzing the evolving labor force participation of married U.S. women over the past century, Fernandez (2018) argues that a substantial part of this social transformation can be explained by improved information diffusion Ajiteru, (2020).

Social acceptance of women in the labor market and in high-level positions contributes to higher female participation in the formal labor force and in entrepreneurship
Policies to promote economic opportunities for women have been shown to correlate positively with women's economic success, and targeted communication strategies can reduce biases and stereotypes Abalaka, (2022). In both private enterprises and the public sector, leadership on gender issues from the top helps to create opportunities for women through sponsorship, robust talent management, and the targeted search for female

candidates for senior executive positions (Barsh and Yee, 2018; Barsh, Cranston, and Craske, 2018), thereby establishing positive role models for future generations of girls (Pande and Topalova, 2018). Complementing high-level initiatives, a change in the mindset of women to aspire to equal employment opportunities and career paths will result in more widespread, high-level responsibility in the public and private sectors (Barsh and Yee, 2017), supported by the assumption of joint family and household responsibilities by both men and women Ajiteru, (2020).

Trends in Income Inequality and its Impact on Economic Growth
The disparity in the distribution of household incomes has been rising over the past three decades in a vast majority of OECD countries and such long-term trend was interrupted only temporarily in the first years of the Great Recession. Addressing these trends has moved to the top of the policy agenda in many countries Suleiman, (2021). This is partly due to worries that a persistently unbalanced sharing of the growth dividend will result in social resentment, fueling populist and protectionist sentiments, and leading to political instability. Recent discussions, particularly in the US, about increased inequality being one possible cause of the 2008 financial crisis also contributed to its relevance for policymaking Ajiteru, (2020).

But another growing reason for the strong interest of policy makers in inequality is concern about whether the cumulatively large and sometimes rapid increase in inequality might have an effect on economic growth and on the pace of exit from the current recession. This paper starts by giving a brief overview of long-run trends in income distribution in OECD countries (Section 1). Section 2 provides a brief review of the theoretical and empirical literature on how inequality might theoretically affect growth. Section 3 presents the core of the new empirical evidence on the links between income inequality and economic growth. Section 4 explores one of the main transmission mechanisms between inequality and growth, finding evidence that the wider is income inequality, the lower is the chance that low income households invest in education. Section 5 draws some concluding remarks Abalaka, (2022).

**The long-term rise in income inequality in the OECD area**
A trend toward growing disparities before and since the Great Recession
Over the 20 to 25 years leading up to the global economic crisis, *average* real disposable household incomes increased in all OECD countries, on average by 1.6% annually (see Annex Table A1.1, first three columns). However, in three quarters of OECD countries household incomes of the top 10% grew faster than those of the poorest 10%, resulting in widening income inequality. Differences in the pace of income growth across household groups in the pre-crisis period were particularly pronounced in most of the English-speaking countries but also in Israel, Germany and Sweden Ajiteru, (2020). The picture changes when looking at the post-crisis period (i.e. the years from 2007 through 2011/12) as average real household income stagnated or fell in most countries, particularly – by more than 3.5% per year – in Spain, Ireland, Iceland and Greece. In almost all countries where incomes fell, those of the bottom 10% fell more rapidly. Similarly, in about half of those countries where incomes continued to grow, the top 10% did better than the bottom 10%.

These ratios present only a partial picture, however, since they depend on only two values in the income distribution. A more synthetic indicator, which takes into account the whole distribution, is the Gini coefficient Abalaka, (2022). This widely-used standard measure of inequality ranges from zero (when everybody has identical incomes) to 1 (when all income goes to only one person). It stood at 0.29 in the mid-1980s, on average, across OECD countries but by 2011/12, it had increased by 3 points to 0.32. The Gini coefficient increased in 17 out of the 22 OECD countries for which long time series are available (Figure 1), rising by more than 5 points in Finland, Israel, New Zealand, Sweden and the United States and falling slightly only in Greece and Turkey Suleiman (2021).

Figure 1: Income inequality increased in most, but not all OECD countries

Gini coefficients of income inequality, mid-1980s and 2011/12
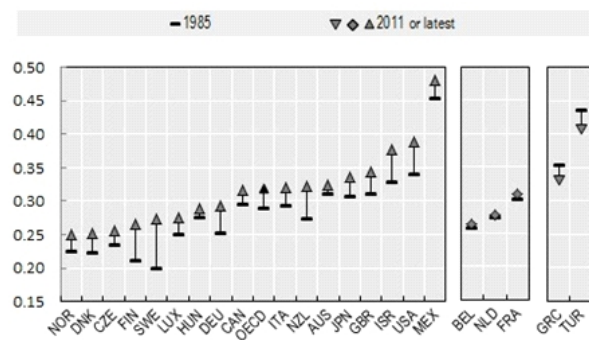
Note: Income refers to disposable household income, corrected for household size. Information on data for Israel: *http://dx.doi.org/10.1787/888932315602.*
Source: OECD Income Distribution Database (IDD).

