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Statistical Analyses on the Impact of Demographic Factors on Fertility Rate in Malaysia

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Abstract: *This study investigates the relationship between demographics and economics factors (such as women education, women labor participation, degree of urbanization, infant mortality rate and women life expectancy) on fertility rate in Malaysia over the period 1979 until 2014. The relationship is determined by using Autoregressive Distributed Lag (ARDL) approach and the results have shown the existence of the relationship between fertility rates and most of the factors of interest except degree of urbanization.*
Key Word*: demographic factor; fertility rate; ARDL*

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I. Introduction

Fertility rate can be defined as the average number of births per woman her lifetime. It becomes the major factor that contributes the changes in world population as it is part of demographic transition. Demographic transition can be referred as the model that describes the changing pattern of population over time. On the other words, it is a transition from high birth and high death to low birth and low death as a county develops from pre-industrial to an industrialized economic system.

The fertility rate in each country might be different due to several factors as it involved subjectivity and may not apply across culture (Claire et al., 2003). The factors can be social, cultural, economic, demographic or even politic. Malaysia however experiencing decline in fertility which lead to the increment number in life expectancy and ageing population. Based on the demographic trends, Malaysia encounters deterioration in total fertility rate where from 3.4 children per woman in 1991 to 3.0 in 2000 and this condition continues to drop until it reaches at 2.1 in 2012. This situation becomes a problematic condition since we do not want this decline to be continued in the long term.

II. Literature Reviews

There are a lot studies have been done to determine the impact of such factors: women education, women participation in labor force, urbanization, age for first marriage, family income, health care, infant mortality rate, women life expectancy and contraceptive use on the fertility rate. The studies may give different result as it depends on how the county works and how demographic transition takes part. Amongst them are: Chani et al. (2011), Saleh and Subramaniam (2014), Lai and Tey (2014), El-Ghannam (2005), Abu Bakar et al. (2013), Lee and Ng (2012), Lau et al. (2014) and Siah and Lee (2014).

Chani et al. (2011) made an overview on fertility trends in Pakistan and found that each country has different fertility rate due to reliability of this rate on demographic, socioeconomics, and cultural determinants. Furthermore, their findings have shown that the decline in fertility rate in Pakistan was related to women education. In other words, when more educated women are in Pakistan, they intend to less giving birth due to work and profession constrains. The study also found that there was an existence of both short and long run relationships between fertility and women's education by using ARDL bound testing approach to integration. This result also supported by Saleh and Subramaniam (2014) and Lai and Tey (2014) as they found that women education was significant factors that contribute to the changes in fertility rate.

El-Ghannam (2005) investigated the fertility deferential in Less Developed Countries (LDC's) and More Developed Countries (MDC's). The result indicated that there was the relationship between total fertility rate and women participation in labor force; where the more women completing the university degree bring to the increment number of women becoming economically active in the labor force. Besides, Abu Bakar et al. (2013) also stated that in the long run and short run estimations by ARDL approach, female labor force participation was relevant and has impact on fertility rate. Saleh and Subramaniam (2014) suggested that women nowadays are tending to involve in technologically wise than the older generation. The different perception towards having the more children and a large family were existed because of huge age gap between them.

The study by Lai and Tey (2014) studied on the factor that contributes to the fertility determinants in Philippines. The finding was the numbers of children show rural-urban differentials as urban women having fewer children compared to their rural counterparts. Urban women tend to stop childbearing at younger age compared to rural women. This study was in line with Saleh and Subramaniam (2014) and Chani et al. (2011) with the conclusion that area of living is one of the factors that provide significant impact on the fertility rates of women.

