Gender Diversity and enterprises' innovative capability: Evidence from mediating effect of women years of education in Nigeria

By

Tukur Garba, Ph.D.
(Professor of Development Economics)
Department of Economics
Faculty of Social Sciences,
Usmanu Danfodiyo University Sokoto,
PMB 2346, Sokoto, Nigeria.
E-Mail: ttukurus@yahoo.com, garba.tukur@udusok.edu.ng
Mobile Phone No.: +234-8063101057

And

Erika Kraemer-Mbula, Ph.D.
Professor of Economics
University of Johannesburg, South Africa
E-Mmail: erikakm@gmail.com, erika@ieri.org.za
Mobile Phone No.: +27123823075

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ABSTRACT

This study investigates whether female workers' years of education mediate the influence of gender diversity on innovative capability of enterprises in Nigeria. Although past enterprise studies in some parts of the world provide substantial evidence on the relationship between gender diversity and enterprises' innovative capability, investigating the mediating effect of education on this relationship has been ignored, particularly in Nigeria which is ranked very low (128 out of 141 countries) in the global innovation index 2015. This study therefore addresses this gap. The study uses three waves Nigeria Enterprise Surveys panel dataset collected in 2007, 2009 and 2014, for a sample of 1,566 enterprises to circumvent the problems associated with application of cross-sectional designs in mediation studies. The study applies Hicks and Tingley (2011) two equations mediation analysis approach with robust standard error. The analysis has been done using Stata econometric package version 14. The results of the inferential analysis in this study indicate that female workers' years of education mediate fully and positively the effect of gender diversity on innovative capability of enterprises in Nigeria. By implication, for the gender diversity to enhance innovative capability of an enterprise, female workers must be empowered with some level of formal education.

1. Introduction

Innovation is commonly agreed to be a key factor for the development of both businesses and economies (Wojnicka-Sycz, & Sycz, 2016). Innovation is also known to have propelled the process of industrialisation, in the last centuries, and continues to underlie industrial development nowadays (Lundvall, 2010). Moreover, given the role of innovation in industrialisation and sustainable development, fostering it has been captured as part of goal number 9 of the sustainable development goals (SDGs). The degree of novelty is also often discussed in connection to innovation, leading to the description of new products, processes or organisational activities as more "radical" (completely new) or "incremental" (significant improvements). The most commonly used definition of innovation is in the third edition of the Oslo Manual in 2005 as 'the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisation method in business practices, workplace organisation or external relations' (OECD/Eurostat, 2005, para. 146). The Nigerian government agrees with this view, as reflected in the Nigeria Vision 20:2020 document, which acknowledges that innovation plays an important role in economic growth and the process of industrialisation (National Planning Commission, 2009). However, despite the important role that innovation plays, most existing indicators of innovation suggest that Nigerian enterprises are not amongst the most innovative, as

indicated by a range of indicators including R&D as percentage of GDP of 0.2% (well below the targeted 1%) (NACETEM, 2008), and also the country ranks very low (128 out of 141 countries) in the global innovation index 2015 – below India (81), Senegal (84), Botswana (90), Kenya (92) and Rwanda (94) (Dutta, Lanvin, & Wunsch-Vincent, 2015).

This paper is based on the premise that innovation is a core engine of economic growth (through the promotion of industrial development), and for this reason it deserves to be promoted (Scandizzo & Ventura, 2016) by identifying the factors that foster it. It also builds on the understanding that Nigerian enterprises need to develop technical efficiency to innovate and create new goods that are globally competitive, and ensure the effective and efficient use of resources (i.e. natural and human) available. To date, Nigeria remains a major exporter of low value primary goods and commodities, displaying a very low level of export diversification, making the economy highly volatile and vulnerable to international price shocks. In this context, it is critical to develop the innovation capacity of the enterprises in the country for industrialisation, in order to compete favourably with other industrialised countries in the international markets. In view of this, factors that influence innovation (education, gender diversity, among others) should be investigated.

The important role of education in promoting more entrepreneurial attitudes and behaviours is now widely acknowledged (European Commission, 2008). According to the Organisation for Economic Cooperation and Development [OECD] (2007), governments can also play a more direct role in fostering innovation via public investment in science and basic research which can play an important role in developing ICT and other general-purpose technologies and, hence, enabling further innovation. This highlights the importance of reforming the management and funding of public investment in science and research (education), as well as public support to innovative activity in the private sector (OECD, 2007). It has been observed that some nations take the lead in innovation capability over others, and a major factor for this disparity of innovative capability is the quality of human capital (education) linked to the innovation activities carried out in these nations (Banerjee, 2014). Hence nurturing human capital (education, especially for women and girls) at all levels and in all sections of a society can be crucial for developing the foundation for innovation (Banerjee, 2014). Therefore, at the heart of all innovation lies the human factor, identified as its soul and purpose, and to build an innovation-driven nation

means educating well its people and providing them enough resources and incentives to chase their dreams (Banerjee, 2014). Education is therefore central in enhancing innovative capability of enterprises. This view is in line with Nobel Prize winner, Amartya Sen's understanding of human ''capabilities' as the core of development (Sen, 2005).

