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Causal Relationship Between Female Labor Force Participation Rate and Total Fertility Rate: An Empirical Evidence from Mena Countries

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ABSTRACT

This study aims to investigate the causal relationship between female labor participation rate and fertility rate in MENA countries. It uses the data of Female Labor Participation Rate (FLPR) and Total Fertility Rate (TFR) from the World Database Indicators (WDI) which spans the period from 1990 to 2020. It is a quantitative approach that applies the panel unit root test, Pedroni residual test, Vector Error Correction Model, and Granger Causality test. The findings revealed the existence of cointegration between the two variables, meaning that there is a long-run effect between FLFPR and TFR in MENA countries. Furthermore, there is the occurrence of a unidirectional causal relationship that runs from the TFR to FLFPR, in that the female labor participation rate in MENA countries depends on the total fertility rate. The results from the world economic report of 2019 showed that the MENA countries have the lowest female labor force participation in the world, and the relationship between the total fertility and female labor force participation rate is inversely proportional. MENA countries need to impose the necessary economic policies for female empowerment in the labor market. Good and effective policies for female empowerment in the labor market will provide a positive direct proportional relationship between female labor force participation and total fertility in MENA countries.

Keywords: Female labor participation rate, Total fertility rate, Granger causality, Vector error correction model, MENA countries
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1. Introduction

The labor participation rate of females in the labor market of MENA countries is less efficient when compared to the European and NAFTA union (Skadsen, 2017). Also, the International Labor Organization report showed that the unemployment rate of females in the world labor market is above 50% (Tsani, Paroussos, Fragiadakis, Charalambidis, & Capros, 2012). Despite a substantial improvement a few years ago for females in MENA countries who participated in the labor market, the economic development gender gap remains one of the largest in the world. Female labor force participation in MENA is the lowest globally, estimated at 20 percent in 2019 (ElAshmawy, Muhab, & Osman, 2020). The female labor force from the age of 15 to 64, had a positive significant contribution to global economic development (Sahai, 2021). Thus, the participation of females as the labor force in the market and the total fertility rate increased the demand in the world labor market (Groshen & Holzer, 2021). However, females' participation in the labor market begins at the family level, community level, national level and international level, which led to the reduction in the unemployment rate in the community level (Burns, Schlozman, & Verba, 2021).

Despite the increase of females in the labor market, efficient production should be evaluated from aspects of the educational system, life expectancy, fertility rate, healthy perspectives, and implementation of good and effective socioeconomic policies (Ranganathan & Shivaram, 2021). In general, policies for female labor force participation in the labor market contribute to society's development (Kabeer, 2021). However, factors like education level, availability of the social services and fertility rates cannot be an obstacle to prevent females who participated in the labor market equilibrium (Bolzani, Crivellaro, & Grimaldi, 2021). Therefore, there is a need to allow the females to participate in the labor market. For this reason, there should be the investigation into the causal relationship between the FLFPR and TFR in MENA countries.

The study asked the following questions: is there any causal relationship between the FLFPR and TFR? Is the correlation of variables unidirectional or bidirectional? Does the FLFPR depend on TFR or does TFR depend on the FLFPR or do both variables depend on each other. Is there any cointegration effect between the FLFPR and TFR? This study contains three sub-sections; a literature review, data, methodology and estimated results, and conclusion. The following is the literature review.

2. Literature Review

The relationship between the female labor force participation rate and total fertility rate in the world labor market was discussed by different scholars. The relationship between the FLPR and TFR argument differ among countries. Women's participation in the labor force and the fertility rate depends on countries' social policies. While some countries experience a positive correlation between the two variables, others experience an inverse relationship between FLFPR and TFR. For example, in most developing countries a decrease in TFR found to increase FLFPR. In other words, an inverse relationship was found between the FLFPR and TFR in developing countries. The Scandinavian countries have a positive proportional relationship between FLFPR and TFR. The FLFPR increased in a positive proportional relationship with TFR.

