Women in Science, Technology, Engineering and Mathematics (STEM); Implications for Growth in Nigeria

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ABSTRACT

This paper investigated the implications of women in Science, Technology, Engineering and Mathematics (STEM) on growth in Nigeria. Annual data from 1980-2017 on female labour force participation rate, male labour force participation rate and total labour force participation rate in the country were collated. Real gross domestic product was employed as a proxy for growth. The main objective of this study was to examine the impact of women in STEM on growth in Nigeria considering the proportion of female employed in the labour force relative to male. The existence of cointegration was established between RGDP and the control variables and on this basis, the long and short-term autoregressive distributed lag (ARDL) model was employed to account for any potential non stationarity in the model. The results reveal that in both the short-term and the long-term, there exist a positive relationship between female labour force participation rate and real gross domestic product, male labour force participation rates and real gross domestic product and a negative relationship between total labour force participation and real gross domestic product. The findings led to the conclusion that economic growth can be stimulated through the adoption of both short-term and long-term policies to ensure that women in STEM contribute immensely to real gross domestic product in the economy.

Keywords: STEM, ARDL, Female labour force participation rate, Male labour force participation rate, Total labour force participation rate.

1.0 INTRODUCTION

1.1 Women in science, technology, engineering and mathematics (STEM) fields typically construed as well-compensated, high-status professions with universal career appeal (Ceci et al 2009, Griffith 2010) is thought of having significant impact on a number of policies targeted at accelerating the pace of productivity, inclusive growth and sustainable development.

Nonetheless, stereotypes and educational differences can lead to the decline of women in STEM fields. These differences start as early as the third grade according to Dee (2007), with boys advancing in math and science and girls advancing in reading.

This paper seeks to consider the vast opportunities that abound to any economy in terms of increase in output as a result of having more women in STEM relative to men translating into increase in female labour force participation relative to male by adopting a pragmatic approach.

It was asserted that the rising female employment captured by the rising female labor force participation rates in the rich countries has been a major driving force behind global gross domestic product in the last two decades at the world economy level. The stimulating impact of rising female labor force participation has been found widely in India and China; the states growing the fastest, reducing poverty and child mortality the most are those with the highest percentage of women in the labor force (Blumberg, 2006).

1.2 Objectives of The Study

The aim of this paper is to examine the impact of women in STEM on growth, considering the proportion of women involved in the labour force relative to men in the economy.

The specific objectives include to:

(i) examine the contribution of the labour force to productivity (output) in the economy,

(ii) compare the contributions of female labour force participation rates and male labour force participation rates toward growth in the economy.

2.0 LITERATURE REVIEW

2.1 Theoretical Framework

According to modernization theorists, changes in the professional or occupational structure (meant to be the increasing availability of service and white-collar jobs) and increases in educational opportunities as well as reduction in fertility rates and ultimately household responsibilities are the conduit through which economic growth is related to women's participation in the labour force. Modernization process is associated with increased labour demand, socially accepted education and employment of women and lower fertility rates Heckman (1978); Standing (1981); Bauer and Shin (1987). Some theoretical and empirical studies in the literature have found that female labor force participation has positive and strong links with economic growth (Tansel (2002); Fatima and Sultana (2009)). Worldwide trends indicate that women have a relatively more stable relationship between labor market participation and economic growth.

2.2 An Overview of Participation of Women in STEM

Women in STEM engaged in the labour force has significant impact on the pace and distribution of economic growth, sustainable development and improvement in the overall welfare of states and nations. However, a number of indices including stereotypes and differences in education can result into a fall in the proportion of women engaged in STEM field and invariably, the proportion of women engaged in the labour force.

In comparison with men in STEM, women's representation is relatively low as adduced by a number of societal, psychological as well as innate factors.

On the societal perspective for the low representation of women in STEM in comparison with their male counterparts, Schiebinger (1999) opines that women are twice as likely to leave jobs in science and engineering than men are as a result of discrimination. Miyake et al (2010) posits that negative stereotypes about women's quantitative abilities may lead people to devalue their work or discourage these women from continuing in STEM fields. While Taylor and Hosch, (2004) in 'The black sheep effects'' opine that women who are established in STEM fields will be more likely than established men to assist early career women with sufficient qualification and will be less likely than men to assist early career women with insufficient qualifications, Cooper (1997) and Ellemers et al (2004) in 'The Queen Bee effect' provides explanations as to the reasons higher-status women, particularly in male-dominated professions, could actually be far less likely to help other women than their male counterparts could. The effect being identical to the Black Sheep effect but relates majorly to women.