Similarly, the role of women in innovation and economic growth cannot be overemphasised. According to Economist Intelligence Unit (2012), just like in USA where number of women in the workplace has added nearly 2 percentage points a year to economic growth, nowadays, women in the developing world are poised to have a similar impact especially if they can be properly educated, equipped and empowered (Economist Intelligence Unit, 2012). In line with this, Ritter-Hayashi, Vermeulen, and Knoben (2016) argue that gender diversity among a firm's employees has been found to positively impact innovation in developed countries. Therefore, the role of gender diversity in promoting innovative capability of enterprises in developed countries is well documented in the literature.

Despite the presumed positive effect of gender diversity on innovative capability, the empirical literature focusing on this connection does not always provide evidence to support such a relationship. Therefore, academic research does not yield consistent findings regarding the effect of gender diversity on innovative capability of enterprises for industrial development. Some of the tentative reasons for the inconsistent findings in this respect, may be:

First, gender diversity may not have a direct effect on enterprises' innovative capability, but an indirect effect through years of education of the women. However, investigating the mediating effect of education on this relationship has been largely ignored, in Africa in general, and particularly in Nigeria. Second, the existing body of research does not clearly resolve how or why gender diversity affects innovative capability of enterprises for sustainable industrial development. Therefore, this study aims to advance the understanding of this relationship by exploring the influence of intervening factor (years of education of women) that may impact the relationship between gender diversity and innovative capability of enterprises for sustainable industrial development in Nigeria. Moreover, to the best knowledge of the authors of this paper, there is not a single study on the mediating effect of education on innovative capability of enterprises on

Nigeria despite its glaring policy relevance. Another contribution of this study is application of longitudinal design to study mediation effect, because most substantive investigations of mediation continue to be based on cross-sectional designs despite the problems associated with using cross-sectional designs to study mediation effect (Maxwell et al., 2011). This study therefore addresses these gaps by providing answers to some research questions.

The central question to this study is: does the years of education of female workers mediate the effect of gender diversity on innovative capability of an enterprise in Nigeria? If it does, is the effect full or partial? Therefore, the objectives of this study are to investigate whether female workers years of education mediate the effect of gender diversity on innovative capability of enterprises in Nigeria; and to identify the nature of the mediation, full or partial. These objectives constitute a current policy issue in achieving gender equality and empowerment of all women and girls in Nigeria through participation in labour market and education, as goal number 5 that is contained in Sustainable Development Goals (SDGs). On the basis of the aforementioned objectives, this study tests the hypotheses that: a) Female workers years of education do not mediate the effect of gender diversification on innovative capability of enterprises in Nigeria; b) Female workers years of education do not mediate fully the effect of gender diversity on innovative capability of enterprises in Nigeria.

This paper has been divided into six sections. This section apart, section 2 deals with theoretical framework while section 3 dwells on literature review. Section 4 deals with data and methodology, section 5 is concerned with results while section 6 concludes the paper.

2. Theoretical Framework

The importance of innovation and education for enterprises and economic growth is well documented and has long been part of growth theory, beginning with Schumpeter's (1934) seminal work (McGuirka, Lenihan, & Hart, 2015). Schumpeter highlighted the role of science, technology and human capital in explaining differing growth rates at both microeconomic and macroeconomic levels through entrepreneurial actions (McGuirka et al., 2015). Diversity can also be in form of age, race and ethnicity, gender, religion and beliefs, disability, and international diversity (Mujahid, 2013). On the one hand, diversity can serve as a source of creativity and innovation that

can provide a basis for competitive advantage; but on the other hand, it may yield negative effects such as causing misunderstanding among workers in an organization due to language barriers and socio-cultural differences, or a disruptive factor for the organization, a source of suspicion and conflict in the workplace (Mujahid, 2013). These negative effects can lead to absenteeism, poor quality of products, low morale and loss of competitiveness (Mujahid, 2013). But could these negative outcomes of diversity happen as a result of low levels of education among employees? If we are to understand whether diversity affects innovative capability, counting the number of women representatives in an enterprise may not be sufficient, but also paying attention to the impact of the years of education.