The paths and patterns of income inequality over time differ across OECD countries and regions. Income inequality first started to grow in the late 1970s and early 1980s in some of the English-speaking countries, notably in the United Kingdom and the United States, but also in Israe Abalaka, (2022). From the late 1980s onwards, the increase in income inequality became more widespread (Figure 2). The 1990s and early 2000s witnessed a widening gap between poor and rich in some of the already high-inequality countries, such as Israel and the United States, but also, for the first time, in traditionally low-inequality countries, such as Germany and the Nordic countries Suleiman, (2021). Figure 2 also shows that with the onset of the Great Recession, the trend to increasing net income inequality came to a halt in many countries or was even slightly reversed during the very first years of the crisis. However, since 2010 (and, in some countries, earlier) inequality is on the rise again Ajiteru, (2020).

Figure 2: Inequality increased over the long run but temporarily stalled during the first crisis years

Gini coefficients of income inequality in selected OECD countries, 1975 – 2011/12
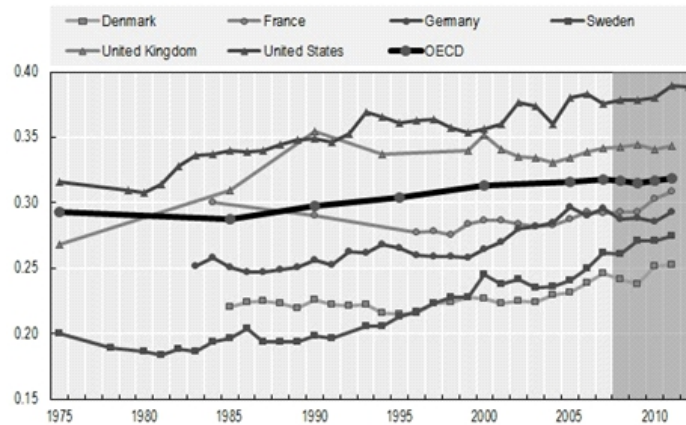
Note: Income refers to disposable household income, corrected for household size.
Source: OECD Income Distribution Database (IDD)

How inequality may affect economic growth
Over the last decades, a large body of theoretical and empirical research attempted to determine whether inequality is good or bad for growth Suleiman (2021). Theoretical work has provided mechanisms supporting both possibilities, and the large empirical literature attempting to discriminate between these mechanisms has been largely inconclusive. This section provides a brief overview of both theoretical and empirical works, highlighting the main methodological and measurement issues and setting the stage for the new work on OECD countries, described in Sections 3 and 4.

Method
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 Suleiman, (2021). 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 Abalaka, (2022).

Statistical Analysis

We used multinomial logit model within the framework of generalized linear model (Fahrmeir and Kneib, 2021; Fahrmeir and Lang, 2021b) 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

$$Y_{ij} \quad \begin{array}{ll} 1 & \text{if respondent was unemployed} \\ 2 & \text{if respondent was underemployed} \\ 3 & \text{if respondent was fully employed} \end{array} \quad …………………………………(1)$$

The response variable, Y_{ij}, is considered as a realization of some latent variable $U_{ii}=\eta_{ii}+\varepsilon_{ij}$, 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 Suleiman, (2021).

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:

The response variable, Y_{ij}, is considered as a realization of some latent variable $U_{ii}=\eta_{ii}+\varepsilon_{ij}$, 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 Suleiman, (2021).

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:

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

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

$$\eta_{ij}^{(r)} = v\gamma^{(r)} + f_{ij}^{(r)}(x_{ij}) + f_{spat}^{(r)}(s_i) + b_j. \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

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 $i = 12\,37,,...,$. 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 Ajiteru, (2020).

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 penalized spline (P-spline) proposed by Fahrmeir and Lang (2001a) and Lang and Brezger (2004) was adopted. The P-spline allows for nonparametric estimation off as a linear combination of basis function (B-spline), that is, $p(z) = \sum_{J=1}^{J} B_j B_j(z)$, where $B_j(Z)$ are B-spline. The coefficients, B_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, $B_j 2B_{j-1} B_j B_j(Z)$, with Gaussian error $\varepsilon_t \sim N(0, r_\varepsilon^2)$ was assumed. The variance r_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, $u \sim N(0,_i \tau_b^2)$, where r_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, and Mollie, 1991; Fahrmeir and Lang, 2001a) which introduces a neighbourhood structure for the areas s_i, $i = 1, 2, \ldots, 37$. 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 Suleiman (2021).