Other societal explanations include the lack of support/ role model (Warren 2018, Toh 2018, Ceci et al 2014, Cheryan et al 2011), harassment and mentorship (Griffith 2010, Stout et al 2011).

The psychological factors for women's low representation in STEM relative to their male counterparts as stated by Su et al (2009) include lack of interest, lack of confidence and in a meta- analysis, opined that while men prefer working with things, women prefer working with people and classifying interest by RAISEC method; Realistic, Investigative, Artistic, Social, Enterprising, Conventional, discovered that men indicate stronger Realistic and Investigative interests and women on the other hand, display stronger Artistic, Social, Enterprising and Conventional interests

Also relating to the psychological perspective is the lack of confidence which according to Pell (1996) erupts from adolescence which can be attributed to unqualified or effective teachers. Teachers' gendered perceptions on their students' capabilities can create an unbalanced learning environment and deter girls from pursuing further STEM education (Barbara et al 2017). Keller et al (2001) noted that teachers can further transfer the stereotyped beliefs unto their students. Johnson (2007) shows that student-teacher interactions affect girls' engagement with STEM as teachers often give boys more opportunity to figure out the solution to a problem by themselves while telling the girls to follow the rule (Schiebinger, 1999). Teachers are also more likely to accept questions from boys while telling girls to wait for their turns (Pell, 1996) which is partly attributed to gender expectations that boys will be active but that girls will be quiet and obedient (Lips, 2008).

Page (2015) discovered that women steer away from STEM fields because they believe they are not qualified for them and suggested the encouragement of girls to participate in more mathematics classes to increase their interests. Ellis et al (2016) observed that of STEM-intending students, while 35% of women stated that their reason for leaving calculus was as a result of their inability to comprehend the material, only 14% of men gave the same reason. The difference in reason for leaving calculus is thought to develop from women's low level of confidence in their ability, and not actual skill and thus, continue to establish that women and men have different levels of confidence in their ability and that confidence is related to how individual's perform in STEM fields (Ellis et al 2016). Kelly (2013) opined that programs designed to diminish anxiety in math or improve confidence have a positive impact on women continuing their pursuit of a career in the STEM field.

Steinberg (2012) purports that besides lack of confidence barring women from entering STEM fields, women in upper-level courses with higher skill are more strongly affected by the stereotype that they do not possess innate ability to succeed as constrained upon them by nature, which impact a negative effect on women's confidence despite making it through courses designed to filter students out of the field.

Another psychological reason adduced for low representation of women in STEM is stereotype threat arising from the fear that an individual's actions will confirm a negative stereotype about the individual's in-group which creates additional stress, consuming valuable cognitive resources and lowering task performance in the threatened domain (Schmader & Johns 2003, 2002, Spencer et al 1999 and Steele et al 1995). Individuals are susceptible to stereotype threat whenever they are assessed in a domain for which there is a perceived negative stereotype about a group to which they belong. Steele et al (2002) opine that individuals who identify strongly with a certain area are more likely to have their performance in that area hindered by stereotype threat than those who identify less strongly with the area implying that even highly motivated students from negatively stereotyped groups are likely to be adversely affected by stereotype threat and may have to disengage from the stereotyped domain. Bork (2012) also observed that negative stereotypes about girls' capabilities in mathematics and science drastically lower their performance in mathematics and science courses as well as their interest in pursuing a career in STEM.

The innate explanation bothers on the proposition that STEM fields are largely considered by both teachers and students to require more innate talent than skills that can be learned (Miller, 2015). It was further proposed that the tendency to view women as having less of the required innate abilities could result in assessing women as less qualified for STEM positions. Ellis et al (2016) concluded that without strong skills in calculus, women cannot perform as well as their male counterparts in any field of STEM, which leads to the fewer women pursuing a career in these fields and that a high percentage of women that do pursue a career in STEM discontinue on this pathway after taking calculus as it was discovered to be a class that weeds out students from the STEM pathway.

