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The Impact of Economic Growth on Female Labour Force Participation: Evidence from Southern African Countries

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ABSTRACT

This paper investigates the impact of economic growth on female labor force participation in Southern Africa, testing the feminization U-shaped Hypothesis. The paper drew from the fact that there is conflicting empirical evidence about the existence of the U-shaped relationship between economic growth and female labor force participation. We argue that cross-country predictions of the U-shaped hypothesis in Southern Africa can give a balanced reflection of the nexus when the region's uniqueness and diversity are incorporated. This kind of investigation may not only help in finding compatible actionable policies to upsurge female labour force participation, but also promote evidence-based policies for the economic empowerment of women in Southern Africa.
Based on the panel threshold and fixed effect model on 15 SADC countries over the period 2000–2018, the findings confirm the U-shaped relationship between growth and female labor force participation in Southern Africa. But the U disappears in the Islands when data is disaggregated according to geographic regions within Southern Africa i.e. (Islands, landlocked, and not landlocked/with coastline countries). The study recommends that the analysis of economic growth and female labor force participation nexus in Southern Africa should consider the importance of geographic locations. This is especially critical since female labour force participation in parts of SADC like the islands and landlocked countries may be influenced by challenges that are geographically inherent to them.

Keywords: Economic growth; female labor force participation; geographic locations; feminization U-Hypothesis.

1.0 Introduction

Female labor force participation (FLFP) is a long-time global concern that existed even before the 1880s (Fernández, 2013; Tilly et al., 1976; Psacharopoulos & Tzannatos, 1989). Hitherto, many researchers seek empirical and theoretical explanations to determine factors responsible for trends in the rate of FLFP (Iheonu, etal., 2020; Idowu and Owoeye, 2019). The quest to explain FLFP emanates from the realization of the benefits that could be attained if the rate of FLFP was to remain high. Such benefits include poverty alleviation, economic growth, and development as well as achievement of the Sustainable Development Goals (SDGs) (Verick, 2018). A higher rate of FLFP is also associated with a reduction in the levels of infant and child mortality (Akinyemi, Solanke and Odimegwu, 2018), a decrease in sex discrimination, increase in empowerment of women (Shirazi,

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2012). Moreover, improvement in the FLFP rate enables countries to enjoy the demographic dividends that come with a decline in fertility rates which also allows the working-age population to be higher than the proportion of dependents (Klassen and Pieters, 2012). Besides, half of the adult population in the world is made up of women (Pimkina & De la Flor, 2020).

The renowned feminization U-Hypothesis is a stylized fact (Verick, 2018) used to explain the economic growth- female labour force participation nexus. It assumes a non-linear U-shaped relationship between economic growth and female labor force participation (Luci, 2009). The relationship also involves changes in other factors like fertility rates, female formal education, female formal employment, the rate of female self-employment, the time that women spent on unpaid family care duties, and social norms towards married women (Goldin, 1995). A positive change in these factors should lead to higher rates of female labour force participation (Klasen, 2019). But this has not been the case in many developing countries (Backhaus & Loichinger, 2021) since social exclusion in employment persists, the gender gap in employment widens (Anyanwu & Augustine, 2013) and women continue to engage in poor-quality jobs to escape poverty or to lessen hardships of economic shocks (Verick, 2018). Looking at the experience of fast growth in the developed world, their success story can be attributed to high numbers of women in formal employment, i.e., women make up half of their labor force (Iheonu et al., 2020).

This paper examines the relationship between economic growth and FLFP in Southern Africa, especially for countries that fall under the Southern African Development Community (SADC). Evidence suggests that FLFP is devalued in SADC and women form a large portion of the poor with limited access to resources and economic opportunities. The SADC is also male-dominated in terms of formal employment (Nyamweda & Morna, 2019). The lack of job opportunities for women in some SADC countries propels women to engage in poor quality jobs (Altman & Pannell, 2012) inherent in the informal economy and whose job security depends largely on the absence of global crises (Rogan & Skinner, 2020).

An investigation of the feminization U-hypothesis focusing on Southern Africa especially countries under SADC is needed considering the dearth of literature in this region and the high rate of unemployment among women. Many cross-country studies which previously examined the U-shaped relationship between economic growth and female labor force participation in Africa include Verme (2014) and Chapman (2015) who examined the MENA countries. Also, Klasen (2019) expanded from MENA to other developing countries like Latin America and South Asia. Idowu and Owoeye (2019) looked into the five African regions (Northern, Central, Western, Eastern, and Southern Africa, though only nine countries were from Southern Africa) while (Iheonu et al., 2020) focused on West Africa. Even though a few scholars included some SADC countries in their analysis of FLFP but the gap remains. The noticeable contribution to the study of FLFP in Africa include the work of Ntuli and Wittenberg (2013) and Yakubu (2010) who looked into FLFP in South Africa; Gronzales et al. (2015) focused on both Sub-Saharan Africa and OECD countries; Sackey (2005) both looked into Ghana. But some of these studies are country-specific while others focus more on education as a key factor driving FLFP. In addition, Southern Africa is already dragging behind its regional counterparts when it comes to economic growth (African Development Bank, 2019) making it necessary to investigate the growth- FLFP nexus in the region.

Nonetheless, the present study is different from previous studies because we employ the threshold panel models to estimate the growth- FLFP nexus. Most studies used other models, for instance, Gaddis and Klasen (2014) found less robust evidence for the U-shape hypothesis by testing both a static (ordinary least squares - OLS and fixed effects) model and a dynamic (autoregressive) model. Verme (2014) divided analysis between parametric and nonparametric evidence. The researcher's nonparametric evidence confirmed that the U-shape hypothesis did hold both worldwide and within the MENA region. Lahoti and Swaminathan (2013) analyzed the relationship between economic development and FLFP in India by using dynamic panel methods but did not find the U-shaped relationship. The panel threshold methodology has been previously used by (Hansen, 1999). Moreover, it has been used by (Wang & Wang, 2021) and acknowledged by (Wang, 2015) as the extensively used method in macroeconomics and financial analysis due to its simple and apparent economic implications. In our analysis, data is further disaggregated to estimate the nexus between economic growth and female labor force participation by geographic locations namely; landlocked, Islands, and not landlocked countries. Using geographic economics to analyze the nexus is not common in the literature but can bring better insights into the relationship.

