THE IMPACT OF INFANT MORTALITY RATE AND FEMALE LABOUR FORCE PARTICIPATION ON FERTILITY RATE IN UNITED STATES

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DECLARATION

We hereby declare that:

(1) This undergraduate research project is the end result of our own work and that due acknowledgement has been given in the references to ALL sources of information be they printed, electronic, or personal.

(2) No portion of this research project has been submitted in support of any application for any other degree or qualification of this or any other university, or other institutes of learning.

(3) Equal contribution has been made by each group member in completing the research project.

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ADF	Augmented Dickey-Fuller test
AIC	Akaike information criterion
ARCH	Autoregressive Conditional Heteroscedasticity
ARDL	Autoregressive-Distributed Lag
CE	Cointegrating Equation
CUSUM	Cumulative Sum test
CUSUMSQ	Cumulative Sum square test
DW	Durbin Watson
ECT	Error Correction Term
FLPF	Female Labour Force Participation
FMLA	Family and Medical Leave Act
G7	Group of 7
GDP	Gross Domestic Product per Capita
JB	Jarque-Bera teat
JJ	Johansen and Juselius test
MMWR	Morbidity and Mortality weekly report
MR	Infant Mortality Rate
OCED	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
PP	Phillips-Perron test
RESET	Ramsey's Regression Specification Error
SIC	Schwarz information criterion
SIDS	sudden infant death syndrome
TEDU	Tertiary Education of Female
TFR	Total Fertility Rate
US	United States
VAR	Vector Autoregressive Model
VECM	Vector Error Correction Model

Abstract

The aim of this paper is to examine the impact of the determinants on the fertility rate in United States over the period 1971-2010 and the variables will be the female labour force participation and the infant mortality. Under this study, we will be using (Unit Root Test, Cointegration test, Granger Causality test, Impulse Response, Variance Decomposition and Parameter stability tests) in our empirical testing. In result, we obtain a positive short run relationship between female labour force participation with fertility rate and a negative long run relationship infant mortality rate with fertility rate.

Chapter 1: Introduction

1.0 Background

According to the report about the Fertility Levels and Trends as Assessed in 2012 Revision of World Population Prospects that obtained from the population division of Department of Economic and Social Affair of the United Nation, it found that the fertility has declined significant in all countries (see table 1.1), age at marriage has been rising around the world. Besides that, it also found out that there are 80 countries had a total of fertility rate that below the sub replacement of fertility rate.

Sub replacement of fertility rate is 2.1 and it defined as the number of children for each woman that needed to replacement her and her partner in the next generation (Brewster & Rindfuss, 2000). Furthermore, seventy five countries (thirty nine in Europe, nineteen in Asia, twelve in Latin America and the Caribbean and another two in Africa and also Northern America and one in Oceania) among 80 countries that had below sub replacement fertility rate are those populous countries and they accounted 48 percent of the world population. Total fertility rate[1] is an important issue and need to pay more concern on it. Declining in total fertility rate will cause population growth slowly and affect the population ageing. It is due to decreasing in young generation while increasing in older person.

Besides that, we can observe that those well developed nations had an average of 1.66 children for each woman and the least developed nations had an average of 4.53 children for each woman (table 1.1). As we know that developed countries will have a higher economic growth compare to the least developed countries. Labour force growth in developed countries also higher than the least developed countries.

[1] fertility rate is the average of number of children that the average woman will have in her lifetime.

Higher labour force growth will also lead to increasing in female and male labour force participation. According to Adsera (2003), those countries that have a higher level of female labour participation, will tend to have a fertility rate that close to sub replacement rate. In contract, countries that have lower level female labour participation will above the sub replacement rate.

Those countries that have economically advanced will tend to has low fertility level. From table 1.1, we can notice that Developed regions is the major area that having the lowest total fertility rate compare to others and followed behind the Europe. The declining in total fertility rate had caused the increasing the proportion of elderly and decreasing the proportion of younger.

Moreover, industrialization, economy growth, better medical condition, and increasing in living standard had cause the declining in infant mortality rate (Narayan & Smyth, 2006; Narayan, 2006; Georage, 2009). Therefore, through the table 1.2 below, we able to found that developed region had the average of 6 for the numbers of annual deaths per 1,000 births and followed by Europe, average of 7 for the annual deaths per 1,000 births. However, we found that developing region had an average number of 46 for the annual deaths per 1,000 births and it is far higher than the developed region as showed. Drops in infant mortality rate bring a fact that the higher of survival chances of infant and this will lead to a dropping in the fertility level. This is because the family might not planning to increase the family members since the life expectancy at birth as showed in table 1.3 is much higher compare to the past decade. We also able to notice that developed region (76.90) are under a same condition as mentioned above compared to developing region (66.96) and the fact is the life expectancy at birth in North American (78.36) is the highest compared to others according to table 1.3.

Table 1.1: Total fertility rate for the Development Groups, Major Area and World with Selected Period

Development group and the major area	total fertility rate (average number of children per women)			
	1950 - 1955	1970 - 1975	1990 - 1995	2005 - 2010
World	4.97	4.44	3.04	2.53
Most developed regions	2.83	2.15	1.67	1.66
Developing areas	6.08	5.36	3.38	2.69
Least developed nations	6.55	6.75	5.77	4.53
Other less developed nations	6.02	5.18	3.08	2.40
Africa	6.59	6.66	5.71	4.88
Asia	5.83	4.99	2.96	2.23
Europe	2.67	2.17	1.57	1.54
Latin America and Carribbean	5.85	5.02	3.02	2.30
Northern America	3.35	2.01	2.00	2.02
Oceania	3.83	3.23	2.49	2.47

Source: Population Division of the Department of Economic and Social Affair of the United Nation (2013)

Table 1.2: Infant mortality rate for the Development Groups, Major Area and World by Selected Period

Development group and major area	Infant mortality rate (average annual deaths per 1,000 births)			
	1950-1955	1970-1975	1990-1995	2005-2010
World	135	86	59	42
Developed regions	60	22	11	6
Developing regions	153	96	65	46
Least developed countries	199	148	107	72
Other less developed countries	146	88	55	39
Africa	187	133	103	73
Asia	146	88	55	37
Europe	72	25	13	7
Latin America and Carribbean	126	80	38	21
Northern America	31	18	9	7
Oceania	60	42	28	22

Source: United Nations, Department of Economic and Social Affairs, Population Division (2013)

Table 1.3: Life expectancy at birth for the Development Groups, Major Area and World with Selected Time Period

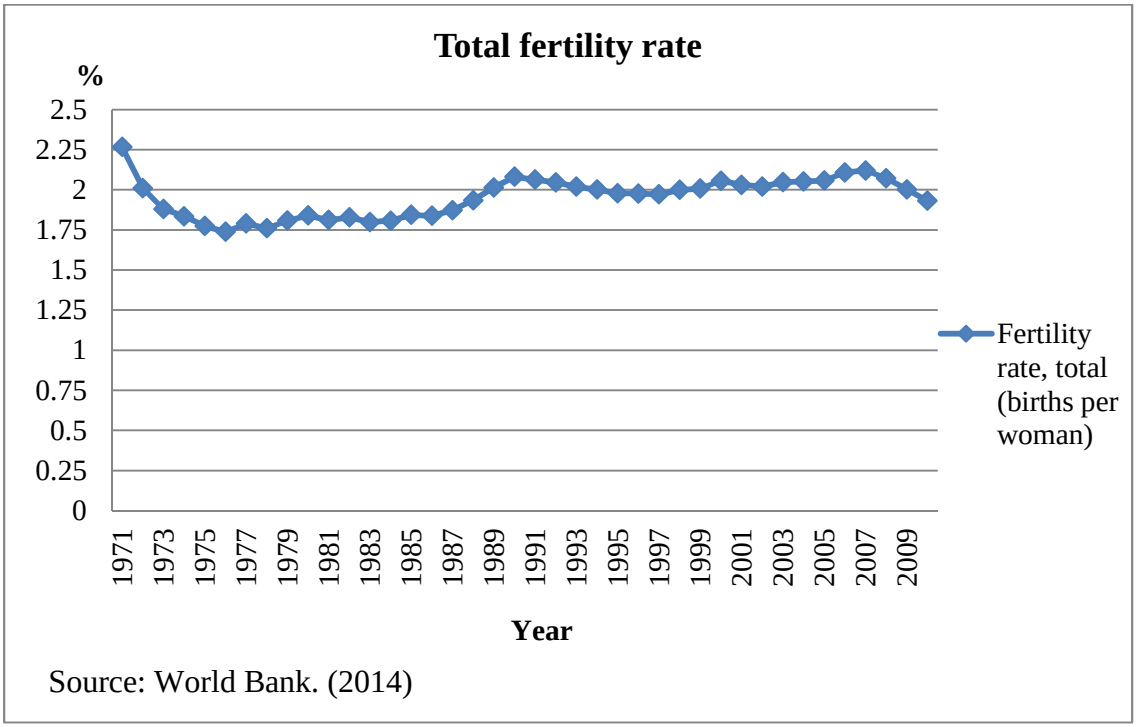
Development group and major area	Life expectancy (average number of years of life expected)			
	1950-1955	1970-1975	1990-1995	2005-2010
World	46.91	58.82	64.76	68.72
Developed regions	64.67	71.08	74.09	76.90
Developing regions	41.62	55.77	62.72	66.96
Least developed countries	36.41	44.33	51.68	58.40
Other less developed countries	42.41	57.66	64.81	68.81
Africa	37.38	46.46	51.74	55.55
Asia	42.24	57.72	65.41	70.28
Europe	63.59	70.61	72.57	75.28
Latin America and Carribbean	51.37	61.03	68.93	73.45
Northern America	68.59	71.41	75.84	78.36
Oceania	60.44	66.37	72.53	76.84

Source: United Nations, Department of Economic and Social Affairs, Population Division (2013)

1.1 United States

1.1.1 Total fertility rate for United States

Figure 1.1: Total fertility rate for United States from year 1971-2010



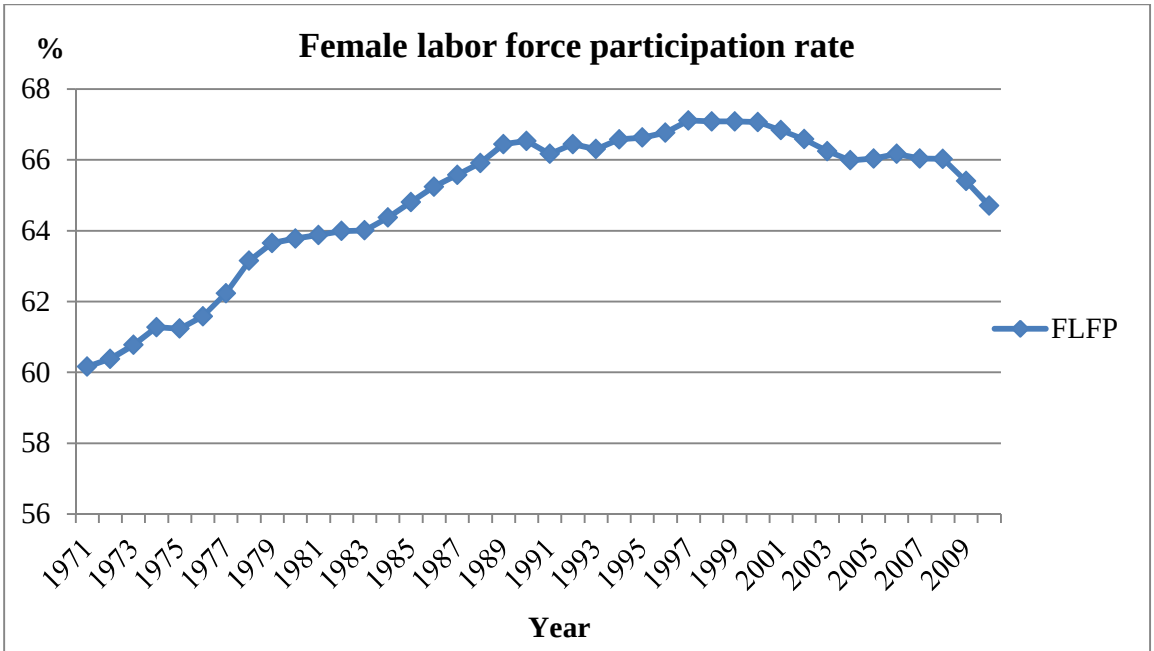
Source: World Bank. (2014)

From figure 1.1 above, we can notice that there was a declining trend of the total fertility rate in United States at the starting point from the highest in year 1971 (2.266%) to the lowest in year 1978 (1.76%). According to Stein (2007) who is a writer for 'The Washington Post", the declining is due to the birth control pill and also other phenomenon like women tend to delay to pregnant in order to extend their studies. Besides, during the 1970s, United States is having a baby bust as well. Thus, this is causing the total fertility rate dropped below the replacement level in United States. After the dropping in the 1970s, we able to notice that there is an increasing in the late 1980s. This is because of the increasing in the birth rate among the married women become more stable according to Cancian and Reed (2009). However, they also mentioned that there is an opposite trend during the 1990s where the level of

married women decline and this will cause the proportion of birth to drop. Declining trend of the total fertility rate of United States not only will cause the annual population growth of the country decline, it also will affect the age specific distribution of population. In 2000s, there is an increasing in the total fertility rate which might because of the immigration according to Castellano (2013).