Williams (1992) in his paper; ‘‘The Glass Escalator: Hidden Advantages for Men in the 'Female' Professions’’ concludes that while men in female-dominated occupations may contend with negative stereotypes about their masculinity, the men may also enjoy some benefits and suggests that women in male-dominated occupations tend to hit a glass ceiling which can impede them to aspire to the top of their profession while men in female-dominated occupations may hit a glass escalator which confers on the men the opportunity to excel in female-dominated profession.

However, there is a unanimous conclusion in the literature on increasing the number of women in STEM that girls must be given access to technology and opportunities to learn digital skills from a young age.

2.3 Increasing Women’s Participation In STEM

Sonnert et al (2007) and Stout et al (2011) proposed the need for mentorship and opined that the support and encouragement of a mentor can make a lot of difference in women's decisions of whether or not to continue pursuing a career in their discipline in STEM fields. Griffith (2010) asserts that this may be particularly true for younger individuals who may face many obstacles early on in their careers since these younger individuals often look to those who are more established in their discipline for help and guidance, making the responsiveness and helpfulness of potential mentors incredibly important.

Johns et al (2005) proposed educating individuals about the existence of stereotype threat while Marx and Roman (2002) proposed the use of role models as a technique for alleviating stereotype threat.

On the issue of addressing the digital gender gap in the country, Ogundipe suggests that digital skills should be part of the school curriculum to encourage budding ICT talents and according to Okello, the implication of including digital skills as part of school curriculum implies that governments must invest in appropriate STEM education for young girls and boys in ways that allow them to be creative, to explore and to innovate.

A number of programmes targeted at encouraging women and girls to venture into male-dominated professions in STEM should be embarked upon while being aggressively supported by the government, society, parents, teachers and care-givers. A number of organizations include; The United State government’s Department of State's Bureau of Educational and Cultural Affairs TechGirls and TechWomen, exchange programs which teach Middle Eastern and North African girls and women skills valuable in STEM fields and encourage them to pursue STEM careers, UNESCO Teach-Her-Initiative, United Kingdom’s Wise program, The Educate-to-Innovate campaign of the Obama administration in cooperation with the White House Council on women and girls targeted at increasing the participation of women and girls in STEM fields.

At the national level, programmes targeted towards increasing the number of women and girls in STEM include; Girls Coding of Pearl Africa Foundation, InspireIT, Women’s Technology Empowerment Centre (W.TECH.) Paradigm Initiative Nigeria and The Visiola Foundation.

2.4 Empirical / Stylized Facts

Gresky et al (2005) found that women who were encouraged to draw self-concept maps with many nodes did not experience a performance decrease on a math test while women who did not draw self-concept maps or only drew maps with a few nodes did perform significantly worse than men on the math test and concluded that the effect of these maps with many nodes was to remind women of their "multiple roles and identities," that were unrelated to, and would thus not be harmed by, their performance on the math test.

Johns et al (2005) found that women who were taught about stereotype threat and how it could negatively impact on their performance in math performed as well as men on a math test, even when stereotype threat was induced and also performed better than women who were not taught about stereotype threat before they took the math tests. This results into an increase in the number of women in STEM as well as the labour force with the accompanying improvement in the pace and distribution of output, improvement in maternal health, reduction in infant / child mortality and increase in the wealth of nations.

Marx and Roman (2002) discovered that women who took a math test that was administered by a female experimenter did not suffer a fall in their performance when compared to women whose test was administered by a male experimenter. Additionally, these researchers found that it was not the physical presence of the female experimenter but rather learning about her apparent competence in math that buffered participants against stereotype threat.

Mclntyre et al (2003) observed that female participants who read about successful women, even though these successes were not directly related to performance in math, performed better on a subsequent math test than participants who read about successful corporations rather than successful women.

Stearns (2016) showed that female teachers can also act as role models for young girls as the presence of female teachers positively influences girls' perceptions of STEM and increases their interest in STEM careers.

