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FEMALE LABOUR FORCE PARTICIPATION AND TOTAL FERTILITY RATE: NEW EVIDENCE FROM ASEAN COUNTRIES

This paper made an attempt to empirically examine the relationship between female labour force participation (FLFP) and total fertility rate (TFR) in 5 ASEAN countries, namely, Indonesia, Malaysia, the Philippines, Singapore and Thailand. This paper employed the panel data analysis to examine the relationship between 2 variables. The main findings of this paper are that there exists a long-run equilibrium relationship between female labour force participation and total fertility rate. The findings also indicate that there is no causal relationship between them, except that the number of children is a cause of change in female labour force participation in ASEAN the long run.

Keywords: *female labour force participation; total fertility rate; ASEAN.*

JEL Classification: *J21, J16.*

Фумітака Фуруока

ПРИСУТНІСТЬ ЖІНОК НА РИНКУ ПРАЦІ ТА ЗАГАЛЬНИЙ РІВЕНЬ НАРОДЖУВАНОСТІ В КРАЇНІ (ЗА ДАНИМИ КРАЇН АСЕАН)

У статті зроблено спробу емпірично оцінити взаємозв'язок між участю жінок у праці і загальним рівнем народжуваності в країні на прикладі 5 країн АСЕАН - Індонезії, Малайзії, Філіппін, Сінгапуру та Таїланду. Для порівняння взаємозалежностей змінних застосовано аналіз панельних даних. Результати його підтверджують існування довгострокової взаємозалежності між зайнятістю жінок і рівнем народжуваності. У довгостроковій перспективі кількість дітей у сім'ї побічно впливає на участь жінок у праці.

Ключові слова: *присутність жінок на ринку праці; загальний рівень народжуваності; АСЕАН.*

Фумитака Фуруока

ПРИСУТСТВИЕ ЖЕНЩИН НА РЫНКЕ ТРУДА И ОБЩИЙ УРОВЕНЬ РОЖДАЕМОСТИ В СТРАНЕ (ПО ДАННЫМ СТРАН АСЕАН)

В статье сделана попытка эмпирически оценить взаимосвязь между участием женщин в труде и общим уровнем рождаемости в стране на примере 5 стран АСЕАН - Индонезии, Малайзии, Филиппин, Сингапура и Тайланда. Для сравнения взаимозависимостей переменных применен анализ панельных данных. Результаты его подтверждают существование долгосрочной взаимозависимости между занятостью женщин и уровнем рождаемости. В долгосрочной перспективе количество детей в семье косвенно влияет на участие женщин в труде.

Ключевые слова: *присутствие женщин на рынке труда; общий уровень рождаемости; АСЕАН.*

1. Introduction. An intricate relationship between female labour force participation (FLFP) and total fertility rate (TFR) is a very important topic in the economics

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and demography research. However, the main question is which factor is original cause of another factor. More precisely, would FLFP cause TFR? Alternatively, TFR would cause FLFP? (Mishra and Smyth, 2010).

On the one hand, low TFR can be caused by high level of FLFP. As Dyson (2010) argued, a decline in the fertility rate can be caused by a reduction of marriage or a marriage at a later age. In other words, if a female decided to purse her own career, she may postpone her marriage or may decided to remain single due to her financial stability from own earnings.

On the other hand, high level of FLFP can be caused by low TFR. Dyson (2010) pointed out that a female can be free from life dominated by childbearing and childcare if there is a decline in the fertility rate. In other words, a fall in number of children may liberalize a female from child-related domestic unpaid job and may promote female participation at the labour market.

However, the relationship between female labour force participation and total fertility rate can be complex. In case of Malaysia, total fertility rate in the country is relatively low, 2.57 % in 2008, drastically decreased from 4.14% in 1980. However, female labour force participation rate has basically remained stagnant for the last 20 years. According to it, female labour force participation rate in 1970 was 37.2%. 20 years later female labour force participation rate increased to 46.7% in 1990. However, female labour force participation decreased slightly to 45.7% in 2008 (Chong, 2010).

