A study of the factors affecting the total fertility rate in South Korea

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ABSTRACT

In 2014, the total fertility rate (TFR) of South Korea was 1.21 children per woman, which was the lowest level among OECD member countries, and also one of the lowest in the world. As the decline of the total fertility rate has been so rapid and the mortality rate has also declined sharply, the population of South Korea has been aging at a fast speed. If these circumstances persist, the financial burden of supporting aging people will place heavy pressure on young people, and the labour market will be strained by the decreasing productive population. To solve the low fertility problem, it is very important to find out what are the causes of low fertility.

In this study, the model divides the factors causing a low fertility rate into two categories - demographic and values factors (the entry rate into tertiary education of women, the age at first marriage of women, and the crude divorce rate) and economic and social factors (the nominal GNI per capita, the female employment rate, and the ratio of educational cost to household consumption expenditure). Through correlation analysis and univariate regression analysis I find that each of the six independent variables has a negative correlation with the total fertility rate. Also, the results of the multiple regression analysis indicate that the three variables which are related to women have negative effects on the total fertility rate. However, the coefficients of the other three variables are not statistically significant. Thus, I suggest that the Korean government focus on support policies that help women to balance work and child-rearing to increase the total fertility rate.

I. Introduction

The low fertility rate issue of South Korea has proceeded at an unprecedented pace. In 2014, the total fertility rate (TFR)[1] of South Korea was 1.21 children per woman, which was the lowest level among the OECD member countries and also one of the lowest in the world. According to the Economic Commission for Europe (ECE), to sustain population levels, the average number of children that a woman has in her lifetime should be approximately 2.1 (in developed countries), which is called population replacement level. If the total fertility rate falls below the population replacement level, the society is considered to be a low-fertility society. Also, if the total fertility rate is below 1.3, the society is classified as a lowest-low fertility society (Kohler, Billari & Ortega, 2002). Thus, South Korea is classified as a lowest-low fertility society. To make matters worse, the speed of decline of the total fertility rate is too rapid. Besides, since the mortality rate has also declined rapidly, the population of South Korea has been aging, and the speed of this population shift is one of the fastest ever in the world. If these circumstances persist, there will be serious negative effects.

First of all, the financial burden of supporting an aging population will increase due to the rapid increase of the elderly population. For example, huge social costs caused by a rapid increase in medical expenses and pensioners will increase the burden on young people. This may lead to a deepening of conflicts between the generations. Secondly, there will be a sharp decrease in the productive population. Because of this, the labour market will tighten, and this would decrease national income and the economic growth rate. These negative effects could cause the total fertility rate to go down, leading to a vicious circle.

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[1] The total fertility rate in a specific year is the total number of children that a woman has in her child-bearing years.

Consequently, the low fertility rate is closely connected with a country's economy, and may cause many social problems. The Korean government started to introduce counter policies to solve the low fertility rate issue in 2000, and further research is being carried out actively. Although the Korean government has presented various counter policies and spent $80 billion over ten years to raise the low fertility rate,[2] these policies have been regarded as simple childbirth encouragement policies rather than long-term counter policies. Accordingly, many experts have criticized government policy failures and suggested many counter proposals.

In this study, assuming that the factors affecting the low fertility rate have a complex interrelation with one another, I approach the topic through two elements - the demographic and the values factors which arise from a change in people's consciousness and attitude, and the economic and social factors which result from a change in the external environment. For each element, explanatory variables are selected, and then statistical data are collected. Using the collected data, I analyze the trends and characteristics of the low fertility rate of South Korea, and estimate total fertility rate regression models. Lastly, based on the results from the estimation, I do a comprehensive evaluation of the factors affecting the low fertility rate and reach a conclusion.

[2] In 2006, the Ministry of Health and Welfare Korea presented the first plan for an ageing society and population (2006-2010), and then they announced the second plan for an ageing society and population (2011-2015) in 2010.

II. Literature Review

Economists explain fertility behaviour in relation to economic behaviour. They have studied the factors affecting the fertility rate through both microscopic and macroscopic approaches. The microscopic approach explores the impact of an individual's or a household's income level on their fertility rate. In other words, it focuses on an individual's utility maximization when time and resources are limited.

