

Causality Between Female Fertility and Female Labour Force Participation in Asean-5

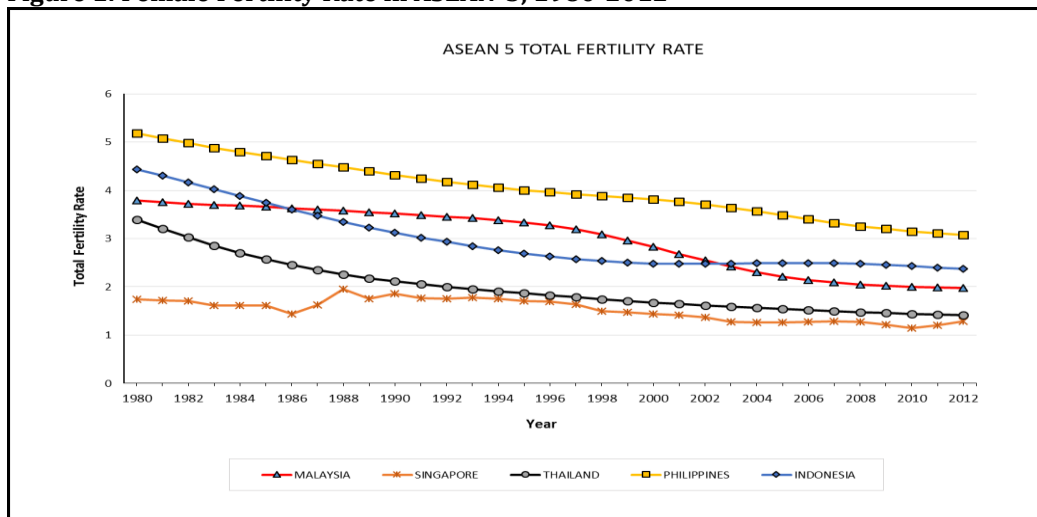
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Abstract: Researches on whether female fertility determines labour force participation or *vice versa* have reached mixed results. A high participation of females in the labour market can reduce fertility, conversely, high female fertility can also reduce female participation in the labour market. As such, this paper sets out to answer the question of “What causes what?” Having established the existence of cointegration for individual ASEAN-5 countries using time-series data and also for a panel of ASEAN-5 countries, we found the presence of bidirectional causality between female fertility and female labour force participation. We therefore conclude that for the ASEAN-5 countries, any policies undertaken to increase female fertility will have profound impact on female labour force participation rate.

1. Introduction

The question of whether female fertility determines labour force participation or *vice versa* has produced mixed results. A high participation of females in the labour force can reduce fertility. Conversely, high female fertility can also reduce female participation in the labour market. As such, this paper sets out to answer the question of “What causes what?” Easterlin’s theory stressed that fertility has a positive relationship with relative income of a couple. This theory focuses on two main aspects. First, it focuses on the effect of birth rates on the relative number of young adults to older adults and second, the effect of this relative number on earnings and unemployment.¹ Alternatively, the New Home Economics theory proposed that raising children are considered as a time intensive occupation, and this in turn will increase the value of time for females (educated female), thus exerting a negative effect on fertility. This model thus establishes a link between the decisions taken on fertility and those concerning the other activities of the household, such as labour force participation and consumption.² Figure 1 below shows that female fertility is steadily declining for all ASEAN-5 countries with the exception for Singapore for the period 1980-2012. Singapore somewhat displayed an episode of increasing female fertility from 1.621 (1987) to 1.956 (1988). Overall, female labour force participation displays an increasing trend for all ASEAN-5 countries (Figure 2).