The mediating (intervening) variable explains how or why the independent variable affects the dependent variable (Williams, 2017). The mediation of years of education of female production workers between gender diversity and innovation capability of an enterprises can be supported by human capital theory. This is especially important because most innovation within manufacturing SMEs in Less Income Countries (LICs) occurs incrementally via learning by doing, for which human capital at the firm level is critical (Voeten, 2015). Enterprises have to mobilize capabilities primarily in order to create value. The development of these capabilities allows the mobilization of skills and knowledge (education) which are required for promoting innovation. The *a priori* expectation is that, the higher the ratio of an enterprise's female production workers to the total number of production workers, the more innovative the enterprise is expected to be. But how does this relationship exist? After all, we know for an enterprise having higher ratio of female production workers does not directly in itself lead to innovation. To answer this question, one needs to find out if there are any intervening variables. From the literature, it has been identified that years of education of female workers can explain the relationship between gender diversity and an enterprise's innovative capability. The higher the years of education of female production workers, the more innovative they are likely to be. This means that an enterprise with some proportion of educated female workers will engage in innovative activities, which may lead to enhancing its innovative capability. In view of this, years of education of female production workers can be the intervening variable in the relationship between higher gender diversity and innovative capability of an enterprise.

The relationship between education and innovation has already been intensively investigated both theoretically and empirically in the first-generation models of endogenous growth (Aghion & Howitt 1998; Barro 1999; Romer 1990). Apart from being the "engine of innovation", education is also a key determinant of knowledge absorptive capacity that enables firms not only to generate new knowledge but also to understand and adopt external new knowledge and technology (Vandenbussche, Aghion, & Meghir 2006) for innovative capability (Arvanitis, Loukis, & Diamantopoulou, 2016).

A mediating variable mediates between two variables and is considered as the bridge that must be crossed to get from an independent variable (IV) to a dependent variable (Musairah, 2015). In a mediational model therefore, IV is hypothesized to have an effect on a dependent variable (DV) through one or more intervening variables called mediators (Musairah, 2015).

Once a researcher wants to make a more accurate explanation of the causal effect an independent variable has on a dependent variable, then he needs to focus on mechanisms that make causal chain possible, which may require a mediator to fill in the missing variables in the causal chain (Musairah, 2015). For example, a mediation model can be illustrated as in Figure1.
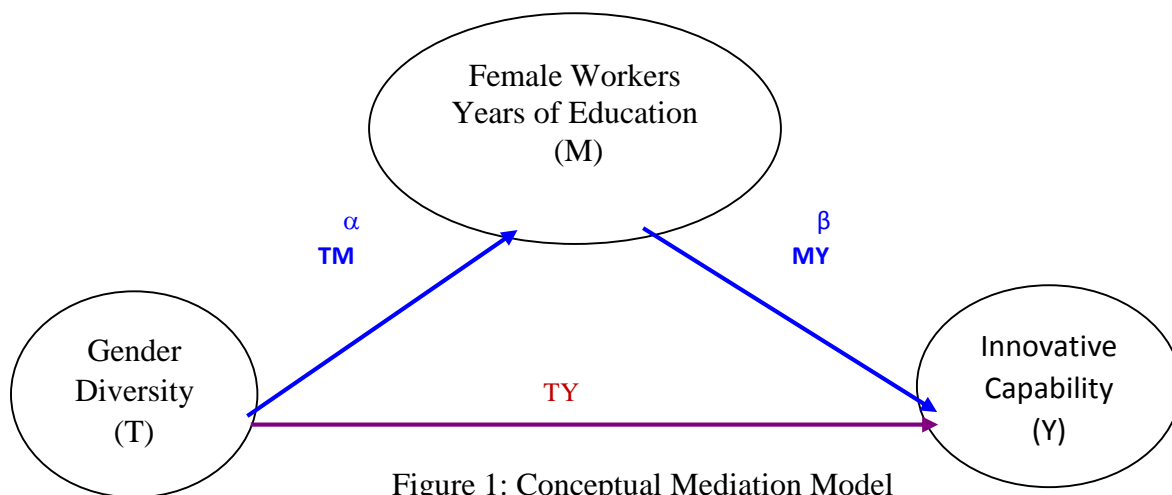

Figure 1: Conceptual Mediation Model

The conceptual mediation model in Figure 1 shows the mediating role of years of education of female production workers (*M*) as a transmission mechanism between gender diversity (*T*) and

innovative capability of an enterprise (*Y*). If *T* is no longer statistically significant but *M* is statistically significant when *M* is controlled in the model, the finding supports full mediation. However, if both *T* and *M* are statistically significant, *i.e.*, both *T* and *M* significantly predict *Y*, the finding indicates partial mediation (Wu, 2010), that is, *M* has partial mediating effect on the relationship between *T* and *Y*. For full mediation, the standard mediation analysis reveals that there is no direct effect of *T* (independent variable) on dependent variable (*Y*) once a mediating variable has been taken into account in the mediation model. Thus, this analysis appears to confirm that *M* mediates the relation between *T* and *Y*. In fact, the analysis leads to a conclusion that *M* mediates fully the relationtion because *T* is no longer related to *Y* after controlling for *M*. Such a conclusion appears to be of obvious scientific importance because it suggests that the mechanism has been discovered whereby *T* leads to *Y* through *M*.