For example, Becker (1960) models the relationship between income and fertility through the income elasticity of demand for children. He regards fertility behaviour as a demand for consumer durables, and argues that an increase in income would increase the demand for children. From the point of view of consumer choice theory, the fertility rate has a positive relationship with income because, as for other commodities, an increase in income stimulates the demand for children, one kind of consumer durable good. According to him, fertility is determined by five factors: income, child costs, knowledge (of contraception), taste, and uncertainty. Using and analyzing cross-sectional data sets which are derived from U.S. Bureau of the Census data for 1953 and 1958, he shows that there is a positive correlation between income and fertility if other factors affecting fertility remain unchanged.

In comparison with Becker's (1960) opinion that there exists a positive correlation between income and fertility, Leibenstein (1974) asserts that there is a strong tendency to improve child-rearing quality by investing more money rather than increasing the number of children as income increases. He classifies the utility of a child into three types of utility - consumption utility, work or income utility, and security utility - and cost into two types of cost - direct cost and indirect cost.

Firstly, consumption utility implies that a child is regarded as a consumer good, and that the activities of giving birth to and rearing children themselves provide their parents with utility. Secondly, work or income utility means that utility arises from the role of children as household labour, since children are regarded as production goods. Thirdly, security utility is the expected value of the utility that parents would enjoy as they lean on their children in their old age, as children are regarded as insurance for the future. Lastly, direct cost includes feeding, housing, clothing, and schooling a child until she or he is financially independent, while indirect cost is considered to be the opportunity cost of the parent's loss of time spent working due to rearing children.

The factors affecting fertility have also been studied through a macroscopic approach, and in this approach, the effect of the national economy or economic fluctuations on the fertility rate is measured. Employment instability of the nation and recessions become causes of changes in the fertility rate. Andersson (2000) asserts that an increase in the female unemployment rate raises the number of participants in vocational-training programs and extends the period of education, so that it has a negative effect on fertility in Sweden. He uses data derived from the Swedish population register system during the years 1985–1995, and estimates intensity-regression (or proportional-hazard) models.

Andersson (2000) finds that women who have relatively low income and women enrolled as students tend to have lower fertility than other women. Furthermore, he also finds that, during the 1990s, the rise in the number of women with these characteristics can explain part of the fertility rate drop. Hoorens, Parkinson and Grant (2005) also come to a similar conclusion. They suggest that one of the main causes of the decline in fertility in Sweden in the

late 1990s is a structural change in the labour market. To be specific, young people have difficulty finding a job in the labour market; therefore, their willingness to have a child falls.

Some researchers focused on factors which are related to women because fertility has much to do with women. Mason and Kuhlthau (1992) find that women's age, education (measured in years), race (whether African-American), and labour force participation affect low fertility due to child care constraints. They collected data from personal interviews with a probability sample of mothers who had preschool-aged children living in three counties (Wayne, Macomb, and Oakland) in the Detroit metropolitan area in January-June 1986, and estimate logistic response models relating personal and family characteristics to perceived child care constraints on birth timing and on numbers of children through logit analysis.

Mason and Kuhlthau (1992) find that fertility is most affected by labour force participation. In particular, employed women will avoid having a child if they are not able to find proper child care methods in situations where they are unable or unwilling to drop out of the labour force or reduce their work load. However, they emphasize that the status of women's employment itself directly affects fertility more than child care methods do. This is because the reason why employed women avoid having a child is that they are not able to continue their career, rather than problems finding childcare facilities.

Feyrer, Sacerdote and Stern (2008) analyze the determinants of fertility rate differentials between high-income nations, focusing on the factors resulting from changes in the position of women in society. They assume that exogenous social changes like technological progress increase employment opportunities for women, and these opportunities allow women to move up in social class. They use data from 1975 to 2000 for Europe, the United States, and Japan and

analyze the correlation between women's market work and the fertility rate, dividing the period into three phases.

In the earliest phase, there is a negative relationship between women's employment rate and the fertility rate. This is because the wage differential between women and men is huge, and women are anticipated to bear much of the responsibility for child care at home; consequently, most women raise children rather than work outside the home. These social phenomena have improved to some degree in the second phase, but the increase in fertility is insignificant. However, in the final phase of development, employment opportunities for women increase sharply with technological progress, and the wage difference between men and women decreases. Thus, women's social status rises, so that the share of housework and child care for women decreases, which makes the fertility rate increase.