The study conducted by Feyrer, Sacerdote, and Stern (2008) argued that a higher percentage of women in the labor market was accompanied by a lower fertility rate (Feyrer et al., 2008). Also, the study conducted by Burtz and Ward (1979) found that when the fertility rate decreased, women's demand for entering the labor force increased and this created an opportunity for having children (Burtz & Ward, 1979).

Bowen and Finegan (1969) argued that two opposite effects could emerge when birth rate increased. The first effect was that as women's need for finding a job increased due to the increase in the number of children in the family, which necessitated a higher family income. The opposite effect was a decrease in FLFPR because an increase in the number of children at home required the mother to spend more time caring the children at home instead of searching for a job. In this context, the income in a family would decrease (Mishra & Smyth, 2010).

Burtz and Ward (1979) argued that current fertility patterns were countercyclical. The emergence of countercyclical fertility behavior over the past two decades was explained by the dramatic increase in the employment of women. The increase in aggregate demand over the past two decades raised the income of both males and females. The substitution effect of the female wage increases dominated the income effects of rising male and female income, thereby leading to countercyclical fertility behavior (Farley & Allen, 1987).

The research conducted by Sundström and Stafford (1992) indicated that Sweden and Ireland, parallel to the European union, experienced a positive relationship between FLFPR and TFR in 1980 and early 1990 by having higher FLFPR accompanied by a higher TFR (Sundström & Stafford, 1992).

McNown and Rajbhandary (2003), by using time series data, found a correlation between TFR and FLFPR. The study revealed a cointegration effect and unidirectional relationship which runs from TFR towards FLFPR meaning that FLFPR depended on TFR (McNown & Rajbhandary, 2003). Engelhardt, Kögel, & Prskawetz (2004) researched the relationship between FLFPR and TFR by using Panel data, VECM, Granger Causality in his methodology. He found cointegration effects and a causal relation from TFR to FLFPR. The results indicated that an increase in TFR leads to a decrease in FLFPR (Engelhardt et al., 2004).

Most of the studies on FLFPR and TFR focused on the cointegration and causal relationship effect. But most of the analyses on MENA countries could not come up with specific solutions for the implementation of good policies to increase FLFPR of the MENA countries from lower levels to middle levels according to the World economic report. In this study both the long-term effect long-term run relationship between the FLFPR and TFR in MENA countries was analyzed. Additionally, several social policies are discussed, which contribute to increasing females' participation in the labor market with the aim of attaining positive progress in social-economic development. Furthermore, the next section is related to the data, methodology, and estimated results of this study.

3. Data, Methodology and Estimated Results

3.1. Data

The study used the panel data from the World Database Indicator (WDI) with two variables of FLFPR and TFR over a thirty-year period from 1990 to 2020. The data on FLFPR and TFR was mostly gathered from MENA countries[1]. The variables are introduced in the form of a natural logarithm to express the estimated variables in percentage form. Also, the variables are presented in the form of lnFLFPR and lnTFR.

3.1.1. Methodology

This study adopts an applied quantitative methodology and a theoretical and empirical approach. Thus, the methodological part enabled us to explain and discuss economic models and econometric techniques in the analysis. On top of that, this section starts with a theoretical approach and continues with an empirical analysis.

3.1.2. The Panel Unit Root

The panel unit root is used to determine the existence of stationary and nonstationary data. In this context, the presence of stationary and nonstationary data is evaluated based on the order of integration. The order of integration represents the integration of the variable which is free from heteroscedasticity and multicollinearity problems (Smeekes, 2015). The identification of the stationary and nonstationary panel data is determined by a majoritarian decision. From these perspectives, the Panel unit root test consists of three phases, as used by Levin, Lin and Chu (2002), Im, Perasan and Shin (2003) and Breitung (2000), and each includes LLC, IPS and UB respectively (Lee & Chang, 2008). All three tests are used to determine the stationarity of the variables regarding their integration. Thus, analyzing

[1] Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunisia, United Arab Emirates and Yemen.