Martens et al (2006) investigating self-affirmation to aid in alleviating stereotype threat discovered that women who affirmed a personal value prior to experiencing stereotype threat performed as well on a math test as men and as women who did not experience stereotype threat.

Women's Right Online research discovered that women in urban poor areas across the Global South are up to 50% less likely to have internet access and The United Nation's International Day for Women and Girls in Science (2017), geared at celebrating the critical contribution of women in science and technology emphasized the existence of digital gender gap that millions of women are either offline, silenced by hostile online spaces, or falling behind in acquiring critical skills needed for STEM careers.

3.0 METHODOLOGY AND DATA ISSUES

To investigate the relationship between economic growth and women in STEM, annual data on female labour force participation rate and Real Gross Domestic Product; RGDP were employed. Data on male labour force participation rate as well as total labour force participation rate were also included in the analysis. The labour force is defined as the number of individuals who are employed and those that are unemployed but available, willing to work and have scouted for a job recently but could not get employed.

This study adopted the seminal contribution of Dogan and Akyuz (2017) and data was sourced from the World Development Indicators; WDI and International Labour Organisation (ILO) statistics. Female labour force participation rate is given as percentage of female labour force participation as a ratio of the percentage of the total labour force. The series were examined to determine whether their mean and variance are constant and confirm that the covariance of the series depends on the lead or lag series and not on time. Real gross domestic product (RGDP) was employed as a proxy for economic growth as it allows for the distortion of fluctuating prices on intertemporal total output.

The ARDL bound test was employed as it allows for estimation of series of I(0) and I(1) series. The base-line model employed for this paper is given as:

$$RGDP_t = \delta_0 + \delta_1 FLFP + \delta_2 MLFP + \delta_3 TLFP + \varepsilon_t \quad \text{...(1)}$$

Following the work of Pesaran et al (2001), the long run equation is given as:

$$\Delta RGDP_t = \gamma_0 + \sum_{i=1}^{q} \gamma_i \Delta RGDP_{t-i} + \sum_{j=0}^{m} \gamma_j \Delta FLFP_{t-j} + \sum_{k=0}^{n} \gamma_k \Delta MLFP_{t-k} + \sum_{l=0}^{r} \gamma_l \Delta TLFP_{t-l}$$
$$+ \mu_i RGDP_{t-i} + \mu_j FLFP_{t-j} + \mu_k MLFP_{t-k} + \mu_l TLFP_{t-l} + \varepsilon_t \text{..}(2)$$
$$i = 1, \ldots\ldots, q;\ j = 0, \ldots\ldots., m; k = 0, \ldots\ldots, n; l = 0, \ldots\ldots r$$

Further, the Error correction model adapted for this study is given below;

$$\Delta RGDP_t = \varphi_0 + \sum_{i=1}^{V_1} \varphi_i RGDP_{t-i} + \sum_{j=0}^{V_2} \varphi_j FLFP_{t-j} + \sum_{k=0}^{V_3} \varphi_k MLFP_{t-k} + \sum_{l=0}^{V_4} \varphi_l TLFP_{t-l} + ECT_{t-1} \text{.............................}(3)$$
$$i = 1, \ldots\ldots, V_1;\ j = 0, \ldots\ldots., V_2; k = 0, \ldots\ldots, V_3; l = 0, \ldots\ldots V_4$$

4.0 EMPIRICAL ANALYSIS AND DISCUSSION OF RESULTS

4.1 Data Issues and Preliminary Analysis

The study employed data from the World Bank's World Development Indicators for the period 1980 to 2017. The group statistical features of the series adopting the standard procedures for variables with time series properties was embarked upon from conducting the descriptive statistics presented below:

Table 1: Descriptive Statistics of Variables

	FLFPR	**MLFPR**	**TLFPR**	**RGDP**
Mean	43.04550	68.38268	56.23504	3.32E+13
Maximum	48.30000	74.80000	57.00000	6.98E+13
Minimum	34.45455	61.90000	54.80000	1.52E+13
Std. Dev.	4.804775	4.943332	0.694443	1.84E+13
Skewness	-0.353420	0.013750	-0.516157	0.844781
Kurtosis	1.621134	1.246753	1.993987	2.112288
Jarque-Bera	3.801412	4.868169	3.289746	5.767531
Probability	0.149463	0.087678	0.193037	0.055924
Sum	1635.729	2598.542	2136.932	1.26E+15
Sum Sq. Dev.	854.1769	904.1516	17.84330	1.26E+28
Observations	38	38	38	38

Source: Researchers' compilation using E-views 10. Note: FLFPR, MLFPR, TLFPR, RGDP represent female labour force participation rate, male labour force participation rate, total labour force participation rate, real gross domestic product.