The testable hypothesis is that there is a U-shaped relationship between economic growth and female labor force participation in Southern Africa and its geographic locations. The next section of the paper gives a background of the study and a synopsis of the theoretical and empirical literature on the relationship between growth and FLFP. Then section three discusses the data and empirical methodology while section four presents the estimation results and discusses the findings. Section five summarizes the study and provides policy recommendations.

2.0 Background

Countries in Southern Africa decided to form a regional economic integration in 1992. One of the major reasons for forming SADC was the pressing need to accelerate the economic and social development of its

member countries to improve the standards of living of their people (Evans, 1997). This led to the formation of the Gender Unit of SADC in 1997. The unit had to pursue six priority areas, of which number four is empowerment programs for SADC women. Later, in 2008, the SADC Protocol on Gender Development was adopted to deal with womwomen'sonomic empowerment (SADC, 2012). Over the years, SADC endeavored to increase economic opportunities for women in terms of access to more and better jobs, creating a business climate that encourages them to start and continue to do businesses, improving access to a financial sector that supports women, implementing gender-sensitive trade policies and employment policies that promote women to be in top lethe vel of management in the private sector which has been dominated by men for a long time. Unfortunately, women are still not well represented in senior and middle management positions as compared to their male counterparts (SADC Selected Economic and Social Indicators, 2018). Southern Africa ranked lowest compared to its regional counterparts. In 2018 Southern Africa had an estimated GDP growth of 1.2 percent. The other five economic regions of Africa ranked higher as follows; Central Africa at 2.2 percent, West Africa at 3.3 percent, North Africa at 4.9 percent, and East Africa at 5.7 percent (African Development Bank, 2019).

Although economic growth and economic development have been used interchangeably in the study of female labor force participation, the two concepts are not the same. Nafzinger (2006) argues that in terms of semantics there is a thin difference between the two concepts. Economic development depicts economic growth accompanied by changes in output distribution and economic structure. These changes may include an improvement in the material well-being of the poorer half of the population; a corresponding increase in GNP share of industry and services; an increase in the education and skills of the labor force; substantial technical advances originating within the country (Nafziger, 2006). All the same, the feminization hypothesis predicts that during economic development, as countries grow, the rate of FLFP changes (Boserup, 1970; Luci, 2009). The transition from a subsistence agricultural economy to an industrialized and labor-intensive economy brings about a change in the rate of FLFP (Olivetti, 2013). Thus, the dynamics in the rate of FLFP are due to structural changes in the economy (Çağatay and Özler, 1995; Goldin, 1995; Gaddis and Klasen, 2014).

3.0 The U-shaped Relationship between Economic Growth and FLFP

The pioneering work on the feminization U-Hypothesis includes (Sinha, 1967; Boserup, 1970; Durand, 1975) and who discovered that economic development determines the rate of FLFP. That is, when economies are at low-income levels, FLFP is high in subsistence farming and other unpaid and or informal jobs. This is because the demand for female labor in the industrial sector greatly declines due to the advent of industrialization. At this phase, the nature of jobs available requires brunt and that social stigma against working women prevails. But when a country is at a high-income level, FLFP in formal employment is higher than in informal employment. This is because when industries expand, more white-collar job openings which are deemed suitable for women, emerge. In between these two extremes of low and high-income levels is a transformation process that involves changes in fertility rates, female education, and social norms. This explains the plateau phase of the U-curve, whereby women are preoccupied with their career and skills acquisition. Also, low fertility rate and social stigma against working women facilitate changes in FLFP at this phase. After the plateau phase, FLFP gradually increases with the level of growth and development, leading to a U-shaped curve (Goldin, 1995). Good-sized evidence verified the existence of the U-shaped relationship between female labor force participation and economic growth and development, including the work of the following scholars; Iheonu et al., (2020); Altuzarra et al., (2019); Chapman (2015); Tam (2011); Luci (2009); Cagatay & Ozler (1995); Goldin (1995).

As research on feminization U-hypothesis evolves, researchers tend to include other factors in their analysis, including unemployment (Altuzarra et al., 2019), urbanization (Fatima & Sultana, 2009), and recently, the income inequality measured by the Gini coefficient, the Atkinson index and the Palma ratio (Iheonu et al., 2020). There are many factors that can cause the relationship between the level of economic development and FLFP to differ across countries (Durand, 1975). These distinctive features of countries may be in a form of gender discrimination (Goldin, 1995; Boserup, 1970), different religious beliefs (Muslims versus Christians) (Fernández, 2013), and the income status of countries (Mammen & Paxson, 2000; Lechman and Kaur, 2015). It is logical then to deduce that other factors such as the geographic setup of Southern Africa (i.e. conglomeration of countries that are either island, landlocked, or not landlocked) may influence the nature of the relationship between economic growth and FLFP in Southern Africa. Hence, economists have also noted the crucial role of economic geography on development and growth since economic policy choices are influenced to a large extent by geography. For instance, the geographic location of a country has an impact on economic growth through its effects on such issues as transport costs, disease burdens, and agricultural productivity. Thus, geographic considerations should be taken into account in econometric and theoretical studies of cross-country economic growth (Gallup, Sachs, & Mellinger, 1999).