3. Review of Literature

3.1 Gender diversification and innovative capability of enterprises

Gender diversity has been frequently found to have a positive effect on innovation (Ritter-Hayashi et al., 2016). Using the Spanish PITEC (Panel de Innovación Tecnológica) panel dataset from 2007 to 2012 for innovative manufacturing and service firms, and applying multivariate probit model, Teruel, Parra, and Segarra (2015) find that gender diversity has a larger positive impact on the probability of carrying out product and organisational innovations in larger teams than it does in smaller teams. Furthermore, using micro-level cross-sectional dataset of the research-based German business and enterprise sector for a sample of 1,873 enterprises, and applying robust linear regression and probit regression, Schneider and Eckl (2016) find that firms that employ research teams with a higher degree of diversity (i.e. firms with more foreign and female researchers as well as researchers with more diverse subjects of studies), have a better innovative capacity. In addition, using cross-section dataset for a sample of 1,775 Danish firms and applying logit regression, Østergaard, Kristinsson, and Timmermans (2011) find a strong positive and significant effect of gender diversity on innovation, indicating that being diverse in gender composition contributes positively to the likelihood of enhancing innovative capability of an enterprise. It has also been argued that the more women and men can contribute divergent knowledge and experiences to a firm's knowledge pool, the more diverse the knowledge pool becomes, the more it will hence serve as a driver for firm innovation (Ritter-Hayashi et al., 2016).

On the contrary, using panel dataset for the period 2012 to 2015 for a sample of 25 banks listed on United Arab Emirate (UAE) stock markets and applying generalised least squares method, Iren and Tee (2017) find that gender does not significantly affect innovativeness of banks. In view of this, findings are inconclusive on the influence of gender diversity and education on innovative capability of enterprises. This justifies further investigation of the relationship between the two variables.

3.2 Mediating effect of education on the relationship between gender diversification and innovation capability of enterprises

In trying to explain the channels through which education may affect economic growth as an externality, Aghion, Boustan, Hoxby, and Vandenbussche (2009) argue that educational investment fosters technological innovation. It is also widely recognised that formal education is a key driver of knowledge (Hausman, 2005) and the magnitude at which it is available to women differs vastly among countries. Therefore, it is expected that when women have access to higher degree of educational opportunity and knowledge, they will be able to lead to better realization of the benefits that gender diversity can bring for innovation (Ritter-Hayashi et al., 2016). Many of the composite indicators for the innovation scoreboard reflect that a high level of human capital is generally regarded as one of the key factors for innovation because those who are highly-educated are more creative, and high skill is necessary to use new technologies for innovation (Støren, 2016). According to Dutta et al. (2015), countries that demonstrate rising levels of innovation input and output are those that make remarkable improvement in skilled labour force with expanded tertiary education, among other factors. Furthermore, using cross-sectional dataset for a sample of 1,583 observations from six regions of Spain for last quarter of 2010, and applying factor analysis, Martínez-Román & Romero (2017) find that the entrepreneur's education plays a more significant role in the core dimension of a firm's innovativeness. Similarly, using cross-section dataset for a sample of 1,775 Danish firms and applying logit regression, Østergaard et al. (2011) find a positive and significant effect of education on innovation.

Furthermore, using firm level panel dataset of the World Bank Enterprise Survey for a sample of 15,157 firms in 15 developing countries in South Asia, the Middle East and Africa, and applying a hierarchical binary logistic regression, Ritter-Hayashi et al. (2016) find that gender

diversity increases the likelihood to innovate for firms operating in countries with rising levels of women's economic opportunity (including access to education) on the one hand and decreases the innovation likelihood for firms operating in countries that are at the low end of providing women's economic opportunity (access to education) on the other hand. According to Ritter-Hayashi et al. (2016) gender diversity among a firm's employee has been found to positively impact innovation in developed countries. In an African context, Uden, Knoben, and Vermeulen, (2014) use cross-sectional dataset of Enterprise Surveys 2013 for Kenya, Tanzania and Uganda and apply logistic regression analysis, and find a significant positive relation between levels of education and innovation.

But on the contrary, using cross-sectional dataset for a sample of 496 entrepreneurs in Ghana, and applying multilevel logit regression, Robson, Haugh, and Obeng (2009) do not find any significant positive relation between training (education) and innovation in Ghana. Moreover, using panel dataset for the period 2012 to 2015 for a sample of 25 banks listed on United Arab Emirate (UAE) stock markets and applying generalised least squares method, Iren and Tee (2017) find that education does not significantly affect innovativeness of banks. Similarly, Arvanitis et al. (2016) find no correlation between human capital and innovation.

From the literature reviewed in this subsection, it can be recapitulated that the findings on the role of education in promoting innovative capability of enterprises are also inconclusive, suggesting the need for further investigating mediating effect of education on innovative capability of an enterprise.

4. Data and Methodology

This section deals with the type and kind of data, and methods of data analysis applied in carrying out this study.