Real gross domestic product was employed instead of nominal gross domestic product to allow for the impact of inflation on intertemporal output. The female labour force participation rate is given as the percentage of female labour force participation as a ratio of the percentage of the total labour force. Male labour force participation rate is given as the percentage of male labour force participation as a ratio of the percentage of the total labour force. The total labour force participation rate is the number of people who are available or willing to work or have looked for a job recently as a percentage of the total population.

4.2 Unit Root Test Results

Table 2: Unit Root (Stationarity) Test.

Variable	Augmented Dickey-Fuller (ADF) Test Statistics		Phillips Perron (PP) Test Statistics	
	Level	First Difference	Level	First Difference
RGDP	1.0303 (0)	-4.9243(0)***	0.7029(3)	-4.9215(1)***
FLFPR	-2.2092(1)	-0.9064(1)	-3.1088(4)**	-
MLFPR	-1.0081(1)	-3.6266(0)***	-0.8718(4)	-3.6738(3)***
TLFPR	-1.5208(1)	-3.0342(0)**	-1.3420(4)	-3.0778(3)**
Significance level: 1%	-4.198	-3.605	-4.198	-3.605
5%	-3.523	-2.936	-3.523	-2.936
10%	-3.192	-2.606	-3.192	-2.606

Note: The values presented in parenthesis in the ADF test are the selected delay lengths using the Schwarz Information Criterion (SCI) and the maximum delay length is 9. Optimal delay length, Newey-West Bandwith (Automatic Selection) criteria using Bartlett Kernel (default) spectral estimation method was employed in the PP test.***, **, * indicate statistical significance at 1%, 5% and 10% levels respectively.

Following the results of the ADF, the series are a combination of I(0), I(1) and I(2). However, with the PP test statistics, the series are a combination of I(0) and I(1). Therefore, the ARDL border test is applicable.

Table 3: The Vector Auto Regression Analysis: Detection of Delay Length for Bound Test

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-115.6618	NA	0.020805	7.478863	7.662080	7.539594
1	106.7374	375.2987*	5.25e-08*	-5.421090	-4.505005*	-5.117434
2	117.6528	15.69085	7.60e-08	-5.103301	-3.454348	-4.556720
3	134.9480	20.53801	8.04e-08	-5.184249	-2.802428	-4.394743
4	146.3725	10.71052	1.42e-07	-4.898283	-1.783595	-3.865852
5	181.1881	23.93569	7.65e-08	-6.074255	-2.226698	-4.798899
6	208.3653	11.89005	1.14e-07	-6.772833*	-2.192409	-5.254552*

Note: * indicates lag order selected by the criterion, LR, FPE, AIC, SC, HQ indicate sequential modified LR test statistic (each at 5% level), final prediction error, Akaike information criterion, Schwarz information criterion respectively.