Meanwhile, the gap between men and women in the share of housework and child care is determined by social recognition of the female role, and this affects the fertility rate. However, the effect varies across countries. In the case of Japan, Italy, and Spain, for example, it is difficult for women to escape from the second phase because the convention that house work and child care are the responsibility of women still remains strong, even though labour market opportunities for women are plentiful. However, as this kind of social atmosphere has gradually eased in recent years, the fertility rate differential among high-income nations is expected to narrow.

Unlike earlier studies, Feyrer, Sacerdote and Stern (2008) extend the perspective of the analysis of factors affecting the fertility rate by including and analyzing differences in social recognition of the female role as one of main factors. This contribution has been recognized as a new approach to the analysis of fertility rates.

There have also been studies of the factors affecting the fertility of not only one country but also a combination of many countries using panel data. D'Addio and d'Ercole (2005) study the trend in fertility and the factors affecting fertility through cross-sectional analysis of 19 OECD member countries[3] in the year 1999, and panel-data analysis of 16 OECD member countries[4] over the period 1980-1999. They use data derived from OECD sources.

First of all, they find that the fertility rate of all of the OECD countries has fallen sharply, but the pace of this decline differs across countries. Secondly, with respect to the factors affecting fertility, their cross-country analysis of 19 OECD countries suggests that the total fertility rate is higher when childcare is more widely available, the direct costs of children are lower, the proportion of women in part-time jobs is higher and maternity leaves are longer. The coefficients of other variables such as the female employment rate, the opportunity costs of children[5] and differences in values with respect to the gender roles of young men and women in the family are not statistically significant.

Furthermore, their dynamic panel data analysis of 16 OECD countries implies that the fertility rate is higher when cash transfers to families are higher, replacement wages during parental leave are higher, female employment is higher, and the proportion of women working

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[3] The nineteen countries are Austria, Belgium, Canada, Czech Republic, Germany, Denmark, Finland, France, Greece, Ireland, Italy, Japan, Korea, the Netherlands, Portugal, Spain, Sweden, the United Kingdom, and the United States.

[4] The sixteen countries are Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Netherlands, Portugal, Spain, Sweden, the United Kingdom, and the United States.

[5] The opportunity costs of children are measured by "the difference in equivalized disposable income between a couple formed by one earner without children and a couple with two earners without children" (D'Addio and d'Ercole, 2005, 60).

part-time is higher. The fertility rate is lower when unemployment rates and opportunity costs for mothers are higher, and parental leave is longer.

Hondroyiannis (2009) also uses panel data from 1960 to 2005 for 27 European countries[6] obtained from World Bank Gender Statistics, Eurostat, and the AMECO[7] database to analyze the determinants of the fertility rate. He employs three panel data estimation methods: fixed effects, random effects and dynamic OLS estimation. He shows that the infant mortality rate, the nuptiality rate, female employment, real per capita output, the real wage, and uncertainty are the main demographic and economic factors that influence the change in fertility; especially, it turns out that a low infant mortality rate, high female employment, and a low nuptiality rate decrease fertility rates. Initially, an increase in female employment leads to an increase in individual or household income which leads to growth of the fertility rate. However, as female wages continue to increase, the fertility rate decreases because of an increase in the opportunity cost of time devoted to childcare.

In addition, Hondroyiannis (2009) argues that, as having children is a crucial decision which involves responsibility, present income as well as future income should be considered. In this respect, economic uncertainties such as the decline of productivity and unemployment have a huge effect on the fertility rate. Moreover, the growing economic uncertainties that European societies have faced in recent years would account for declining fertility rates. Although this study has some limitations in that policy variables such as family allowances and unemployment

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[6] The 27 countries are Austria, Belgium, Denmark, Germany, Greece, Spain, France, Ireland, Italy, Luxembourg, Netherlands, Portugal, Finland, Sweden, United Kingdom, Norway, Czech Republic, Cyprus, Latvia, Lithuania, Hungary, Iceland, Malta, Poland, Slovak Republic, Bulgaria, and Romania.

[7] AMECO is the annual macro-economic database of the European Commission's Directorate General for Economic and Financial Affairs (DG ECFIN).

benefits are not included in the data, it provides a new perspective to account for declining fertility rates by including the factor of economic uncertainty.

As mentioned before, South Korea has experienced a seriously low fertility rate and it is one of the major social issues in South Korea. Therefore, there have been many studies of this issue. Seo (2009) is one of them. He divides the factors causing a low fertility rate into two categories, demographic and values factors and economic and social factors, to examine the precise causes of the low fertility rate in South Korea. The data were obtained from KOSIS (2007),[8] and he used annual time-series data from 1985 to 2007 to estimate a regression model of the total fertility rate.

