The Dilemma of Female Labour Force Participation (FLFP) and Fertility rate in Asian-6 Countries: A Panel Cointegration Approach

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Abstract The principal objective of this paper is to investigate the dilemma between the female labour force participation rate and total fertility rate for the Asian-6 countries from the period 1995 to 2013 using panel cointegration and long-run structural estimation. The cointegration results confirm that the female labour force participation rate and total fertility rate are cointegrated for the panel of Asian-6 countries. Whereas, long-run Granger causality authenticate the causality run from the total fertility rate to the female labour force participation rate. Moreover, the results show that 1percent increase in the total fertility rate cause in a 0.44 percent decrease in the female labour force participation rate for the Asian-6 countries. The TFR highest negative effect observed in Indonesia and smallest observed in Thailand. The results of fully modify ordinary least square confirm the long run panel relationship between female labour force and total fertility rate.
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1- Introduction

The dilemma of female labour force participation rate (FLFP) and the total fertility rate (TFR) is a general problem for the developed and less develop economies. The existing studies only discussed the correlation between female labour force participation and total fertility ratio. While the current study deal with correlation as well as causation between them. However, it is tenable that two variables could be highly correlated, but it may not cause to each other. Similarly model based on correlation presume a one period proportional stationary framework, whereas the effect of TFR and FLFP on each other is unlikely to be immediate and this reality have leads to FLFP and TFR to be model led in a dynamic manner and also as an autoregressive procedure. In the current economic literature question of causality "what causes what?" has received attention. The main intention of the current study is to inspect closely and thoroughly the causal relationship between FLFP and TFR for a panel of Asian-6 countries over the period 1995–2013. For the purpose to examine causality study used concept of "Granger causality" and for Granger causality it is not essential to agree with causality in the usual sense of the word. Furthermore, for the purpose to confirm causality study apply unique combination of econometric approaches in three different directions.

In the first step study applied panel unit root for the purpose to confirm stationarity and level of integration. For the purpose to examine cointegration, Kao panel cointegration technique has been used. In the first step ultimate goal of the study is to confirm the causality, where stationarity and Kao cointegration leads study towards causality because these are the necessary steps before apply granger causality. So, after confirm the stationarity and cointegration Granger causality approach has been applied. Second, the long-run relationship between FLFP and TFR is examined through fully-modified ordinary least squares (FMOLS). Third, the study used most recent data from Asian-6 countries.

Six-Asian Country's Comparison between TFR and FLFP

I-Indonesia

The total Indonesian population 234,181,400 is recorded and ranked 4th as most populated country in the world. Among Asian-6 countries Indonesia was ranked 3rd with the average TFR 2.347 per woman and ranked 4th with the average FLFP 51 percent during the period of 1995-2013. In 1995 TFR start from 2.699 and continuously decreasing up till 2.163 in 2013, While, FLFP begin with 49 percent and increased up to 51 percent.

II- Malaysia

The total Malaysian population 28,306,700 is recorded and ranked 44th as most populated country

in the world. Among Asian-6 countries Malaysia was ranked 2nd with the average TFR 2.891 per woman and ranked 6th with the average FLFP 43 percent during the period of 1995-2013. In 1995 TFR start from 3.301and continuously decreasing up till 2.555 in 2013, While, FLFP begin with 43 percent and decreased in 1997 up to 42 percent but 2000 it is continuously increased up to 45 percent.

III- Philippines

The total Philippines population 94,013,200 is recorded and ranked 12th as most populated country in the world. Among Asian-6 countries Philippines was ranked 1st with the average TFR 3.511 per woman and ranked 5th with the average FLFP 49 percent during the period of 1995-2013. In 1995 TFR start from 4.006 and continuously decreasing up till 2.881 in 2013, While, FLFP begin with 49 percent and shows some fluctuations with increasing and decreasing trend butt overall its show decreasing trend.

IV- Singapore

The total Singapore population 4,987,600 is recorded and ranked 114th as most populated country in the world. Among 6-Asian countries Singapore was ranked 6th with the average TFR 1.363 per woman and ranked 3rd with the average FLFP 53 percent during the period of 1995-2013. In 1995 TFR start from 1.71 and continuously decreasing up till 1.187 in 2013, While, FLFP begin with 50 percent and increased up to 55 percent

V-Thailand

The total Thailand population 63,447,374 is recorded and ranked 21st as most populated country in the world. Among Asian-6 countries Thailand was ranked 5th with the average TFR 1.671 per woman and ranked 2nd with the average FLFP 66 percent during the period of 1995-2013. In 1995 TFR start from 1.862 and continuously decreasing up till 1.534 in 2013, While, FLFP begin with 66 percent and shows variation up till 2013 with 65 percent.