1.1.2 Female labour force participation rate of United States

Figure 1.2: Female labour force participation rate of United States from 1971 to 2010



Source: Bereau of Labour Statistic. (2014)

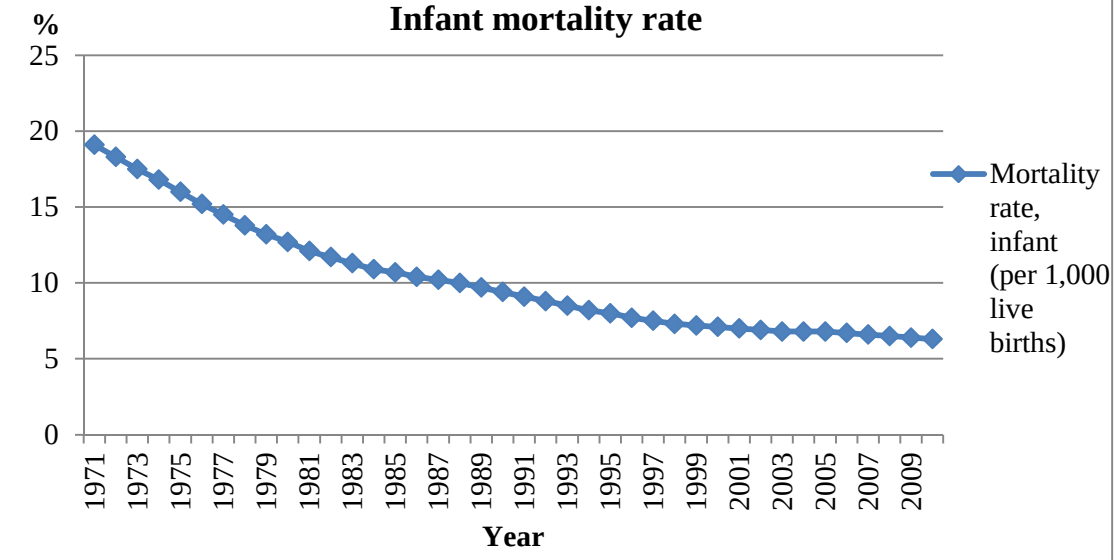
Figure 1.2 shows the trend of female labour force participation[2] in United States from year 1971 until year 2010. From there, it illustrated constant upward from 60.16% in year 1971 to 66.53% in year 1990. According to Lee and Mather (2008) this is because more and more youths are entering into the industries especially including the increasing in female labor force in the 1970s and which cause the

[2] Female labour force participation is the female adult population in the labor force at aged 16-64.

increasing of the trend. Furthermore, Juhn and Potter (2006) also mentioned about the increasing of the entry of the married women into the industries and which cause the expanding of the female labour force involvement in the late 1970s and also in 1980s as well. However, we are able to notice that in year 1990 is showing a dropping from 66.53% to 66.17% in year 1991. In fact, there is an unstable trend happened in the 1990s which cause the trend to become an unpredictable trend. According to Juhn and Potter (2006), a lingering business cycle effect the will affect the low-skilled women might be the cause of the unstable. Moreover, in year 2000 onward to year 2005, we are able to know that there is a continuously decline in the trend from 67.07% to 66.03% in year 2005. Juhn and Potter (2006) claimed that the declination is happening after the 2001 recession and cause the slowdown in the trend. It takes times to recovery slowing as we able to notice there is a slightly increasing in year 2006 from 66.03% to 66.17%. However, it dropped again in year 2007 to 66.03% onwards. It was cause by subprime crisis.

1.1.3 Infant mortality rate of United States

Figure 1.3: Infant mortality rate of United States from 1971 to 2010

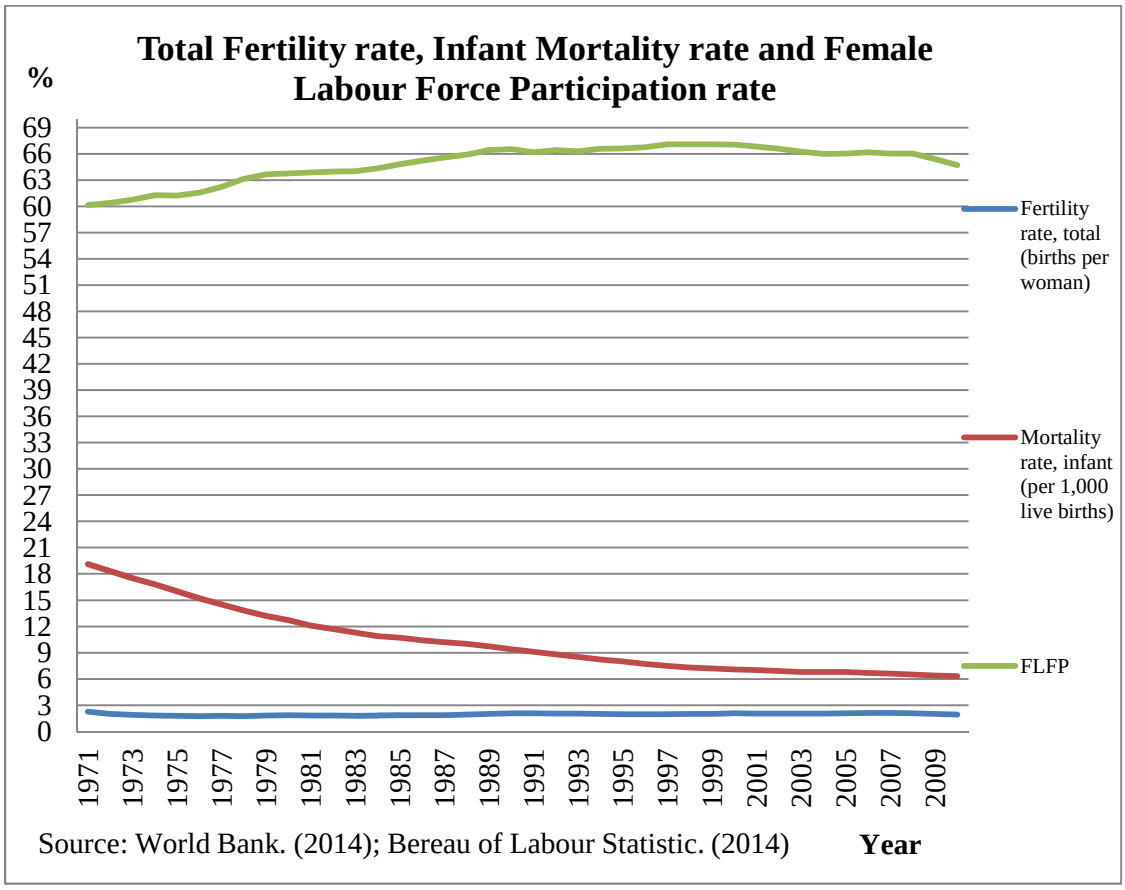


Source: World Bank. (2014)

Figure 1.3 shows the trends in Infant mortality rate for United States from 1971 to 2010. Infant mortality rate is the death of a child less than one year old. In table 1.4, United States has a highest infant mortality level of 19.1 per 1,000 live birth in 1971, while lowest is 6.3 per 1,000 live birth in 2010. United States's infant mortality level has significantly declined between 1971 and 2010. In general, the IMF in United States decreased by 12.8 during that time period. According to (MMWR) Morbidity and Mortality weekly report (1999), started from 1950s the improvement in medical technology is helping in reducing the IMF in United States. Through the report, we able to know that reducing in infant death in 1960s till 1980s are due to the improvement in the prenatal care and the development in medical industry. MMWR report also mentioned that the reduction in 1990s is because of the falling in the sudden infant death syndrome (SIDS) and other diseases that will affect the infant as well. This declining in the diseases and expansion in the medical industry is being continuously maintained in after 1990s onwards.

1.1.4 Total fertility rate, Female labour force participation and Infant mortality rate of United States

Figure 1.4: Total fertility rate, Infant mortality rate and Female labour force participation rate of United States from 1971 to 2010



Under this figure, overall we able to notice that the fertility trend in United States is still did not increase a lot and remaining low under 3 during the period where the female labour force involvement is increase slowly over 1971 to 2003. But despite the fact that the total fertility rate is still did not change a lot even there is a declining in female labour force participation level after year 2007. Besides of that, the infant mortality rate in United States is continuously reducing due to the improving in the living standard and also the medical industry. According to the demographic

transition theory by Lee (2003), the increasing in living standard and advance in medical technology will lead to the reducing in infant deaths and the total fertility rate as well. However, even though we notice that there is slightly drop in after the year 2007, the total fertility rate is still around the sub replacement, 2.1 and even below it. Thus, we suspect that the total fertility rate in United States might be affected by the reduction in the infant deaths as the theory mentioned.

1.2 Problem Statement

Total fertility rate is the average number of children where the average woman will have in her lifespan. Recently, there is a fertility crisis which means the total fertility rate is declining and even close to sub replacement level is happening around the world. A total fertility rate is determined by the variables that would affect the growth of the total fertility rate either increase or decrease. There is some serious issue have been raised up for the world to concern on it due to the fertility crisis like a low fertility would cause the labour force growth to be declined or slow or even will affect the economic activities in current or future. Newman (2012) mentioned that a falling birth rate would be a huge issue to the country. This is because he claimed that an increasing in the productivity or an individual wealth can be generated from the large population. Once a decreasing in the population happened, there will have some economy issues to rise up.

Other than that, we able to notice that total fertility rate and IMF in developed region is more serious compare to the developing country as mention above in the background. Besides, according to the table 1.3, the life expectancy at birth in developed region also higher than the developing region and we also found that the North American actually have a life expectancy that is even higher than the Europe. Through this, we are curious that what actually is affecting the total fertility rate to be fluctuated and what is the relationship between the variables especially in a developed country, United States. This is because developed nations are far more advances compare to other developing nations. Besides, a developed country usually would

have a high ferility as the population is higher compare to developing countries. Thus, we decide to choose to investigate the total fertility rate in United States compare to other countries like Europe countries or Asia countries.

In addition, recently we also found that fertility problem had become a global issue to the world especially in the developed countries like United States, European, or Spain (Lee, 2012). A lower fertility level consequence will cause the developed countries to change into “one child” society or even a cause the older population to keep increasing. This will cause the economy to slow down due to the less productivity produce. Furthermore, we found that United States actually is facing baby boom in 1950s till 1960s during the post-World War II due to the reason where the soldiers returned to their country and desire to marry and build a family by Stoneham (n.d.). However, after that a boom bust is happened in the 1970s which cause the huge declining in the total fertility rate as showed in figure 1.1 above.

In fact, most of the former researchers like Cheng (1999); Narayan (2006); Lee and Ng (2012); Papapetrou (2014) had done the related topic on total fertility rate, mortality rate and female labor force participation rate with other variables. However, there is lack of studies between total fertility rate with female labor participation and the infant mortality rate especially is in United States. This is because we found that a lot of the researchers studies on G7 countries, Asean, Taiwan, Japan or even United Kingdom. Other than that, we also noticed that normally study the researcher will examine United States in OECD group with other OECD members like Ahn and Mira (2002); Mishra and Smyth (2010) but fewer of them will test on United States individually. Therefore, even though Europe countries have the lowest fertility according to table 1.1, we did not choose Europe because there are many researchers examined on Europe before such as Papapetrou (2014); Lee, Lim and Hwang (2012).

Besides of that, we also found that currently in United States is under a condition where the total fertility rate is beginning to drop below than some large and advance Europe countries like France according to The Economist (2012). Hence, this even more convince us to choose United States as the country to study.

1.2.1 Factor that might influence the total fertility rate

1.2 (a) Female labour force participation

A slow labour force expansion will cause the downward trend in the labor market. However, Adsera (2003) claimed that the fertility level is affected by female labor force participation level whereby the fertility level would more close to the sub replacement level if the female labour force involvement level is higher. However, we realize that the female labour force particiaption in United States is actually lower than other developed countries like Canada or Singapore according to the table 1.4 below and own a total fertility level that is below the sub replacement, 2.1 at 1.66 according to the figure 1.1 which is different with Adsera (2003). Besides of that, we also found that there is some of the researcher clarified about the positive relationship of female labour force participation with the total fertility rate whereby an increasing in the FLFP will cause the increasing in the total fertility rate by Ahn and Mira (2002). Therefore, we decide to examine the total fertility rate in United States rather than other country like Japan or Europe countries which have been done by many researchers and set female labour force participation as the independent variable to test total fertility rate.