In Southern Africa, approximately 70% of women are informal cross-border traders. So, cross-border trade is a source of livelihood for many women which also contributes a lot to the GDP of Southern Africa. But this kind of trade has mishaps that negatively affect women enterprises and the effect of these mishaps differ across border posts (Blumberg et al., 2016; Gofhamodimo, 2018). While landlocked countries may be

particularly disadvantaged by their lack of access to the sea (Gallup et al., 1999), income levels may be precarious in small island economies because they are vulnerable to variations in economic, natural, and political forces (Tisdell, 2009). Sustaining the development of a small island is in itself a very challenging exercise for any government and people due to socioeconomic issues such as the overexploitation of resources, adverse terms of trade, outward migration of skills, foreign debt servicing, and drug trafficking (Obasi, 1994 in Philip Ndegwa et al., 1995). These geographic limitations tend to affect FLFP. For instance, female unemployment remained a major problem in the Mauritian society (Tandrayen-Ragoobur et al., 2011). Some gaps in the literature remain, especially on the economic growth-FLFP nexus in SADC and its geographic diversity. Scarce literature related to this matter includes (Herrera et al., 2016) who focused on fertility and FLFP in Madagascar, and (Gaddis & Ranzani, 2020; Tandrayen-Ragoobur; et al., 2011) who analyzed the determinants of FLFP in Mauritius. Though these country-specific studies provide insights into FLFP in the Islands, they do not provide an all-inclusive view of the SADC geographic situation necessary to make growth-labor force participation policies that are compatible with SADC and the whole of Southern Africa.

The empirical literature which refutes the U-Hypothesis includes the work of Gaddis and Klasen (2011) who discovered that the U-Hypothesis does not hold when dynamic instead of static panel data methods are employed and made a conclusion that, "while it remains possible that today's advanced economies transitioned through the U throughout their economic development, the U-shape seems to have little relevance for most developing countries today" (Gaddis, 2011 pp. 28). In another study, the U-shaped feminization Hypothesis is not supported for the Western African region (Iheonu, etal., 2020). Chapman (2015) finds that structural change from agriculture to industry insufficiently explains the falling FLFP along the declining part of the U-curve. However, there is empirical evidence in support of the U hypothesis in Africa for instance, Idowu and Owoeye (2019) find that the relationship between FLFP and economic development is inverted U-shaped.

4.0 Data and Empirical Methodologies

The data for this study come from 15 Southern African countries and cover the period 2000 to 2018. The dependent variable is FLFP and the independent is GDPPC (gross domestic product per capita). All the variables were chosen based on the contemporary literature. The list of countries included in the study and corresponding population are listed in Appendix 1. Description of variables used in the study is provided in Appendix 2. The geographic locations of SADC are provided in Appendix 3.

This study employs the panel threshold technique to examine the inverted U-shaped relationship between economic growth and FLFP. The panel threshold methodology has been used by Hansen (1999) and Wang and Wang (2021). The threshold effect describes what happens when one variable attains a certain point, causing another variable to change its trend (Huang, Liu, Cai, Hao, & Lei, 2018). As the threshold model expresses a nonlinear relationship between variables, it is thus a suitable model for threshold effect.

The threshold regression model starts with a single threshold. The choice of the sample separation points in threshold regression models is unsystematic, which complicates the regression process and makes the findings difficult to be interpreted. However, Hansen (1999) developed a panel threshold model with isolated effects to address the weaknesses of the classic threshold analysis methodologies. As the threshold model can determine the threshold value and checks its significance, the regression findings are easily interpretable.

For a single threshold, the panel threshold regression setting is as follows:

$$y_{it} = \mu + \theta_0 Z_{it} + \theta_1 X_{it}(q_{it} < \gamma) + \theta_2 X_{it}(q_{it} > \gamma) + u_i + e_{it} \quad (1)$$

Where y_{it} is the explained variable, Z_{it} is the control, X_{it} is the explanatory variable, q_{it} is the threshold variable, and γ is the threshold limit, which separates the equation into two regimes. $\boldsymbol{u_i}$ is the country fixed effect, while e_{it} is the noise and $\boldsymbol{i}$ and $\boldsymbol{t}$ are entity and year indices respectively.

5.0 Model Parameter Estimation

The threshold model is run under different threshold settings for parameter estimation. A traditional linear model is then produced by fitting the computed threshold value(s) into the threshold model (Yi & Xiao-li, 2018). The OLS technique is used to calculate the sum of squared residuals (SSR) $s_1(\gamma)$ for each linear model. The exact threshold value is that which minimizes the SSR of the full model.

The OLS estimation is then used to estimate β as follows:

$$\hat{\beta}(\gamma) = (X^*(\gamma)'X^*(\gamma))^{-1}X^*(\gamma)'Y^* \quad (2)$$

Applying the fixed-effect transformation to the explanatory and outcome variables, Eq. (2) yields X* and Y*. The vector of the residuals is given as: $\hat{e}^*(\gamma) = Y^* - X^*(\gamma)\hat{\beta}(\gamma)$ and the corresponding SSR by:

$$s_1(\gamma) = \hat{e}^*(\gamma)'\hat{e}^*(\gamma) \quad (3)$$

Eq. (4) below is then used to find the ideal threshold value $\hat{\gamma}$ which minimizes $s_1(\gamma)$ in Eq. (3). In addition, the slope coefficient $\hat{\beta} = \hat{\beta}(\gamma)$ is found using;

$$\hat{\gamma}(\gamma) = arg_{\gamma} mins_1(\gamma) \quad (4)$$

6.0 The Threshold Model Test

Two post estimation tests are conducted to determine the threshold effect after the threshold estimation. The first tests the presence of the threshold effect and the second checks whether the estimated threshold is significant.

For the threshold effect test, the null hypothesis of no threshold effect: H_0: $\theta_1 = \theta_2$ is tested against the alternate hypothesis H1: $\theta_1 \neq \theta_2$. The expected coefficients, residuals, and SSR are obtained from the OLS estimation. The likelihood ratio statistic for the null hypothesis is given as follows:

$$F_1 = \frac{s_0 - s_1(\hat{\gamma})}{\hat{\sigma}^2} \quad (5)$$

This statistics does not satisfy the standard χ^2 distribution since the threshold value $\hat{\gamma}$ in Eq. (5) is uncertain. Hansen (1999) deals with this shortcoming, by using bootstrapping to reproduce the asymptotic distribution, compute the actual probability value, and determine the significance of the threshold effect.