VI-Vietnam

The total Vietnam population 85,789,573 is recorded and ranked 13th as most populated country in the world. Among Asian-6 countries Vietnam was ranked 4th with the average TFR 1.991 per woman and ranked 1st with the average FLFP 69 percent during the period of 1995-2013. In 1995 TFR start from 2.666 and continuously decreasing up till 1.791 in 2013, While, FLFP begin with 73 percent and decrease up to 67 percent.

Among Asian-6 countries three countries (Indonesia, Malaysia and Singapore) showing negative relationship between TFR and FLFP while three countries (Thailand, Vietnam and Philippines) showing positive relationship between two variables. This complex, controversial and inconsistent results open the research gate for the researchers for further investigation.

2. Theoretical perceptions on fertility and female labour force participation

The different researchers (Cheng et al (1997), Engelhardt et al (2004)) investigates increase in TFR in two ways, negative effect of TFR on FLEP and positive effect of TFR on FLEP. On the negative side, increase in number of children can increase the amount of home work, which causes to reduce the chance of mother to seek work in the market. These results support the hypothesis of incompatibility role and stated that there is a negative relationship between TFR and FLFP because of the sprain of being employee and mother. However, on the positive side, if the number of children increase there is need to increase in household's income too and it may cause for mother to seek outside employment.

On the other hand, if FLFP is increase and effect negative on TFR it means its support the hypothesis of incompatibility role. Further, if female employees having children and they admission in child care centre than it is opportunity cast so, FLFP negatively affect TFR. Additionally increase in FLFP cause in the disruption towards female's career success, apparent in the hammering of a higher prospective future income tributary and non-pecuniary settlement including appreciation and status related with a more senior post in her chosen profession. An additional opportunity cost of increase in numbers of children may perhaps the loss of camaraderie and social associations in the place of work that serve as a point of liberate outside the home. However, researcher investigates that the relationship between FLFP and TFR revolutionize from a negative to a positive value in the 1980s (Ahn and Mira 2002).

The studies (Engelhardt et al. (2004), Narayan and Symth (2006)) explore that the countries with lowest TFR also have lowest level of FLFP and vice-versa. These finding support the hypothesis of 'public response' hypothesis that hypothesize public level responses such as altering approach towards working women, increased accessibility of childcare and state-mandated paid maternity have alleviate the inappropriateness between having children and remaining in paid employment. It is concluded that causality run from TFR to FLFP and FLFP to TFR it may has negative effect of TFR on FLFP and FLFP on TFR which support the hypothesis of incompatibility role. However, if causality runs from TFR to FLFP and FLFP to TFR it may has a positive effect TFR on FLFP and FLFP on TFR which support the public response hypothesis.

3- Review of Existing Literature

The dilemma of FLFP and TFR is a recent deliberate issue among researchers. Many researchers found different relationships and causation between FLFP and TFR. whereas; numerous studies have used method based on correlation and found there is positive or negative relationship between FLFP and TFR. But a small numbers of studies addressed the problem of causation between FLFP and TFR. The studies, Zimmermann (1985), utilized annual time series data of Germany from the year 1960 – 1979; Cheng (1996b), employed annual time series data of USA from 1948 – 1993 and Cheng et al. (1997), used annual time series data of Japan from 1950 – 1993 found that there is evidence of causality between both variables.

Furthermore, Cheng (1996a) investigated the causation between TFR and FLFP American females. The results confirm the causality from FLFP to TFR. Engelhardt et al. (2004) used annual time series data from Sweden, Italy, UK, Germany and France from the year 1960 to 1994 and utilized cointegration and Granger causality. The results showed that there long run causality for all countries. Narayan and Smyth (2006) explored the relationship between TFR, FLFP and infant mortality rates in Australia from 1960–2000 and investigate that TFR and infant mortality rate both jointly Granger cause FLFP. As mentioned earlier there not various studies utilized panel cointegration and panel causality between these two purposed variables. So, this the contributions of present study to apply panel cointegration and panel causality to get better results.

4-Data Source

The annual time series data have been used from 1995 to 2013 for the Asian-6 countries namely, Malaysia, Indonesia, Thailand, Singapore, Philippines and Vietnam. The data of total fertility ratio and female labour force participation collected from World Bank data base and converted in to natural logarithm before analysis. The TFR is the weighted mean of age specific fertility rates and FLFP is defined as the adult female population with the age group 15 – 65 years in the labour force.