Lee and Ng (2012) examined the determinants of fertility rate in Singapore. It is found that reducing infant mortality rate was important in increasing fertility. The result indicated that infant mortality has negative association to the fertility in the long run. Lee and Ng suggested that declining infant mortality encourages women to have more children. This evidence also supported by Lau et al. (2014). They investigated the impact of infant mortality rate and female labor force participation on fertility rate in United States. The result for the long run shows that infant mortality was significant and has negative relationship with the fertility rate. However, the result by Lee and Ng (2012) and Lau et al. (2014) are contradicted with Siah and Lee (2014). The results by them indicate that mortality changes have significant and positive long-run effect on fertility rate.

Due to such interest, the main purpose of this study is to investigate the relationship between demographics and socioeconomic factors on the fertility rates in Malaysia. These factors are considered to determine the changes in fertility rate in Malaysia. To achieve the aim of this study, the ARDL procedure is utilized over the period 1979-2014.

III. Data and Methodology

This study uses of secondary data of fertility rate, demographic and socioeconomic factors such as women education, women participation in labor force, degree of urbanization, women life expectancy and infant mortality rate; which are available at Department of Statistics Malaysia and World Development Indicators (WDI) database by World Bank. The study is applied in Malaysia that covers from the period of 1979 to 2014 which gives 35 total numbers of years.

The impact of demographic and socioeconomic factors on fertility rate in Malaysia is determined by the following model:

$$TFR_t = f(WE_t, WLFP_t, URB_t, WLE_t, IMR_t)$$

where TFR, WE, $WLFP$, URB, WLE and IMR represents total fertility rate (births per woman), women education is measured by secondary school enrollment of female (%), women labor force participation rate is taken for female above the age of 15 years, urbanization is proxy by urban population as a percentage of total population, women life expectancy at birth and infant mortality rate (per 1,000 live births).

Econometric Approach

Stationarity and co-integrated variables are important to obtain reliable regression results (Chani et al., 2011). Regression result obtained through Ordinary Least Square (OLS) method may be spurious and misleading if the stationarity and co-integrating among the variables are absence. Thus, the Augmented Dickey-Fuller test is used to check the stationarity of the variables. The Auto Regressive Distributed Lag (ARDL) model is also employed to find the co-integrating relationship of the variables such as total fertility rate (TFR), women education (WE), women participation in labor force (WLFP), degree of urbanization (URB), women life expectancy (WLE) and infant mortality rate (IMR).

Unit Root Test (Augmented Dickey-Fuller Test)

By assuming the variable is free from time trend, the following hypotheses are stated to investigate the stationarity of variables:

$$H_o: \delta = 0 \ (X_t \ is \ non \ stationary)$$
$$H_A: \delta < 0 \ (X_t \ is \ stationary)$$

with the following regression model is used in Augmented Dickey-Fuller Test (Chani et al., 2011):

$$\Delta X_t = \alpha + \delta X_{t-1} + \sum_{j=1}^{q} \gamma_j \Delta X_{t-j} + \epsilon_{1t}$$

where

$\Delta X_t = X_t - X_{t-1}$ (first difference)

q = number of lags in the dependent variable

ARDL Bound Testing Approach

The application of co-integrating method is used due to mix order of integration with some of the variables are modeled with I(0) and others are I(1). This approach also has the ability to check for short run relationship as well as long run. Lau et al. (2014) stated that the ARDL approach is the appropriate method to be adopted because it is suitable in small sample size as this study use only 35 observations (from year 1979 until 2014). To find the co-integrating relationship, Unrestricted Error Correction Model (UECM) is applied:

$$\Delta TFR_t = \beta_0 + \beta_1 TFR_{t-1} + \beta_2 WE_{t-1} + \beta_3 WLFP_{t-1} + \beta_4 URB_{t-1} + \beta_5 WLE_{t-1} + \beta_6 IMR_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta TFR_{t-1} + \sum_{j=0}^{p} \alpha_i \Delta WE_{t-j} + \sum_{s=0}^{p} w_s \Delta WLFP_{t-s} + \sum_{s=0}^{p} v_s \Delta URB_{t-s} + \sum_{s=0}^{p} c_s \Delta WLE_{t-s} + \sum_{s=0}^{p} r_s \Delta IMR_{t-s} + \varepsilon_t \quad (1)$$

In model (1), β_0 and ε_t represent the intercept and a white noise series of residuals, respectively. The existence of co-integration among the variables is tested using Wald F-test. In Wald F-test, The null hypothesis H_o : $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$ representing that there is no co-integration among the variables against the alternative hypothesis, H_A : at least one of $\beta_i \neq 0$ where *i*= 1, 2, 3, 4, 5, 6 stating that co-integration exist among them or at least one variable is consist long run relationship with other variable.