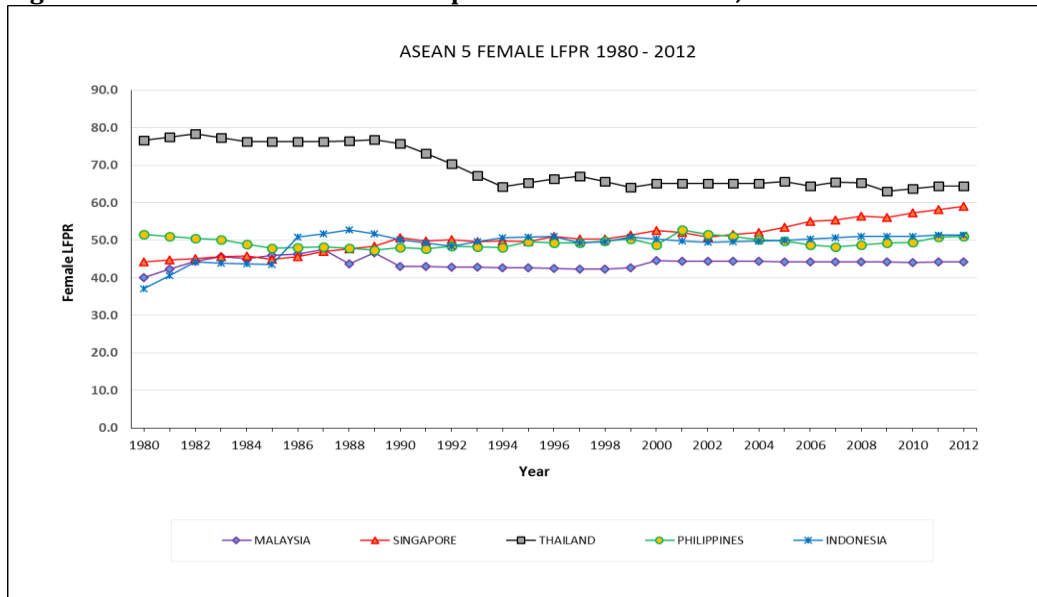
Figure 1: Female Fertility Rate in ASEAN-5, 1980-2012



¹Brown R. L. and Norville, C. (n.d.). Theories of Fertility. Paper available at <https://uwaterloo.ca/waterloo-research-institute-in-insurance-securities-and-quantitative-finance/sites/ca.waterloo-research-institute-in-insurance-securities-and-quantitative-finance/files/uploads/files/01-06.pdf>

²Diebolt, C. and Doliger, C. (n.d.). Becker vs. Easterlin Education, Fertility and Growth in France after World War II. Paper available at <http://iussp2005.princeton.edu/papers/50088>

Figure 2: Female Labor Force Participation Rate in ASEAN-5, 1980-2012



Mahdavi (1990) proposed that an increase in the female labour force participation rate can cause a decline in fertility for industrialized countries. Narayan (2006) for example showed that female labour force participation rate is negatively related to female fertility for Taiwan for the period from 1966 to 2001. The same relationship was observed by Namchul and Ji-Sun (2008) and also Chun and Oh (2002) for the case of Korea. Ahn and Mira (2002) also highlighted the negative effects of female labour force participation rate on growth of fertility rate in the case of the Organization of Economic Cooperation and Development (OECD) countries. The female labour force participation rate is also found to be negatively related to the fertility rate in the case of Canada (McNown and Ridao-Cano, 2004). Beguy (2009) further noted that an increase in women employment reduces female fertility in the case of Lome, while for Dakar a positive relationship was observed between women employment and fertility rate. An inverse relationship between female fertility and female labour force participation was also found by Bloom et al. (2009) for an unbalanced five year panel covering the period from 1960 to 2000 for 97 countries. Conversely, Cheng (1996b) argued that the female labour force participation does not affect the probability of fertility rate in the case of the United States (US). Even though an inverse relationship is observed for many countries between female fertility and female labour force participation, Del Boca (2002) found that low labor market participation rates of married women accompanied low birth rates for Italy, as well as in other Southern European countries.