Malaysia's relative low fertility rate accompanying by relatively low level of female labour force participation can be explained by a gender stereotype about the role of a female in the society and lack of support for female workers. Francis Loh (2010) pointed out that many female employees remained unpaid and invisible. This is because many women in Malaysia are employed in informal sector and perform so-called "casual work". Loh suggested that it is important for Malaysian society to change the attitude to erase the gender stereotypes. Devaraj (2010) pointed that there is a lack of support for female workers who have taken care of their children, the elderly and the sick and the disabled. She is also concerned about the lack of appropriate policy to decrease the "double-day" burden of female workers.

This paper makes an attempt to examine empirically the relationship between female labour force participation (FLFP) and total fertility rate (TFR) in 5 ASEAN countries, namely, Indonesia, Malaysia, the Philippines, Singapore and Thailand. Following this introduction, previous research on the determinants of female labour force participation will be discussed in Section 2. Next section explains research methods. Section 4 reports the empirical findings followed by the conclusions.

2. Literature review. The determinant of female labour force participation, or more specifically the relationship between female labour force participation and total fertility rate, remained an important research topic in the HR economics. Many researchers made attempt to examine this intricate relationship between them. Jacob Mincer is the first HR economist who conducted systematic and empirical researches on the female labour supply. Mincer (1962) pointed out a stationary increase at the labour force participation of women in the US labour market. Gronau (2003) argues that it is "much more difficult to find" theoretical support for "increased participation of their wives". Bailey (2004) found that the major determinant of the increased female labour force participation is the stream of biotechnological advancements that have provided women greater control over childbearing decisions since 1940s.

According to Goldin (1995), advancements in household technologies allowed women greater freedom and time to increase their educational attainment. They devoted more time to the labour market and were able to engage in better paid jobs. Gustaffon (1992) found that a woman's own wage is a more important determinant of female labour supply as compared to the husband's income apart from nonearned income and hours of work of a woman. Therefore, policies that increase female net wages are more likely to increase female labour supply. Saget (1999) in her study on the labour force participation rates for Hungarian females also stressed that woman's own wage apart from the earnings of other members of the household and non-labour income affect a female's decision to work. It is interesting however to note that own wage is not known for those who do not participate at the labour market.

Kassim and Anaman (2004) found that age, total number of work positions held, hiring of a housemaid, length of time out of work, and educational attainment significantly influenced participation of women in formal labour market. The researchers adopted the standard neoclassical model based on an agreed utility function of both husband and wife, and the maximization of this single-family utility function subject to the family budget constraint. However, Connolly (1997) implied that although women are actively seeking for a job, they may not be able to find employment. Therefore, the probability of participating at the labour market depends on the potential market wage, other income as well as a set of individual characteristics and financial constraints.

More recently, Greenwood et al. (2005) introduced an interesting concept called the "Engine of Liberation" to analyze female labour force participation. According to it, diffusion of home appliances successfully liberalized women from unpaid household production and encouraged them to enter the labour market. Coen-Pirani et al. (2010) empirically examined the "Engine of Liberation" hypothesis by using the US census microlevel data. They found empirical evidence to support the "Engine of Liberatin" hypothesis that the diffusion of household appliance contributed to the increase in the labour force participation of married women.

Some researchers considered the number of children or fertility rate to be an important factor to determine female labour force participation. Using the generalized residual method, Xie Xiaodi (1997) suggested that children are endogenous to the participation decision and are likely to be exogenous to the hours of work decision for married women. Children under 6 especially have a dramatic negative impact on the labour force participation of married women.

More recently, Dyson (2010) argued that decline of fertility rate allows women lead lives that are much less constrained by household affairs. In other words, a reduction in the number of children may allow women to have lives more like those experienced by men, participating in labour and pursing own career development.

Mishra and Smyth (2010) empirically examined the relationship between female labour force participation and total fertility rates in the OECD countries. Their findings are not sufficiently conclusive. There is either unilateral causality from female labour force participation to total fertility rates, or vice versa, depending on methods of measuring the female labour force participation or time span.