1.2 (b) Infant mortality rate

Other than female labor force participation, infant mortality rate had been set as the independent variable for our studies to test total fertility rate. There is a demographic transition theory mentioned that the infant mortality tend to reduce due to the upgrading in living standard and also in the medical technology which bring by

the industrialization (Lee, 2003). This is because an improvement in the living standard and medical technology will tend to increase the life expectancy and yet will cause the infant deaths to be reduced more. A reduce in infant mortality indicated that the fertility to be reduced .Therefore, we tend examine the relationship to test the relationship between the infant mortality rate with the total fertility rate. This is because there are fewer of researchers showed a positive effect with the total fertility rate according to Chowdhury (1988) and Vlasoff and Khuda (n.d.) and a negative relationship by Narayan (2006). Furthermore, we able to notice that some of the researchers like Breierova and Duflo (2002); Newell and Gazeley (2012) were analyzing the data of British from late of 1850s to early of 1900s and this proved that there is no relationship between the infant mortality rate with the total fertility rate. Other than that, we notice that the fact that infant mortality rate in United States actually is much lower compare to other developed countries according to figure 1.5 below and this also supported by Sanghavi (2007) mentioned about the real infant mortality problem in America especially in United States. The author noticed a report about that the United States is the second worst compared to other developed countries when tied together with Slovakia and Malta from a group named as Save the Children.

Thus, overall we notice that there are fewer studies or evidence to prove the relationship between fertility with female labour force participation and infant mortality rate in United States. Therefore, we will concern on the of total fertility rate in United States in this study throughout the research period year 1971- 2010 and here is the questions that arise in this study,

i. Is the change in female labour force participation or infant mortality rate will give any impact to the total fertility rate?

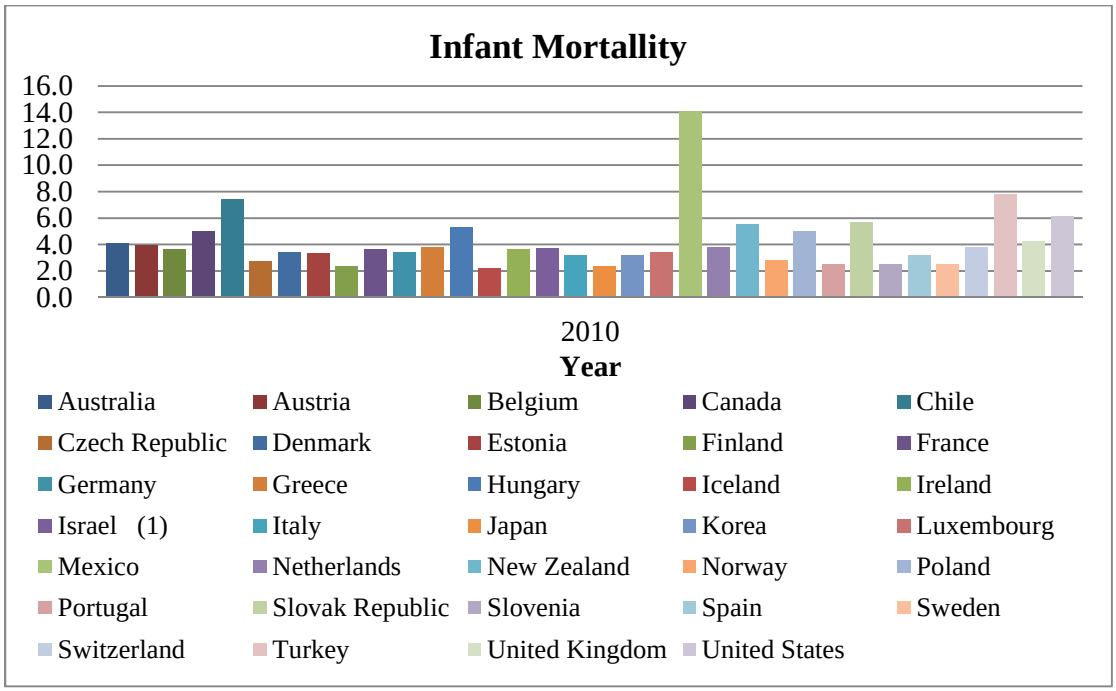
ii. Is there any relationship exist between the female labour force participation with the total fertility rate and the relationship between infant mortality rate with the total fertility rate?

Table 1.4: Female labour force participation rate (% of female population ages 15+)

Country Name	2012
Japan	48.09999847
United Kingdom	55.70000076
United States	56.79999924
North America	57.29122244
Singapore	59
Canada	61.59999847
Least developed countries: UN classification	65.70662403

Source: World Bank (2014)

Figure 1.5: Infant mortality（deaths per 1,000 live births) for OECD nations for 2010



Source: OECD Health Data: Health status: OECD Health Statistics (2014)

1.3. General Objective

i. To investigate the relationship between variables (infant mortality rate and female labour participation) on the total fertility rate of United States over 1971-2010.

1.4. Specific Objective

i. To investigate the long run relationship among total fertility rate with female labour force particiaption and also the infant mortality rate.

ii. To examine the short run relationship among total fertility rate with female labour force participation and the infant mortality rate.

1.5. Significance of the study

In this study, we tried to define the long term and short term effect of infant mortality rate and the female labour force participation on the total fertility rate. Recently we found that the total fertility rate in United States is dropped below the sub replacement which is at 2.0 according to Craine (2010) and Lee (2012). Therefore, conducting this research is able to contribute further information and the understanding of this topic to allow people to be more concern on the low fertility matter.

Other than that, our contribution in this study is able to provide knowledge and allow more people to further more understanding the factors that affect the fertility level. This would allow the policymaker to implement more policies to avoid or to improve the facilities or subsidies on this issue. Besides that, the knowledge about the determinant of fertility can be useful in influential the population policies. If

the fertility level continued low, it will cause zero population growth. Moreover, lower total fertility rate will affect United States shift into “one child” society. The economic growth and the structural of housing design will also be affected. If the country falls into “one child” society, the structural of housing design will change to 2 or 3 bedroom rather than 5-6 bedroom Moreover, low fertility will affected the working-age population which means there is more older population in the labour market and less younger population in the market. Consequences, this will cause age structure of labour market to change and the productivity will also facing declining situation. This would contribute to inefficient of the market. These situations also currently has been facing by those developed countries like Oceania countries and Japan because they are sharing the almost the same economy background like they might using the same advance technology and they are also one of the OECD countries. Therefore, this study is able to give more research information to them to implement or design policy to avoid the “one child” society situation and also to avoid the age structure in the labour market to change a lot.

1.6 Chapter Layout

The following sections are organized as follow: Chapter 2 briefly discuss the literature review that study by other researcher. Chapter 3 presents the econometric methodology that we used. Chapter 4 describes about the empirical result from our findings. Chapter 5 concludes with the discussion of main results, recommendations, limitation and conclusions.

Chapter 2: Literature review

2.0 Introduction

Over the past few years, the matter of fertility, female labour force participation, and infant mortality has carried about the attention among researchers such as Cheng (1999); Norehan, Nor'Aznin and Hussin (2013); Papapetrou (2004); Narayan (2006); Wang (2014); Breierova and Duflo (2002) and so on. This research has been carried out the relationship of total fertility rate between female labour force and infant mortality. Section 2.1 will be conducted on the relationship between female labour force participation rate and fertility rate. Section 2.2 will add on the infant mortality as variables.

2.1 Female labour force participation rate and fertility rate

In this literature review, we decided to include female labour force participation to determine the rate of fertility. Cheng (1999) had done his study about the cointegration and causality between fertility and female labour participation in Taiwan by using panel cointegration and Granger causality. He found that no cointegration and no causal relation. In Taiwan, those women employment do not necessarily having small children at home. Those women who have children do not necessarily have to withdraw their work. They can hire babysitter to take care their children or ask their parents to help them to take care of their children. Which mean that the female labour force participation rate does not necessarily influence the total fertility rate.

On more recent researchers, Lee and Lee (2014) investigated the same two

variables but included the childcare availability as variable in Japan by using data description and unit root test with structural breaks, bounds test, Granger causality, and autoregressive distributed lag (ARDL). They found that the relationship is strongly negative by using data from year 1971 to 2009. When the problems of childcare scarcity, declining fertility rates and work-family conflict faced by the growing female labour force participation in Japan. Which mean that the female labour force participation is negatively related to fertility while the childcare is positively related to female labour force participation. Japan's culture of long work hours imposing women to adjustment between obtaining a good job and having a family. Since the 1990s, the Japanese government failed to encourage childbirth by implemented pro-natal policies such as childcare market deregulation, childcare center expansion in the Angel Plan and New Angel Plan, and provision of childbirth grants because they will be penalized, if they leave work to do familial duties. However, Cheng, Hsu and Chu (1997) had done their study about the causality between Japanese female labour force participation and their fertility rate by using Granger causality to observe the period of 1950 to 1993. They also found that no causal relation between female labour force participation and fertility in Japan. In addition, Obadic, Cipin and Pripuzic (2007) also done their study about female labour force participation and fertility in Croatia by using Granger causality, unit root, and cointegration to observe the period from 1961 to 2004. They found that there is no cointegration but female labour force participation Granger causes the fertility negatively. It should implement some policies to invoke more women employment to have children by paid them maternity leave. Moreover, Shin and Moon (2006) had done their study about the fertility, relative wages, and labour market decisions by using selectivity-corrected panel estimations. They found that is a negative relationship between female labour force participation and fertility. The presence of a new birth is significantly discourages teachers to leave out their job to take care of their baby. The higher relative wages for teachers afford an appropriate motivation for females to become teachers. Which mean the relative wages is positively related to female labour force participation but female labour force participation is negatively related to fertility. The government try to increase the teachers' salary to secure

teacher supply, but the fertility will drop because teachers will choose not to give birth since they have no time to take care of their child.

Norehan, Nor'Aznin and Hussin (2013) had done their study about fertility model and female labour force participation in all six ASEAN countries by using Pearson correlation and panel causality test. To observe the period from 1995 to 2009, they claimed that there is a mixed correlation in all six ASEAN countries of Malaysia, Singapore, Thailand, Indonesia, Philippines, and Vietnam, but none of them have a strong correlation. During 1970s and up to early 1980s, the female labour force participation was strongly significant negative to fertility, but the correlation had become significant positive by the late 1980s. For instance, countries which having a greater female labour force participation usually will have higher fertility rate, vice versa.

Papapetrou (2004) investigated the female labour force participation affect fertility in UK from year 1958 to 1998 by using Granger causality and cointegration and he found that there is a causal relationship. According to Papapetrou (2004), the following current advances in demographic and economic theory the relationship between female labour force participation and fertility is revisited the changes in the labour market and the whole real economic activity. He claimed that extending the approximating equations to control for the effects of changes in real wages makes a female labour force participation positively related to fertility while negatively related between fertility and real wages. This can be explain by fertility should not be considered as exogenous to female labour force participation, the labour market or the growth process. Other than that, Grogan (2013) had done his study about fertility, household formation rules and female labour force participation in post-communist countries. He found that female labour force participation is indirectly positive related to fertility. For patrilocal context prevail, the consequent fertility have large impacts by the sex of the female's first born child. Based on the traditional, for those whose first child is female will reduce consequent fertility, while for those whose first child is male will not reduce consequent fertility. Female will get an offer which is the resident daughter-in-law for those whose first child is males, it may reduce their

housework responsibilities. When the housework responsibilities had been reduce, those women able to having a job to earn some income. Moreover, Azmat and Gonzalez (2010) had done their study about the targeting fertility and female labour force participation through the income tax in Spanish. They found that their relationship is positive. The tax credit are very powerful in increasing the female labour force especially for those women who only have low-educated. The tax credit is able to enhance the fertility effect of the child deductions, and increase the female labour force participation. The government has introduced a new tax credit and increased child deductions for female labour force participation with small children under three. Fertility will increase since female labour force participation able to balance in their work and their family due to the policies which is subsidized childcare and maternity leave. On the other hand, Lee, Lim and Hwang (2012) had done their study about the women's employment, fertility, and economic growth in a relative study of 8 East Asian and 15 European Union countries by using panel SVAR model and examine the variance decomposition to observe the period from 1980 to 2008. They found that European Union countries have a stronger endogenous relationship between female labour force participation and fertility compared to the East Asian countries. This is because the EU citizens are free to move among labour markets based on the regional integration. However, migrant labor constitutes only a small portion of the total labour force in East Asian countries.

Ahn and Mira (2002) had done their study about fertility and female labour force participation within OECD countries by using Butz and Ward's framework as a 'benchmark'. To observe the period from 1970 to 1995, they found that there is a mixed correlation which is during 1970s and up to early 1980s and the relationship was strongly significant negative, but the correlation had become significant positive by the late 1980s. This is because more income will affect them have the ability to have more children. However, Mishra and Smyth (2010) found that fertility is negatively related to female labour force participation within OECD by using Granger causality testing and panel cointegration from year 1995 to 2005. This is because children will increase the work in the home, and this will influence mother

has no time to looking for outside job based on the difference level of age. During the period, GDP increasing continuously for almost 10 years and hourly wages had increased by 10.1% since 1996 in United States. It will cause high female labour force participation. They will hard to re-enter the workforce after giving birth because employer will think family will affect their performance. Thus, it will affect the fertility rate in future and cause negative relationship between fertility and female labour force participation. At the same time, Mishra, Nielsen and Smyth (2010) also found that the relationship between fertility and female labour force participation is negative in G7 countries (Canada, France, Germany, Italy, Japan, UK and USA) by using Granger causality and panel cointegration from year 1960 to 2006. Because of the opportunity cost, those female who in the workforce, they will choose to put off having a children. Mishra, Nielsen and Smyth (2010) will have different result with Ahn and Mira (2002) since they are using the different test to observe the study.