For the second test, the null hypothesis is H0: $\hat{\gamma} = \gamma_0$, while the alternative hypothesis is H1: $\hat{\gamma} \neq \gamma_0$. The likelihood ratio statistic is calculated as follows:

$$LR_1(\gamma) = \frac{s_1(\gamma) - s_1(\hat{\gamma})}{\hat{\sigma}^2} \quad (6)$$

In Eq. (6), $s_1(\hat{\gamma})$ is the actual SSR under the threshold model, while $s_1(\gamma)$ is the estimated SSR for different threshold settings. $\hat{\sigma}^2$ denotes the probable SSR scaled by the reciprocal of the degrees of freedom. It should be noted that the obtained likelihood ratio statistics are non-standard statistics. The baseline value that is used to decide whether or not the original hypothesis rejected, is given by: $d(\alpha) = -2\ln(1 - \sqrt{1-\alpha})$. When $LR_1(\gamma) < d(\alpha)$, the original hypothesis is rejected at the α level of significance.

Model Specification

This work employs the panel threshold model to investigate the impact of GDPPC on FLFP in Southern Africa.

Our baseline linear model is given as follows:

$$FLFP_{it} = \theta_0 + \theta_1 GDPPC_{it} + \theta_2 FDI_{it} + \theta_3 FP_{it} + \theta_4 FE_{it} + \theta_5 FR_{it} + \theta_6 WPP_{it} + u_i + e_{it} \quad (7)$$

Hypothesis H_1 according to which economic growth shows a threshold effect on female labor force

$$FLFP_{it} = \theta_0 + \theta_{11} GDPPC_{it} I(q_{it} < \gamma) + \theta_{12} GDPPC_{it} I(q_{it} \geq \gamma) + \theta_2 FDI_{it} + \theta_3 FP_{it} + \theta_4 FE_{it} + \theta_5 FR_{it} + \theta_6 WPP_{it} + u_i + e_{it}$$

participation is then tested. If the test result is significant, the coefficient of GDPPC will take more than one value contingent on the number of thresholds.

For single and double thresholds, we have the following two equations:

(8)

$$FLFP_{it} = \theta_0 + \theta_{11} GDPPC_{it} I(q_{it} < \gamma) + \theta_{11} GDPPC_{it} I(\gamma \leq q_{it} < \gamma_1) + \theta_{11} GDPPC_{it} I(q_{it} \geq \gamma_2) + \theta_2 FDI_{it} + \theta_3 FP_{it} + \theta_4 FE_{it} + \theta_5 FR_{it} + \theta_6 WPP_{it} + u_i + e_{it}$$

(9)

We then separate countries according to their landlocked status to explore if geographic location of countries within SADC has a role in explaining female labor force participation. If the U-shaped hypothesis is confirmed, then the change in female labor force participation is temporary and simply reflects the development process which would correct itself in due course. But if the hypothesis is not supported, then other factors are responsible for change in female labor force participation and need to be investigated.

6.1 Descriptive Statistics

Table 1 below shows the average value of FLFP in the 15 countries is 47.244%, with minimum and maximum values of 34.18% and 55.25% respectively. The average of the LnGDPPC is 7.38 dollars and a maximum of 9.30 dollars. The LnFDI has a mean value of 23.66 dollars, a minimum value of 17.53 dollars, and a maximum value of 24.07 dollars. Except for the standard deviation of the fertility rate (FR), which is higher than expected, all of the above-mentioned variables, including the controls, have low standard deviations, implying less spread and absence of outliers.

Table 1.

Descriptive statistics.

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
FLFP	300	47.24381	4.075501	34.18383	55.24704
LnGDPCC	300	7.382822	1.091985	5.620604	9.301025

Ln FDI	300	23.6637	.385843	17.52921	24.07147
FP	300	50.91224	.8061476	49.55758	52.88408
FE	300	1.733753	1.400852	.194	6.511
FR	300	106.2351	41.83416	25.2786	196.6992
WPP	300	19.18611	12.7884	-60.90909	46.2988
cty1	300	8	4.327713	1	15
year	300	2009.5	5.775916	2000	2018

6.2 Multicollinearity Test

Except for LnFDI, which has a weak correlation with FLFP, the correlation between the dependent and independent variables is average to strong. The correlations between the independent variables are generally modest, with the exception of FR and LnGDPPC, which has an above-average negative correlation. Based on the correlation matrix, it is possible to deduce that multicollinearity is unlikely to exist.

Table 2.

Correlation matrix.

Variables	FLFP	LnGDPPC	LnFDI	FP	FE	FR	WPP
FLFP	1.0000						
LnGDPPC	-0.5233	1.0000					
LnFDI	0.1745	-0.1503	1.0000				
FP	0.4227	0.2014	0.0567	1.0000			
FE	-0.3830	0.4407	-0.0254	-0.2554	1.0000		
FR	0.7017	-0.6909	0.1665	-0.0978	-0.3198	1.0000	
WPP	0.3237	0.1054	-0.0542	0.1979	0.0611	0.1659	1.0000

6.3 Threshold Test

We effected 300 bootstrapping to test the presence of the threshold effect. We successively performed single, double and triple threshold tests depending on the significance of the threshold effect. Based on the threshold test, we concluded that there is a double threshold effect between FLFP and GDPPC in this group of 15 countries. The results of the bootstrapping reveal that for the single threshold effect, the F-statistic is 230.25, which is higher than that of the 1% critical value of 116.438, pointing to the fact that the single threshold effect is significant at the 1% level. Similarly, the F-statistic of the double threshold effect is 275.68, which is also higher than the F-statistics of the 5% critical value of 252.52, indicating the presence of a double threshold effect at the 5% level of significance. The F statistics of the triple threshold effect is 41.47 which is less than that of the 10% significant level, implying no threshold effect. As a result, it can be concluded the GDPPC and FLFP have curvilinear relationship in these 15 countries between 2000 and 2018 inclusively, when fertility is used as the threshold variable. So, GDPPC has a significant double threshold effect on FLFP. Table 3 shows the bootstrapping results.

Table 3.

Bootstrapping Test.