By conducting a correlation analysis for the fertility rate and each potential determinant of it, Seo (2009) finds that among the independent variables, the number of first marriages of women, the proportion of married women, and the rate of increase of the real wage (household) have a positive relationship with the total fertility rate. The age at first marriage of women, the divorce rate of women (over the age of 15), the ratio of educational costs to household consumption expenditure, the proportion of women who are temporary employees, and the female labour force participation rate have a negative relationship with the total fertility rate. Furthermore, the value of the Pearson correlation coefficient between the number of first marriages of women and the total fertility rate is 0.945, which is relatively high.

Secondly, he conducts a multiple regression analysis, and estimates the best regression model, using the backward elimination method. As a result, a model including three explanatory variables - the number of first marriages of women, the proportion of married women, and the

[8] KOSIS refers to Korean Statistical information service, the national statistical database operated by Statistics Korea

female labour force participation rate - is selected as the best total fertility rate regression model. For this model, the value of R^2 is 0.933; thus, this model has relatively high explanatory power.

In addition, using data for 16 cities in South Korea from 1997 to 2007, Seo (2009) estimates a total fertility rate regression model for each city. The results show that two independent variables, the age at first marriage of women and the divorce rate of women, have the greatest effects on the total fertility rate in seven large metropolitan cities. In contrast, the proportion of married women is the factor which has the biggest influence in nine small cities. Thus, it turns out that the factors affecting the total fertility rate differ across cities.

Lee and Choi (2012) also explore the development of a model of the fertility rate, which depends on changes in the social environment and policy. They conduct panel-data analysis on ten OECD member countries[9] that experienced a fertility rate drop below the population replacement level and a rebound over the period 1995-2009. They use data obtained from the OECD, the World Bank, and the KOSIS website and the sample size is 150 observations. They use the total fertility rate (TFR) as the dependent variable, and the independent variables are the crude marriage rate (CMR), the infant mortality rate (IMR), the Out-of-wedlock birthrate (OUTB), the age of women at their first childbirth (AFC), the female labour force participation rate (FLFPR), nominal gross national income per capita (PGNI), the gender-related development index (GDI), the entry rate into tertiary education of women (FUER), health expenditure as a percentage of GDP (HEXP), and family policy expenditure as a percentage of GDP (FEXP). The estimated regression model as a result of panel-data analysis is as follows:

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[9] The ten countries are Belgium, Denmark, Finland, France, Italy, the Netherlands, Norway, Sweden, Switzerland, and the United Kingdom.

$$(1)\quad TFR = 1.86 + 0.096CMR_{(t-1)} - 0.015IMR + 0.009OUTB - 0.052AFC - 0.005FLFPR + 0.018PGNI_{(t-1)} + 0.440GDI_{(t-1)} + 0.002FUER_{(t-4)} - 0.003HEXP_{(t-2)} + 0.100FEXP_{(t-2)}$$

Lee and Choi (2012) put a one-period lag on nominal gross national income per capita, an economic factor, and a two-period lag on health and family policy expenditure as a percentage of GDP, a policy factor. They put a four-period lag on the entry rate into tertiary education of women because it is considered that the possibility of marriage and childbirth increases after finishing one's education. In the case of the crude marriage rate, a one-period lag is employed to allow for the gestation period after marriage. The other variables are demographic factors which are assumed to affect the fertility rate directly in the relevant year, thus they included no lag for them. The explanatory power of this model is 71%, which is relatively high.

In addition, Lee and Choi (2012) use this model to predict the total fertility rate in South Korea from 2006 to 2010. They find only a slight difference (±0.1) between the predicted value and the actual total fertility rate, except in 2009. Thus, we can conclude that the model developed in this study is a fairly sophisticated model. It is also very useful in that it is able to measure how much the total fertility rate changes when demographic factors, economic factors, sociocultural factors or political factors change.

