Mathematical Sciences and Informatics Journal
Vol. 2, No. 1, May 2021, pp. 57-62
http://www.mijuitmjournal.com
DOI : 10.24191/mij.v2i1.12984

Female Labor Force Participation and Gross Domestic Product in the Peninsular Malaysia using Panel Cointegration and Granger Causality Testing

Siti Sarah Januri
Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, Negeri Sembilan Branch Seremban Campus, Negeri Sembilan, Malaysia
sarahjanuri @uitm.edu.my

Zaitul Anna Melisa Md Yasin
Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, Negeri Sembilan Branch Seremban Campus, Negeri Sembilan, Malaysia
melisa@uitm.edu.my

Mas Hamizah Ahamad
Department of Statistic Malaysia, Putrajaya, Malaysia
mashamizah.ahmad@dosm.gov.my

Rosmini Roseli
Telekom Research & Development Sdn Bhd, TM Innovation Centre, Cyberjaya, Selangor Malaysia
rosminiroseli@tmrnd.com

Mohamad Saifuddin Mohd Ridza
Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, Negeri Sembilan Branch Seremban Campus, Negeri Sembilan, Malaysia
zammy2804@gmail.com

Sharina Salmi Azmi
Academy of Language Studies, Universiti Teknologi MARA, Negeri Sembilan Branch Seremban Campus, Negeri Sembilan, Malaysia
shari179@uitm.edu.my

Article Info

Article history:

Received Feb 05, 2021
Revised April 15, 2021
Accepted May 20, 2021

Keywords:

Gross Domestic Product
Female Labor Force Participation
Panel Root Test

ABSTRACT

Malaysia's economy has experienced significant structural changes from being an agricultural-based economy to a manufacturing-dominated one. The economic growth nevertheless has also increased the cost of living and noted a repercussion to the number of married couples due to the women nowadays are focused on their career. This study investigates the relationship between the female labour force participation (FLFP) and gross domestic product (GDP) for thirteen states in Malaysia. The results of the study indicated that both variables were stationary after the first differencing. The seven Pedroni test statistics obtained from the co-integration test indicated the significance of the variables hence the conclusion that FLFP and GDP are co-integrated and can be treated as the dependent variables. The panel granger causality test revealed the lack of a causal relationship between FLFP and GDP, thus suggesting that FLFP has no effect in increasing GDP growth in Malaysia. Consequently, FLFP causes good relationship between children and mother.

Corresponding Author:
Zaitul Anna Melisa Md Yasin
Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, Negeri Sembilan Branch Seremban Campus, Negeri Sembilan, Malaysia
email: melisa@uitm.edu.my

1. Introduction

Notable socio-economic events have taken place in the current age and evolved women's revolutionary rights and lifestyle. No longer are the role of women limited to family institutions, their involvement now can be seen in many sectors, including the manufacturing, industrial, academic institution, and services. Trends are heavily affected by how much women's labor force participation depends on their household's economic conditions, how jobs deemed appropriate for more educated women are growing relative to the supply of more educated women, whether growth strategies are promoting female employment, and to what extent women are able to break down occupational barriers within the sectors where women predominantly work [1]. It can be seen education as a potential booster of the officially recorded female labor supply in developing countries [2].

Female labour force participation measures the amount of women labour available for production in a country. A range of economic, demographic and cultural factors influence women's labour force participation, attracting the attention of both neoclassical and feminist economists [3]. In Malaysia, female labor force participation increased 0.4% to 55.6% in 2019 as compared to 55.2% in 2018 [4]. This rate is considered low if compared to developed countries like US where the participation rate is about 75% to 80% [5].

The role of the working women have significantly effect to increase the economy of the country [6], [7] and they have robust relationship between working women and currency exchange rate [8]. They can also develop their working career and promote their responsibilities in the career more explicitly. Such an implication can also be predicted in Malaysia. On the economic outlook, Malaysia's economy has experienced many significant structural changes from being an agricultural-based to a manufacturing-dominated. In the early phase of this expansion, female labour force participation (FLFP) was shown to decrease, but after the economy achieved stability, a positive relationship emerged and women`s participation in the labour market gradually increased [9]. This trend indicates that the expansion in economy has led to the increment of women's involvement in the labour force. In terms of growth domestic product (GDP), Malaysia recorded an increment by 6.2 percent in the third quarter of 2017, a rate higher than previous quarter (5.8 percent). With the gradual increase of the GDP, FLFP is predicted to increase as well.

Thus, this research was conducted to uncover the causal relationship between FLFP and GDP in Malaysia, particularly from 2010 to 2016. This study is considered important because the relationship between the two variables would change over time due to several factors.