Furuoka's (2012) findings indicated that there is no causal relationship between female fertility and female labour force participation for a panel of ASEAN-5 countries, except that the number of children is a cause of change in female labour force participation in ASEAN-5 countries in the long run. Mishra et al. (2010) found a long-run Granger causality runs from total fertility rate to female labour force participation rate and that a 1 percent increase in total fertility rate results in a 0.4 percent decrease in female labour force participation rate for a panel of G7 countries. Cheng et al. (1997) found that for Japan, the causality runs from female fertility to female labour force participation, where women's employment do not hinder or reduce the probability of having more children, but having small children at home can discourage women from seeking employment outside. Salamaliki et al. (2013) established a bidirectional indirect causality between female labor supply and fertility. Narayan and Smyth (2006) found that in the short run, there is unidirectional Granger causality running from fertility rate to female labour force participation while in the long run the fertility rate Granger cause female labour participation. Lau et al. (2014), and observed a unidirectional causality between female labour force participation and fertility for the US, whereby female labour force participation Granger causes fertility. Nor Aznin et al. (2014) also noted from their panel causality tests, the existence of uni-directional long-run causality from fertility to female labour force participation for 6 ASEAN countries, namely Malaysia, Singapore, Philippines, Indonesia, Thailand and Vietnam.

Given the empirical literature above, this paper, first, investigates the direction of relationship between female fertility and female labour force participation for the ASEAN-5 countries using time series and

panel data sets. Second, the paper ascertains the speed of adjustment of those two variables during shocks. Finally, the paper identifies the direction of causality between female fertility and female labour force participation for ASEAN-5 using panel data sets. The paper is thus organized as follows. The second section will elaborate on the empirical strategy used in this study. The third section will focus on the results and discussion while the final section concludes.

Empirical Strategy: Time data series are collected for 5 ASEAN countries, namely Malaysia, Singapore, Thailand, Indonesia and the Philippines. The data for the two main variables used in this analysis, female fertility rate (*FR*) and female labour force participation rate (*FLFPR*) covering the period of 1980 to 2012, are obtained from the World Development Indicators (CD-ROM, 2014). We follow the empirical model developed by Mishra and Smyth (2010), which looked at the causality between *FLFPR* and *FR* for OECD countries. The bilateral estimate for this study is specified as follows

$$\ln FLFPR_{it} = \alpha_0 + \alpha_1 \ln FR_{it} + \varepsilon_t \quad (1)$$

$$\ln FR_{it} = \beta_0 + \beta_1 \ln FLFPR_{it} + \mu_t \quad (2)$$

where, $\ln FLFPR$ and $\ln FR$ represent the logarithm form of female labour force participation rate and female fertility rate for ASEAN-5, respectively. Before proceeding with the panel cointegration and causality tests, we employ two panel unit root test, Im et al. (IPS, 2003) and Breitung (2000) tests to check the stationarity properties of the variance. The IPS statistics is asymptotically $N(0, 1)$, as T and N goes to infinity. This test is meant to test whether the null hypothesis for each series in the panel has unit root for all cross sectional units against the alternative test that at least one of the series is stationary. To confirm the stability of panel stationarity test, we also employ the Breitung unit test, where this method requires specification of numbers of lags in each cross-section panel augmented Dickey-Fuller (ADF) regression.

Once panel unit root tests are performed and the order of the integration is determined, we proceeded to the second stage that is to identify the existence of cointegrating relationships between the variables used in the analysis. We used the Larsson et al. (2001) approach to determine the linkages between *FLFPR* and *FR* for ASEAN-5. Larsson et al. (2001) present a maximum-likelihood based panel test for the cointegrating rank in heterogeneous panels by following the heterogeneous VAR(k_i) model as follows:

$$Y_{it} = \sum_{k=1}^{k_i} \Pi_{ik} Y_{i,t-k} + \varepsilon_{it} \quad (3)$$

Where, $i=1,2,\dots, N$. Each panel groups represent $Y_{i,-k_i+1} \dots \dots Y_{i,0}$ and it's considered as fixed, while the error term (ε_{it}) is independently identically distributed. Larsson et al. (2001) cointegration rank hypothesis of null hypothesis is $H(r): \text{rank}(\Pi) \leq r$ and alternative hypothesis represent as $H(p): \text{rank}(\Pi) = p$. In terms of identifying the significance stages, we will use Larsson's et al. (2001) critical values based on the rank (r), expected value $E(Z_k)$ and the variance $\text{VAR}(Z_k)$. The standardize Larsson et al (2001) cointegration statistic which can be define as \overline{LR} -statistic can be define as follow