Choi (2013) researches the impact of local government policy on low fertility rates. He uses data from 2001 to 2010 in 16 regions - the seven metropolitan cities and nine provincial areas of South Korea - and analyzed the changes in fertility rates using a pooled time-series-cross-section analysis. The data are derived from the KOSIS website and the metropolitan council population policy casebook (2011) and the sample size is 160 observations. The independent variables consist of local policy factors, the child welfare budget per child, the number of public officials per child, and the number of public kindergartens. The control

variables are divided into three categories: economic factors, sociocultural factors, and demographic factors. To be specific, the economic factors are female labour force participation, the unemployment rate, the automobile tax,[10] and gross regional domestic product (GRDP), and the sociocultural factors are the housing supply ratio, and the ratio of farm worker households to total households. In the meantime, the demographic factors are the age of first marriage, the crude marriage rate, the ratio of fertile women (from the age of 15 to 45) to the female population, and family structure as measured by the proportion of multigenerational households in which grandparents and grandchildren live together. The dependent variable is the total fertility rate (TFR).

The results of this study show that the child welfare budget per child, the number of public officials per child, and the number of public kindergartens have a positive relationship with the total fertility rate. This implies that local governments' policies to counter low fertility rates seem to be working. Although these three independent variables do not measure all aspects of the local governments' policies to raise the low fertility rate, these variables capture the heart of the policies. Furthermore, the total fertility rate is negatively related to female labour force participation and the age at one's first marriage. Choi (2013) suggests that the local governments should provide policy support to make women's work environment more family-friendly so as to minimize the drop in the fertility rate due to women's economic activity, so that women are able to balance work and family. But the other variables, except the crude marriage rate, do not have statistically significant coefficients.

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[10] The automobile tax is taxation for vehicle ownership. The amount of tax is different depending on the size of vehicle, the purpose of the vehicle, the year it was manufactured and size of engine displacement.

As Choi (2013) admits, it is true that the number of independent variables included in the model is insufficient due to data limitations. Thus, it seems that if further research is carried out after fertility policies have taken effect, more sophisticated research can be conducted. In this paper, I hope to contribute to the literature by carrying out a study of the fertility rate in South Korea with the most recent time-series data.

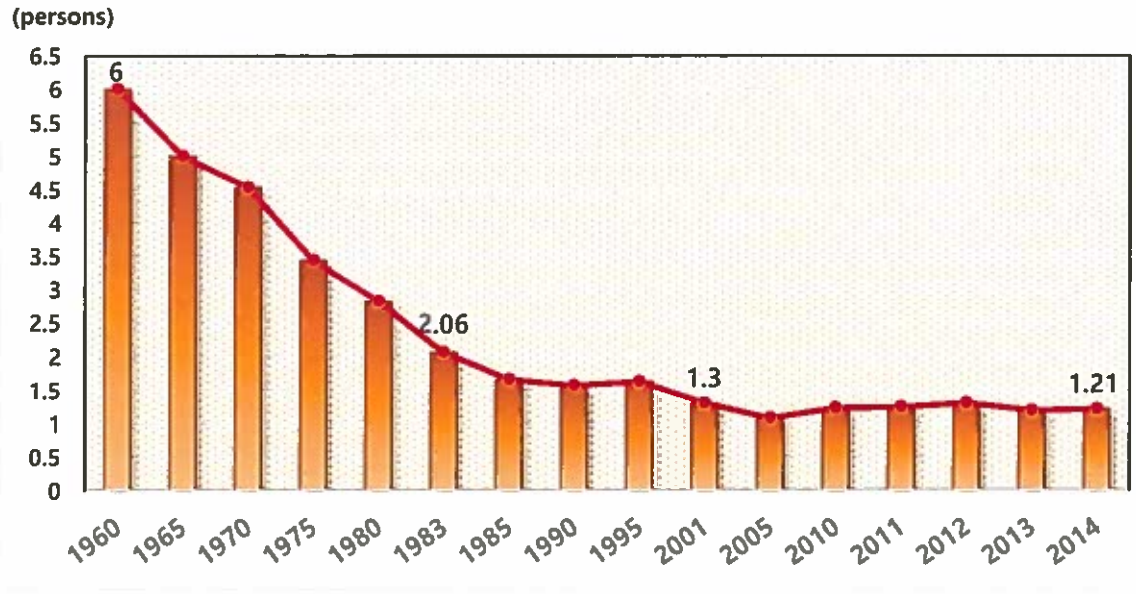
III. Trends in Fertility and its Determinants

A. Trend in Fertility in South Korea

In 1960, the total fertility rate in South Korea was 6.0 children per woman, which was very high. With rapid industrialization, urbanization, and an improvement in medical standards, the mortality rate declined sharply. As many people flowed into South Korea from North Korea after the Korean war, the population increased. Thus, the government enforced a strong population control policy as a part of its economic development plan. and lower fertility rates began to appear. From the 1960s to the 1970s, the population control policy was focused on the supply of contraception, sterilization surgery, and a program of public relations regarding family planning. In the early 1980s, a more explicit policy of having up to two children was reinforced through restrictions and a reward system, and inducement of artificial termination of pregnancy (Wee, 2007).