3. Data and Methods. This study used several panel data methods to examine the determinants of female labour force participation. This paper assumed that female labour force participation is mainly determined by the number of children or total fertility rates. In other word, the function for female labour force participation can be expressed as:

$$FLFP = f\,(TFR), \tag{4}$$

where *FLFP* is female labour force participation, *TFR* is total fertility rates or the number of children. This function could be estimated as follows:

$$FLFP_{it} = \beta_0 + \beta_1 TFR_{it} + \varepsilon, \tag{5}$$

where β_0 is constant, β_1 is slope coefficients and ε is the error term. $FLFP_t$ is female labour force participation rate in country *i* at year *t*. TFR_t is a proxy for the number of children and total fertility rate in country *i* at year *t*. All the data were obtained from the World Bank Database (World Bank, 2010).

This paper employed the following 3 panel data analysis to examine the relationship between female labour force participation and total fertility rates in the ASEAN countries: 1) panel unit root test; 2) panel cointegration test; 3) panel Granger causality test.

Panel unit root tests are based on the following equation in which *N* is a cross-section over the period *T*, and y_{it} is generated by the first-order autoregressive process (Maddala and Wu, 1999):

$$y_{it} = (1-\varphi_i)\mu_i + \varphi_i y_{it} + \varepsilon_{it} \qquad i = 1.......N,\ t = 1..........T, \tag{2}$$

where φ_i is coefficients, μ_i is constants, and ε_{it} is error terms. The null hypothesis of unit root could be written as $\varphi_i = 1$ for all the *i*. So, equation (2) could be expressed as:

$$\Delta y_{it} = \alpha_i + \beta_i y_{i,t-1} + \varepsilon_{it},$$

where $\alpha_i = (1-\varphi_i)\mu_i$ and $\beta_i = -(1-\varphi)$.

The null hypothesis of unit roots becomes

$H_0 : \beta_i = 0$ for all *i*,

against an alternative

$H_1 : \beta_i < 0$ for $i = 1,2, ...N_1$, $\beta_i = 0$ for $i = N_1+1, N_1+2, ...N$.

Panel unit root test could be considered as an extension of univariate unit root test. A procedure that is widely used to test the unit root hypothesis is the ADF test. A standard version of individual ADF test is based on the following regression (MacKinnon, 2002):

$$\Delta y_t = \beta_0 + \beta_1 y_{t-1} + \sum_{j=1}^{p} \delta_j \Delta y_{t-j} + \varepsilon_t, \tag{3}$$

where β_0, β_1, and δ_j are coefficients, and ε_t is an error term.

This paper uses different panel unit roots tests, such as Levin-Lin-Chu (LLC) test and Im-Pesaran-Shin (IPS) test. First of all, the LLC test is based on the pooled panel data as follows (Levin and Lin, 1992):

$$\Delta y_{it} = \rho y_{i,t-1} + \alpha_0 + \sigma_t + \alpha_i + \theta_t + \varepsilon_{it},$$

where ρ, α_0, σ are the coefficients, α_i is individual-specific effects, θ_t is a timespecific effect. According to Levin and Lin (1993), the LLC test could be conducted in 4 steps. In step one, subtract the cross-section average from the data. The cross-section average can be computed as:

$$\bar{y} = 1/N\sum_{i=1}^{N} y_{it}.$$

Then, apply ADF test to each individual series and normalise the disturbance. The ADF model could be expressed as:

$$\Delta y_{it} = \rho_i y_{i,t-1} + \sum_{j=1}^{p_i} \delta_{ij} \Delta y_{i,t-j} + \alpha_i + \varepsilon_{it}. \tag{4}$$

This is an equivalent to performing two auxiliary regressions of Δy_{it} and $y_{i,t-1}$ on the remaining variable in equation (4). Let the residuals from these two regressions be $\hat{e}_{i,t}$ and $\hat{V}_{i,t-1}$, respectively. Then, regress $\hat{e}_{i,t}$ on $\hat{V}_{i,t-1}$

$$\hat{e}_{i,t} = \rho_i \hat{V}_{i,t-1} + \varepsilon_{it}, \tag{5}$$

where $\hat{e}_{i,t}$ is the orthogonalized innovation, $\hat{V}_{i,t-1}$ is the orthogonalized lagged level.