$$\gamma_{LR}\{H(r)|H(p)\} = \frac{\sqrt{N}(\overline{LR}_{NT}\{H(r)|H(p)\} - E(Z_k))}{\sqrt{\text{Var}(Z_k)}} \quad (4)$$

We also adopt the Dynamic Ordinary Least Square (DOLS) proposed by Kao and Chiang (2000) to identify the long-run cointegration relationship. The DOLS technique provides a consistent estimate of standard errors that can be used for inference with normal limiting properties. When, *FLFPR* is the dependent variable, $i=1, 2 \dots T$; the panel DOLS estimator can be rewritten as:

$$\beta'_{DOLS} = \sum_{i=1}^N \left(\sum_{t=1}^T \ln FLFPR_{it} \ln FLFPR'_{it} \right)^{-1} \left(\sum_{t=1}^T \ln FLFPR_{it} \ln FR'_{it} \right) \quad (5)$$

Basically, the DOLS estimators do not give efficient estimates in the presence of unique order of integration of the variables. To solve this problem, the Fully Modified Ordinary Least Square (FMOLS) method developed by Pedroni (2001) is applied to calculate the values of long-run estimates. The FMOLS technique generates consistent estimates in small samples and does not suffer from large size distortions in the presence of endogeneity and heterogeneous dynamics. To determine the long- and short-run dynamics along with the error correction term, we employ Pesaran et al. (1999) or known as Pooled Mean Group (PMG) estimates. The following equation represents the PMG estimates:

$$\ln FLFPR_{it} = \sum_{k=1}^p \beta_{ik} \ln FLFPR_{i,t-k} + \sum_{k=0}^q \delta_{ik} \ln FR_{i,t-k} + \mu_i + \varepsilon_{it} \quad (6)$$

According to the Pesaran et al. (1999), when we use PMG estimates, we need to assume that the disturbance terms will independently distribute over the groups and the mean value equal to zero, while the variance is above than zero ($\sigma_i^2 > 0$). Using the PMG estimates we are able to determine the speed of adjustment, which indicates the variables archive to the long-run equilibrium from short-run disequilibrium conditions. From equation (7), ect_{t-1} are the error correction term and the γ_i represent the coefficient measuring the speed of adjustment and it must be significant with negative sign. The fixed effects error term represented by μ_i and ε_{it} , indicate the panel error term. Thus, there exists a PMG with error correction term that can be formulated as follows

$$\ln FLFPR_{it} = \alpha_1 + \sum_{k=1}^{m-1} \beta_{ik} \Delta \ln FLFPR_{i,t-k} + \sum_{k=0}^{n-1} \delta_{ik} \Delta \ln FR_{i,t-k} + \gamma_i ect_{i,t-1} + \mu_i + \varepsilon_{it} \quad (7)$$

To test the Granger causality effects, we employ the panel causality test developed by Dumitrescu and Hurlin (2012), known as DH Granger causality test. The DH Granger causality test is a simplified version of the Granger (1969) non-causality test for heterogeneous panel data models with fixed coefficients. Under the null hypothesis of non-causality, each individual Wald statistic converges to chi-squared distribution with degree of freedom. The standardized test statistics $Z_{N,T}^{HNC}$ for $T, N \rightarrow \infty$ is as follows

$$Z_{N,T}^{HNC} = \sqrt{\frac{N}{2M}} (W_{N,T}^{HNC} - M) \rightarrow N(0,1) \quad (8)$$

2. Results and Discussion

Table 1 displays the results for the panel unit root test using two methods, the IPS and Breitung tests. The results reveal that the null hypothesis of unit roots for the panel data of the female fertility and female labour force participation cannot be rejected in levels, while in first differences this hypothesis is rejected. These results indicate that both the variables under study are non-stationary in level, but emerged stationary in first differences.