5- Econometric methodology and results

The different econometric approaches have been applied to test the causality as well as relationship between TFR and FLFP.

Unit Root Test

Before apply cointegration and causality it is preliminary to test stationarity and level of integration. The augmented Dickey-Fuller (ADF) and Phillips Perron test for unit root have been applied. The results in Table 1 suggest that all the variables of each countries are non-stationary at level and become stationary at first difference it means the level of integration of all variables are I(1).

Table 1. ADF and PP Unit Root Test

Country	ADF Unit root test			
	TRF		FLFP	
	Level	First Difference	Level	First Difference
Indonesia	0.761	0.032*	1.981	0.000*
Malaysia	0.321	0.045*	0.987	0.045*
Philippines	0.061	0.001*	0.891	0.032*
Singapore	0.098	0.030*	0.762	0.010*
Thailand	0.754	0.012*	1.987	0.023*
Vietnam	1.896	0.000*	0.056	0.049*
Country	PP Unit root test			
	TRF		FLFP	
	Level	First Difference	Level	First Difference
Indonesia	0.761	0.032*	1.981	0.000*
Malaysia	0.321	0.045*	0.987	0.045*
Philippines	0.061	0.001*	0.891	0.032*
Singapore	0.098	0.030*	0.762	0.010*
Thailand	0.754	0.012*	1.987	0.023*
Vietnam	1.896	0.000*	0.056	0.049*

Note: * statistically significant at 5 percent

Cross Sectional Dependence (CD) Test

It is observed that the Panel unit root tests are more powerful because of joint information from cross section data and time series data. But it is observed that panel unit test are facing enormous problem of cross-sectional dependence. The test applied for check panel cross sectional dependence (CD) is proposed by Pesaran (2004). The statistics based on uni-variate AR (p) specification with the level of variables $p \leq 4$. The null hypothesis (H_0) stated that output innovation is independent by cross sectional. The critical values for CD test are 1% = 2.57, 5% = 1.96 and 10% = 1.64. The test statistics proposed by Pesaran (2004) are reported in Table 2.

Table 2. Cross Section Dependence Test

Cross Section correlation of the errors in the ADP regression across Six-Asian countries				
1995-2013 (T = 19, N = 6)				
	p = 1	p = 2	p = 3	p = 4
TFR				
Î	0.134	0.118	0.321	0.104
CD	4.532***	3.312***	3.041***	3.041***
FLFP				
Î	0.091	0.043	0.051	0.055
CD	2.413**	1.214	1.314	1.312

Note: **, *** denoted for statistically significant at 5 %and 1% level, respectively.

The CD test is significant at 1%, and TFR correlation coefficient observed around 0.1. The correlation coefficient for FLFP is much lower and the CD statistic is only statistically significant at one lag.

Panel Unit Root Test

The panel unit root is based on different tests. The prominent tests are Im *et al*.(2003) Levin *et al*.(2002) and also include IPS test statistic (CIPS) proposed by Pesaran (2007). According to LLC tests it is presumes that countries include in the test are unite towards the equilibrium value with the same velocity under the alternative hypothesis (H_1). The panel unit root test results are reported in Table3. The results of utilized tests confirm that FLFP and TFR are I (1).

Table 3. Panel Unit Root Test Results

	TFR		FLFP	
	Level	Difference	Level	Difference
IPS	2.62	-7.31***	3.21	-4.82***
LLC	-0.18	-6.89***	0.54	-5.12***
CIPS	-2.312	-5.012***	-1.675	-3.123***

The IPS test is less restrictive as compare to LLC because IPS test does not make assumption like LLC test. The IPS test looks towards the solution of CD problem. For transformed the data IPS test subtract the cross sectional means and apply the *t*-bar statistic. However, Strauss and Yigit (2003) suggested that humiliate across the panel does not habitually eradicate CD. Strauss and Yigit argue that CIPS test is more powerful as compare to IPS test and LLC test because CIPS unambiguously permit for CD by suitably truncating the IPS *t*-bar statistic.

Cointegration Test

To investigate the cointegration between TFR and FLFP this study applied Johansen maximum likelihood (JML) approach developed by Johansen (1988) instead of Kao's cointegration approach. The results for maximum likelihood reported in Table4. The results are suggested that null hypothesis (H_0) of no cointegration rejected for Indonesia, Vietnam and Singapore and null hypothesis of one cointegration cannot be rejected in these countries. Furthermore, null hypothesis of no cointegration and null hypothesis of one cointegration cannot be rejected for Malaysia, Philippines and Thailand.