Lau et al. (2014) stated that if the calculated Wald or F-statistic is larger than upper critical value bounds, the null hypothesis is rejected and it can be concluded that there is co-integration exist among the variables. But, when the test statistic lesser than the lower critical value bounds, the null hypothesis is failed to reject and it means there is no co-integration among the variables. However, if the Wald or F-statistic fall inside upper and lower critical value bounds, the inference is inconclusive. According to Chani et al. (2011), the long runs as well as short run coefficients of the variables are considered constant and reliable if the included variables are co-integrated.

IV. Results and Discussion

The Augmented Dickey Fuller (ADF) unit root test is applied to investigate the stationarity of the data. According to the result from the individual unit root of ADF tests, it is found that the null hypothesis can be rejected at first difference I(1) (integrated of order one) for all variables except urbanization (URB). The results in Table 1 indicate that infant mortality rate (IMR) is stationary at level. While the other variables like total fertility rate (TFR), women education (WE), women labor force participation (WLFP), infant mortality rate (IMR) and women life expectancy (WLE) are stationary at I(1). The variable like urbanization (URB) is not stationary either at I(0) or I(1). Thus, URB is omitted from the model as this data will invalidate the methodology.

Table 1: Augmented Dickey Fuller (ADF) Test for Unit Root

Variables	ADF test at level		ADF test at 1st difference	
	t-statistics	Prob. Values	t-statistic	Prob. Values
TFR	0.407583	0.9801	-2.750920	0.0772***
WE	-1.904736	0.3263	-5.106292	0.0002*
WLFP	-1.786527	0.3806	-2.946446	0.0515***
IMR	-3.149868	0.0331 **	-2.630555	0.0975***
WLE	-1.830773	0.3593	-3.375507	0.0207**
URB	-0.797833	0.8066	-1.242695	0.6438

Note: The lag length selected based on Schwarz Information Criterion (SIC) and this ranges from lag zero to lag 5. *, **, and *** shows the rejection of null hypothesis of non-stationary at 1%, 5% and 10% significant level.

The result for ARDL bounds test approach to co-integration is shown in Table 2. The calculated F-statistic is 53.29235 when the variables of total fertility rate (TFR), women education (WE), women labor force participation (WLFP), infant mortality rate (IMR) and women life expectancy (WLE) are included. It can be seen that the null hypothesis of no long run relationship exist are rejected in all level of significant 1%, 5% and 10%. The F-statistic is higher than upper critical bound. It can be concluded that there is evidence of long run relationship and co-integrating exist among women fertility rate (TFR), women education (WE), women labor force participation (LWLFP), infant mortality rate (IMR) and women life expectancy (WLE) over the period 1979-2014.

Table 2: ARDL Bounds Test

Test Statistic	Value	K
F-statistic	53.29235	4

Critical Value Bounds

Significance	I(0) Bound	I(1) Bound

10%	2.2	3.09
5%	2.56	3.49
1%	3.29	4.37

According to the long run result in the Table 3, it shows that all independent variables gave significant effect on the dependent variable. WE is positively and significantly related to TFR at 5%. Long run relationship suggests that 1% increase in women education tend to increase the fertility rate by 0.007%. The coefficient of WLFP also indicates that WLFP is significant at 10% and positively affect the TFR. It is means that an increase of 1% in women labor force participation will increase the fertility rate by 0.006%. Contrary to popular literature, mostly the study found that decline in fertility rate is typically offset by an incline in women education and women labor force participation in the long run. However, this study found the opposite result as WE and WLFP give positive correlation to the FTR although the changes are small.