4.1 Data

This study uses three waves Nigeria Enterprise Surveys panel dataset collected in 2007, 2009 and 2014, conducted by the World Bank. These surveys are normally administered to a representative sample of firms in the non-agricultural formal private economy. Sample is

consistently defined in all countries and includes the entire manufacturing sector, the services sector, and the transportation and construction sectors. The Enterprise Surveys collect a wide array of qualitative and quantitative information through face to face interviews with firm managers and owners regarding the business environment in their countries and the productivity of their firms. The surveys are an ongoing World Bank project in collecting both objective data based on firms' experiences and enterprises' perception of the environment in which they operate.

Panel dataset has been used in this study because of some problems associated with cross-sectional dataset in mediation analysis. Cole and Maxwell (2003) and Maxwell, Cole and Mitchell (2011) explain the difficulties of estimating mediational effect using a cross-sectional design (Musairah, 2015). They find that estimates of meditational effects from cross-sectional designs may be seriously biased and argue that the results of analyses based on cross-sectional data are unlikely to accurately reflect longitudinal mediation effects (Cole & Maxwell, 2003; Maxwell et al., 2011). Therefore, the timing of measurements is critical in mediation analysis (Musairah, 2015).

Cases exist in which the cross-sectional design erroneously detects a meditational effect when it does not in fact exist, and conversely also fails to detect a meditational effect when it does exist, and such results raise grave questions about the routine use of cross-sectional meditational analyses (Maxwell and Cole, 2007). Most original presentations of methods for studying mediation did not explicitly consider the role of time despite the fact that mediational processes necessarily develop over time (Maxwell et al., 2011). Despite recent methodological work arguing for longitudinal designs to study mediation, most substantive investigations of mediation continue to be based on cross-sectional designs because only recently some studies have begun to examine the problems associated with using cross-sectional designs to study mediation effect (Maxwell et al., 2011).

4.2 Sample Size and Sampling Technique
The dataset consists of 1,914 enterprises in 2007, a total of 2,847 enterprises in 2009, and 1,893 enterprises in 2014. However, the panel was formed on the basis of the number of enterprises that matched themselves in each of the three periods. In 2007 a total of 473 enterprises were eligible

for matching, 310 of them were eligible in 2009, and 783 of them were eligible in 2014, having the same set of variables. This gives a total of 1,566 enterprises that were eligible to form the panel with the same set of variables for the three periods. Therefore, this study uses a sample of 1,566 enterprises for data analysis to achieve its objectives.

The enterprises for Nigeria were selected by the World Bank using stratified random sampling technique as part of probability sampling method. Three levels of stratification were used, by stratifying the enterprises based on industry, region, and size, using two sampling frames (a sampling frame built using data compiled from the National Bureau of Statistics (NBS), and the one built using local and municipal business registries). Stratified sampling technique was applied to make sure that the final total sample includes establishments from all different sectors and that it is not concentrated in one or two of industries or sizes or regions.

4.3 Variables Measurement

This section deals with demonstration of how each of the variables captured in this study is measured for the purpose of inclusion in the econometrics models specified. The variables are measured as follows:

4.3.1 Measures of enterprises' innovative capability

According to Organisation for Economic Cooperation and Development [OECD/Eurostat] (2005), four different types of innovation are identified. These are product innovation, process innovation, marketing innovation and organizational innovation. For the purpose of this study, each type of innovation capability has been measured as follows:

Product/Service innovation capability: This is measured as a dummy variable taking a value of 1 if an enterprise introduced any new or significantly improved product or services in the last 3 years, and 0 if otherwise.

Process innovation capability: This has been measured as a dummy variable taking a value of 1 if an enterprise introduced new or significantly improved methods of manufacturing or producing goods or services in the last 3 years, and 0 if otherwise.

Marketing innovation capability: This is measured as a dummy variable taking a value of 1 if an enterprise introduced any new or significantly improved logistics, delivery, or distribution methods for inputs, products, or services in the last 3 years, and 0 if otherwise.

Organizational innovation capability: This is also measured as a dummy variable taking a value of 1 if an enterprise introduced any new or significantly improved knowledge management system and skill in the last 3 years, and 0 if otherwise. Therefore an enterprise is considered innovatively capable in any of the aforesaid types of innovation if it introduced any new or significantly improved aspect of each of the types.

4.3.2 Measurement of gender diversification

This is measured in this study as a ratio of number of female permanent full-time production workers to the total number of permanent full-time employees at end of last fiscal year.

4.3.3 Measurement of female workers' years of education

This variable has been measured in this study as average number of years of education of typical female production workers.

4.4 Methods of Data Analysis

This study applies both descriptive and inferential methods of data analysis. Descriptive method in form of mean, minimum, maximum, frequency and percentages has been applied in this study to be able describe the characteristics of the dataset. However, inferential method of data analysis has been augmented to descriptive method in order to be able to test the hypotheses developed and draw inferences for policy formulation. For the inferential method, Hicks and Tingley (2011) two equations mediation analysis approach has been applied, in the form of ordinary least squares (OLS) and logit models with robust standard errors. The analyses have been done using Stata econometric package version 14.