In conclusion, we found that some of the gap between the female labour force participation and fertility. From the literature reviews, we know that although all of them are developed countries but they show the different results which is negative relationship in Taiwan and Japan, but positive relationship in UK, 3 East Asian (Japan, Singapore and South Korea) and 15 EU countries. The same situation also presented by the developing countries whereby all of them are showing the different results which is negatively in Croatia, but positively in 5 East Asian (China, Indonesia, Malaysia, Philippine and Thailand). However, we found that US is one of the countries that involved in OECD countries and G7 countries. From the literature reviews, we know that US has a gap between the female labour force participation and fertility since they get the different results which is positive relationship in OECD countries (Ahn and Mira, 2002) and negative relationship in G7 countries (Mishra, Nielsen and Smyth, 2010) at the same period.

We try to investigate the hypothesis of the relationship between the female labour force participation and fertility based on the indirect impact of female labour force participation on fertility. From the study of Lee and Lee (2014) and Shin and

Moon (2006), we found that the relationship is negative. However, due to the study that investigated by Papapetrou (2004), Grogan (2013), Ahn and Mira (2002), and Azmat and Gonzalez (2012), we found that the relationship is positive. From the literature reviews, we make a hypothesis that the relationship between fertility and female labour force participation will be positive since more of the study conduct that the indirect impact of female labour force participation on fertility will get the positive result in female labour force participation and fertility. And we are going to include another one of the variable which is infant mortality in our research.

2.2 Fertility rate, infant mortality rate and female labour force participation rate

In this literature review, we decided to include infant mortality rate and female labour force to determine the rate of fertility. Narayan (2006) investigated the determinants of the fertility rate in Taiwan from year 1966 to 2001 by using ARDL bounds testing. The determinants that included in his research are female labour force participation, mortality and income. According to the result of his research, the impact of female labour force on fertility rate in the long run is statistically significant and positive but there is a no relationship between infant mortality rate and fertility rate no matter in short or long run.

On more recent researchers, Lee and Ng (2012) also run the ARDL bounds testing by using infant mortality rate and female labour force participation as determinants to investigate the relationship between total fertility rate and the determinants in Singapore. They are surprising from the results they found; there is a negative long run effect between infant mortality and fertility in Singapore. In another words, when the rate of infant mortality in Singapore decrease, it actually encourages Singaporean women to give birth more children, thus the fertility rate increase.

Narayan (2006) and Lee and Ng (2012) had different results which are no

relationship and negatively relationship in long run respectively. Even they were using same in methodology (ARDL bounds test) in their research but they still couldn't get same results. The possible factors are Taiwan is a demographic development country which not similar to Singapore. Even though the empirical result of Narayan (2006) shown it is insignificant. Taiwan has closely similar demographic transition in other Asian countries which is decreasing the fertility and infant mortality rate. However, Singapore is decreasing in the infant mortality but increasing in the fertility rate. The infant mortality rate and fertility rate can be affected by others effect like strong religion effects. For example, Muslims exhibit a lower mortality rate but higher fertility rate, parents encouraged to give birth more children and increase awareness to reduce the neonatal rate (Bhalotra & Soest, 2007).

According to Khuda and Vlassoff (n.d.), economic development is affected by the demographic changes positively or negatively. The decrease in fertility rate may due to the development projects in rural areas. This can explain by when the incomes increase, parents in rural area will have higher standard living, they are more likely to afford for the schooling fees for their children. The cost for raising their children will increase, this will lead to parents have to limit their fertility, thus the fertility rate will decrease. When the incomes increase, they will give their family better quality of living example like food with higher nutrition, better health and medical cares. In another words, infant mortality will decrease and may also lead to the fertility to decline. Based on the demographic transition theory (Chowdhury, 1988), modernisation, urbanization and industrialization will cause income increase, the standard living increase and the quality of health and medical fertilities. Thus it will decrease the infant mortality rate and cause the fertility rate to decline as well. The relationship between infant mortality rate and fertility rate is positive which is consistent to Khuda and Vlasoff (n.d.). In the study of Canning, Gunther, Sebastian and Bloom (2013) merged all the unrestricted and recoded data from Demographic and Health Surverys (DHS) included 46 low and middle income countries such as India and Philippine in Asian , Turkey in Europe and Zimbabwe and Ghana in Africa, and they found the result is consistent to the Chowdhury(1988) demographic

transition theory which is the relationship between infant mortality rate and fertility rate mostly are positive, which mean that the infant mortality rates decrease will lead to the rate of children born decrease as well. Other than that, the study of Wang (2014) also found that the changes in infant mortality have a directly positive effect to the declining of fertility rate in developing countries.

Breierova and Duflo (2002) had done their study about the effect of education on fertility and child mortalilty in Indonesia by using data from 1973 to 1978. They claimed that the parental education determines the rate of fertility and the rate of child mortality but not the child mortality determines the rate of the fertility. They claimed that the education of the parents has a very strong causal effect on the decreasing of the child mortality but they found no direct relationship between the child mortality rate and the fertility rate. The possible factor that Breierova and Duflo (2002) found no relationship are the time period they used in their study is too short which only 6 years from 1793 to 1978. Newell and Gazeley (2012) were analysing the data of British from late of 1850s to early of 1900s. They found that there is no support for a causal mortality-fertility relationship because the infant mortality rates and the fertility rates are not correlated across the Britain's cities in the long run.

Last but not least, we found that there are several results depend on the sample size and different types of methodology they used. From the literature reviews, we also knew most the theory claimed that the relationship between infant mortality and fertility rate is positive. However, based on empirical results and evidences, some of the researchers do claimed that the relationship is positive but some do not but most of them found out there are a positive relationship. Even there are some researchers found that there is totally no relationship between the infant mortality rate and the fertility rate. However, we make a hypothesis based on the literature reviews, that the relationship between infant mortality and fertility might be positive since we are examining US which is a developed country. Therefore, we decided to run several tests to examine the relationship between those variables.

Chapter 3: Methodology

3.0 Introduction

This chapter explains the sources of data, study variable and statistical methods to be used in the analysis.

3.1 Theoretical Framework

3.1.1 Demographic Transition Theory

Demographic transition theory refers to a change from a relative high into low for the birth and death rate. This is demonstrating through a demographic transition model developed in 1929 by Warren Thompson. There are four stages in the theory:

In stage 1, birth and death rates are very high because they are approximately equilibrium and the populations are grows slowly. While in stage 2, birth rates still stay high but the death rates are start drop dramatically because the reduce of the factor cause infant mortality due to the improvement in nutrition, pharmaceutical industry, and cleanness. Besides that, the population is begins to grow quickly.

In stage 3, birthrates start to drop quickly and death rates are still carrying on dropping, but are more slowly comparing to stage 2. Because of economic and social gains, and the decrease of infant mortality, the craving for large families is decreasing as well. Lastly is stage 4, both rates are approximately equilibrium but at a much lower rate and the population growth is slight as well.

This is an ideal image of population change with 4 stages in the model. The model is a simplification that relates to some countries as a group in different categories and not precisely defines all individual cases.

3.1.2 Life History Theory

Life history theory describes the stages of growth, infancy, childhood, youth, and maturity and seeks to explain the differences in development times, fertility, and death of living organisms.

Infant mortality rate may be the best indicator in all the stages for life history of human because it will affect the fertility rate and the population. Therefore, the continuing efforts are done by physicians and public health to improve health and reduce the factors that cause mortality that are influence human's life history.

According to Strassmann and Gillespie (2002), there is a negative relationship between infant mortality rate and fertility rate. When there is a downturn in infant mortality, there is a high fertility rate.

3.1.3 Economic Theory of Fertility

According to Del Boca, Aaberge, Colombino, Ermisch, Francesconi, Pasqua and Strom (n.d.), the theory refers to an increase in women's education level and wage rates will increase the labor participation and a decrease in fertility. However, the existence of a negative relationship between the fertility and female labor participation was theoretically established by Willis (1974).

There are several reasons for a negative relationship between female labor and fertility. One of the reasons is the pension system sustainability in most European

countries such as Europe and U.S. This is because low fertility decreases the possible sustainability of the pension system. While, a high female labor force participation rate increases its sustainability.

After year 1985, the female labor force participation continued to increase but fertility rates started to reduce at a lower rate or in some countries start to grow again. The sequential change in the relationship between female labour has mainly been found in the changes on social rules towards working mothers and the effects of the policies that diminish unsuitability between childbearing and female employment.

This result indicates that it is important for female labor force participation and fertility to be measured as a joint decision and those policies encouraging fertility may have a contrary effect on female employment stated by Del Boca (2002, February).

3.2 Econometric Model

The model consist three variables which are the total fertility rate, the infant mortality rate and the female labour force participation rate. These three variables were following the model specification that postulate by Narayan and Symth (2006) which converted these three variables into logarithm to analysis the data.

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$$InTFR_t = \beta_0 + \beta_1 InIMR_t + \beta_2 InFLFP_t + \varepsilon_t$$

lNTFR = Log of total fertility rate

INMR = Log of infant mortality rate

INFLPF = Log of total female labour force participation rate

ε = error term

t = t-th (time period)

β_0 = constant term

β_1 and β_2 = slope of coefficient of independent variables

We assume the infant mortality is positive relationship with fertility due to demographic transition theory. Demographic transition refers change from a relative high into low for birth and death rate. Industrialization, economy growth, better medical condition, and increasing in living standard had cause the declining in infant mortality (Narayan & Smyth, 2006; Narayan, 2006; Georage, 2009). In 1937, at United States, the diarrheal diseases that cause death had been reduced extremely when pediatric understanding of fluid and electrolyte therapy increased greatly and in 1997, the death from infectious diseases reduced extremely when the sulfonamide drugs become well-known. The improvement in the medical condition will decrease the cause of infant mortality (Wegman, 2001).

While for female participation in the labor force, we expect it is positive affect fertility. Inconsistency among childbearing and female labour force will be reduce when increasing in the accessibility of childcare and paid maternity leave for married women. In United States, the pension system sustainability is the main reason that indicating a positive relationship among female labor and the fertility. If such policy is supported, then United States would not necessarily lead to a decline in fertility that experienced in the past which is before year 1985 (Del Boca, Aaberge, Colombino, Ermisch, Francesconi, Pasqua & Strom, n.d).

3.3 Data and Sample

Data that we collect was in annual form for the year 1971 to 2010. The variable that we examine was total fertility rate (TFR), infant mortality rate (IMR) and female labour force participation (FLFP). TFR is the total fertility rate in term of children per women. IMR is infant mortality rate per 1,000 live births. FLFP defined as the proportion of the population of total adult female in the labor force at the aged 16–64 years. The data of TFR and IMR were obtained from World Bank and FLFP was obtaining from Bureau of Labour Statistic.

3.4 Unit Root Test

Recently, testing for unit roots has already become a standard procedure in time series studies and the application of unit root test such as Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) are the more popular tests within it.

Unit root test is important because of the importance of stationarity. Stationarity is important because the absence of unit root indicates that the series has some variances are not be determined by time and that the effects of shocks dissolve over time. Besides that, the existence of non-stationary variables will cause a spurious regression which has high R^2 and t-statistic is significant but the results would not consist of any economic meaning.

3.4.1 Augmented Dickey-Fuller test

The initial Dickey-Fuller(DF) test assumption does not taken dynamic effect in the series into the account are serially uncorrelated and this problem was solved in the development of the Augment Dickey-Fuller(ADF) test and another advantage is it can examine for a larger and complicated models.

The ADF test model can be group as with trend or without trend. For example:

Model with constant and without trend: $\Delta Y_t = \mu + \delta Y_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta Y_{t-1} + \varepsilon_t$

Model with constant and with trend :$\Delta Y_t = \mu + \beta_t + \delta Y_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta Y_{t-1} + \varepsilon_t$

The null hypothesis of ADF test is Y_t is non-stationarity (Y_t has unit root) and alternative hypothesis is Y_t is stationarity (Y_t has no unit root). The null hypothesis is rejected when test statistic is less than critical value, otherwise do not reject. It means that the series is stationary.

The test statistic used will be:

$$\frac{\hat{\delta} - \delta}{SE(\hat{\delta})}$$

and the critical value can be obtained from the tao-statistical table that modified from Fuller (1976). There is a common problem in ADF test that is what is the optimal lag of the dependent variable should be included. To solve it, we use the Schwarz Information Criteria (SIC) determine the optimal number of lag by choosing the min SIC.

3.4.2 Phillips-Perron test (1988)

Phillips and Perron's (1988) test can be seen as Dickey-Fuller test that have made dynamic to consecutive correlation by using Newey-West (1987) heteroscedasticity and autocorrelation-consistent covariance matrix estimator. PP test is deal with the autocorrelation problem in DF test and the PP tests different with ADF test mostly in how they deal with heteroscedasticity and serial correlation in the error.