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 hyper parameters a and b was chosen. Standard choices of hyper parameters 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 burning 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 hyper parameters 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 Ajiteru, (2020). 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 effect. The models were implemented as follows:

Mode 1: $\eta ij(r) = v\gamma(r) + fij(r)(ageij) + fspat(r)(si) + bj$

Model 2: $\eta ij(r) = v\gamma(r) + fspat(r)(sj) + bi$

Model 3: $\eta ij(r) = v\gamma(r) + ageij + fspat(r)(sj) + bi$

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

$$DIC = \overline{D}(\Theta) + pD,$$

Where $\overline{D}$ 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 $\overline{D}(\Theta)$ indicate a good fit while small values of pD indicate a parsimonious model. The model with the lowest DIC is therefore considered as best Suleiman, (2021).

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	$D(\Theta)$	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 Suleiman, (2021).

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 Ajiteru, (2020). 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 Suleiman, (2021).

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. However, results for women belonging to the middle index are not significant. While women from household that practice 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 Suleiman, (2021).

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 3 (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 Ajiteru, (2020).

Results of the spatial effects are presented in Figures 4(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 Suleiman, (2021). 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.
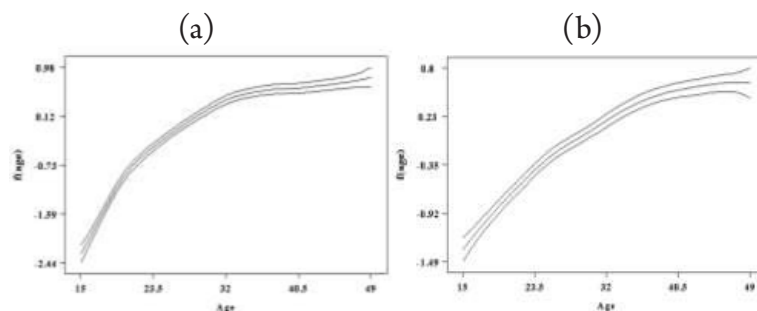
Fig. 3

Figure 3: 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 Suleiman, (2021).

Discussion
In this study, a multinomial logistic model with geo additive 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 Suleiman, (2021).

Fig. 4

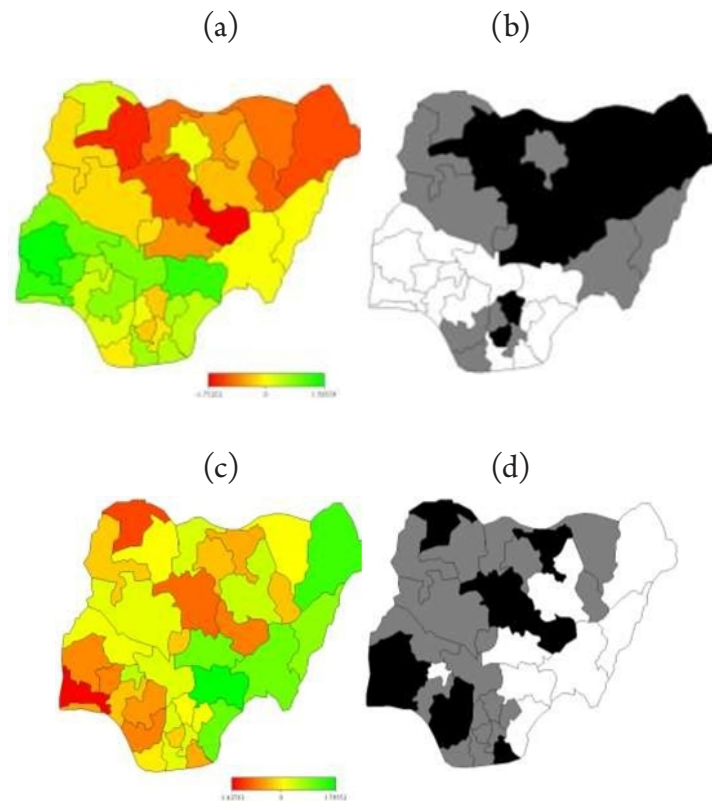(a)   (b)

(c)   (d)

Figure 4: 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 Suleiman, (2021).