Mediation analysis is a mechanism that uncovers possible causal mechanisms in behavioural research (Musairah, 2015). Therefore, a mediator is a variable that a researcher can capture in a

model to explain a process or mechanism through which one variable affects another (Musairah, 2015). Hicks and Tingley's (2011) mediating approach has been applied in this study due to some key practical limitations of the earlier methods (such as structural equation model, factor analysis, *inter alia*) in mediation analysis. The limitations according to Hicks and Tingley (2011) include: First, some earlier approaches to mediation analysis largely relied on some form of structural equation modeling and unfortunately, the methods were not derived from a formal framework for causal inference and did not permit sensitivity analyses with respect to key identification assumptions; second, earlier methods were difficult to correctly extend to non-linear models (like logit and probit) which handle binary dependent variables (Hicks & Tingley, 2011). But Hicks and Tingley's (2011) mediation approach enables users to conduct sensitivity analyses and cover several common statistical models that handle binary dependent variables. Sensitivity analysis allows an analyst to state how an estimated quantity would change for different degrees of violation of the key identification assumptions. Furthermore, since the sequential ignorability (SI) assumption can never be tested directly, sensitivity analysis is a key component of conducting causal mediation analysis to assess the violations to the key identification assumptions required for interpreting mediation results causally (Hicks & Tingley, 2011). That is, the treatment assignment is assumed to be ignorable (statistically independent of potential outcomes and potential mediators). This assumption is common and is also called unconfoundedness, exogeneity, or no omitted variable bias assumption (Hicks & Tingley, 2011). The sensitivity analysis investigates how robust the results are to the violation of the SI assumption (Hicks & Tingley, 2011). Sensitivity analysis also allows the analyst to state how an estimated quantity would change for different degrees of violation of the key identification assumptions, and because the SI assumption can never be tested directly, sensitivity analysis is a key component of conducting causal mediation analysis (Hicks & Tingley, 2011). In view of this, a sensitivity analysis should be conducted (Hicks & Tingley, 2011).

This study therefore applies mediation analysis using the Stata computational approach via logit and robust OLS regression models. Mediation effect approach has been adopted in this study to provide a more accurate explanation of the causal effect the education has on innovative capability of enterprises in Nigeria. This approach therefore makes causal chain of effect possible and helps in avoiding the problem of missing variable bias. Therefore, years of education of female

production workers can explain the relationship between higher gender diversity and innovative capability of an enterprise.

4.5 Model Specification

According to Hicks and Tingley (2011) mediation approach, the mediation effect under the sequential ignorability (SI) assumption is equivalent to fitting two regressions as:

$M_{it} = \alpha_1 + \beta_1 T_{it} + \lambda_1 Y_{it} + \varepsilon_{1it}$ ---------------------------(1)

$Y_{it} = \alpha_2 + \beta_2 T_{it} + \lambda_2 M_{it} + \varepsilon_{3it}$ --------------------------(2)

Where:

M = Mediator

Y = The outcome (dependent variable)

T = Treatment (independent variable)

Therefore, evidence for mediation is said to be likely if:

1. The parameters β_1 and λ_1 in Equation 1 are significant; that is, there is evidence of a linear relationship among the independent variable (T), the outcome (Y) and the mediator (M);

 2. The parameter λ_2 in Equation 2 is significant, indicating that the mediator (M) helps predict the dependent variable (Y), and also β_2, the effect of the independent variable (T) directly on the dependent variable (Y) becomes significantly smaller in size relative to β_1 in Equation 1, or β_2 not significant at all. If β_2 is significantly smaller in size relative to β_1, then, M partially mediates the effect of T on Y. But if β_2 is not significant at all, then M fully mediate the effect of T on Y.

In the first equation, the user specifies the model for the mediator variable and in the second Equation, the user specifies the model for the outcome variable, i.e. the dependent variable (Hicks & Tingley, 2011). Available model types for this mediation analysis approach are OLS regression, probit, and logit (Hicks & Tingley, 2011). This approach has an advantage over that of Ender (2011) and that of Sobel (1982) and Goodman (1960) which run only logistic regress model even if the dependent variable is a continuous (quantitative) variable. If an analyst had a binary mediator or outcome variable, then a probit or logit model could be used instead of a regress model (Hicks & Tingley, 2011) but if the outcome is a continuous variable, regress or other

appropriate commands can be used. If the 'treatment' variable in the model is not a binary (dummy) variable, '0 1' cannot be put in the parentheses after the variable name, as they cannot be in the mediation sensitivity test model even if it is a dummy. If the mediator is not a dummy variable, the model for the first parenthesis should not be a categorical dependent variable model. Similarly, if the outcome variable is not a dummy variable, the model in the second parenthesis should not be a categorical dependent variable model. According to Hicks & Tingley (2011), in practice, researchers are interested in an average of the mediation effects known as the average causal mediation effect (ACME) and average direct effect (ADE).