stationary data should follow the Maddala and Wu (1999) process for identifying the integration effect. In addition, the Fisher test, ADF and PP can be used to test the stationarity of the data (Maddala & Wu, 1999). The existence of integration is associated with stationarity conditions. If the variable is found to be less than 5% by its probability, this means that, the respected variable is stationary, otherwise it is non-stationary (Arbia & Baltagi, 2008). Once, the variable is found to be in a stationary state, it implies that the variable defines the order of integration, which can exist at level, at first difference level. and at second difference level (Baffes, 1997). In terms of the equations, the panel unit root test according to Im (2003) can be expressed as follows:

$$Y_{it} = \beta_i Y_{it-1} + \delta_i X_{it} + \varepsilon_{it} \tag{1}$$

The letter "i" equal to 1 …...N indicates the individual countries in the data, t 1 represents the number of the period of the years, Y_{it} represents the dependent variable, X_{it} represents the independent variable in the model including the random effect error, the symbol β_i represents autoregressive coefficients in the model, ε_{it} and stands for stationary error term. Therefore, the average of ADF which follows serial correlation diagnosis should be presented as follows:

$$\varepsilon_{it} = \sum_{j=1}^{p_i} \phi_{ij} \varepsilon_{it-j} + u_{it} \tag{2}$$

Thus, by substituting the right-hand side of equation 2 into equation 1 above, the ADF regression equation will be presented as follows:

$$Y_{it} = \beta_i Y_{it-1} + \sum_{j=1}^{p_i} \phi_{ij} \varepsilon_{it-j} \quad \delta_i X_{it} + u_t \tag{3}$$

The letter in equation 3 stands for the maximum value of ADF lag. The null hypothesis of panel data of each series is given as $H_0 : \rho_i = 1$ and the alternative hypothesis is $H_0 : p_i < 1$. Therefore, Im (2003) uses both mean t-statistic and average of individual t statistics in testing the null hypothesis of unit root for each variable.

Then. the four tests of panel data are implemented, and grounded on the ADF tool like Lev, followed by Lin and Chu (2002). All tests restrict parameter by positioning them, it identifies the cross-sectional regions as represented bellow,

$$\Delta Y_{it} = \alpha_i + \beta_i Y_{(t-1)i} + \sum_{j=1}^{w_{ij}} \delta_{ij} \Delta Y_{(it-j)} + \varepsilon_t \tag{4}$$

Here 'i and j' represent the individual country the year respectively, which are included in the time-series data. Apart from that, the analysis can have the following null hypothesis.

The hypothesis testing for LL can be expressed as follows: $\beta_i = \beta = 0$ {null hypothesis}, $\beta_1 = \beta_2 = \beta_T < 0$ {alternative hypothesis} where the test is created on the t-statistics concept. On the IPS side, the hypothesis testing of panel data can be represented as follows: $\beta_i = 0$ {null hypothesis}, $\beta_i < 0$ {alternative hypothesis}. The concept of the IPS is constructed on the mean group through which average value of $t_{\beta i}$ can be obtained by using the ž statistic that can be expressed as follows:

$$\check{Z} = (\frac{N(t-E(t))}{Nvar(t)})^{1/2} \quad (5)$$

Here, 't' represents the mean of the data. But the mean t can be obtained by taking $t = (1/N)\sum_{i=1}^{N} t_{\beta i}$, the term E(t) from the model represents the mean, whereas var(t) indicates the variance of the model while $t_{\beta i}$ is their generation of the simulations.

3.1.3. The Panel Cointegration Test

This study used the Pedroni (1999) test to detect the cointegration effect after the integration effect is found from the panel unit root step. The Pedroni test uses heterogeneous panel data which operates with two different residual-based tests. The first step has four tests: panel υ statistic, panel t-statistic, panel PP[2] statistic and panel ADF[3] statistic. The second step is the Pedroni's test which has three test statistics; group P t statistic, group t PP statistic, and group ADF t-statistic. In general, these tests can accommodate individual specific short run, individual random and fixed effect, and individual effect of the slope coefficients (Pedroni, 2004). The main target of introducing the Pedroni test is to determine the presence of a cointegration effect, which defines the long run effect. The Pedroni (1999) test can be presented as

$$Y_{it} = \alpha_{it} + \delta_{it}\, t + \beta_i X_i + \varepsilon_{it} \quad (6)$$

Both Y_{it} and X_{it} are studied variables from panel data with a measurement of an (N * T) x 1 and (N*T) x m, respectively. The Pedroni test processes the heterogeneity panel data separately to determine the long-term effect between variables. The panel data can be represented or estimated in terms of heterogeneous and group mean panel cointegration. These two types of obtaining the cointegrations are presented below.