The regression standard error is estimated as:

$$\hat{\sigma}^2_{ei_i} = \frac{1}{T - P_i - 1} \sum_{t=p+2} (\hat{e}_{i,t} - \hat{\rho}_i \hat{V}_{i,t-1})^2. \tag{6}$$

Levin and Lin (1993) suggest the following normalization to control the heteroscedasticity in errors:

$$\tilde{e}_{i,t} = \frac{\hat{e}_{i,t}}{\hat{\sigma}_{ei_i}}, \tag{7}$$

$$\tilde{v}_{i,t-1} = \frac{\hat{v}_{i,t-1}}{\hat{\sigma}_{ei}}, \tag{8}$$

where $\tilde{e}_{it}$ is the normalized innovation, $\tilde{V}_{it}$ is the normalized lagged level. In the following step, the ratio of the long-run to short-run standard deviation for each individual data can be estimated as:

$$s_i = \frac{\sigma_{yi}}{\sigma_{ei}}, \tag{9}$$

where σ_{yi} is the long-run standard deviation, and σ_{ey} is the short-run standard deviation. The average standard deviation ratio could be estimated as:

$$\hat{S} = \frac{1}{N}\sum_{i=1}^{N} \hat{s}_i.$$

The LLC test statistics could be obtained from the following regression:

$$\tilde{e}_{i,t} = \rho \tilde{v}_{i,t-1} + \tilde{\varepsilon}_{i,t}.$$

Secondly, the IPS test is based on the mean value of individual ADF statistics or *t*-bar (Im, Pesaran and Shin, 2003). There are two steps to estimate the IPS test statistics. In the first step, we obtain the individual ADF statistics. In the second step, we obtain *t*-bar or mean values of individual ADF statistics:

$$t\text{-bar}_{NT} = \frac{1}{N}\sum_{i=1}^{N} t_{iT_i} \quad (5)$$

The corresponding standardised t-bar statistics is given by:

$$Z_{tbar} = \frac{\sqrt{N}\left\{bar - N^{-1}E(t_{T_i})\right\}}{\sqrt{N^{-1}\sum_{i=1}^{N} Var(t_{T_i})}}, \quad (6)$$

where $E(t_T)$ is the mean of t_T and $Var(t_T)$ is the variance of t_T. Im et al. (2003) provide Monte Carlo estimate of $E(t_T)$ and $Var(t_T)$.

On the other hand, two or more time series with unit roots could be related or have some linear combination if these variables are cointegrated (Davidson and MacKinnon, 2004). If the independent and the dependent are cointegrated, the residual e_{it} will be integrated of order zero, denoted I(0). In other word, unit root test of residuals could be used to analyse the cointegrating relationship between variables. This paper uses Pedroni panel cointegration test to examine whether the residuals are integrated of order zero.

Pedroni (1994, 2004) uses two types of panel cointegration tests. The first one is "panel statistic" that is equivalent to unit roots statistic against homogenous alternative. The second one is "group mean statistic" that is analogous to the panel unit root tests against heterogeneous alternative.

Pedroni (2004) argues that "panel statistics" can be constructed by taking the ratio of the sum of the numerators and the sum of the denominators of the analogous conventional time series statistics. The "group mean statistics" can be constructed by first computing the ratio corresponding to the conventional time series statistics and then computing the standardized sum of the entire ratio over the N dimension of the panel.

This paper uses two panel cointegration tests suggested by Pedroni (1994, 2004), namely "panel ADF statistics" and "group mean ADF statistics". The two versions of the ADF statistics could be defined as:

$$\text{Panel — } Z_t = (\tilde{s}^2_{NT}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{e}^2_{i.t-1})^{-1/2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{e}_{i,t-1}\Delta\hat{e}_{i,t}, \quad (8)$$

$$\text{Group Mean — } N^{-1/2}Z_t = N^{-1/2}\sum_{i=1}^{N}(\sum_{t=1}^{T}\hat{s}_i\hat{e}^2_{i,t-1})^{-1/2}\sum_{t=1}^{T}\hat{e}_{i,t-1}\Delta\hat{e}_{i,t}, \quad (9)$$

where $\hat{e}_{i,t}$ represents the residuals from ADF estimation, $\tilde{s}_{NT}$ is the contemporaneous panel variance estimator and $\hat{s}_i$ is the standard contemporaneous variance of the residuals from the ADF regression[1]. The asymptotic distribution of panel and group mean statistics can be expressed in:

$$\frac{\kappa_{N,T} - \mu\sqrt{N}}{\sqrt{\nu}} \Rightarrow N(0,1), \quad (10)$$

where $\kappa_{N,T}$ is the appropriately standardised from for each of statistics. On the other hand, μ is the mean adjustment term and ν is the variance adjustment term. Pedroni provides Monte Carlo estimates of μ and ν (Pedroni, 1999).