5. Results

This section deals with presentation and interpretation of both descriptive and inferential results of this study.

5.1 Descriptive Results

Table 1 presents the descriptive results of distribution of the enterprises by formality (formal registration) status. The results indicated that 26.44% of the enterprises captured in the dataset were formally registered and 73.56% of them were not formally registered. The results therefore suggest that majority of the enterprises by the surveys in Nigeria were informal by status.

Table 1: Distribution of the Enterprises by Formality (Registration) in three periods

Formality (Registration)	Frequency	Percentage
Formally registered	414	26.44
Not formally registered	1,152	73.56
Total	**1,566**	**100**

Source: Generated from Nigeria Enterprise Surveys Panel Dataset, 2007, 2009, & 2014, using Stata econometric package version 14.

Table 2 presents the descriptive results of the measures of female worker's years of education and gender diversification. The results indicated that the mean years of education of female production workers was 0.36 with a minimum of 0 years and a maximum of 46 years of education. From the results, minimum of 0 years indicated that there were some production female workers who did not undergo formal education at all while some were able to attain up to 46 years of education. These findings suggest the need for empowering female production workers educationally.

Table 2: Descriptive results of the measures of female workers' average years of education and gender diversification in three periods

Variable	Mean	Minimum	Maximum
Average number of years of education of typical female production workers	0.367	0	46
Ratio of number of female permanent full-time production workers to permanent full-time employees at end of last fiscal year	0.028 (2.80%)	0	1 (100%)

Source: Generated from Nigeria Enterprise Surveys Panel Dataset, 2007, 2009, & 2014, using Stata econometric package version 14.

For the gender diversification, that is, representation of women and girls at work, the results indicated that some enterprises with minimum ratio of 0 had no a single female worker in their enterprises and on average, some of them had only 2.80% female workers at production unit of the enterprise. However, there were also some enterprises that had exclusively (100%) female production workers.

Table 3: Description of Incidence of Innovation by its Types in three periods

Innovation Type	Variable Category	Frequency	Percentage
Product/Service Innovation	Innovative	325	20.75
	Non-innovative	1,241	79.25
Process Innovation	Innovative	448	28.61
	Non-innovative	1,118	71.39
Marketing Innovation	Innovative	413	26.37
	Non-innovative	1,153	73.63
Organisational Innovation	Innovative	374	23.88
	Non-innovative	1,192	76.12

Source: Generated from Nigeria Enterprise Surveys Panel Dataset, 2007, 2009, & 2014, using Stata econometric package version 14.

Table 3 presents the descriptive results of incidence of innovation by type of innovation among the enterprises captured in the dataset. The results indicated that the incidence of product/service innovation among the enterprises was 20.74% while that of process innovation was 28.61%. Furthermore, the incidence of marketing innovation stood at 26.37% and that of organisational innovation was 23.88%. The findings therefore indicated that process innovation constituted the highest (28.61%) incidence of innovation among the enterprises. These findings suggest low level incidence of innovation among enterprises in Nigeria since they failed to achieve even 50% incidence of innovation in any of the four types of innovation. This calls for policy direction towards improving innovative capability of enterprises for sustainable industrial development in Nigeria.

5.2 Inferential Results

This section deals with the results of OLS and Logit models using Hicks and Tingley (2011) two equations mediation analysis approach.

Table 4 presents the inferential results of the mediation for sensitivity test. From the results in Table 4, all the conditions for achieving mediating effect of female workers' years of education on the relationship between gender diversity and innovative capability of enterprises for sustainable industrial development in Nigeria have been fulfilled. For all the four types of innovation, there is a significant positive linear relationship among gender diversification, innovation capability of enterprises and mediating variable (female workers' years of education) in the results of Equation 1 (OLS regression results). In addition, all the models are statistically adequate and significant at 1% level. Therefore, the first condition for achieving mediation effect on the basis of Hicks and Tingley (2011) mediation analysis approach has been fulfilled. However, one can notice that the R-squared values for all the models are too low, which is expected of a panel dataset.

Similarly, results of the Equation 2 (logit regression results) also indicate the satisfaction of the second condition for achieving mediating effect. From the results, the coefficient of the mediator (years of education of female production worker) is statistically and positively significant in all the four models at either 5% or 1% level while the treatment, that is, independent variable (gender diversity) is not statistically significant in all the four models.