Panel υ - statistic;

$$Z_{\upsilon} = (\sum_{i=1}^{N}\sum_{i=1}^{T} L_{11i}^{-2}\, \hat{e}_{it-1}^{2})^{-1} \quad (7)$$

[2] The PP test (named after Peter C. B. Phillips and Pierre Perron) is a unit root test.

[3] The ADF test is a statistical procedure to test whether a time series contains a unit root. D. A. Dickey and W. A. Fuller developed it in the 1970s.

Panel p – t-statistic;

$$Z_p = \left(\sum_{i=1}^{N} \sum_{i=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{it-1}^{2} \right)^{-1} \sum_{i=1}^{N} \sum_{i=1}^{T} \hat{L}_{11i}^{-2} (\hat{e}_{it-1} \Delta \hat{e}_{it} - \hat{\lambda}_{it}) \quad (8)$$

Panel PP – t-statistic;

$$Z_t = \left(\sigma^2 \sum_{i=1}^{N} \sum_{i=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{it-1}^{2} \right)^{-1/2} \sum_{i=1}^{N} \sum_{i=1}^{T} \hat{L}_{11i}^{-2} (\hat{e}_{it-1} \Delta \hat{e}_{it} - \hat{\lambda}_{it}) \quad (9)$$

Panel ADF t-statistic;

$$Z_t^* = \left(\hat{S}^{*2} \sum_{i=1}^{N} \sum_{i=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{it-1}^{*2} \right)^{-1/2} \sum_{i=1}^{N} \sum_{i=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{it-1}^{*} \Delta \hat{e}_{it}^{*} \quad (10)$$

Group p- t-statistic;

$$\hat{Z}_p = \sum_{i=1}^{N} \left(\sum_{i=1}^{T} \hat{e}_{it-1}^{2} \right)^{-1} \sum_{i=1}^{T} (\hat{e}_{it-1} \Delta \hat{e}_{it} - \hat{\lambda}_{it}) \quad (11)$$

Group PP- t-statistic;

$$\hat{Z}_t = \sum_{i=1}^{N} \left(\sigma^2 \sum_{i=1}^{T} \hat{e}_{it-1}^{2} \right)^{-1/2} \sum_{i=1}^{N} \sum_{i=1}^{T} (\hat{e}_{it-1} \Delta \hat{e}_{it} - \hat{\lambda}_{it}) \quad (12)$$

Group ADF- t-statistic;

$$Z_t^* = \sum_{i=1}^{N} \left(\sum_{i=1}^{T} \hat{S}^2 \hat{e}_{it-1}^{*2} \right)^{-1/2} \sum_{i=1}^{T} (\hat{e}_{it-1}^{*} \Delta \hat{e}_{it}^{*}) \quad (13)$$

Hence, $\acute{L}_{11i}^{-2}$ represents an estimation of the long-run covariance matrix, $\Delta \hat{e}_{it}$ and $\hat{e}_{it-1}$ is the residual from the panel cointegration equation above. Therefore, the parameter $\tilde{\sigma}^2$, $\hat{s}^2$ and $\hat{s}^{*2}$, represent the long run and contemporaneous variances of every country in the data. When the panel cointegration identifies the presence of cointegration between the variables, the next step is explaining how to get the Vector Error Correction Model (VECM). Basically, if the ECT is negative then there is long run effect, otherwise there is short run effect. The next step is to determine the VECM with ECT from the FLFPR and TFR.

3.1.4. The Vector Error Correction

The presence of the cointegration effect means that the VECM should be applied for finding the long run effect between the variables. Furthermore, the VECM is to find both equations of cointegration and speed of the adjustment, which is recognized as the ECT. A negative speed of the adjustment leads to the existence of a cointegration effect and thus a long-term effect. If it is positive, then there is only a short-term effect. In this study, a cointegration effect has only been found for lnFLFPR and a short run effect on the lnTFR.