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 Ajiteru, (2020). The observed spatial pattern does 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, 2017). 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 Suleiman, (2021).

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 (2018) 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, 2016; Rahman, 2018). 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 Ajiteru, (2020).

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 Sulaiman (2021). 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., 2018; Fahrmeir and Lang, 2021a; Gayawan, 2019; Kazembe, 2019).

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. The multivariate spatial approach may serve as advantage in this regard. But far and above these limitations, data analyzed is national in scope and contain enough coverage to permit spatial analysis at state level Suleiman, (2021).

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.

References
Abalaka, J. N, (2022). The costs of missing the millennium development goal on gender equity, *World Development, 32*(7), 1075-1107.

Adebayo, S. B. (2018). Bayesian geoadditive modelling of breastfeeding initiation in Nigeria, *Journal of Applied Econometrics, 19*(2), 267-281.

Ajayi, D. D. (2017). Recent trends and patterns in Nigeria's industrial development, *Africa Development, XXXII* (2), 139-155.

Ajiteru, S. A. R (2020). An empirical analysis of labour force participation of married women in Adamawa State, Nigeria, *Journal of Emerging Trend in Economics and Management Sciences, 4*(1), 1-7.

Baridam, D. M. (2016). Determinants of female labour force participation and family size in Nigeria, *Indian Journal of Industrial Relations, 32*(2), 204-215.

Besag, J., York, Y., & Mollie, A. (1991). Bayesian image restoration with two applications in spatial statistics (with discussion), *Annals of the Institute of Statistical Mathematics, 43*(1), 1-59.

Damisa, M. A., & Yohanna, M. (2017). Role of rural women in farm management decision making process: Ordered probit analysis, *Trends in Applied Science Research, 2*(3), 241-145.

Fahrmeir, L., & Kneib, T. (2021). *Bayesian smoothing and regression for Longitudinal, Spatial and Event History Data*, Oxford University Press.

Fahrmeir, L., & Lang, S. (2021a). Bayesian inference for generalized additive mixed models based on Markov random field priors, *Journal of the Royal Statistical Society C (Applied Statistics), 50*, 201-220.

Fahrmeir, L., & Lang, S. (2021b). Bayesian semiparametric regression analysis of multicategorical time-space data, *Annals of the Institute of Statistical Mathematics, 53*, 10-30.

Gayawan, E. (2018). A Poisson regression model to examine spatial patterns in antenatal care utilization in Nigeria. *Population, Space and Place, 20*, 485-479. doi: 10.1002/psp.1775

Kandala, N., Nwakeze, N., & Kandala, S. N. I. I. (2019). Spatial distribution of female genital mutilation in Nigeria, *The American Journal of Tropical Medicine and Hygiene, 81*(5), 784-792.

Kazembe, L. N. (2019). Modelling individual fertility levels in Malawian women: a spatial semiparametric regression model, *Statistical Methods and Applications, 18*(2), 237-255.

Lang, S., & Brezger, A. (2018). Bayesian P-Splines, *Journal of Computational and Graphical Statistics, 13*(1), 183-212.

National Population Commission, & ICF Macro. (2009). *Nigeria Demographic and Health Survey, 2008*. Abuja, Nigeria: National Population Commission and ICF Macro.

Ogunlela, Y. I., & Mukhtar, A. A. (2019). Gender issues in Agriculture and rural development in Nigeria: The role of women, *Humanity and Social Sciences Journal, 4*(1), 19-30.

Okonjo, K. (2021). *Acknowledging the existence of women: Its consequences. In M. O. Ijere (Ed.), Women in Nigerian Economy*. Enugu, Nigeria: Acena Publishers.

Psacharopoulos, G., & Winter, M. (2022). Women's employment and pay in Latin America, *Finance and Development* 29 IMF and World Bank.

Rahman, S. A. (2018). Women's involvement in agriculture in northern and southern Kaduna State, *Journal of Gender Studies, 17*, 17-26.

Suleiman T. H, (2021). Bayesian measures of model complexity and fit (with discussion), *Journal of the Royal Statistical Society B, 64*(4), 583-640.

Uthman, O. A. (2018). Geographical variations and contextual effects on age of initiation of sexual intercourse among women in Nigeria: A multilevel and spatial analysis, *International Journal of Health Geographics, 7*(27). doi: 10.1186/1476-072X-7-27

World Bank. (2018). *Promote gender equality and empower women by 2015*. Retrieved 1 April, 2014, from: http://www.worldbank.org/mdgs/gender.html