Finally, this paper employed Granger causality test (Granger, 1969; Engle and Granger, 1987) to analyse the causality between female labour force participation and total fertility rate. The Granger causality test could be based on the following Vector error correction models (VECMs):

$$\Delta FLFP_{it}=c_1+\alpha_1\Delta FLFP_{it-1}+..+\alpha_k\Delta FLFP_{it-k}+\beta_1\Delta TFR_{it-1}+.. +\beta_k\Delta TFR_{it-k}+\gamma_1 EC_{t-1}+\varepsilon_1 \quad (14)$$

$$\Delta TFR_{it}=c_2+\alpha_1\Delta TFR_{it-1}+..+\alpha_k\Delta TFR_{it-k}+\beta_1\Delta FLFP_{it-1}+.. +\beta_k\Delta FLFP_{it-k}+\gamma_2 EC_{t-1}+\varepsilon_2, \quad (15)$$

where Δ is the difference operator; ECt-1 is the one-period lagged value of the error correction term, γ_1 and γ_2 are the coefficients for the error correction terms, c_1 and c_2 are the constants; $\alpha_1 ....\alpha_k$ and $\beta_1 ......\ \beta_k$ are the slope coefficients.

The Granger causality could be examined by using the Wald test for the joint hypothesis:

$$\beta_1=\beta_2=......\beta_k=0. \quad (16)$$

This panel Granger causality test could detect both the short-run and the long-run causalities. More precisely, the Wald test of the independent variables could be interpreted as the short-run causal effect while the significance correction term (EC_{t-1}) could be interpreted as the long-run causal effects.

4 types of causal relationship between population and economic development are possible:

(1) *Independence:* There is no causality between female labour force participation and total fertility rate, which could be interpreted as an independent relationship between the variables;

(2) *Fertility-driven female labour force participation*: There is a unidirectional causality from total fertility rate to female labour force participation, but not vice versa, which could be interpreted as evidence in support for the existence of the "low fertility-led" high level of female labour force participation;

(3) *Female labour force participation-driven low fertility rate*: There is a unidirectional causality from female labour force participation to fertility rate, but not vice versa, which could be interpreted as evidence in support for the existence of the "female labour force participation-led" low level of fertility rate;

(4) Two-way causality: There is a unidirectional causality from female labour force participation to total fertility rate, and vice versa, which could be interpreted as a mutually reinforcing bilateral causality between the variables.

4. Empirical Results. First of all, the augmented Dickey-Fuller (ADF) test was employed to test stationarity of the time series data. The results obtained from the ADF tests are shown in Tables 1 and 2. Furthermore, the empirical results from the panel unit root test are reported in Table 3. Despite of minor differences in the findings, the ADF test seems to indicate that both *FLFP* and *TFR* are integrated of order one, I(1). Thus, these two variables have the same order of integration.

[1] This paper uses the unweighted versions of statistics. Pedroni (2004) argues that in Monte Carlo simulation, he found that unweighted statistics tend to outperform the weighted statistics.

Table 1. **ADF Unit Root Test (FLFP)**

	Level		First Difference	
	Constant without trend	Constant with trend	Constant without trend	Constant with trend
Indonesia	-1.731(0)	-2.438(0)	-4.453(0)**	-4.414(0)**
Malaysia	-0.931(0)	-3.127(0)	-4.283(0)**	-4.203(0)*
Philippines	-2.076(0)	-2.144(0)	-6.184(0)**	-6.203(0)**
Singapore	-1.120(0)	-1.743(0)	-5.962(0)**	-5.953(0)**
Thailand	-1.436(0)	-2.228(0)	-3.002(0)**	-2.982(0)

Notes: Figures in parentheses indicate the number of lag structures.
** indicates significance at the 1% level
* indicates significance at the 5% level