Thus, the ECT has been applied for lnFLFPR as the dependent variable and not for lnTFR. The following equation represents the cointegration effect and the second one represents the short run for lnTFR.

$$\Delta \text{lnFLFPR}_{it} = \beta_{it} + \sum_p \beta_{11it}\, \Delta \text{lnFLFPR}_{(t-1)i} + \sum_p \beta_{12it}\, \Delta \text{lnFTFR}_{(t-1)i} + \Psi_{it}\, \text{ECT}_{t-1} \quad (14)$$

The equation above represents the long-run effect that occurs in the lnFLFPR, and the symbol *Ψ* represents the coefficient of the speed of the adjustment. Since there is no long run effect to the

lnTFR, the short-run effect equation of the TFR can be represented as follows:

$$\Delta \text{lnTFR}_{it} = \beta_{it} + \sum_p \beta_{11it}\, \Delta \text{lnTFR}_{(t-1)i} + \sum_p \beta_{12it}\, \Delta \text{lnFFLFPR}_{(t-1)i} \quad (15)$$

This means that the equation above has no error correction term meaning there is no long run effect. The ECT is used to determine the existence of the cointegration process and the speed of adjustment, but it does not help to determine the causal correlation among the variables. At this point, the Granger causality test will be used to detect the direction of the relationship between the variables, i.e., whether unidirectional or bidirectional. Therefore, the next section is reserved for the Granger tests.

3.1.5. The Granger Causality

Existence of a cointegration effect between logFLFPR and logTFR indicates the possibility of having a causal relationship between them. The existence of cointegrations shows the need for adjustment of disequilibrium. Thus, the ECT needs error correction of cointegration per year. The presence of an error correction implies the change in the endogenous variable as a function of the disequilibrium in the cointegration level and the change of the other exogenous variable(s). The mechanism of co-integration which found to be co-integrated at either $\Delta FLFPR_t$ or ΔTFR_t alternatively, the lagged error correction term can be caused by its function of both, $FLPRT_{1-t}$ and TFR_{1-t}. Below are the two equations which explain the Granger Causality test.

$$\Delta \text{lnFLPR}_{it} = C_{it} + \sum_{j=1}^{m} \theta_{11j} \Delta \text{inFLPR}_{(t-1)i} + \sum_{j=1}^{n} \delta_{12j} \Delta \text{lnTFR}_{(t=1)i} + \sum_{j=1}^{k} \delta_{11i} \text{ECM}_{j=1} + e_{it} \quad (16)$$

$$\Delta \text{lnTFR}_{it} = C_{it} + \sum_{j=1}^{m} \delta_{12it} \Delta \text{lnTFR}_{(t=1)i} + \sum_{i=1}^{n} \theta_{2j} \Delta \text{lnFLFR}_{(t=1)} + \sum_{j=1}^{k} \delta_{2j} \text{ECM}_{j=1} + e_t \quad (17)$$

The symbol Δ represents the first difference of the nonstationary variable. Θ and δ are parameters that need to be tested, C_t is constant, and e_t is an error term. By utilizing this test, we would be able to test whether there is a unidirectional causality or bidirectional causality (or feedback). The equation model above contains VECM, which can be the source of causation. The equation 16 and 17 have a significant statistical expression for the different causality tests.

3.2. Estimated Results

This part refers to the empirical analysis, which usually displays the estimated results that are found from empirical analysis. This section starts by providing information about the panel unit root test for determining the stationarity.