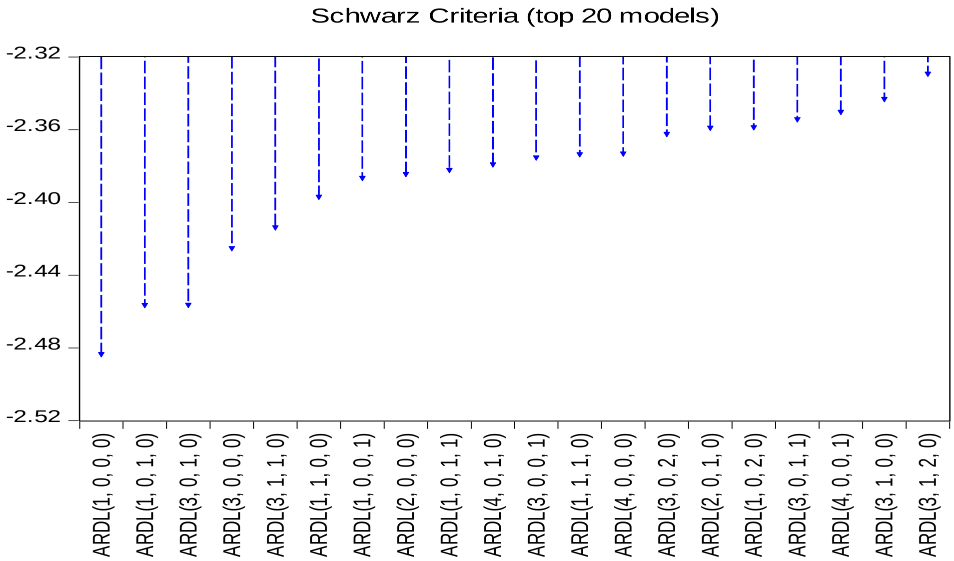
The Schwarz Information Criteria (SIC) is adopted in determining the delay length for the Bound test given that its optimal delay length is 1 when the maximum delay length is 6. There is therefore no auto correlation as SIC takes the minimum value.

Table 4: ARDL Bound Result (Conditional Error Correction Regression)

Variable (Long run)	**Coefficient**
Tlfp	-0.0618
	(0.0757)
Mlfp	0.0086
	(0.0201)
Flfp	0.0147
	(0.0093)
Lnrgdp(-1)	-0.0710
	(0.0654)
Constant	4.4781
	(1.7924)**
Short run	
Tlfp	-0.0618
	(0.0619)
Mlfp	0.0086
	(0.0159)
Flfp	0.01469
	(0.00662)**
Lnrgdp(-1)	0.9289
	(0.0622)***
Constant	4.4781
	(1.6146)***
ECT	-0.0710
	(0.0116)***
Diagnostic tests	
R^2 **= 0.989**	**F-statistics = 709.182 (0.0000)**
$\bar{R}^2$ **= 0.987**	**DW = 2.03**

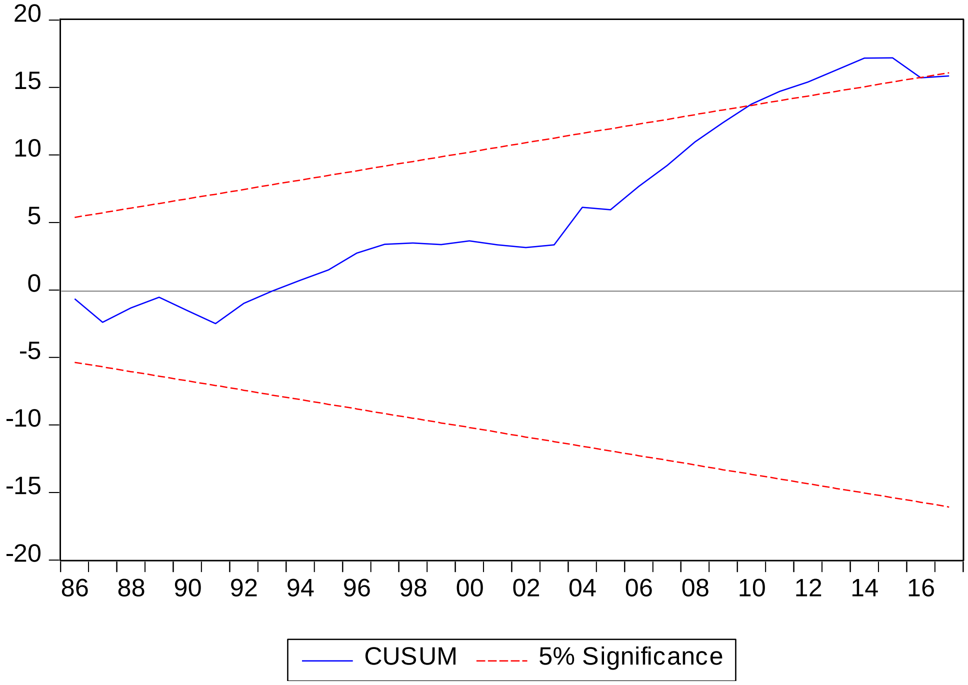
Source: Researchers' compilation. Note: Tlfp, Mlfp, Flfp, lnrgdp(-1) represent total labour force participation, male labour force participation, female labour force participation, lag of natural logarithm of real gross domestic product. Standard errors are given in parenthesis. For the F-statistics, the p-value is given in the parenthesis.