Trends are heavily affected by how much women's labor force participation depends on their household's economic conditions, how jobs deemed appropriate for more educatedwomen are growing relative to the supply of more educatedwomen,whether growth strategies are promoting female employment, and to what extent women are able to break down occupational barriers within the sectors where women predominantly work.

2. Methodology

The aim of this research is to analyse the causal relationship between the FLFP and GDP in Malaysia within the period 2010 – 2017 and covers 13 states in Malaysia. The panel unit root test, the panel co-integration test, and the panel Granger causality test were employed in order to determine the causal relationship between them.

2.1 Panel Unit Root Test

Panel unit root testing arises from time series unit root testing. The difference between a panel unit root test and a time series unit root test is that the former requires the consideration of the behavior of a time-series dimension, *T*, and a cross-sectional dimension, *N*. The panel unit root test was employed in the work of [10] and [11], to list a few. In one study [11], the unit root test was used to test the stationary of the data. The stationary of data was employed to ensure all the statistical properties like mean, variance and autocorrelation are constant over time. In the same study [11], the unit root test was performed well as the number of cross sections, *N*, and was between 10 and 250 states; and the time series, *T*, was between 5 and 250 years. The Levin-Lin-Chu test may also be considered as the unit root test of Dickey-Fuller (DF) and augmented Dickey-Fuller (ADF). In the DF and ADF tests, data is not considered stationary if the null hypothesis is accepted; the data is stationary if the null hypothesis is rejected.

Therefore, the Levin-Lin-Chu model takes the following form:

$$Y_{it} = \alpha_0 + \rho Y_{it-1} + \sum \varphi_k Y_{it-k} + \delta_{it} + \vartheta_t + u_{it} \quad (1)$$

Null hypothesis (H_0) and alternative hypothesis (H_1) are as follows:

H_0: p = 0 (each time series in the panel is not stationary)
H_1: p < 0 (each time series in the panel is stationary)

The panel data was said to be stationary when the *p* value at LL test value is less than 0.05 thus rejecting the null hypothesis. However, if one variable is still not stationary at first level of differencing order, then other variables that are already stationary also have to proceed until all the variables achieve the result at the same level of differencing order.

2.2 Panel Cointegration Test

The Panel Cointegration Test was used to determine the existence of a long-run relationship between the variables. If the FLFP and GDP have a panel unit root, the issue whether the data have a long-run relation will arise. Thus, the panel cointegration test by [6] was used in this study. Pedroni's test allows considerable heterogeneity for cointegration in the models of panel data.

$$GDP_{it} = \alpha_i + \beta_i FLFPR_{it} + \varepsilon_{it} \quad (2)$$

where, t = time series
i = state
α = the parameter of the explanatory variables
ε = error term

According to the equation (2), GDP is treated as the dependent variable while FLFP is treated as the independent variable. Seven different statistics were used to test the null of no co-integration in a heterogeneous panel [12]. If more than half of the seven different statistics are significant (*p* value less than 0.05), it can be concluded that there is a co-integration relationship between the variables. In the Pedroni test, two groups were pooled within the dimension and between dimensions. "Within dimension" is a panel test consisting of v-statistic, rho-statistic, PP-statistic and ADF-statistic. This dimension was used to test the null hypothesis, H_0: $\beta_i = \beta_0$, for all *i* against H_1: $\beta_i = \beta_A \neq \beta_0$, where the value of β_A is the same for all *i.* Meanwhile, "between dimensions" is a group test consisting of rho-statistic, PP-statistic and ADF-statistic. This dimension was used to test the null hypothesis, H_0: $\beta_i = \beta_0$, for all *i* against H_1: $\beta_i \neq \beta_0$, so that the values of β_i are not constrained to be the same under the alternative hypothesis. In the case of a small sample, the "between-dimension statistic" will be higher than "within dimension." Accordingly, the panel co-integration test was noted at 5% level of significance.

2.3 Panel Granger Causality Test

The panel Granger causality test was applied to examine the cause-and-effect relationship between the two variables at a time in a time series. Empirical data sets were used to find the patterns of correlation. The panel Granger causality test is closely connected to the concept of cause-and-effect, despite the possibility that both are not precisely the same. For example, variable A is causal to variable B if variable A causes variable B or vice versa.

As mentioned [13] when nonstationary variables are co-integrated, a vector autoregression (VAR) in first differences will be left behind. If there exists a long run association between those variables, the panel Granger causality test for a long-run relationship was applied to the dynamic error correction model (DECM) description. This signifies that the conventional VAR model was elevated by the retrieval of a one-period lagged error correction term from a co-integrated model.