Table 4. Johansen cointegration test results

Maximum Eigen value statistics for H_0 : *rank* = *r*			
Country	*r* = 0 (17.3, 19.4, 23.8)	*r* ≤1 (10.7, 12.6, 16.6)	*p*
Indonesia	21.03**	11.44	2
Malaysia	17.78	7.15	1
Philippines	9.87	7.74	2
Vietnam	31.35***	8.93	2
Thailand	10.12	5.44	1
Singapore	25.35***	9.12	2

Note: **, *** rejected null at 5% and 1% level, respectively

It is concluded that there is a single cointegration vector for three (Indonesia, Vietnam, Singapore) out of Asian-6 countries. The Pedroni (2000) panel cointegration test have been applied to confirm the long run relationship between both variables. Pedroni (2000) presents seven different statistics to test the null of no cointegration in heterogeneous panels. Pedroni divided these seven tests into two groups. Group one called within dimension panel test and second group called between dimension group tests. The seven Pedroni (2000) test statistics are as reported in Table5 and these statistics are based on the estimated residual form.

$$TFR_{i,t} = \alpha_i + \beta_i FLFP_{i,t} + \varepsilon_{i,t} \qquad (1)$$

Here FLFP and TFR are defined as above and $\varepsilon i\ t = \eta i\ \varepsilon i\ (t-1) + \mu i\ t$ are the estimated residuals from the panel regression. The values of seven statistics and two groups are tabulated in Pesaran (2004). If the calculated values are higher than tabulated value the null hypothesis of no cointegration can be rejected and it is suggested that there is exist long run relationship between TFR and FLFP. The results of panel cointegration presented in Table 5.

Table 5. Panel Cointegration Tests

Pedroni Test			
	Statistics	*r* = 0	*r* ≤ 1
TFR has cointegration			
Panel of v-statistics	0.32431	*35.12***	13.19
Panel of rho test-statistics	0.33400		
Panel of PP test-statistics	0.42071		
Panel of ADF test-statistics	-0.14563		
Group rho test-statistics	1.43251		
Group PP test-statistics	1.34210		
Group ADF test-statistics	0.56213		
FLFP has cointegration			
Panel of v-statistics	1.34512		
Panel of rho test-statistics	-1.67123*		
Panel of PP test-statistics	-2.41231**		
Panel of ADF test-statistics	-2.13210**		
Group rho test-statistics	-2.42131**		
Group PP test-statistics	-3.43231***		
Group ADF test-statistics	-3.34412***		

The results are reported in Table 5 suggested that in case of FLFP as dependent variable six out of seven statistics confirm panel cointegration and in case of TFR as dependent variable none of statistics can reject the null hypothesis of no cointegration. These seven statistics are residual-based; to aggregate the probability-values of the individual JML cointegration test statistics Fisher $\chi 2$ cointegration test utilized.

Causality Test

After the confirmation of cointegration study examine the direction of causality between the TFR and FLFP.As it is confirmed that there is long run relationship between both variables, Granger causality for long run relationship run with dynamic error correction model (DECM) specification. The DECM is estimated by follow a two-steps procedure. First, study estimates the cointegration between TFR and FLFP follow the JML procedure. Second, study utilize the results of this cointegrating relation to estimate the EC term $\hat{E}C\hat{T}_{it} = TFR_{it} - \hat{\alpha}_i - \hat{b}_t - \hat{\beta}_i FLFP_{it}$.

Now study estimate ECM:

$$\Delta TFR_{it} = \alpha_{1i} \sum_{l=1}^{P} \alpha_{11ip} \Delta TFR_{it-p} + \sum_{l=1}^{p} \alpha_{12ip} \Delta FLFP_{it-p} + \phi_{1i} ECT_{it-1} + \varepsilon_{1it} \quad (2)$$

$$\Delta FLFP_{it} = \alpha_{2i} \sum_{l=1}^{P} \alpha_{21ip} \Delta FLFP_{it-p} + \sum_{l=1}^{p} \alpha_{22ip} \Delta TFR_{it-p} + \phi_{2i} ECT_{it-1} + \varepsilon_{2it} \quad (3)$$

where TFR and FLFP are already defined, denoted first difference,

Δ	=	First Difference
ECT	=	Error correction term
p	=	Lag length

The results of long run panel causality are presented in Table6. The Wald test shows that variables are significant in the Equation 2 and 3. According to results reported in Table6 the null hypothesis (H_0) TFR does not cause FLFP is rejected, while the null hypothesis (H_0) FLFP does not cause TFR cannot be rejected at the 5% significance level. Finally findings of these results suggested that there is a unidirectional long-run Granger causality relationship running from TFR to FLFP. In case of large N and small T the dynamic panel data usually face the problem of Nickell (1981) bias. In this study we used large $T = 19$ and small $N = 6$ so the Nickell (1981) bias is negligible and can be ignored.