Table 4: Mediation Regression Results for Sensitivity Test

Equation	Independent Variables	Dependent Variables			
		1	2	3	4	5
		Mediator (*female workers' years of education*)	Mediator (*female workers' years of education*)	Mediator (*female workers' years of education*)	Mediator (*female workers' years of education*)
1 **OLS** **Regression**	**Gender diversity**	6.024 $(4.92)^{***}$	6.150 $(4.50)^{***}$	6.046 $(4.98)^{***}$	6.082 $(5.00)^{***}$
	Innovative capability	2.058 $(2.40)^{**}$	3.033 $(3.36)^{***}$	2.854 $(3.30)^{***}$	2.744 $(3.23)^{***}$
	R^2	0.087	0.103	0.102	0.100
	F Value	15.49^{***}	18.46^{***}	18.24^{***}	18.00^{***}
		Product/Service Innovation	**Process Innovation**	**Marketing Innovation**	**Organisational Innovation**
2 **Logit** **Regression**	**Years of education of female production worker (Mediator)**	0.035 $(2.37)^{**}$	0.057 $(3.27)^{***}$	0.052 $(3.22)^{***}$	0.049 $(3.15)^{***}$
	Gender diversity	0.022 (0.06)	-0.328 (-0.92)	-0.156 (-0.46)	-0.199 (-0.59)
	Pseudo R^2	0.014	0.029	0.026	0.024
	Chi-Squared Value	6.30^{**}	11.77^{***}	11.37^{***}	10.63^{***}
	No correlation in error terms (ACME = 0)	0.20	0.3	0.30	0.30

Source: Generated from Nigeria Enterprise Surveys Panel Dataset, 2007, 2009, & 2014, using Stata econometric package version 14.

Significant at 5% (**); 1% (***). Figures in parentheses are t ratios for OLS and z ratios for Logit, and those in the last row are the p-values.

In addition, all the four models are statistically significant at either 5% or 1% level, suggesting they are statistically adequate for policy formulation. For the sensitivity test results, the results in Table 4 indicate the acceptance of the null hypothesis which states the error terms are not correlated looking at the p-value of each model. In all the four models, the p-values of the test indicate the rejection of the alternative hypothesis which states the error terms are correlated. This suggests that female workers' years of education fully mediates the effect of gender diversity on innovative capability of enterprises for sustainable industrial development in Nigeria. Therefore, the influence of gender diversity on innovative capability of enterprises in Nigeria is fully as a result of female workers' years of education.

Although the R^2 and Pseudo R^2 values in all the models are small, the F statistic of each model is significant, indicating the adequacy of all the models. According to Gujarati (1995) and Gupta (1999), sometimes researchers play the game of maximizing R^2, that is, choosing the model that gives the highest R^2. But this may be dangerous, for in regression analysis, our objective is not to obtain a high R^2 *per se* but rather to obtain dependable estimates of the true population regression coefficients and draw statistical inferences about them. In empirical analysis it is not unusual to obtain high R^2 but find that some of the regression coefficients either are statistically not significant or have signs that are contrary to theoretical expectations (Garba & Abdullahi, 2010). Thus, the researcher should be more concerned about the logical or theoretical relevance of the explanatory variables to the dependent variable and their statistical significance. On the other hand, if R^2 is low, it does not mean the model is necessarily bad (Gujarati, 1995) as long as most of the parameters and F statistic are statistically significant.

6. Conclusions and Policy Implications

From the inferential findings of this study, it has been concluded that female workers' years of education mediate positively the effect of gender diversity on innovative capability of enterprises in Nigeria. Similarly, female workers' years of education mediates fully not partially the effect of gender diversity on innovative capability of enterprises for sustainable industrial development in Nigeria. Furthermore, gender diversity on its own does not enhance innovative capability of an

enterprise for sustainable industrial development in Nigeria without some level of formal education. In addition, the result of descriptive analysis indicate that there is low level of incidence of innovation among enterprises in Nigeria.

Therefore, by implication, empowering female workers with some level of formal education will make gender diversity enhance innovative capability of an enterprise for sustainable industrial development. This may be achieved through policies that will ensure provision of free education and scholarships for women and girls by all stakeholders in government and private organisations.

Provision of enabling environment for innovation for sustainable industrial development may help in solving the problem of low level of incidence of innovation among enterprises in Nigeria. This may also be achieved by formulating policies that will ensure adherence to the rule of law in form of copyright protection and punishment against piracy, and provision of qualitative education that support innovative capability for sustainable industrial development through funding science and technology research and other related activities.

Suggestions for Further Studies

Given the need for understanding the mediation effect of women education level on the relationship between gender diversity and enterprises' innovative capability at different strata, future studies that would consider disaggregation of the mediation analysis at micro, small, medium and large scale levels should be encouraged. In addition, other studies that would consider their analysis at formal and informal levels of enterprises would be a welcome idea. This research could be expanded by exploring the types of education (in terms of disciplines, and level – primary, secondary, tertiary) held by females and their impact on innovation capacity in firms. In relation to this latter point, it would also be interesting to explore the difference between formally acquired education and experience-based learning, in shaping the innovative capacity of firms in Nigeria and Africa at large.

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