Table 2. **ADF Unit Root Test (TFR)**

	Level		First Difference	
	Constant without trend	Constant with trend	Constant without trend	Constant with trend
Indonesia	-3.500(2)**	-2.112(2)	-2.942(1)*	-3.471(1)*
Malaysia	-4.121(2)***	-1.706(2)	-8.866(1)***	-6.026(2)***
Philippines	-3.191(2)**	0.491(2)	-2.287(1)	-4.734(2)***
Singapore	-1.056(0)	-2.001(0)	-6.082(0)***	-6.011(0)***
Thailand	-2.757(2)*	-5.038(2)***	-3.098(2)**	-3.726(1)**

Notes: Figures in parentheses indicate the number of lag structures.
*** indicates significance at the 1% level
** indicates significance at the 5% level
* indicates significance at the 10% level

Table 3. **Panel Unit Root Test and Panel Co-integration Test**

Panel Unit Root Tests				
	Levels		First Differences	
	Individual effects	Individual effects and linear trends	Individual effects	Individual effects and linear trends
LLC test				
FLFP	1.162	0.192	7.940**	6.552**
TFR	5.552**	0.403	5.747**	4.389**
IPS test				
FLFP	0.155	0.412	8.136**	6.825**
TFR	3.494**	0.059	7.596**	6.810**
Pedroni Panel Co-integration Test				
	Individual effects		Individual effects and linear trends	
Panel ADF Statistic	-1.060		-1.565*	
Group Mean ADF Statistic	-1.420*		-1.850**	

** indicates significance at the 5% level
* indicates significance at the 10% level

The results of the panel cointegration tests are reported in Table 3. Despite some difference, both the panel ADF test and group ADF test indicate there is a cointegrating relationship between FLFP and TFR. These findings shows a long-run relationship between the two variables (FLFP and TFR) which means that these variables are cointegrated.

Finally, the panel Granger causality test was employed to examine the causality relationship of these two variables. The results obtained from the chi-square statistics, the p-values, the coefficient of the error correction term (ECTt-1) and the t-statistics are reported in Table 4.

Table 4. **Panel Granger Causality**

Malaysia		
(a) TFR> FLFP		
Variable	Chi-square test statistics	Probability
Δ *TFR*	0.005	0.943
	Coefficient	t-statistics
ECT_{t-1}	-0.001	-0.362
(b) FLFP> TFR		
Variable	Chi-square test statistics	Probability
Δ *FLFP*	0.218	0.643
	Coefficient	t-statistics
ECT_{t-1}	0.001	7.067**

Notes: ** indicates significance at the 1 % percent level

First of all, the null hypothesis that *TFR* did not Granger-cause *FLFP* could not be rejected in both short-run and long-run. Therefore, the results indicated that increase in the number of children does not seem to cause any change in female labour force participation in ASEAN countries. Secondly, the null hypothesis that *FLFP* did not Granger-cause *TFR* could not be rejected in the shortrun. However, the null hypothesis can be rejected in the long run. Therefore, the result indicated that increase in female labour force participation does cause a change in total fertility rate in ASEAN in the long run.

In short, the panel co integration test detected a long-run co integrating relationship between two variables, such as FLFP and TFR. However, the panel Granger causality test does not detect any causal relationship between these variables, except that increase in female labour force participation does cause a change in total fertility rate in ASEAN in the long run.

5. Concluding Remarks. Current study empirically examined the relationship between female labour force participation (*FLFP*) and total fertility rate (*TFR*) in 5 ASEAN countries, namely, Indonesia, Malaysia, the Philippines, Singapore and Thailand. This paper employed the panel data analysis to examine the relationship between two variables.

The main findings of this paper are that there exists a long-run equilibrium relationship between female labour force participation and total fertility rate. The findings also indicated that there is no causal relationship between them, except that increase in female labour force participation does cause a change in total fertility rate in ASEAN in the long run.

Future studies on the determinant of female labour force participation may want to focus on other factors, such as wage level of female workers or working experience of female workers. In any case, it is a ripe moment for development economists or HR economists to have a closer look from different angles at one of the fundamental socioeconomic factors — female labour force participation.

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