Table 1: Panel Unit Root Tests

	At level		At first difference	
	$\ln FR$	$\ln FLFPR$	$\Delta \ln FR_{it}$	$\Delta \ln FLFPR$
IPS	-0.368 (0.356)	-2.100** (0.017)	-2.592* (0.004)	-5.749* (0.000)
Breitung	1.417 (0.921)	-1.217 (0.111)	-7.885* (0.000)	-4.989* (0.000)

Note: * and ** significant at 1% and 5% levels respectively. The optimal lag, based on AIC and p -values, are in parentheses.

Table 2 shows the results of panel cointegration test using two methods namely Johansen Fisher cointegration (for individual countries) and also Larsson et al. (2001) heterogeneous panel

cointegration (for panel of five countries). The results reveal that there are two cointegrating relations for Indonesia at 5% level of significance while for remaining ASEAN countries namely Malaysia, Philippines, Singapore and Thailand there are only one cointegrating relation at 5% level of significance. The results of Larsson et al. (2001) heterogeneous panel cointegration test reveals that there is a long-run relationship between the those variables over the sample period because the panel likelihood ratio is 16.392 which has exceeded the critical value of 12.53 at 5% level of significance. As such, we reject the null hypothesis of no cointegration at panel level. Based on the likelihood based panel cointegration test we can thus conclude that both female fertility and female labour force participation are cointegrated for ASEAN-5 countries. Table 3 below shows the results from both DOLS and FMOLS methods. When *FR* is used as the dependent variable, for all countries, the *FLFPR* is found to be significant. For all ASEAN-5 countries, with the exception for Thailand, a negative relationship can be observed, which concurs with the theory and also findings from many other researchers. On the other hand, when *FLFPR* is used as the dependent variable, a negative relationship can be observed for all ASEAN-5 countries, except for Thailand. However, for Thailand, using both DOLS and FMOLS methods, we found that female fertility is not significant. Subsequently, panel DOLS and panel FMOLS were constructed, and we found that a negative relationship can be observed for the panel dataset.

Table 2: Cointegration Test Results

Country	Johansen Fisher cointegration		
	$r=0$	$r \leq 1$	Rank (k)
Indonesia	34.963*	11.145*	2
Malaysia	28.499*	0.162	1
Philippines	19.805*	0.056	1
Singapore	15.574*	0.658	1
Thailand	50.534*	9.500	1
<i>Panel_{Fisher}</i>	71.83*	29.46*	2
	Larsson et al. heterogeneous panel cointegration		
	$r=0$	$r \leq 1$	Rank (k)
Indonesia	19.897*	15.049*	2
Malaysia	15.443*	1.466	1
Philippines	9.453	1.625	0
Singapore	6.537	0.720	0
Thailand	30.627*	12.575*	2
$E(Z_K)$	6.086	1.137	
$Var(Z_K)$	10.535	2.212	
$Panel_{LR}$	16.392*	6.287	1
CV=5%	12.53	3.84	

Note: * denote statistically significant at 5%. Critical value based on Larsson's et al. (2001)

Table 4 displays the results for the estimation of PMG for long-run and short-run coefficients of the female fertility and female labour force participation with their respective adjustment coefficients. The cointegration is performed following Pesaran et al. (1999). For the female fertility equation, the adjustment coefficient produced the expected sign and is significant at the 1 percent level. For the female labour force participation equation, the coefficient of adjustment has the expected sign but is only significant at the 10 percent level. This result reveals that there is an adjustment dynamic from short-run to long-run equilibrium. When the long-run coefficients are considered, significant coefficients are obtained for both equations. Using the PMG for fertility equation, the coefficient obtained is -0.157, while for female labour force participation, the coefficient obtained is -0.048. The Hausman test results indicate that in both cases, restriction of homogeneity in the long-run is not rejected at the 1 percent significance level.