While the other coefficient such as WLE shows the significant result at 5% significant level but negatively related to the TFR. In the long run effect, it shows that as the number of women life expectancy increase by 1% thus the total number of fertility rate will decrease by 0.94%. This result follows the study by El-Ghannam (2005) indicates that increase in women life expectancy results the declination in fertility rate. Next, IMR coefficient shows positive sign and statistically significant at 10%. The result indicates that as the number of infant mortality rate increase by 1% then the number of total fertility rate also will increase by 0.029% in the long run. The result obtained for IMR also follow the study by Siah and Lee (2014) in the case of Malaysia as they stated mortality changes have a significant and positive long-run impact on fertility rate.

Table 3: Long Run Relationship of ARDL (2, 2, 2, 4, 0) Model

Variable	Coefficient	Std. Error	t-Statistic	p-value
WE	0.006866	0.002228	3.081818	0.0071
WLFP	0.005885	0.002924	2.012362	0.0613
WLE	-0.941409	0.029094	1.764184	0.0000
IMR	0.029434	0.016684	1.764184	0.0968
C	79.574857	2.543607	31.284258	0.0000

Table 4 shows the short run dynamics analysis. Based on the results, all independent coefficients such WE, WLFP, WLE and IMR are significant at 1%, 5% and 10% significance level in the short run. This result indicates that WE have positive and negative impact to the TFR in the short run. Although at lagged first of women labor force participation, D(WLFP) shows insignificant level but at lagged second, D(WLFP(-1)), it shows significant result and negatively correlated. In the short run, it means that WLFP gave negatively related to the TFR.

WLE also indicates negatively and significantly affect to the TFR on the short run at lag two to four periods. But at lag-one period, WLE shows insignificant result. Thus, based on result, it can be concluded that WLE has negatively affect to the TFR. For the short run IMR, the coefficient indicates positive sign and significantly related to the TFR at 10% significance level.

The coefficient error correction term (ECT) shows the speed of adjustment from short run to long run equilibrium. According to Chani et al. (2011), ECM should be statistically significant with negative sign to prove that established long run relationship is stable. Thus, the result obtained from co-integrating form indicates that the coefficient has negative sign of -0.144317 and significant at 5% significance level.

Table 4: Short Run Dynamics of ARDL (2, 2, 2, 4, 0) Model

Variable	Coefficient	t-Statistic	p-value
D(TFR(-1))	1.514692	67.290892	0.0000*
D(WE)	0.000594	4.490001	0.0004*
D(WE(-1))	-0.000580	-4.737222	0.0002*
D(WLFP)	-0.000060	-0.288911	0.7764
D(WLFP(-1))	-0.000594	-2.781978	0.0133**
D(WLE)	0.036024	0.076934	0.9396
D(WLE(-1))	-2.320226	-4.203604	0.0007*
D(WLE(-2))	-1.197733	-2.240611	0.0396**
D(WLE(-3))	-1.155390	-3.111245	0.0067***
D(IMR)	0.004556	2.111312	0.0508***
ECT(-1)	-0.144317	-17.950913	0.0000***

V. Conclusion

Empirical results show that there exists long run as well as short run relationship between fertility and women education, women labor force participation, infant mortality rate and women life expectancy in Malaysia. However, the degree of urbanization is omitted from the model as the data is not stationary.

Based on the results, women education, women labor force participation and infant mortality rate are positively related to the fertility rate in the long run while women life expectancy is negatively related. However, in the short run, both women education and women labor force participation are negatively related while women life expectancy and infant mortality rate indicates the same relationship as long run.

Thus, it can be concluded that in the short run, women education, women labor force participation and women life expectancy play role in fertility reduction in Malaysia. While in the long run, only women life expectancy is inversely related to the fertility rate.

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