Threshold	Single	Double	Triple
F-Statistic	230.25***	275.68**	41.47
P-Value	0.0000	0.0275	0.2900
Critical Values			
1%	116.438	328.47	260.17
5%	90.232	252.52	102.45
10%	77.242	165.46	65.66

Note: *p<0.10, **p<0.05, ***p<0.01

We calculated thresholds and their corresponding 95% confidence intervals. The single and double threshold values are 59.1762 and 80.2276 with confidence intervals of (55.4586, 59.6191) and (79.4997, 80.6428) respectively. Consequently, the relationship between GDPPC and FLFP is curvilinear as there is double threshold effect between them. Table 4 shows thresholds and their 95% intervals.

Table 4.

Thresholds and 95% Confidence Intervals.

Threshold Value	95% Confidence Interval	
	Lower Value	Upper Value
59.1762	55.4586	59.6191
59.1762	55.4586	59.6191
80.2276	79.4997	80.6428

6.4 Double Threshold Regression

The results of double threshold regression in table 5 show that GDPPC has a three-interval nonlinear variation in its influence on FLFP, as its coefficient changed from positive to negative and changed again in value but remained negative. When qit<9.822, its coefficient is 8.0428, when $59.176 \leq \text{qit} < 80.228$, the coefficient of GDPPC is -1.4809 and when $q \geq 80.228$, its coefficient is -1.7442. The coefficients of GDPPC at all the different threshold intervals are significant at the 1% level. As the coefficient of GDPPC is negative at higher threshold levels, this suggest that its definite coefficient in the quadratic form will be negative which meets one of the conditions of the U-shaped curve as its coordinates at the minimum point most be positive. Overall, the relationship between FLFP and GDPPC in the 15 countries has been nonlinear across the sample period, indicating that as GDPPC increases, its impact on FLFP changes.

Table 5.

Double Threshold Regression.

Variable	Coefficient	T-Stat
LnFDI	0.0124	(0.17)
FP	2.0173 ***	(15.97)
FE	-0.5801***	(-10.60)
F R	-0.0208***	(-5.39)
WPP	0.0061	(1.38)
LnGDPPC(q< 59.176)	8.0428***	(19.87)
LnGDPPC($59.176 \leq q < 80.228$)	-1.4809***	(-5.79)
LnGDPPC($q \geq 80.228$)	-1.7442***	(-6.85)
Cons.	-51.7436***	(-6.91)

Note: *p<0.10, **p<0.05, ***p<0.01

6.5 Quadratics Fixed-Effects Regression

The threshold effect methodology of investigating the U-shaped relationship between GDPPC and FLFP is completed by estimating the following quadratics fixed-effects regression:

$$FLFP_{it} = a_0 + a_1 GDPPC_{it} + a_2 (LnGDPPC_{it})^2 + e_{it}$$

Table 6 shows that as the coefficient of LnGDPPC is negative (-33.303) and that of its square is positive (2.3037) and are both significant at the 1% level, the U-shaped relationship between GDPPC and FLFP is confirmed; that is, female labor force participation will decrease initially with increase in per-capita gross domestic product and start increasing after attaining a certain level of development.

Table 6.

Quadratics Fixed-effects Regression.

Variable	Coefficient	T-Stat
LnGDPPC	-33.303***	(-21.15)
$(LnGDPPC_{it})^2$	2.3037***	(21.67)
Cons	164.82***	(28.28)

Note: FLFP is a dependent variable. t stats are presented in the parenthesis, *p<0.10, **p<0.05, ***p<0.01.

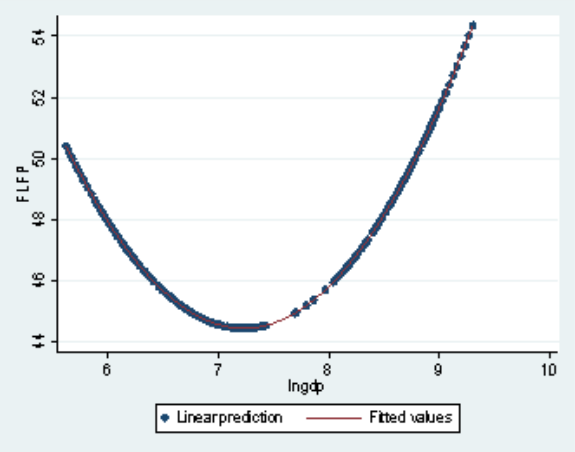


Figure 1: The U-shaped relationship between economic growth and female labour force participation in SADC.

6.6 Test of the U-shaped Relationship by Geographic Locations

The result of the bootstrapping reveals the single threshold effect for both the landlocked and not landlocked panels and a double-threshold effect for the Island countries. For the not landlocked group, the F-statistic is 270.90, which is higher than that of the 1% critical value of 32.679, pointing to the fact that the single threshold effect is significant at the 1% level. The F statistics of the double threshold effect is 15.75 which is less than that of the 10% critical value of 183.141, implying no double threshold effect. Similarly, for the landlocked countries, the F statistic of the single threshold effect is 32.86 which is higher than that of the 10% critical value of 31.3097, suggesting the presence of a single threshold effect at the 10% level of significance. For Island, the F-statistics of the single and double threshold effect are 32.40 and 19.62 which are respectively significant at the 1% level. The F statistics of the triple threshold effect is 16.97 which is less than that of the 10% significant level, implying no triple threshold effect. It is therefore concluded that the GDPPC and FLFP have curvy relationship in these different geographic zones between 2000 and 2018 inclusively, when fertility is used as the threshold variable. So, GDPPC has a significant single and double threshold effects on FLFP.

Table 7.

Bootstrapping Test.

	Not landlocked		Landlocked		Island		
Threshold	Single	Double	Single	Double	Single	Double	Triple
F-statistics	270.90	15.75	32.86	21.55	32.40	19.62	16.97
P-value	0.0000	0.7800	0.0867	0.1267	0.0000	0.0000	0.2333
Critical values							
1%	32.679	378.402	53.9481	65.2369	26.8634	18.8549	40.703
5%	27.559	243.257	39.6816	32.3909	26.6046	17.9810	26.646
10%	22.324	183.141	31.3097	23.7776	19.8871	12.1552	24.450

6.7 Thresholds and 95% confidence intervals

The estimated thresholds, as well as their 95 percent confidence intervals, are shown in Table 8. Not landlocked, landlocked, and the Island have single threshold values of 84.863, 78.564, and 94.8934, respectively, whereas the Island has a double threshold value of 94.893. In all three geographic zones, the threshold test depicts a curved relationship between GDPPC and FLFP.