The null hypothesis of the PP test is the series is non-stationarity (Y_t has unit root) and the alternative hypothesis vice versa. The null hypothesis is rejected when test statistic less than critical value and its means that the series is stationary. The method used for test statistic is same with ADF test and the critical value also obtained from the tao statistical table that same with ADF test used.

One of the advantages of the PP tests compare to the ADF tests is PP tests are dynamic to general forms of heteroscedasticity in the error term, u_t. Besides that, PP test does not have to require lag length for test regression and lastly it is only need a small sample size.

3.5 Cointegration test

Cointegration methods are very common tools in applied economic work since their introduction about twenty years ago. If there are two (or more) series are cointegrated with each other to form an equilibrium relation, they be likely to move closer and in the same way over the time even though the series themselves are non-stationary. Cointegration test is used to determine the long-run economic relationship among variables. We used Johansen and Juselius test (1990), ARDL approach and Vector Autoregressive Model (VAR) to perform the study.

3.5.1 Johansen and Juselius test (1990)

Johansen and Juselius (JJ) test is the test for cointegration among the non-stationary variables where it is compute by seeing at the rank of the π matrix via its Eigen values. The rank for π (r) shows the number of cointegrating vectors and the number of linearity independent rows (columns) in the matrix, π. There are three possibilities for the rank which are r = 0 means no rank which there are no cointegrating relationship, r = m means full rank which all variables are stationary in level form, *I*(0), and 0 < r < m means reduced rank which there is r ≤ (m-1) cointegration relationship (Dimitrios & Stephen, 2006).

In JJ test have 5 models that different in whether have intercept and trend in cointegrating equation (CE) and VAR or not.

The 5 models are:
Model 1: No intercept and no trend in CE and VAR
Model 2: Intercept and no trend in CE, no intercept and trend in VAR
Model 3: Intercept and in CE and VAR, no trend in CE and VAR
Model 4: Intercept in CE and VAR, while linear trend in CE, but no trend in VAR
Model 5: Intercept and quadratic trend in CE and intercept and linear trend in VAR

The model 1 and model 5 are not that realistic and incredible in term of economic theory (Dimitrios & Asteriou, 2006). Therefore, it still left three models (model 2, 3 and 4). In generally, model 3 will be choosing. In JJ test, the hypothesis consists of two test statistics: Trace statistics and Maximum Eigen value statistics. Trace statistics is based on all eigen value together at a same time to conduct hypothesis testing (joint test) while Maximum Eigen value statistics is based on one eigen value at a time (from the largest to smallest eigen value) to conduct hypothesis testing.

The Trace Statistics and Maximum Eigen value tests are test through following:

JJ test based on Trace statistic:

Null Hypothesis	Alternative Hypothesis
r=0	0<r≤m
r≤1	1<r≤m
r≤2	2<r≤m
r=m-1	r=m

The r is the number of cointegrating vectors and the m is the number of non-stationary variables in the system. The null hypothesis will be rejected when test statistic is more than critical value otherwise do not reject. The formula used in Trace method is:

Trace Statistic: $\lambda_{trace(r)} = -T \sum_{i=r+1}^{m} \ln(1 - \hat{\lambda}_i)$

While JJ test based on Maximum Eigen values is:

Null Hypothesis	Alternative Hypothesis
r=0	r=1
r≤1	r=2
r≤2	r=3
r=m-1	r=m

The null hypothesis is rejected when test statistic is more than critical value. The test statistic used in Maximum Eigen method is:

Maximum Eigen value: $\lambda_{\max(r)} = -T \ln\left(1 - \widehat{\lambda_{r+1}}\right)$

The advantages of JJ test are can perform any hypothesis tests about the actual cointegrating relationship (with two statistical procedures) and can capture more than one cointegrating vector. Besides that, it can include two or more variables in the model. However, it is biased for testing finite sample size.

3.5.2 ARDL bound test

ARDL approach was introduced by Pesaran, Shin and Smith (2001). It is also known as bound test approach. Compare to other cointegration methodology (Engle Granger and Johansen & Juselius), it has some advantage in small sample size. The result of Engle-Granger and Johansen and Juselius methodology were unreliable when it uses to investigate the cointegration in small sample data sizes. Pesaran and Shin (1999) display the based estimators of long-run parameters are super-consistent in small and finite sample size, and the estimators of the short-run parameters are $\sqrt{n}$ consistent, where n is sample size. Moreover, ARDL approach can be used whether the regression are in *I*(1), *I*(0) or mutually cointegration but not in *I*(2). Thus, ARDL approach does not be determined by pretesting of the sequence of integration of the variables. It can reduce the conflicting result occur from the traditional unit root tests

and small power of unit root test.

At first, we need to establish the long run relationship. After that, we need to determine the long-run relationship. To examine whether a long term relationship, unrestricted error correction models (UECM) have to form. The UECM equation for each variable used in this study is expressed as follows:

$$\begin{aligned}\Delta lnTFR_t = {} & \alpha_{10} + \alpha_{11} lnTFR_{t-1} + \alpha_{12} lnFLFP_{t-1} \\ & + \alpha_{13} lnIMR_{t-1} + \sum_{i=1}^{p} \alpha_{14} \Delta ln\ TFR_{t-1} \\ & + \sum_{i=1}^{p} \alpha_{15} \Delta ln\ FLFP_{t-1} \\ & + \sum_{i=1}^{p} \alpha_{16} \Delta lnIMR_{t-1} \\ & + \varepsilon_{1t}\end{aligned} \quad (1)$$

$$\begin{aligned}\Delta lnIMR_t = {} & \alpha_{20} + \alpha_{21} lnTFR_{t-1} + \alpha_{22} lnFLFP_{t-1} \\ & + \alpha_{23} lnIMR_{t-1} + \sum_{i=1}^{p} \alpha_{24} \Delta ln\ TFR_{t-1} \\ & + \sum_{i=1}^{p} \alpha_{25} \Delta ln\ FLFP_{t-1} \\ & + \sum_{i=1}^{p} \alpha_{26} \Delta lnIMR_{t-1} + \varepsilon_{2t}\end{aligned} \quad (2)$$

$$\Delta lnFLFP_t = \alpha_{30} + \alpha_{31} lnTFR_{t-1} + \alpha_{32} lnFLFP_{t-1} + \alpha_{33} lnIMR_{t-1} + \sum_{i=1}^{p} \alpha_{34} \Delta ln\ TFR_{t-1} + \sum_{i=1}^{p} \alpha_{35} \Delta ln\ FLFP_{t-1} + \sum_{i=1}^{p} \alpha_{36} \Delta lnIMR_{t-1} + \varepsilon_{3t} \quad (3)$$

The presence of long run relationship is verified by using Wald F-test. The null hypothesis of the model is $\beta_{11}= \beta_{12}= \beta_{13}= 0$ for equation 1, $\beta_{21}= \beta_{22} = \beta_{23}= 0$ for equation 2, and $\beta_{31}= \beta_{32}= \beta_{33}= 0$ for equation 3, it respectively no long run relationship. The alternative hypothesis states that at least one β_j (j=11, 12, 13), β_i (i=21, 22, 23), and β_n (n=31, 32, 33) is not equal to zero, it respectively at least one variable is consist long run relationship with other variables. If the calculated F-statistic of ARDL approach is larger than the upper critical value bounds, the null hypothesis will be rejected and the model can be conclude that it consists of long run relationship and vice versa when test statistic is lesser than the lower critical value bounds. If the calculated F-statistic is fall between the upper and lower critical value bounds, then it is inconclusive. The critical values of the test are obtained from the Table CI (iii) stated in Pesaran et al (2001).

3.5.3 Vector Autoregressive Model (VAR)/ Vector Error Correction Model (VECM)

This model is developed by Sims in 1972. In VAR model, the relationship among variables are identical and the VAR model will be extend in first difference if variables have unit root and the series is not cointegrated. There are four types of VAR models which are:

i) Unrestricted or reduced form VAR

Unrestricted or reduced form of VAR is indicate each variable as a linear function through their history values and the history values of other variables are being measured and a serially uncorrelated error term.

ii) Structural VAR

Structural VAR is uses the economic theory to sort out simultaneous links among the variables.

iii) Recursive VAR

Recursive VAR is composed the error term in regression to uncorrelated the error terms in each previous equation.

iv) Vector Error Correction Model (VECM)

VECM provides the short run relationship and adjustment toward the long run equilibrium.

One important characteristic of VAR is its stability. It can generate stationary time series with variances and covariance structure through given sufficient starting values stated by Pfaff (2008). Besides that, the VAR model allows the variables to be dependent in both cross-sectional and time-series data and is widely use in macroeconomics.

VAR can obtain better forecasts than the simultaneous equation models and it is simple than simultaneous equation models. The VAR model is simple because it can be estimated based on ordinary least squares (OLS) according to Das, Gupta and

Kabundi (2010).

However, there are still some disadvantages of VAR model. The VAR model does not have any economics theory support and its loss degree of freedom. Moreover, it is hard to determine the best lag length of each series and difficult to interpret the obtained coefficients. But these all can be solve through Granger causality test, Impulse response and variance decompositions.

If our variables in the estimated model is all I (1) and cointegrated, the VECM is chosen for our testing because the VAR only can test for the variables that are I (1) but not cointegrated. Then, the VECM is a special form modifying from the Vector Autoregressive Model (VAR). This method is applies in order to evaluate the short run relationship and regulation toward the long run equilibrium. There is possible long run relationship among non-stationary series. The estimation models in VECM (1) form are as follow:

$$\Delta lnTFR_t = \beta_{10} + \beta_{11}\Delta lnTFR_{t-1} + \beta_{12}\Delta lnIMR_{t-1} + \beta_{13}\Delta lnFLFP_{t-1} + ECT_{t-1} + \varepsilon_{1t} \quad (4)$$

$$\Delta lnFLFP_t = \beta_{20} + \beta_{21}\Delta lnTFR_{t-1} + \beta_{22}\Delta lnIMR_{t-1} + \beta_{23}\Delta lnFLFP_{t-1} + ECT_{t-1} + \varepsilon_{3t} \quad (5)$$

$$\Delta lnIMR_t = \beta_{30} + \beta_{31}\Delta lnTFR_{t-1} + \beta_{32}\Delta lnIMR_{t-1} + \beta_{33}\Delta lnFLFP_{t-1} + ECT_{t-1} + \varepsilon_{2t} \quad (6)$$

ECT is the adjustment coefficient. It can tell us how much need to adjust toward the long run equilibrium. If ECT =1, it indicate that 100% of the adjustment take place within the period. If ECT = 0.5, it represent that each year take 50% of the adjustment. If ECT=0, it show that there is no adjustment. The VECM framework can allows us to estimate their causality in Granger-sense that based on the significance of the error correction term and the first-differenced lagged terms for each descriptive variable.

3.6 Granger Causality test

"Granger causality" is an expression for a unique concept of causality in time-series analysis. The concept is very simple which is a variable X will be Granger-causes Y where Y can be well forecast by using the past values of X and Y compare to only use the history of Y alone while other terms are remaining unchanged.

For example, if event A was happens before event B, then A is possible to cause B but impossible for B to causing A. If Granger causality maintains does not promise that X causes Y, then it is suggests that X might be causing B. Therefore, Granger causality is an influential instrument to test for the effects that we assume away or granted. The null hypothesis is whether X does not Granger cause Y or reverse of X and Y and the alternative hypothesis is vice versa with null hypothesis.

The null hypothesis is rejected when test statistic from the test is larger than critical value. The test statistic used is:

$$F = \frac{(SSE_{reduced} - SSE_{full})/(k_{full} - k_{reduced})}{SSE_{full}/(n - K_{full} - 1)}$$

and the critical value used is:

$$F_{\alpha,(K_{full}-K_{reduced}),(n-K_{full}-1)}$$

From the result, we can acknowledge whether X and Y have bidirectional causal effect or unidirectional causal effects even both are independent. Bidirectional causal effect is X and Y granger cause each other and unidirectional causal effect is just either one granger cause another one but do not granger cause from reverse way. If X and Y does not granger cause each other, X and Y are independent or no causality between each other.

3.7 Impulse Response

Granger causality did not tell the complete information about the interaction of the variables of an equation, so it is often of curiosity to know the reaction of interaction among the variables in an equation that involves of several variables. Impulse response function is sketching the trend of a disturbance in one variable on the remaining variables. If one of the variables does not Granger-cause the other variables the impulse responses are zero and the higher the number, the more interaction between the variables.

3.8 Variance Decomposition

The variance decomposition displays the volume of information each variable gives to other variables in an autoregression. It divides the variation in an endogenous variable into constituent shocks to VAR and simply allocates the variance of forecast errors in a given variable to its own shocks and the other variables.

3.9 Parameter stability tests

Cumulative sum test (CUSUM) and cumulative sum square (CUSUMSQ) test was developed by Brown, Durbin and Evan (1975). Pesaran and Pesaran (1997) suggest that applying CUSUM and CUSUMSQ test to test the stability of the long run relationship between those variables in VECM model. This is important because if the parameter changes over the time, the result will be biased and misleading. If the plot of cumulative sum is within 5% critical bounds, it indicates that the parameter is stable. If the cumulative sum is not within two critical lines (5% critical bounds), it indicates that the parameter is instable and there was a structural break when its movement toward the critical lines.