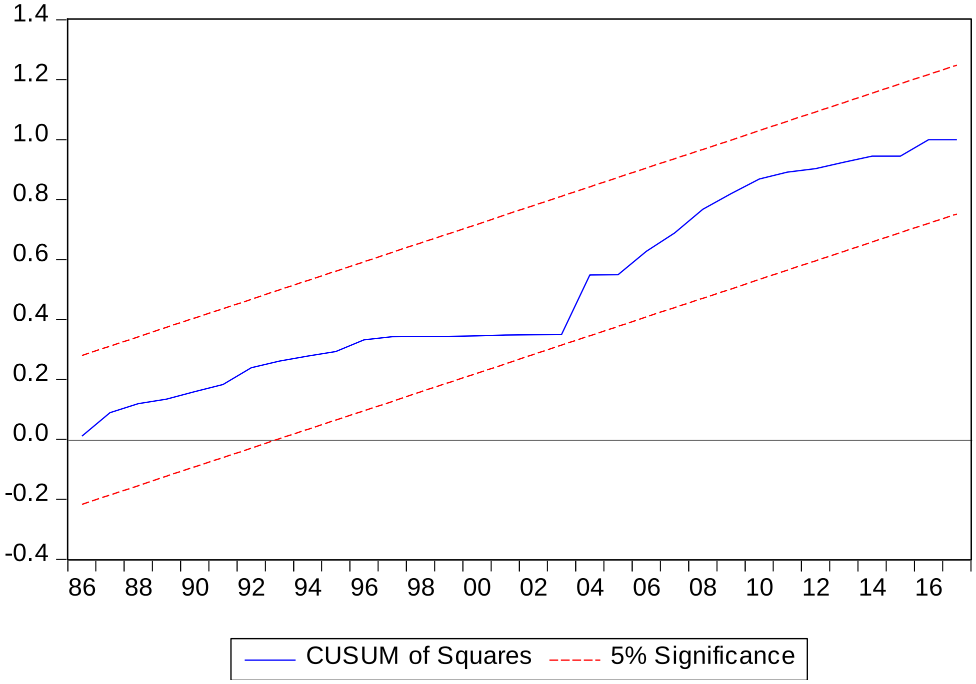
Table 5: Criteria Graph for Model Selection Summary



The best long-term model going by the SIC is the non-correlated ARDL (1,0,0,0) of the 20 most appropriate ARDL models for the long-term analysis.

Figure 1: Bound Test Parameter Stability tests: Cusum and CusumQ





The model's CusumQ indicates that the constant term of the regression equation is stable over time.

4.3 Empirical Results

The empirical analysis focuses on the ARDL model employed for this study. The results from the ADF unit root test revealed that the level of integration is mixed at I(0), I(1) and I(2) while the PP test revealed that the level of integration was mixed at only I(0) and I(1). The PP unit root test therefore reaffirm the appropriateness of the bound test as the preferred estimation framework employed for this study.

The lag length selection based on the different criteria when the maximum delay length is 6 shows the Schwarz Information Criteria (SIC) taking the minimum value and indicating no autocorrelation. The F-statistics from the Unrestricted Error Correction Mechanism (UECM) indicates that there is level relationship among the series in the steady state given that the calculated F exceeds the upper bound at 1 percent conventional level. Given the maximum latency of 6, the most appropriate long-term model according to the SIC is the non- autocorrelated ARDL (1,0,0,0) model. The graph of the 20 best ARDL models for steady state analysis is presented in table 6.

The long-term relation was estimated using the ARDL -bound test and the result of the optimal delayed long term ARDL model (1,0,0,0) is presented in table 3. In the short-term, the relationship between RGDP and TLFP remains insignificantly negative, RGDP and MLFP insignificantly positive, RGDP and FLFP significantly positive at the 5 percent conventional level and RGDP and DLNRGDP statistically significant and positive at the 1% conventional level.