The panel Granger causality test was constructed from the following regression:

$$\Delta GDP_{it} = \alpha_{1i} \sum_{i=1}^{p} \alpha_{11ip} \Delta FLFPR_{it-p} + \varphi_{1i} ECT_{it-1} + \varepsilon_{1it} \quad (3)$$

where

Δ = First Difference
ECT = Error Correction Term
p = Length of lag

A two-stage process was used to select the lag length as suggested in [14]. Following their approach, the ideal length of lag was chosen by augmenting the value of the R^2. A 10% significant level was used for the Granger causality test.

3. Results and Discussion

3.1 Panel Unit Root Result

The panel unit root test was performed to test whether the data was stationary. The null and alternative hypotheses of the test are as follows:

H_0: p = 0 (each time series in the panel is not stationary)

H_1: p < 0 (each time series in the panel is stationary)

Table 1 displays the results of panel unit root test for FLFP and GDP. The results show that the GDP was not stationary at the first order of difference. Thus, all the variables were tested until the second order of difference and the results indicated that all the variables were stationary.

Table 1. Panel Unit Root Result

	Levin, Lin & Chu Test					
	Level		**1st Difference**		**2nd Difference**	
	Test Statistic	**p-value**	**Test Statistic**	**p-value**	**Test Statistic**	**p-value**
FLFP	-5.5807	0.0000*	-8.8190	0.0000*	-9.8930	0.0000*
GDP	14.3576	1.0000	1.5622	0.9409	-9.9137	0.0000*

***significance level at 5%**

3.2 Panel Cointegration Result

The panel co-integration test was conducted to test the presence of a long-run relationship between FLFP and GDP. The test was done by using the data on FLFP and GDP after the second differencing. The null and alternative hypotheses for the co-integration test are as follows:

H_0: There is no cointegration relationship between FLFP and GDP.

H_1: There is cointegration relationship between FLFP and GDP.

Table 2 and Table 3 show the results for the seven different types of Pedroni's co-integration statistics, which captured the pooled and group mean effects. Pedroni proposed seven test statistics, out of which, when four test statistics reject the null hypothesis of no co-integration, then it can be concluded that there is an existence of a long-run relationship between the selected variables [15].

Table 2 and Table 3 indicate the results of Pedroni cointegration test for FLFP ad GDP as dependent variable, respectively. From Table 2 and Table 3, two statistics namely Panel PP-Statistic and Panel ADF-Statistic rejected the null hypothesis of no cointegration at 5% level of significance and established the existence of long-run relationship between the selected variables. Similarly, in group mean effects, Group PP-Statistic and Group ADF-Statistic rejected the null hypothesis of no cointegration among the selected variables at 5% level of significance. Four out of the seven Pedroni test statistics also conclude that FLFP was co-integrated with GDP from 2010 until 2017 as the p value was less than 5% level of significance. Therefore, the results suggest that FLFP and GDP be treated as the dependent variables.

Table 2. Panel Cointegration result for model FLFP - GDP

	Test Statistic	**p-value**
Panel v-Statistic	-2.4788	0.9934
Panel rho-Statistic	2.4002	0.9918
Panel PP-Statistic	-5.2752	0.0000*
Panel ADF-Statistic	-3.1011	0.0010*
Group rho-Statistic	3.6406	0.9999
Group PP-Statistic	-3.3968	0.0003*
Group ADF-Statistic	-1.9190	0.0275*

***significance level at 5%**

Table 3. Panel Cointegration result for model GDP - FLFP

	Test Statistic	**p-value**
Panel v-Statistic	-3.4332	0.9997
Panel rho-Statistic	2.6482	0.9960
Panel PP-Statistic	-4.3691	0.0000*
Panel ADF-Statistic	-2.4686	0.0068*
Group rho-Statistic	3.6356	0.9999
Group PP-Statistic	-6.8402	0.0000*
Group ADF-Statistic	-2.9702	0.0015*

***significance level at 5%**

3.3 Panel Granger Causality Result

The Panel Granger Causality Test was applied upon confirming that the variables were co-integrated. The test was adopted to determine the causal relationship between the two variables. The hypotheses proposed in the Panel Granger Causality Test are shown in Table 4:

H_0: There is no existence of causal relationship between FLFP and GDP.
H_1: There is an existence of causal relationship between FLFP and GDP.

Table 4 displays results for Panel Granger Causality Test attest the absence of a causal relationship between GDP and FLFP as well as between FLFP and GDP. It is due to p-value = 0.1996 and 0.1786, respectively as the *p* value was greater than 5% level of significance. The rejection of hypothesis H_0 indicates the existence of a causal relationship between FLFP and GDP.