Table 1: Unit Root Test of FLFPR and TFR

	FLFPR I(0)	FLFPR I(1)	TFR I(0)	TFR I(1)
Procedure	**t_statistic (Prob)**	**t_statistic (Prob)**	**t_statistic (Prob)**	**t-statistic(prob)**
Levin, Lin and Chu	-6.216(0.41)	-5.863***	4.827(0.99)	-5.347***
Breitung t_statistic	8.3615(1.00)	-9.323*	12.793(0.99)	-.324**
Method				
Im, Pesaran and Shin War-statistic	-7.41(0.34)	-0.963**	-0.789***	-0.825***
ADF Fisher, Chi-square	20.964**	0.879**	0.474**	0.969***
PP Fisher square	7.879**	0744**	0.900(0.99)	0.699**

Notes: N.B Female Labor Force Participation Rate (FLFPR), Total Fertility Rate (TFR), Augmented Dickey-Fuller (ADF), Phillip Peron (PP). ***,**, and * indicate significance at the 1%, 5%, 10% levels respectively
Source: World Database Indicator (2020)

The table above represents the unit root test results that are represented at nonstationary at level I(0) and first difference level I(1). Most of the test statistics in this table are more significant at 0.01% and 0.001%, which is more effective include ADF and PP- Fisher. Thus, we can reject the null hypothesis that represented for FLFPR and TFR being nonstationary and accept the alternative hypothesis that FLFPR and FTR are stationary. The results of the unit root test indicates that FLFPR and TFR are integrated at order one I(1). Due to these results, the data are free from serious correlation and the variables are not affected by the sporous problem. Therefore, the data can be used for the estimation process.

Table 2: Panel Fully Modified Least Square (FMOLS)

Independent Var	Coefficient	Std.Error	t_statistics	Probability
logFTR	-0.098519	0.032642	-3.018204	0.0027

Source: World Database Indicator (2020)

The FMOLS model has been applied to examine the correlation between the FLFPR and FTR in MENA countries. The results from the table above indicates that, about 1% of TFR in MENA countries brings a change by decreasing about 9.85% of the FLFPR in MENA countries. The FMOLS supports the economic principle when the TFR is decreasing, then the FLFPRF is increasing.

Table 3: The Hausman Test

Summary for the test Chi sqr t_statistic d.f. Prob.				
Cross section random 0.397469 1 0.5284				
Cross section of random effects test assessments				
Independent variable	**Fixed**	**Random**	**Var(diff)**	**Probability**
logTFR	-0.423	-0.923	0.000269	0.5284

Source: World Database Indicator (2020)

Table 4 presents the results of the Haussmann test. The results show that the probability is higher than 5%, thus the analysis should obey the random effect that is not a fixed effect. Therefore, this analysis allows us to proceed by finding the cointegration effects. Table 5 indicates the existence of cointegration effect.

Table 4: The Pedroni of Residual Cointegration Diagnosis

Statistic test	t_statistic (Prob)	Weighted (Prob)
Panel v-statistic	6.372**	2.109**
Panel rho- t_statistic	-16.862***	-0.522***
Panel PP-t_statistic	-21.588**	-2.811***
Panel ADF t_statistic	-2.582***	-2.490*
Group rho- t_statistic	0.574	
Group ADF t_statistic	-2.653	

Notes: N.B Augmented Dickey-Fuller (ADF), Phillip Peron (PP), ***,**, and * indicate significance at the 1%, 5%, and 10% levels respectively.
Source: World Database Indicator (2020)

The table above indicates the cointegration effect between the FLFPR and TFR of MENA countries from 1990 to 2020. The Pedroni residual cointegration test has been used to identify the existence of cointegration effect between the FLFPR and TFR. All test statistics that were included in the process of determining cointegration, namely v-t-statistic, PP-statistic, ADF t-statistic, and in the case Group PP–t-statistic, The ADF t-statistic is measured in less than 5% probability. Only Panel rho-statistic and Group rho-statistic has a probability greater than 5%. This indicates that most of the test statistics are significant, and just two of them are insignificant. Therefore, the estimated results indicate that there is cointegration effect between FLFPR and TFR in MENA countries. Thus, the next step is to determine the speed of the adjustment (ECT) due to the cointegration effect between the FLFPR and TFR in MENA countries.

Table 5: Panel Cointegration Equation

Independent Var	Coefficient	Std.Err	t_statistic
C	13.06688	-	-
logFTR	-8.706591	1.70769	5.09847

Source: World Database Indicator (2020)

Table 5 explains the cointegration equation, which shows the negative relationship between FLFPR and TFR. The estimation revealed that as the TFR increases in MENA countries while the FLFPR decreases. However, there is a cointegration effect between the two variables. Therefore, error correction technique should be determined. The next table shows the error correction technique (ECT).