Table 8.

Thresholds and 95% Confidence Intervals.

Geographic Location	Threshold Values	95% Confidence Interval	
		Lower Value	Upper Value
Not landlocked	84.8626	83.4088	116.9260
Landlocked	78.5640	77.6295	79.1870
Island	79.5170	77.4886	82.0526
	94.8934	93.5442	107.3100

The key finding of this study is that GDPCC leads to FLFP reduction in SADC as a whole but not in all its geographic locations. Moreover, GDPCC, FDI, FP, FE, FR and WPP are all essential factors in reducing FLFP in all three geographic locations of SADC. In the Islands, FP, FE and WPP are significant. The land locked countries have all of these factors statistically significant, whereas FDI, FP and FE are significant in the not landlocked countries. The impact of GDP on FLFP has experienced two intervals of nonlinear downward trends in overall SADC and its landlocked and Island countries. When qit<9.150, the coefficient of GDPPC is -0.3780 at the 1% significance level in the landlocked countries. This coefficient is -0.5630 when qit>=9.150, but is only significant if the significant level is raised to 12%. In the Island, when FR<9.818, the coefficient is 9.9637 at the 1% significance level. Table 9 shows the threshold regression.

Table 9.

Threshold Regression by Geographic Locations.

Not Landlocked			Landlocked			Island		
LnFDI	0.4103*	(1.93)	LnFDI	-4.5814***	(-4.21)	LnFDI	-0.0289	(-0.48)
FP	3.6352***	(9.43)	FP	2.2288***	(14.88)	FP	-4.4725**	(-2.15)
FE	-0.1799**	(-3.65)	FE	3.2802***	(8.28)	FE	-0.7435***	(-3.04)
FR	-0.0094*	(-1.66)	FR	-0.0243***	(-3.91)	FR	-.00164	(-0.25)
WPP	0.0092	(1.19)	WPP	-0.0334***	(-4.66)	WPP	0.0131**	(2.28)
LnGDPPC<9.150	7.9742***	(13.23)	(q<9.150	-0.3780	(-0.90)	q<9.818	9.9637**	(14.39)

LnGDPPC($\leq q <$	-	-	-	-	-		9.8209***	(13.92)
LnGDPPC$\geq$ 80.228	-	(-4.28)	$q \geq$9.10	-0.5630*	(-1.83)	q≥9.818	-1.1433	(-0.59)
Cons	1.5140***	(-7.96)	Cons	46.333	(1.50)	Cons	217.612**	(2.15)
	-							
	160.75***							

Note: FLFP is a dependent variable. t stats are presented in the parenthesis, *p<0.10, **p<0.05, ***p<0.01.

We complete the threshold effect methodology of investigating the U-shaped relationship between GDPPC and FLFP by geographic location by estimating the following quadratics fixed-effects regression for each geographic location:

$$FLFP_{it} = a_0 + a_1 GDPPC_{it} + a_2 (LnGDPPC_{it})^2 + e_{it}$$

The results of the above estimations are presented in table 10 below:

Table 10 shows that the coefficient of GDPCC is negative both in the landlocked and not landlocked while the square term is positive the landlocked and not landlocked at 1% significance level. This shows that initially a unit decrease in GDPCC will cause 30.5359 and 38.3257 decrease in FLFP for both the not- landlocked and the landlocked countries respectively. Then the GDPCC will increase again causing FLFP to also rise by 2% and 3% in not landlocked and landlocked countries respectively.

Table 10.

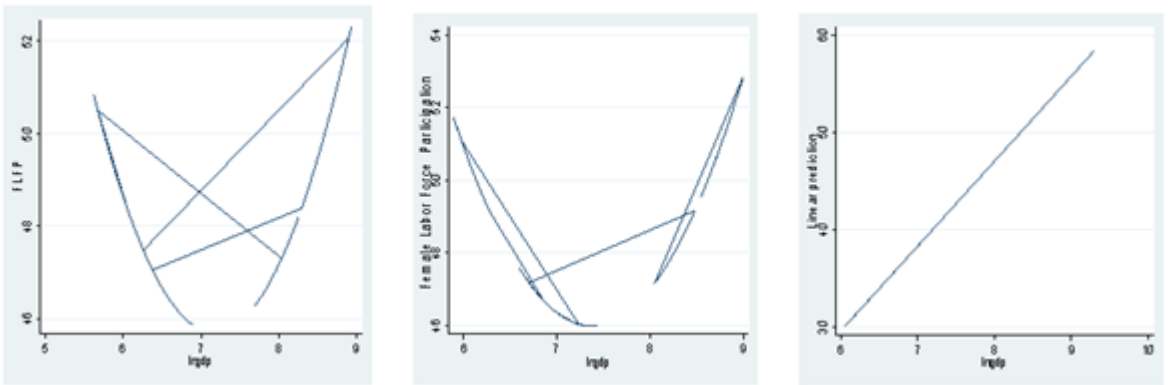
Quadratics fixed-effects regression for geographic locations.

Variable	Not Landlocked		Landlocked		Island	
LnGDPCC	-30.5359***	(- 20.27)	-38.3257***	(-10.41)	8.5114	0.86
$(LnGDPPC_{it})^2$	2.12859***	(19.80)	2.5986***	(10.41)	0.0129	(0.02)
Cons	155.216***	(29.56)	187.304***	(13.85)	-21.873	(-0.52)
Obs.	120		120		60	

Note: FLFP is a dependent variable. t stats are presented in the parenthesis, *p<0.10, **p<0.05, ***p<0.01.

Figures 2a, 2b and 2c below show that there is a U-shaped relationship between GDPCC and FLFP in the countries that are landlocked, not landlocked and island respectively. Whereas figure 2a and 2b confirm the U-shaped relationship in the countries that are not landlocked and those that are landlocked, figure 2c shows that there is no U-shaped relationship between GDPCC and FLFP in the islands.