Table 4. Panel Granger Causality Result

Null Hypothesis	**F-Statistic**	**p-value**
GDP does not Granger cause FLFP	1.6780	0.1996
FLFP does not Granger cause GDP	1.7991	0.1786

***significance level at 5%**

4. Conclusion

This study applied the annual time series data of FLFP and GDP for 13 states in Malaysia from 2010 to 2017. Factors affecting fertility rates should therefore be reviewed to improve the population rate in Malaysia because the growth of population is partially regulated by fertility rates. It is known that Malaysia's economy is growing significantly. The GDP increased 6.2 percent in the third quarter of 2017 which is 0.4 percent higher than the rate in the previous quarter (5.8 percent).

This study managed to uncover the existence of a long-run relationship and a causal relationship between FLFP and GDP by using a panel unit root test, a panel co-integration test, and a panel Granger test for causality. All the variables were found to be stationary after the the second order of differencing using the panel root test. Upon finding that all the variables were stationary, the panel co-integration and panel Granger causality tests were applied to determine the presence of a long-run relationship and the existence of causal relationship between FLFP and GDP. The analyses revealed that a long-run relationship exists between the variables thus indicating a co-integration of FLFP and GDP. Accordingly, the panel Granger causality test was performed for the two variables and the lack of causal relationship between FLFP and GDP was confirmed. Based on these findings, it is inferred that FLFP gives no effects on GDP

Acknowledgements
We gratefully acknowledge the Universiti Teknologi MARA (UiTM), Negeri Sembilan branch, Seremban Campus.

References

[1] S. Klasen, “What Explains Uneven Female Labor Force Participation Levels and Trends in Developing Countries?,” *World Bank Res. Obs.*, vol. 34, no. 2, pp. 161–197, 2019.
[2] G. Psacharopoulo and Z. Tzannatos, “Female labor force participation: An international perspective,” *World Bank Res. Obs.*, vol. 4, no. 2, pp. 187–201, 1989.
[3] Y. OKŞAK and J. Y. Koyuncu, “Does globalization affect female labor force participation: Panel evidence,” *J. Econ. Bibliogr.*, vol. 4, no. 4, 2017.
[4] Mohd Yusrizal bin Ab. Razak, “Department of Statistics Malaysia Press Release,” 2020.
[5] P. A. Mcmanus and K. L. Johnson, “Female labor force participation in the US : How is immigration shaping recent trends ? ☆,” *Soc. Sci. Res.*, vol. 87, no. June 2019, p. 102398, 2020.
[6] D. Baerlocher, S. L. Parente, and E. Rios-Neto, “Female Labor Force Participation and economic growth: Accounting for the gender bonus,” *Econ. Lett.*, vol. 200, p. 109740, 2021.
[7] E. Denkta, “Fertility, Female Labour Force Participation and Part-time Employment of Women : Evidence from OECD Countries,” *Am. J. Econ. 2017,* vol. 7, no. 2, pp. 88–96, 2017.
[8] B. Erten and M. Metzger, “The real exchange rate, structural change, and female labor force participation,” *World Dev.*, vol. 117, pp. 296–312, 2019.
[9] E. Lechman and H. Kaur, “Economic Growth and Female Labor Force Participation – Verifying the U-Feminization Hypothesis.Economic Growth And Female Labor Force Participation – Verifying The U-Feminization Hypothesis. New Evidence For 162 Countries Over The Period 1990-2012. New Ev,” 2012.
[10] K. S. Im, M. H. Pesaran, and Y. Shin, “Testing for unit roots in heterogeneous panels,” *J. Econom.*, vol. 115, no. 1, pp. 53–74, 2003.
[11] A. Levin, C. F. Lin, and C. S. J. Chu, “Unit root tests in panel data: Asymptotic and finite-sample properties,” *J. Econom.*, vol. 108, no. 1, pp. 1–24, 2002.
[12] P. Pedroni, “Purchasing power parity tests in cointegrated panels,” *Rev. Econ. Stat.*, vol. 83, no. 4, pp. 727–731, 2001.
[13] V. Mishra and R. Smyth, “Female labor force participation and total fertility rates in the OECD : New evidence from panel cointegration and Granger causality testing,” *J. Econ. Bus.*, vol. 62, pp. 48–64, 2010.
[14] I. S. A. Abdalla and V. Murinde, “Exchange rate and stock price interactions in emerging financial markets: evidence on India, Korea, Pakistan and the Philippines,” *Appl. Financ. Econ.*, vol. 7, pp. 25–35, 1997.
[15] U. P. Dutta, H. Gupta, and P. P. Sengupta, “ICT and health outcome nexus in 30 selected Asian countries: Fresh evidence from panel data analysis,” *Technol. Soc.*, vol. 59, no. August, p. 101184, 2019.