Table 3: DOLS and FMOLS Estimates

Country	Dependent variable: $\ln FR$			
	DOLS		FMOLS	
	Coefficient	t-statistics	Coefficient	t-statistics
Indonesia	-0.142* (0.030)	-4.620	-0.138* (0.023)	-5.793
Malaysia	-0.556** (0.201)	-2.759	-0.423* (0.156)	-2.711
Phillipines	-0.239* (0.009)	-2.507	-0.234** (0.089)	-2.623
Singapore	-0.028* (0.009)	-2.979	-0.027* (0.008)	-3.243
Thailand	0.139* (0.025)	5.370	0.152* (0.026)	5.827
<i>Panel_{DOLS,FMOLS}</i>	-0.869*** (0.461)	-1.885	-0.985** (0.415)	-2.375
Dependent variable: $\ln FLFPR$				
Indonesia	-0.913* (0.313)	-2.916	-0.830* (0.241)	-3.443
Malaysia	-0.611** (0.288)	-2.119	-0.978* (0.340)	-2.872
Phillipines	-0.409* (0.073)	-5.602	-0.511** (0.221)	-2.312
Singapore	-1.417** (0.544)	-2.604	-1.440* (0.421)	-3.420
Thailand	-3.508 (7.221)	0.485	4.816 (7.363)	0.654
<i>Panel_{DOLS,FMOLS}</i>	-0.204* (0.056)	-3.626	-0.116** (0.046)	-2.528

Note: *, ** and *** significant at 1%, 5% and 10% levels respectively. Standard errors are in parentheses.

Table 4: Heterogeneous Panel Cointegration Test

	Dependent variable: $\ln FR$		Dependent variable: $\ln FLFPR$	
	MG	PMG	MG	PMG
Long-run estimates				
$\ln FR$			-0.106* (0.020)	-0.048** (0.021)
$\ln FLFPR$	-0.264* (0.018)	-0.157* (0.015)		
Short-run estimates				
Constant	0.159 (0.081)	0.132 (0.081)	0.571 (0.159)	0.489 (0.172)
$\Delta \ln FR$			0.203 (0.259)	0.205 (0.288)
$\Delta \ln FLFPR$	0.143 (0.146)	0.146 (0.149)		
ect_{t-1}	-0.066*** (0.035)	-0.061*** (0.035)	-0.325* (0.095)	-0.282* (0.104)
Hausman test	0.13 [0.722]		0.13 [0.359]	

Note: *, ** and *** significant at 1%, 5% and 10% levels respectively. Standard errors and p -values are in () and [], respectively.

To test for causality for panel data, we use the DH Granger causality test. Table 5 reports the results from the DH Granger causality test. This test can be used even under the conditions of cross-sectional dependence (Akbas et al., 2013). Bidirectional causality was found between female fertility and female labour force participation for ASEAN-5. This results contradicts with the findings by Furuoka (2012), where he found that there is no causal relationship between female labour force participation and total

fertility rate, except that the number of children is a cause of change in female labour force participation in ASEAN-5 countries in the long run.

Table 5: DH Granger Causality Test

Direction of causality	W^{DH}	Z^{DH}	p-value
$\ln FR \rightarrow \ln FLFPR$	4.645*	4.967*	0.000
$\ln FLFPR \rightarrow \ln FR$	2.987*	2.661*	0.007

Note: * denote statistically significant level at 1%.

3. Conclusion

This paper established the existence of cointegration for individual ASEAN-5 countries using time-series data and also for ASEAN in a panel context. Further, the Granger Causality test results using panel data for ASEAN-5 countries revealed bidirectional causality between female fertility and female labour force participation. The findings of this study, though contradicts with the findings by Furuoka (2012), are considered more robust and reliable. As such, we conclude that for the ASEAN-5 countries, any policies undertaken to increase female fertility will significantly affect female labour force participation.

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Appendix

Female Fertility Rate and Female Labor Force Participation Rate in ASEAN-5