Figure 2a Figure 2b Figure 2c



Figures 2a, 2b and 2c: The U-shaped relationship by Geographic Locations

6.8 The Levin–Lin–Chu Unit Root Test Results

The Levin–Lin–Chu (2002) unit root test for stationarity in panel datasets is used. The null hypothesis of this test is that all the panels contain a unit root. This choice is based on the fact that we have a balanced panel (i.e each panel has 20 observations). This test shall involve fitting an augmented Dickey–Fuller (ADF) regression for each panel; with at most 10 lags selected based on the AIC. In table 11, it can be seen that except for WPP which is not stationary at level, all the other variables are stationary at level, at the 1% level of significance according to the Levin Lin Chu test. Therefore, dropping WPP, all the variables used for this study are integrated of order zero (i.e., I(0)). Thus, WPP can be dropped before running the quadratic panel regression.

Table 11.
The Levin-Lin- Chu Unit Root Test.

Variable	LLC
FLFP	-5.5871***
LnGDPPC	-4.4699 ***
$LnGDPPC^2$	-3.9007***
LnFDI	-4.0674***
FP	-5.1934 ***
FE	-3.1965 ***
FR	-4.0944 ***
WPP	1.4527

Note: llc test reports the adjusted t* values. The asterisks (*) represent the levels of significance,*p<0.10, **p<0.05, ***p<0.01.

6.9 The Pedroni and Kao Tests

To empirically find out whether there is a long run relationship and dynamic interactions between FLFP and the other variables used, we employed both the Pedroni (1999, 2004) and Kao (1999) panel cointegration test. Both tests have a common null hypothesis of no cointegration, and the alternative hypothesis of both tests is that the variables are cointegrated in all panels. The main purpose here is to test for the absence of cointegration by ascertaining whether the individual variables are error correcting or not. In case of any cointegrating relationship, an error-correction model (ECM) shall be estimated. The ECM shows the speed of adjustment from the short-run equilibrium to the long-run equilibrium. Larger coefficient of the error correction term, implies faster speed of adjustment of the model from the short-run to the long-run.

The ECM is specified as follows:

$$\Delta CAB_{it} = C_i + \lambda e_{t-1} + \sum_{j=1}^{n} \tau_j \Delta FDI_{it-j} + \sum_{j=1}^{n} \varphi_j \Delta M2_{it-j} + \sum_{j=1}^{n} \alpha_j \Delta GDP_{it-j} + \sum_{j=1}^{n} \mu_j \Delta Inflat_{it-j} + \sum_{j=1}^{n} \alpha_j \Delta \text{rexrat}_{it-j} + \sum_{j=1}^{n} \vartheta_j \Delta HCEX_{it-j} + \sum_{j=1}^{n} \gamma_j \Delta NEX_{it-j} + \epsilon_t \dots\dots\dots\dots\dots\dots (13)$$

Table 12 shows that all the panel and group statistics of the Pedroni cointegration test are significant at the 1% level. For the Kao cointegration test, three out of the five statistics are significant, suggesting that the null hypothesis of no cointegation is rejected. Thus, an error-correction model (ECM) shall be estimated.

Table 12.
The Pedroni and Kao Tests.

Test stats.	Pedroni		Kao		
	Panel	Group		t-statistic	P-value
v	-2.031***		Modified Dickey-Fuller	-1.6313*	0.0514
Rho	4.037***	5.476***	Dickey-Fuller	-1.6999**	0.0446
t	-4.087***	-5.770***	ADF	-1.0260	0.1525
ADF	8.141***	8.919***	Unadjusted modified DF	-1.1954	0.1160
			Unadjusted DF	-1.4761*	0.0700

Note: *p<0.10, **p<0.05, ***p<0.01.

The Error Correction Model (ECM)

In the table 13 below the relationship between FLFP and GDPCC is explored. The coefficient of GDPCC is negative and its square term are positive, showing that as GDPCC decreases, FLFP also decreases but then when GDPCC rises again then FLFP also rises at 1% significant level. However, a decrease in FR and WPP leads to a decrease in FLFP at 5% significant level whereas one unit increase in FP causes a 1.182734 increase in FLFP at 5% significant level.

Table 13.
The Error Correction Model.

Variables	FE	FE
LnGDPPC	-22.17353***	0.7488833***
	(0.000)	(0.753)
$(LnGDPPC)^2$	1.628859***	-.0575022
	(0.000)	(.0733)
LnFDI	-0.2353234	-0.48708*
	(0.424)	(0.100)

FP	1.182734***	1.21938***
	(0.001)	(0.000)
FE	-0.0688511	-0.0381337
	(0.634)	(0.465)
FR	-0.0272839**	0.0046535***
	(0.022)	(0.272)
WPP	-0.0403902**	-.0025291
	(0.018)	(0.285)
Cons	11.18759***	11.18759***
	(0.015)	(0.015)
Obs.	300	300

Note: FLFP is a dependent variable. t stats are presented in the parenthesis, *p<0.10, **p<0.05, ***p<0.01.

6.10 Hausman test results

We used Hausman test to test the hypothesis that both fixed and random effects models give the same estimates. We reject this hypothesis when the p-value of χ^2 is less than the 5% and use the fixed effect. As χ^2 is equal to 189.91 with a P-value of 0.0000 which is less than 5%, the fixed effect model is used.

6.11 Results of Fixed Effect Estimation

In the Table 14 below the coefficient of the GDPPC is negative and its square term is positive, showing that at first GDPCC decreases with FLFP and increases again with FLFP. And the coefficient of FP is positive indicating that a unit increase in FP leads to 1.5408 increase in FLFP. However, a unit decrease in FE and FR will cause FLFP to decrease by 2% respectively.

Table 14.

Quadratic Fixed Effects Regression.