A percentage increase in TLFP will generate a deteriorating impact on RGDP coefficient of about 0.062 percentage points while a one percentage increase in MLFP and FLFP will lead to about 0.009 and 0.015 percentage points increase in the RGDP coefficient. A marginal change in RGDP will result to about 0.929 percentage points increase in the RGDP coefficient.

In the long-term, the coefficient of TLFP continued to have a negative and insignificant impact on RGDP with the same coefficient as that of the short-term period. The long-term coefficients of MLFP and FLFP continued to be the same as that of the short-term values. The coefficient of MLFP continued to be insignificantly positive in the long-term with the coefficient of FLFP having a positive but insignificant relationship with RGDP.

A percentage increase in TLFP will result into a 0.0618 percentage points reduction in RGDP, that of MLFP will lead to a 0.0086 percentage points increase in RGDP, that of FLFP will result into a 0.0147 percentage points increase in RGDP, and a marginal change in RGDP will lead to a reduction of 0.071 percentage points in RGDP.

Nevertheless, there is need for the establishment of cointegration to ascertain the validity of the steady state estimates. This cointegration is established adopting a test based on the speed of adjustment or error correction concept. The coefficient estimate from the EC is determined from the model to generate the error correction term labeled ECT. A significant negative coefficient obtained for the ECT indicates evidence of cointegration which is the case of the model employed in this study. The size of the coefficient implies that 0.071% of adjustment takes place in a year.

5.0 SUMMARY AND CONCLUSION

This paper investigated the implications of women in STEM on growth in Nigeria. Annual data from 1980 to 2017 involving female labour force participation rate, male labour force participation rate and total labour force participation rate was collated and real gross domestic product was employed as a proxy for growth in the country. The existence of cointegration was established between RGDP and the control variables and on this basis, the long and short-term autoregressive distributed lag (ARDL) model was employed to account for any potential non stationarity in the model.

Furthermore, the contributions of the total labour force employing the total labour force participation rate on economic growth was considered and the comparison of female labour force participation rate and male labour force participation rate on economic growth in the country was undertaken.

Analysis of the short-term reveal that the error correction coefficient of the model was negative and statistically significant at the conventional levels, implying that short-term deviations are close to long-term equilibrium values.

The long-term results of the ARDL model adopting the SIC model selection method, automatic lag selection and the HAC Newey West coefficient covariance appear to be inconsistent. While there appear to be no difference between the short -term and long-term coefficients of TLFP and MLFP and their significances, the coefficients of the short-term and long-term values of FLFP while being the same and positive, is statistically insignificant in the steady state.

With women constituting 49.5% and men constituting 50.5% of the population (Nigeria Bureau of Statistics 2015), increasing female employment in STEM in the economy is as relevant as male employment in order to hasten the pace and distribution of growth in the country.

In conclusion, the study highlights the implications of women in STEM on growth in Nigeria using the ARDL-bound test. The results reveal that female labour force participation rate and male labour force participation rate exert positive impact on economic growth both in the short-term and long-term and that economic growth can be stimulated through the adoption of short-term and long-term policies.

Total labour force participation rate on the other hand indicates a negative and constant relationship with real gross domestic product both in the short-term and the long-term. This calls for the adoption of policies to provide training, workshops and seminars for the total labour force in the economy in order to improve the quality of their output which has implications for steering the pace and distribution of income in the economy. Also, imperative for policy makers to ensure a positive relationship between real gross domestic product and total labour force participation is the improvement in the human capital measured in terms of nutrition, education and health of the working population as well as improvement in their quality of life and well-being.

Scholarship opportunities in STEM should also be increased to female aspirants to increase female participation in the fields. Role models should also be encouraged to hold discussion with female students and encourage them to pursue professions in STEAM. There is also the need to enlighten females right from adolescence and possibly childhood on the adverse impacts of stereotypes, lack of confidence, self-esteem and male chauvinism.

Further studies can also look into the interaction between education and labour force participation rates in the economy, precisely female labour force participation rate relative to male labour force participation rate and implications for growth in the country.

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