3.10 Diagnostic Checking

There might be some econometric problems exists in our estimated model such as autocorrelation, heteroscedasticity, the error terms are not normally distributed and the model specification error. If the models consist of these kinds of problems, the results will become biased, inconsistent and inaccurate. Thus, it is very important to do diagnostic checking to ensure the model is free from these problems.

3.10.1 Autoregressive Conditional Heteroscedasticity (ARCH) Test for Heteroscedasticity

Heteroscedasticity means the variance of error term is inconsistency. Heteroscedasticity is important because it will complicate the analysis while many methods in regression analysis are based on an assumption of equal or consistency variance of error term. Heteroscedasticity will cause the result biased, inefficient and inconsistent. There is only time series data in our research, therefore, we will apply ARCH test to detect heteroscedasticity problem due to this test is applied specifically for time-series data.

In the test, the null hypothesis for ARCH test is there is no heteroscedasticity problem and alternative hypothesis is vice versa. The null hypothesis would be rejected when Chi-square p-value is lower than the level of significance (α) otherwise does not reject. If we unable to reject null hypothesis, the model estimated do not consists heteroscedasticity problem

3.10.2 Breusch-Godfrey LM test for Autocorrelation

Autocorrelation problem is the current and the past error term has relationship among each other and this most likely to occur in time series data. Compare to

Durbin-Watson (DW) test and Durbin's h test, we choose the Breusch-Godfrey LM test because the DW test will provides inconclusive results and can't take higher orders of series correlation into account and the Durbin's h test is unable to use the lagged dependent variable.

In the test, there is no autocorrelation problem for null hypothesis. The null hypothesis will be rejected if P-value of F-statistics is lower than the level of significance, α. We need to determine its optimal lag length via the minimum AIC and SIC based on the number of lagged residuals when conducting the auxiliary model.

3.10.3 Ramsey's Regression Specification Error (RESET) test for Model Specification

The model specification problem exist in the model if the model is in wrong functional form, omitted a relevant independent variables out from model, the model include irrelevant independent variables, or we have omitted a relevant independent variables include irrelevant independent variables at the same time. Then, it will leads to underfitting of a model that ignoring relevant variables or overfitting of a model that with irrelevant variable.

Ramsey's RESET Test was developed by Ramsey in year 1969 and it is very useful in testing the model specification. In the test, the null hypothesis is the model specification is correct and vice versa in alternative hypothesis. The null hypothesis is rejected when the P-value of F statistics is lower than level of significance, α, otherwise do not reject. If we unable to reject null hypothesis, the model that we estimated is correct model specification.

3.10.4 Jarque-Bera (JB) Test for Normality

Jarque-Bera Test is used to determine whether the error term is normally distributed. The null hypothesis for JB test is error term is normally distributed and vice versa in alternative hypothesis. The null hypothesis would be reject if P-value of Jarque-Bera statistics is lower than the level of significance, α. We should make sure that the JB test statistic value (P-value) is small that not allow us to reject null hypothesis to ensure the error term is normally distributed.

3.11 Conclusion

The estimation will follow the method of estimation shown above. Firstly is start with unit root test to test whether the series is stationarity or not. The Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test is used in unit root test. Then, we will do the cointegration test to determine whether there are cointegrated with each other or not. We will use Vector Error Correction Model (VECM) and Johansen and Juselius (JJ) test to determine the dynamic and long run relationship among variables. Besides that, granger causality is used to test the interaction between the variables and impulse response and variance decomposition is used for a more detail information for the interaction. And then, we will do the robustness test by using female education level and income level as independent variables to make our results more convincing and consistency. Lastly, we will do the diagnostic checking. Following chapter will discuss more detail about the result and some interpretation about it.

Chapter 4: Data Analysis

4.0 Introduction

This chapter will begin with unit root test. Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test were used to estimate the stationary of variables to avoid spurious result. After stationary tests had been conducted, we applied Johansen and Juselius test for long term relationship. In this chapter, we also implement ARDL method. The results of long run estimator and ECM model as shown in table 4.2 and 4.3. Besides that, we apply Granger causality test to study the short term relationship linkages between the variables and the result was shown in table 4.4. Lastly, we illustrate the impulse responses function and variance decomposition (figure 4.3 and table 4.6) to examine how long the effect last for. Moreover, we also do for robustness checking for the model that we obtain.

4.1 Unit Root Test

Unit root test that we use are ADF test and PP test stationary by taking into account of intercept with trend. Table 4.1 indicates the results of ADF and PP tests for three variables which are fertility rate, infant mortality and female labour force participation in level and first difference form. Based on the result, ADF and PP test show that all variables insignificant reject the null hypothesis at 1%, 5% and 10% significance level. It means that all variables are not stationary. Therefore, we need to process to first difference form. The t-statistic of ADF and PP test for three variables reject the null hypothesis. From the combined result (ADF and PP test), it show that all the variables are integrated of order 1, $I(1)$.

Table 4.1 Result of ADF and PP test		
Variable	ADF test	PP test
	Intercept with trend.	Intercept with trend.
TFR	-2.1217(1) [0.5177]	-4.8721 [0.0018]
IMR	-1.2142(1) [0.8932]	-0.6824 [0.9674]
FLFP	-3.6187(1) [1.0000]	1.9265 [1.0000]
ΔTFR	-4.7126(0) [0.0028]***	-4.8100 [0.0021]***
ΔIMR	-3.4994(0) [0.0538]*	-3.6076 [0.0425]**
ΔFLFP	-4.2962(0) [0.0082]***	-4.0340 [0.0158]**

Note: Values show t-statistic for ADF and PP test. Number in bracket represents the number of lag length. The number of lag length was choosing based on Schwarz Information Criteria (SIC). ***, **,* represent reject null hypothesis at 0.01, 0.05 and 0.10 critical value. P-value show in square brackets and we use to compare with significant level.

4.2 Johansen and Juselius Test

We notice that all the variables are integrated of order one, then we can process to cointegration test to test for long term relationship. In our study, there are three variables which are fertility, infant mortality and female labour force participation. Hence, we cannot use Enger-Granger test but we applied Johansen and Juselius test. Table 4.1 presents the Johansen and Juselius test for our three variables. Based on the result, trace statistic test and maximum eigenvalue test indicate that no cointegration at 0.05 significant level. However, when we test the trace statistic test and maximum eigenvalue test at 0.10 significant level, we found that it consists one cointegration relationship among our variables

Table 4.2 Result of Johansen and Juselius test				
Null hypothesis	Alternative hypothesis	Trace Statistic	Critical Value	
			0.05	0.10
m = 0	m >1	28.83219*	29.7971	27.0670
m ≤ 1	m > 2	13.41777	15.4947	13.4288
m ≤ 2	m > 3	1.122702	3.84147	2.70555
Null hypothesis	Alternative hypothsis	Maximum Eigen	Critical Value	
			0.05	0.10
m = 0	m =1	19.0144*	21.1316	18.8928
m = 1	m =2	12.0951	14.2646	12.2965
m = 2	m = 3	1.1227	3.84147	2.70555
Note: **,* indicate rejection of the null hypothesis at 0.05 and 0.10 critical value. m is the number of cointegration.				

4.3 ARDL Bound Test

ARDL bound test is the favorable test that use by recent research in investigate the long run relationship among the variables (Lee & NG, 2012; Narayan, 2006; Narayan & Symth, 2006). In order to study in long run and short run between our variables, we need to compare use Wald test to compare calculated F-statistic with the critical value that obtain by Pesaran et al(1999). At k=2, the critical bound level at 1% significant level is (3.17, 4.14), at at 5% significant level is (3.79, 4.85), and at 10% significant level is (5.15, 6.36). The standard F-statistic when total fertility rate as the dependent variable ($F_{TFR|IMR, FLFP}$) is 4.7978, infant mortality rate as the dependent variable ($F_{IMR|FLFP, TFR}$) is 2.1243, and female labour force participation as the dependent variable ($F_{FLFP|TFR,IMR}$) is 1.6050 show in Table 4.3. They are unable to reject null hypothesis at 5% and 1% significant level because the standard F-statistic is less than the upper critical value bounds. But, the standard F-statistic when total fertility rate as the dependent variable ($F_{TFR|IMR, FLFP}$) is greater

than the upper critical value bounds at 10% significant level. Thus, we can reject the null hypothesis at 10% significant level. As a result, we can conclude that the null hypothesis of no cointegretion relationship cannot be accepted when total fertility rate as the dependent variable.

Table 4.3 Result of ARDL bound test

F-test	10% critical value bounds		5% critical value bounds		1% critical value bounds	
	Lower	upper	lower	upper	Lower	upper
$F_{TFR \mid IMR, FLFP}$ = 4.7978* $F_{IMR \mid FLFP, TFR}$ = 2.1243 $F_{FLFP \mid TFR, IMR}$ = 1.6050	3.17	4.14	3.79	4.85	5.15	6.36

Note: Critical value taken from Pesaran et al.(1999), table C1.iii: Case III with unrestricted intercept and no trend. Asterisks (***) indicate reject the null hypothesis at 0.01, 0.05 and 0.10 critical value.

4.4 Long Run and Short Run Result

From the previous step, we had found cointegration relationship when total fertility rate as the dependent variable ($F_{TFR \mid IMR, FLFP}$). In order to find out the long term relationship, we will use ARDL(1,1,1). The optimum lag length that we use is based on minimum Schwarz information criterion (SIC). Table 4.4 indicate that the result of long run estimator. In long run results show that mortality rate is negatively correlated with fertility rate and significant at 5% level. Increase 1% in mortality rate will decrease the total fertility rate by 0.12%. Interestingly, the female labour force participation is insignificant in long run but had a negative expected sign.

To capture the long run and short run relationship among those variable, we will apply the VECM. In short run, mortality rate is significant and had a positive expected sign correlated with fertility. Female labour force participation is significant at 10% level in short run and it is positively correlated with fertility. In order to

capture the short and long run effect among these three variables, we will use the error correction model. The error correlation term (ECT_{t-1}) is measure the speed of adjustment toward the long run equilibrium. From table 4.4, the ECT that we obtain is -0.2390 and significant at 1% level. It means that it will take approximate 4.18 years to adjust toward the long run.

Besides that, we also conduct a series of diagnostic checking. First, we conduct the Breusch Godfrey LM test. Breusch-Godfrey LM test is to detect whether the model consists of autocorrelation problem. The null hypothesis of no autocorrelation problem is unable reject because the probability of chi-square lagged one (0.1172) is more than 5%. Next, we conduct the ARCH test to detect whether the model consists of heteroscedasticity problem. Under the ARCH test, the probability of chi-square lagged one (0.6307) more than 5% significance level. Therefore, it can conclude that there is no heteroscedasticity in the model. Moreover, the probability for Jarque-Bera Normality test (0.3810) and the probability of f-statistic for Ramsey RESET specification test (0.5414) are greater than 5% significance level. This indicates that the model is unable to reject the null hypothesis which error term is normally distributed and the model is correctly specified.

Furthermore, we also use CUSUM and CUSUMSQ test that proposed by Brown et al (1975) to check the stability of ARDL bound testing approach or parameter constancy. Figure 4.1 and 4.2 show graphical plot of CUSUM and CUSUMSQ test with the 5% level critical value bands. If the cumulative sum is within two critical lines, it indicates that the parameter is stable. If the cumulative sum line is go outside the two critical lines, it indicates that the parameter is instable and there was a structural break when its movement toward the critical lines. From figure 4.1, we can observe that the movement of CUSUMSQ is within two critical lines. However, the movement of CUSUM is outsides two critical lines during the period of 1990-96. There are a mix results that provided by CUSUM and CUSUMSQ test. However, CUSUMSQ test is performing well when dealing with dynamic regression compare with CUSUM test (Deng & Perron, 2007; Caporale & Pittas,

2004). Moreover, Tanizaki (1995) claim that CUSUM test is less powerful in testing finite sample compare to CUSUMSQ. Hence, we will ignore the result of CUSUM test and conclude that the parameter constancy over the time.

Table 4.4 Result of long run estimates		
Variable (In TFR is the dependent variable)	Coefficient	t-statistics
Long run results		
Variable (In TFR is the dependent variable)		
Constant	0.8172	5.2475
In IMR_t	-0.1249	-2.1107***
In $FLFP_t$	-0.3077	-0.5031
Note: *,**,***indicate reject null hypothesis at 0.01, 0.05 and 0. 10 critical value.		

Table 4.5 Error correction model		
Short run result		
Constant	0.0184	2.3302
Δ In IMR_t	0.8584	3.0743***
Δ In $FLFP_t$	1.9440	2.4639***
ECT	-0.2391	-2.7940***
Goodness of fit and diagnostics Checking	Result (p-value)	
R^2	0.4940	
[illegible]	0.4327	
Breusch Godfrey LM test	$\chi 2(1)= 0.0974$	
ARCH test	$\chi 2(1)= 0.5780$	
Jarque-Bera Normality test	$\chi 2\ (2)=0.5156$	
Ramsey RESET specification test	$F(1,32)= 0.8493$	
Note: *,**,***indicate reject null hypothesis at 0.01,0.05 and 0.10 critical value.		