Variables	FE	FE
LnGDPPC	-29.338***	-29.391*** (1.2851)
	(1.2964)	
$(LnGDPPC)^2$	2.0236***	2.0260*** (0.0851)
	(0.0855)	
LnFDI	-0.0924	-0.0923 (0.0783)
	(0.0784)	
FP	1.5408***	1.5338*** (0.1273)
	(0.1291)	
FE	-0.2233***	-0.2198*** (0.0587)
	(0.0597)	
FR	-0.0246***	-0.0241*** (0.0038)
	(0.0040)	
WPP	-0.0016	
	(0.0048)	
Cons	77.904***	78.434*** (9.5184)
	(9.6580)	
Obs.	300	300

Note: FLFP is a dependent variable. t stats are presented in the parenthesis, *p<0.10, **p<0.05, ***p<0.01.

7.0 Conclusion

The primary aim of this study was to test the feminization U-Hypothesis in Southern Africa. The analysis first focused on Southern Africa as a whole, which includes 15 countries belonging to the SADC. Secondly, data was disaggregated into geographic regions of Southern Africa, composed of countries that are landlocked, not-landlocked and islands. The results of this study confirm the feminization U-hypothesis in Southern Africa. Luci (2009) and Chapman (2015) obtained similar results, though with different methodology. However, the influence of economic geography on the U-Hypothesis in Southern Africa surfaces in the islands. This is because when it comes to the islands, the U disappears. However, it is positively verified in both the landlocked and the not-landlocked countries. This could be due to the inherently challenging geography of islands, involving natural disasters (Tisdell, 2009). As such, changes in FLFP rate of islands may not necessarily follow a development path that will automatically rectify itself with time. This may affirm the contention of Gaddis (2013) that the U-Hypothesis may have explained FLFP in the developed countries but may not do so for developing countries. For developed countries, gradual development and subsequent growth duly led to higher rates of FLFP in paid

employment (Boserup, 1970; Luci, 2009; Olivetti, 2013; Goldin, 1995). But for for some developing countries, the explanation of the U-Hypothesis may require additional factors such as the economic geography, to fully address the dynamics of FLFP especially in Southern Africa. Although, landlocked countries face economic setbacks due to lack of access to the sea (Gallup et al., 1999) and cross border trade challenges (Blumberg et al., 2016; Gofhamodimo, 2018), the results of this study confirms the U-Hypothesis in the landlocked. This may be explained by the fact that already a considerable per centage of women in Southern Africa is engaged in cross border trade for employment (Gofhamodimo, 2018). By implication, landlocked countries may be propelled to depend on the not-landlocked countries for employment. In turn this may have a spill-over effect such that economic expansion in the not-landlocked economies, may enhance more women from the landlocked countries to engage in cross border trade. Likewise, Çağatay and Özler (1995) attributes the changes in the FLFP rate to the structural changes in the economy. An important policy implication stemming from this study is that as SADC countries seek to improve employment outcomes for women in the region, the geographic diversity of the region should be given a careful consideration.

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Appendixes

Appendix 1 List of SADC Countries and their population

SADC Member States	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Angola	22 099	22 802	23 533	24 292	25 080	25 901	26 681	27 503	28 359	29 250	30 175
Botswana	1 951	1 988	2 025	2 063	2 101	2 156	2 195	2 230	2 155	2 303	2 339
Comoros	669	687	705	724	744	764	785	806	828	851	851
DRC	70 391	72 884	75 259	77 817	80 462	83 197	85 026	86 895	88 806	91 724	97 356
Eswatini	1 044	1 055	1 067	1 080	1 093	1 106	1 119	1 132	1 093	1 120	1 134
Lesotho	1 887	1 892	1 897	1 901	1 908	1 916	1 924	1 942	1 953	2 183	2 125
Madagascar	19 601	20 142	20 696	21 263	21 842	22 434	23 040	23 658	24 290	25 680	26 969
Malawi	13 520	13 948	14 389	14 845	15 317	15 805	16 311	16 833	17 373	17 564	18 629
Mauritius	1 247	1 250	1 252	1 256	1 259	1 261	1 263	1 263	1 265	1 265	1 266
Mozambique	21 803	22 417	23 050	23 701	24 366	25 042	25 728	26 424	27 864	28 586	29 318
Namibia	2 103	2 143	2 116	2 155	2 196	2 238	2 281	2 459	2 369	2 414	2 459
Seychelles	87	88	87	87	89	91	93	95	96	97	98
South Africa	50 545	51 329	52 129	52 930	53 751	54 574	55 407	56 253	57 098	57 939	58 775
Tanzania	41 916	43 187	44 485	44 929	46 356	47 831	49 359	50 942	52 555	54 199	55 891
Zambia	12 626	13 093	13 719	14 145	14 600	15 023	15 474	15 934	16 405	16 887	17 381
Zimbabwe	12 231	12 336	12 754	13 062	13 368	13 652	13 944	14 240	14 745	15 273	15 573
SADC Total	**273 720**	**281 241**	**289 163**	**296 251**	**304 532**	**312 992**	**320 630**	**328 608**	**337 254**	**347 334**	**360 339**

Source:(SADC, 2020)

Appendix 2 Description of Variables

Variable	Code	Description
Female labour force participation	FLFP	Economically active women aged 15 to 64, who can supply labor for the production of goods and services
Gross domestic product per capita	GDPPC	A measure for economic growth in current U.S. dollars.
Control Variables		
Female Population	FP	Female population between the ages 15 to 64, which counts all residents regardless of legal status or citizenship.
Fertility rate	FR	The average number of children a woman gives birth to
Self-employment	FE	The proportion of female employers
Women Political Participation	WPP	Share of women in leadership positions measured by number of women who are in parliament.
Geographic location	TI	A categorical variable divided into three: (a) Landlocked; (b) not landlocked; (c) Island
Other Codes		
	q_{it}	Threshold critical value
	γ	Threshold variable (Gamma)
	I(.)	Index function
	u_i	Entity fixed effect

Source: Author's compilation based on literature perused

Appendix 3 Geographic Locations of SADC

Geographical location		
Not landlocked	Landlocked	Island
Angola	Botswana	Comoros
Democratic Republic of Congo	Eswatini	Madagascar
Mozambique	Lesotho	Mauritius
South African	Malawi	Seychelles*
Tanzania	Zambia	
Namibia	Zimbabwe	

*Seychelles was excluded due to lack of data

Source: Author's compilation based on literature perused