Table 6. Long-Run Panel causality Tests

H_0:No Causality	X^2	Probability- value
FLFP does not cause TFR	0.66	0.44
TFR does not cause FLFP	3.81	0.01**
** Rejection of the H_0 at the 5% critical value		

Fully Modify Least Square (FMOLS) Test

After the confirmation of cointegration and direction of causality, the study able to test the long-run structural coefficients by using the fully modify ordinary least square (FMOLS). The FMOLS test proposed by Pedroni (2000) and tackles the dilemma of regressors with non-stationary specification as well as the dilemma of simultaneity biases. For the FMOLS estimator, consider a cointegrated system for a panel of $i = 1, 2, \ldots, N$ countries over time $t = 1, 2, \ldots, M$:

$$Y_{it} = \alpha_{it} + \beta X_{it} + \varepsilon_{it} \quad \text{and} \quad X_{it} = X_{it-1} + \mu_{it} \quad (4)$$

The panel FMOLS estimator for coefficient β is

$$\hat{\beta}_{FMOLS} = \left[\sum_{i=1}^{N}\sum_{t=1}^{T} x_{it}x_{it}'\right]^{-1}\left[\sum_{i=1}^{N}\sum_{t=1}^{T}\left(x_{it}y_{it}^{+} - \lambda_{i,\varepsilon u}\right)\right] \quad (5)$$

The results of the panel long run relationship estimator by using FMOLS are presented in Table7. The results explain that TFR of all Asian-6 countries and as a whole have statistically significant negative effect on FLFP.

Table 7. FMOLS estimators Results

Country	FLFP is dependent variables	
	Coefficients	*t*-statistics
Indonesia	-0.66***	-9.45
Malaysia	-0.43***	-6.79
Thailand	-0.12***	-3.34
Singapore	-0.45***	-16.12
Vietnam	-0.13***	-6.13
Philippines	-0.41***	-6.13
Panel	-0.44***	-19.13
***significant at 1% critical value		

The largest effect of TFR on FLFP is observed in Indonesia where 1% increases in TFR cause decrease FLFP by 0.66%. While in three countries among Asian-6 countries effect of TFR on FLFP is almost similar, which is 1% increases in TFR cause decrease FLFP by 0.45%, 0.43% and 0.41% in Singapore, Malaysia and Philippines respectively. Furthermore, the smallest effect of TFR on FLFP observed in Thailand where increases 1% in TFR cause reduce FLFP by 0.12%. The result of the panel long run elasticity suggested that 1% increase in TFR cause FLFP decrease by 0.44%.

The negative equilibrium relationship between FLFP and TFR are the witness of the lack of effective access to childcare. Chevalier and Viitanen (2002) investigate the causality between FLFP with young children and the supply of childcare in the UK. The results are suggested that lack of childcare services confines FLFP and currently increase in demand for childcare only serve to increase costs or

queues rather than have an effect on the supply. The results are leads that if the Government of UK have aim to increase FLFP than change policy in the child care market is required. Similarly, Del Boca (2002b) also suggested childcare improvement and increased access to affordable childcare in Italy. Furthermore, Cleveland et al. (1996) investigates FLFP in Canada and Kreyenfeld & Karsten (2000) in Germany. The results are suggested that FLFP is affected by childcare supply.

Conclusion

The main aim of this study is to investigate the direction of causality between FLFP and TFR for the Asian-6 countries. For the purpose to check the stationarity and level of integration panel unit root test have been applied. After confirmed the stationarity of each variable, panel cointegration and Granger causality test used to examine the cointegration and direction of causality between FLFP and TFR. The panel based cointegration has advantage against individual cointegration that it is more powerful especially in case of small size with less than 50 observations. The results of cointegration confirm the cointegration between proposed variables. In addition results of panel causality suggested that there is causality run from TFR to FLFP in the Asian-6 countries. The results also suggested that there is opposite relationship between FLFP and TFR. The FMOLS techniques are used to examine the long run relationship between FLFP and TFR and results confirm the long run relationship between FLFP and TFR. This study is multivariate setting further it can be extended investigating causality between FLFP and TFR from the bivariate context. Further TFR and FLFP also can consider as factor influence the opportunity cost of having more children like household total income, female education and male unemployment.

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