Figure 4.1 CUSUMSQ test for ARDL model

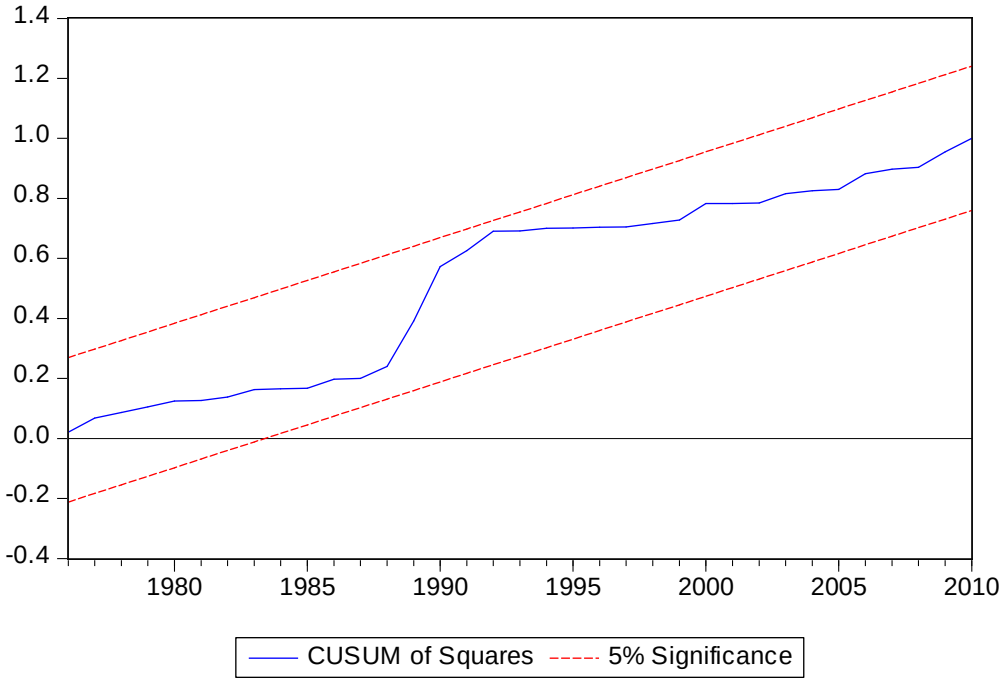
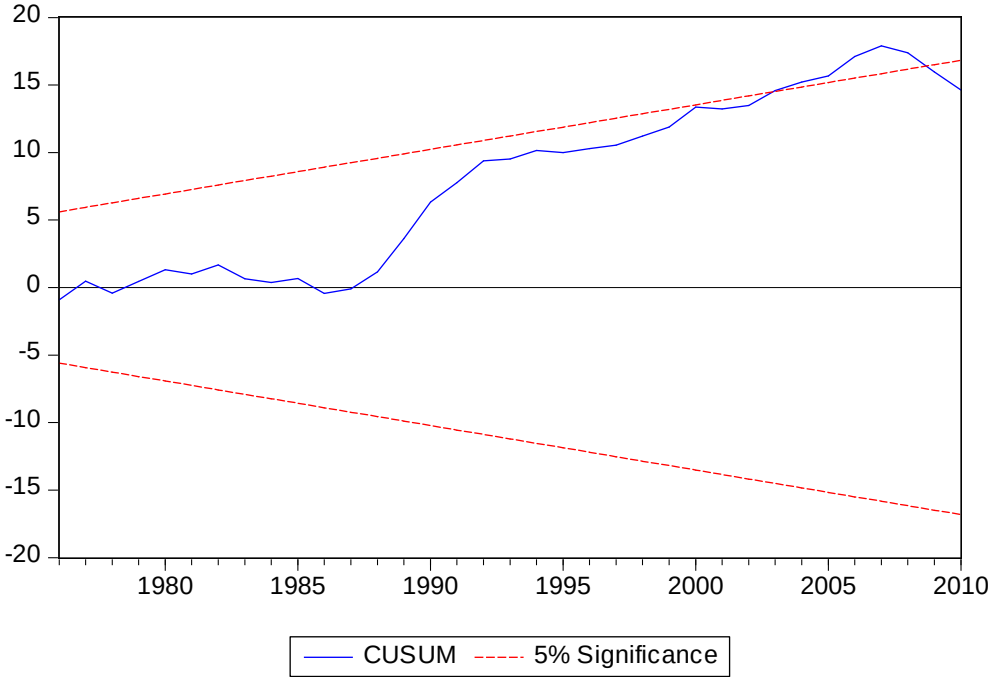


Figure 4.2 CUSUM test for ARDL model



4.5 Granger Causality test

From table 4.6, there is a significant coefficient of ECT_{t-1} (-0.5827) at 1% level. Error correlation term (ECT_{t-1}) is measure the speed of adjustment toward the long run equilibrium. According to Granger (1986), it is an evidence of causality in at least one direction occurs if we find a significant error correlation term. The error correlation term must be between 0 and 1, negative value, and significant at 1% level. It indicates that the series is non-explosive and achieve long-run equilibrium. Based on the result, there is no any granger causality between infant mortality and fertility. But, we can observe that there is a unidirectional causality between female labour force participation and fertility which female labour force participation granger causes fertility at 5% significance level. Besides that, we also found that infant mortality granger causes female labour force participation at 10% significance level. But, we cannot know whether it is positive or negative effect the in short run and how long the effect last for. Thus, we need to process to impulse response function and variance decomposition.

Table 4.6 Result of granger causality test

Variable	χ2-statistic of lagged first differenced term			ECT_{t-1}
	Δ In TFR_t	Δ In IMR_t	Δ In $FLFP_t$	
Δ In TFR_t	-	0.8329 (0.3614)	3.5777** (0.0586)	-0.58267*** [-3.9122]
Δ In IMR_t	0.4960 (0.4813)	-	1.5081 (0.2194)	-0.06305 [-1.6420]
Δ In $FLFP_t$	0.0681 (0.7941)	3.2041 (0.0820)*	-	-0.03927 [-1.5206]

Note: Number in bracket is probability and number in square brackets for ECT_{t-1} is t-statistic value. ***,**,* indicate reject the null hypothesis at 0.01 or 0.05 or 0.10 significance level.

4.6 Impulse Response Function and Variance Decomposition

From the ARDL bound test, we notice that when fertility rate as the dependent variable, there had a cointegretion relationship. Hence, we will only focus on the variance decomposition of fertility. Table 4.6 indicates the results of variance decomposition of D(TFR). Under the variance decomposition of D(TFR), we can see that the 100% of the variability in fertility is explained by its own value during 1st period. After 10 periods, fertility variations are still mainly due to its own changes (86.74%) while 13.26% is explained by combined impact of infant mortality (0.92%) and female labour force participation (12.34%).

In order to study the impulse response function for our variables, we were using the generalized impulse response analysis for unrestricted vector autoregressive that purpose by Pesaran and Shin (1997). According to Pesaran and Shin (1997), the generalized impulse response does not require orthogonalization of shocks and does not depend on the VAR order. Figure 4.3 indicate that the response of fertility rate, infant mortality and female labour force participation changes from one standard deviation shock to each other. From figure 4.3, we can examine whether a variable give response to other variables or not. We can observe that the one standard deviation of female labour force participation will cause a positive impact to fertility. The fertility is significant increase during 1st and 2nd period. After that, it change to insignificant and decline slowly. The result is consistent with the granger causality test result and ARDL model result. Female labour force participation had a short run positive impact to fertility. While the response of fertility to infant mortality tend to had temporary positive impact at a short period. After 4th period, fertility still declining and turn to negative impact.

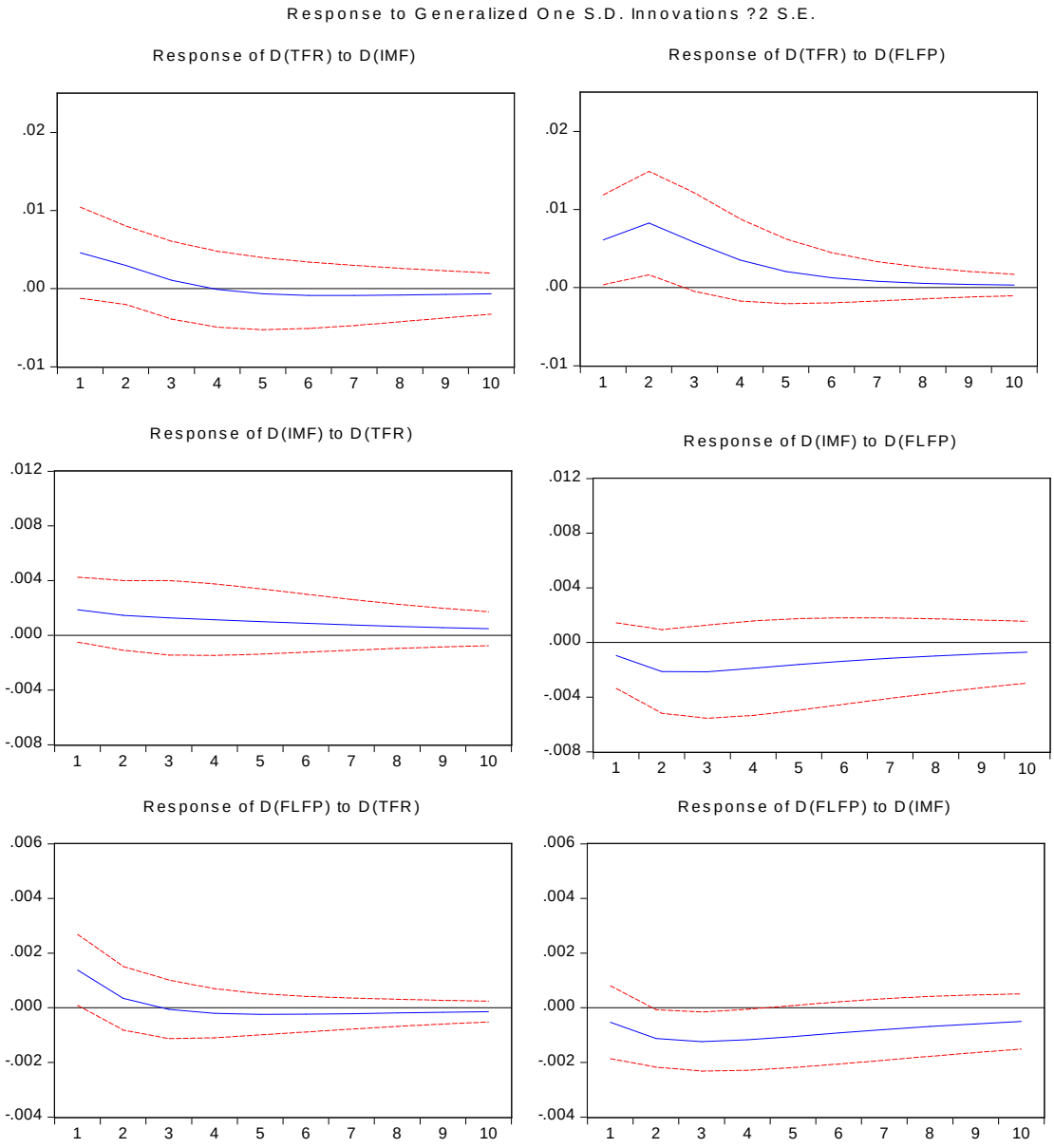
Fertility had a positive impact on infant mortality and female labour force participation had a negative impact on infant mortality when change in one standard

deviation shock fertility and female labour force participation. One standard deviation of female labour force participation will give a significant negative impact to infant mortality during 2nd period to 4th period. It means that the effect of female labour force participation will slowly pick up the effect of infant mortality rate after 1st period. Under the response of female labour force participation to infant mortality, it shows a negative impact. While the response of female labour forces participation to fertility tend to had temporary positive impact at a short period. After 3rd period, fertility still declining continually and turn to negative impact.

Table 4.6 Variance decompositions of TFR

Period	D(TFR)	D(IMR)	D(FLFP)
1	100.0000	0.000000	0.000000
2	93.21153	0.062406	6.726061
3	89.68160	0.060453	10.25795
4	88.23735	0.141674	11.62097
5	87.60671	0.294224	12.09906
6	87.27294	0.464782	12.26228
7	87.06301	0.619180	12.31781
8	86.91829	0.745341	12.33637
9	86.81480	0.843123	12.34207
10	86.73983	0.916824	12.34335

Figure 4.3 Generalized impulse responses



4.7 Discussion

In order to study the relationship between the infant mortality and female labour force participation in US, we will use Johansen and Juselius (JJ) approach and ARDL bound test approach to test for cointegration. Before process to JJ and ARDL approach, we also test for stationary of the variables to avoid spurious result. JJ approach was the favorable test that use by former research while ARDL approach was the favorable test that use by latest research in study the long run relationship among the variables. Both results of JJ and ARDL bound test approach had indicate there is a cointergration relationship among the variables. After that, we will process to long run estimator for ARDL bound test and ECM model.