Table 6: The Error Correction Term (ECT) of FLFPR

ECT/Speed of adjustment	Coefficient	Std.Error	t_statistic	Probability
D(logFLFPR)	-0.01	0.0004	-2.40749	0.0164

Source: World Database Indicator (2020)

The test statistics with a negative sign in Table 6 show the existence of a cointegration effect, meaning that there is a long run relationship between FLFPR and TFR. The ECT value in Table 6 is 0.1% per year. The speed of adjustment per year over the period of 1990-2020 is a very slow percentage for recovering towards the normal equilibrium. The speed is not sufficient for the FLFPR. The analysis shows that there is a higher TFR with a low FLFPR in the labor market in MENA countries. From these perspectives, we can find a causal relationship between FLFPR and TFR. Therefore, Table 7 presents the causal relationship between FLFPR and TRF. Granger Causality analysis was preferred to test whether there is a causal relationship between the variables. Therefore, the next table explains the causality correlation in the context of Granger causality.

Table 7: Granger Causality test

	Null hypothesis	Observation	F_statistic	Prob
LogTFR	does not Granger cause logFLFPR	570	0.38254	0.00046
logFLFPR	does not Granger cause logTFR		0.67852	0.5654

Source: World Database Indicator (2020)

The Granger Causality test indicates a unidirectional causal relationship which runs from TFR to FLPFR. The relationship indicates that FLFPR is indigenous or depends on TFR, and thus TFR is exogenous.

Post estimation

This section is related to checking efficiency and desirability of the model. The post estimation test includes the Panel Cross-section Heteroscedasticity LR test, Residual Cross-Section Dependence test. The post estimation is as follows:

Table 8: The panel Cross-section Heteroscedasticity

Null hypothesis: Residual is homoscedastic			
Likelihood ratio	**value**	**df**	**Probability**
	698.9764	22	0.0000

LR test summary:	
Restricted logL	1208.065
Unrestricted logL	1557.553

Source: World Database Indicator (2020)

Table 8 indicates that the hypothesis of the null analysis is less than 5%. The null hypothesis cannot be rejected. Thus, the data used in this analysis have the homoscedasticity. The homoscedasticity shows that the model's white noise, error term, or random disturbances are the same across all values of the TFR.

Table 9: Residual Cross- Sectional Dependence

Null hypothesis: no cross-section dependence (Correlation) residual			
Test	**t_statistic**	**d.f**	**Probability**
Breuschcus-Pagan LM	242.9580	231	0.23117
Pesaran scaled LM	0.556338		0.5780
Pesaran CD	3.305423		0.0009

Source: World Database Indicator (2020)

Table 9 indicates that most of the test statistics from the Breusch Pagan LM and Pesaran scaled LM has a probability greater than 5 %. Thus, the null hypothesis can be rejected. The null hypothesis stands for "no correlation-sectional dependence", and the alternative hypothesis states the presence of a cross sectional dependence (correlation) residual. All discussions above represent the post estimation tests and the results show that the model is efficient and desirable to be used for obtaining the estimated results.

4. Conclusion

In this study, a causal relationship between the female labor force participation rate and fertility rate is researched for Middle East and North African countries. The empirical data shows the presence of cointegration between the female labor force participation rate and total fertility rate in Middle East and North African countries. The speed of adjustment (ECT) is found to be about 1% per year. The speed of correction or adjustment is very low, and the reason behind this is due to higher rate of fertility with less participation of the females as the labor force in the market in Middle East and North Africa countries. The study also revealed a causal relationship in the direction from total fertility rate to female labor force participation rate. This indicates that the relationship between the female labor force participation rate and total fertility rate in Middle East and North Africa countries is unidirectional. It also found that the relationship between the female labor force participation rate and total fertility rate is inversely proportional, which means that when total fertility rate decreases, female labor force participation rate tends to increase in Middle East and North Africa countries. The policymakers of Middle East and north Africa countries should strengthen and implement effective policies towards empowerment of women in the labor market and increasing the female labor force participation rate.

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