In our result, we found that the infant mortality rate is significant and negative relationship with fertility in long run. It shows that lower infant mortality rate will cause the higher fertility rate in long term. This result is consistent to Lee and Ng (2012) which also using ARDL approach to examine the determinate of fertility rate in Singapore. They suggest that women tend to have more children when infant mortality drop. However, our result shows that there is a positive relationship between infant mortality and fertility.

According to Denise (2009), the main reason of the higher infant mortality rate is due to high rates of premature birth. US was has the highest teenage birthrate and first-day death rate in the industrialized world (Naomi, 2013). In US, one over eight babies was born preterm, or less than 37 weeks gestational age. Majority of teenage mothers are poor and less educated. Moreover, they also receive less prenatal care compare than older mothers. Therefore, their children will likely to be low-birth weight and premature. As we know preterm births will cause undeveloped lungs and an immature immune system of the babies. Thus, it needs persistent and intensive

care at quality hospital. But, over past decade, hospitals in US had been cutting such care due to raising cost over past decade. Thus, there is positive relationship between fertility rate and infant mortality rate in short term. While the reason that the relationship between fertility rate and infant mortality is negative in long term may probability due to the reason of higher infant mortality in US. In US, there are many children die at early age. Thus, it will tend to influence women to have fewer children.

From the granger causality, impulse response function and variance decomposition, we can observe that the female labour force participation have positive effect on fertility in short run. It means that increasing in female labour force participation will cause the fertility rate increase. This result is consistent to Narayan and Symth (2006) and Papapetrou (2004). They found that role of socioeconomic structural change will effect fertility. Another reason cause positive relationship between female labour and fertility maybe due to the availability of child care services. Availability of child care services can help working mother take care their babies and make them more concern to their job. Furthermore, Family and Medical Leave Act (FMLA) of 1993 in US were only allowed employee take up to 12 weeks unpaid leave during one year. Working mother can use this advantage to pregnancy or take care for newborn child. Hence, it will cause the positively significant on fertility rate in short run.

Robustness Check

Table 4.7 Robustness Check Result				
Variable	Model 1	Model 2	Model 3	Model 4
Constant	0.8172 [5.2474]	5.7555 [8.9023]	0.03882 [0.0366]	8.0158 [6.1949]
In IMR	-0.1249** [-2.1108]	-1.3848*** [-3.0021]	-0.8060** [-2.0111]	-1.3935** [-2.2627]
In FLFP	-0.3078 [-0.5031]	1.5886 [0.4636]	-5.4751 [-1.4205]	-6.07152 [0.1000]
In TEDU	-	7.7798*** [6.4533]		9.2352** [7.4751]
In GDP	-		-0.1458 [-0.4635]	0.5606** [3.3614]
In IMR* In TEDU	-	-3.2705** [-3.8914]		-3.3715*** [-3.9361]
In FLFP* In TEDU	-	-3.9591 [-0.6423]		-2.4489 [-0.3464]
In IMR* In GDP	-		-0.1885* [-1.8450]	-0.0415 [-0.7246]
In FLFP* In GDP	-		-1.2572 [-1.2572]	1.1380* [1.8321]
R^2	0.28365	0.8420	0.3714	0.934884
Adjusted R^2	0.244928	0.8187	0.2789	0.91808
F-statistic (p-value)	7.325356 (0.0000)	36.2300 (0.0000)	4.0180 (0.0000)	55.63417 (0.0000)

Note: Number in square bracket represents the value of t-statistic. ***, **,* represent reject null hypothesis at 0.01, 0.05 and 0.10 critical value. P-value show in brackets and we use to compare with significant level.

Model 1: $TFR_t = \alpha_{41} + \alpha_{41} In\ IMF + \alpha_{42} In\ FLFP + \varepsilon_t$

Model 2: $TFR_t = \alpha_{51} + \alpha_{52} In\ IMF + \alpha_{53} In\ FLFP + \alpha_{54} In\ TEDU + \alpha_{55} In\ IMF*In\ TEDU + \alpha_{56} IN\ FLFP*\ In\ TEDU + \varepsilon_t$

Model 3: $TFR_t = \alpha_{61} + \alpha_{62} In\ IMF + \alpha_{63} In\ FLFP + \alpha_{64} In\ GDP + \alpha_{65} In\ IMF\ *In\ GDP + \alpha_{66}\ In\ FLFP*IN\ GDP + \varepsilon_t$

Model 4: $TFR_t = \alpha_{71} + \alpha_{72} In\ IMF + \alpha_{73} In\ FLFP + \alpha_{74} In\ TEDU + \alpha_{75} In\ GDP + \alpha_{76}\ In\ IMF*In\ TEDU + \alpha_{78} In\ FLFP*IN\ TEDU + \alpha_{79}\ In\ IMF\ *In\ GDP + \alpha_{80}\ In\ FLFP*IN\ GDP + \varepsilon_t$

Table 4.7 was the set of our robustness check. Model 1 in Table 4.7 is the baseline model of the test. In model 2, we add in the tertiary education of female (TEDU) and interaction term into the baseline model. TEDU represents the female graduates in tertiary education. The data that we obtain were from the education statistic. For the model 3, we add in the GDP deflator (GDP) and interaction term into the baseline model. The data that we obtain were from the World Bank. In model 4 was added in female graduates in tertiary education level, GDP deflator and interaction term into the baseline model. From the chapter 2, we had observe that some of the researchers (Narayan, 2006; Lee & Ng, 2012; Narayan & Peng, 2006) had add in level of female education and income level as the independent variable in order to examine the relationship of fertility rate. Both of them had found out that female education was significant and income per capita was significant in short run. But, they only focus on the main effect of female education and income per capita on fertility and they do not explain the linkage for female education and income per capita with the female labour participation force and infant mortality. Thus, we need to include female education and income per capita in our robustness check.

In model 1, the result shows that infant mortality is significant and negative impact on fertility but female labour participation force is insignificant on effect the fertility. In model 2, when we add in the female education and interaction term, the infant mortality is significant and remains negative effect on fertility. The interaction term for FLFP and TEDU is insignificant. However, the interaction term of IMR and TEDU is significant and negative with fertility. It may suggest the reason for decline in infant mortality that affect fertility rate rose is due to female that graduate in tertiary education level. Women with education will have more knowledge on prenatal care, immunization and nutrition, thus, infant mortality will decline. Declining in infant mortality rate will tend to increase the intensive of women to give birth.

In model 3, the result shows that the infant mortality is significant and has negative effect on fertility. But, the GDP deflator and female labour force

participation is insignificant. The interaction term for FLFP and GDP is insignificant but the interaction term for IMR and GDP is significant and give negative effect on fertility. It may suggest that increasing in price will affect the infant mortality rate to increase. Increasing in price will cause inflation and reduce the purchasing power of women. Women will unable to afford high cost of medical for premature baby and cause increasing in infant mortality rate. Rising in infant mortality rate will encourage women to give out birth. As such, increasing in price will cause decreasing in fertility. In model 4, we observe that infant mortality is significant and remain negative relationship with fertility when include interaction term. The main effect of female education and GDP deflator is significant and give positive impact on fertility but the main effect of female labour force participation is insignificant. Moreover, the results also show that the interaction term of FLFP with TEDU and IMR with GDP is insignificant. However, the interaction term of IMR and TEDU is significant at 1% significant level. In addition, the interaction term of FLFP and GDP is significant and give positive impact to fertility rate.

Chapter 5 Conclusion

5.0 Introduction

In this section, we will discuss major finding that in our empirical result. Besides that, there also had some limitation in our research. In order to improve our study, we would like to provide some recommendations to further researcher. Moreover, we would also like to provide some ideas to policymaker for designing their policy.

5.1 Summary and Conclusion

Recently, the fertility had decline in all regions and eighty countries had a total of fertility rate that below the sub replacement fertility rate (2.1). Seventy-five countries (thirty-nine in Europe, nineteen in Asia, twelve in Latin America and Caribbean, two in Africa and Northern America and one in Oceania) among eighty countries that had below sub replacement fertility rate are those populous countries and they accounted 48 percent of the world population. Fertility rate is the major contributor to population growth. A declining in fertility rate will cause world population growth slowly in future and the population aging. Furthermore, it causes the childbearing year raise and postpone to old ages. Hence, fertility rate is an important issue and need to pay concern on it. A lower fertility rate is a warning bell for them.

There are many researcher had examine the determinant of fertility rate. Many of researchers had found that female labour force participation significantly affects the fertility rate. However, it is mixed result. Small family need less money for supporting their family and hence decline the incentive of women that seek for job in

labour market. They pay full time in their family during their childbearing years and tend to have more children. Female labour force participation rate will decrease and affect the GDP of the country. Therefore, it is negative with fertility rate, decreasing in female labour participation will cause fertility rate to increase. Female labour participation can be separate to full time working women, part time working women and unemployed women. Female labour force participation tends to increase when part time working women increase. By working part time or flexible hours, married women can compatibility between childbearing and working. Thus, the relationship between female labour force participation and fertility rate are positively correlated.

Demographic transition will is a process when developing country transfers to developed country. Based on the demographic transition theory (Chowdhury, 1988), modernisation, urbanization and industrialization will cause income increase, the standard living increase and the quality of health and medical fertilities. Thus it will decrease the infant mortality rate and cause the fertility rate to decline. However, there are some researchers found negative or no relationship. Thus, we decide to examine the relationship between fertility rate, female labour participation rate and infant mortality rate. The country that we want to investigate was United States. United States had found mixed result for female labour participation rate and fertility rate but no researcher investigates the relationship for infant mortality rate and fertility rate for it.

In order to examine the relationship between TFR, IMR and FLFP in long and short run, we had applied unit root test, cointegration test, granger causality test, impulse response and variance decomposition. By impose unit root test, it can avoid the possibilities of spurious result. Through our result, notice that all the variables are integrated of order 1, *I* (1), which mean stationary at first difference. After that, we process to cointegration test. We had imposed JJ test and ARDL approach test to test for cointegration. Both tests provide us that the model has a cointegration among our variables. From our result, we can obtain that infant mortality rate have negative long run relationship on fertility rate. From the granger causality test, impulse response

and variance decomposition, we found that female labour force participation rate has positive effect on fertility rate in short run. Last but not least, we also run robustness check by include interaction term.

5.2 Policy Implementation

According to our finding, it shows that the female labour force participation rate only affect the fertility rate positively in the short run while there is no relationship in the long run. In order to increase the fertility rate in short run, the US governments might need to increase the female labour force participation first. Many married women or women with children are willing to supply labour but some of the employers are not willing or restrict to hire them. The sexism reason is the employers believe that the productivity of those married women or women with children will be affected directly by their family role. The family role might absorb most of their energy and affect their productivity to decrease. However, what their belief might not be true. The US government might set rules for the employer by ratio their employees at least 1 married women. The governments might also implement some regulation like tax reduction for the firms that offering part timer job especially for married women. When more part time job vacancies are created, they will have more chances to get the job, and more flexibility in working hours. This might encourage them to have child because they are able to continue working during their childbearing year.

The infant mortality rate has a negatively effect on fertility rate in long run. The increase in infant mortality rate will lead the fertility rate to decrease. In another words, the fertility rate will increase, if the infant mortality rate decrease. The US government could subsidies the medical and healthcare industry, to aid the states with high infant mortality rate like Mississippi and Alabama for reducing the infant mortality. It also directly lessens the burden family who can’t afford for high medical cost. However, good doctors and medical are not enough to reduce the infant mortality rate. Therefore, US government could improve the quality in medical especially in prenatal care and step up programs to alert the public about reducing the

unwed teenage pregnancy and revitalizing the family for nurturing their babies. The public might gain back the confident for giving birth hence it increases the fertility rate.

5.3 Limitations and recommendation

In our study, we only included the female labour force participation rate (FLFP) and the infant mortality rate (IMR) to examine the total fertility rate (TFR). However, there are few types of FLFP. Which are full time working women, part time working women and unemployed women. Even thought our empirical result shown the FLFP is significant to TFR but it doesn't show whether which type of FLFP affects the TFR, Each of them has different impacts to the fertility rate. When the part time job is limited, married women who want to work will having dilemma whether working for fulltime or not working, and they are forced to choose either one. For full time working women, they might not suitable for having a large number of children (Del Boca, 2003).

In order to get a better and more accurate result in the fertility rate, we would like to recommend the future researcher divided the female labour force participation into three variables: full time working women, part time working women and unemployment women. Therefore, divided the female labour force participation into three variables will help to obtain better results and explanation. The result that runs off will be more accurate and provide better information to the policymakers for future decision making.

Robustness Checking

In the impulse response function, we were using the generalized impulse response analysis rather than Cholesky decomposition. Generalized impulse response analysis was does not require orthogonalization of shocks and does not depend on the VAR order. However, ordering of variable is important. Based on Cholesky decomposition, if the ordering of variable change, it will give a dramatically effect on the responses. Thus, we suggest that future researcher can apply an ordering of the variables in the Vector Autoregression Model.

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