As shown in Figure 3.1, the total fertility rate continued to decrease until the mid-1980s, and it reached 2.06, the population replacement level, in 1983. From the mid-1980s to the mid-1990s, the total fertility rate was relatively stable at approximately 1.5-1.8. However, after South Korea experienced a financial crisis in 1998, the fertility rate decreased rapidly. In 2001, especially, the total fertility rate decreased by 11.6% compared with the previous year (2000). It was now only 1.3, causing South Korea to be classified as the lowest-low fertility society in the world. As of yet, South Korea has not been able to escape from the lowest-low fertility rate.

Figure 3.1 The Total Fertility Rate in South Korea (1960-2014)



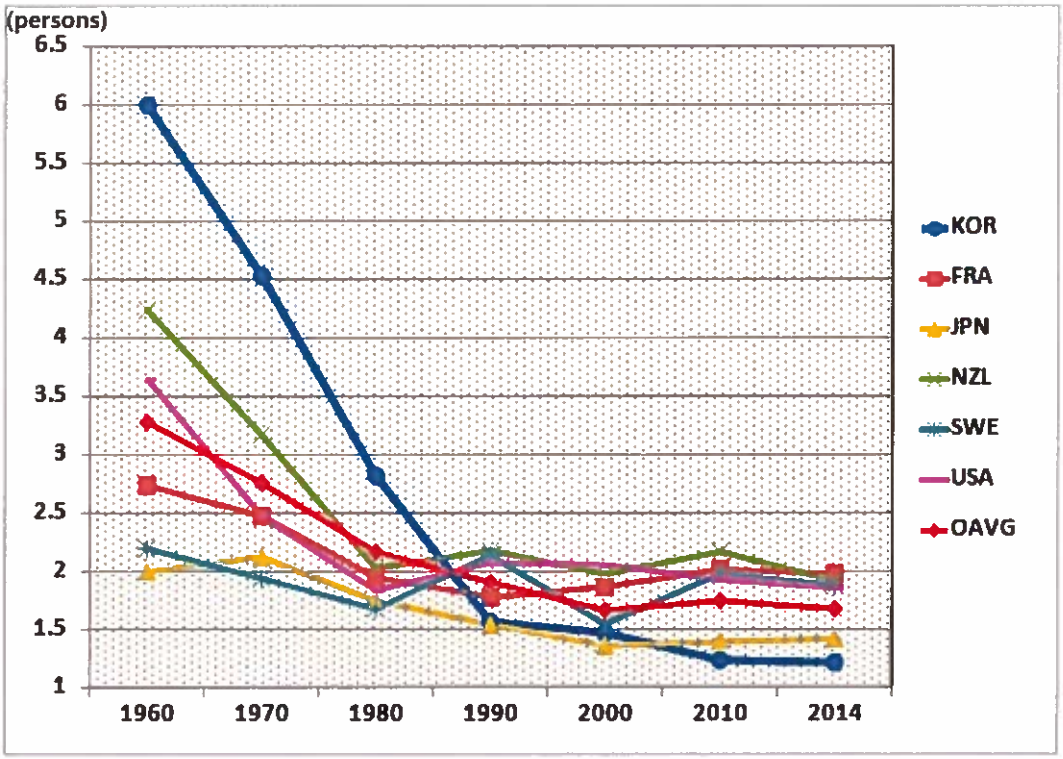
Data Source: OECD (2016), *Fertility rates*

However, this long-lasting decrease in the total fertility rate does not appear to be a transient effect of the population control policies of the past and the financial crisis. As Korean society has changed through industrialization and urbanization, women themselves have desired to control their number of pregnancies due to financial reasons and the social and the financial burden of child rearing. Women's new experience of low fertility created through this process has transformed naturally from social need to an individual choice. Thus, even though the government suspended the population control policy in the mid-1980s, the continuing decline in the total fertility rate is cause for concern, especially given the fact that women have made their own decision to choose low fertility.

Not only does South Korea have one of the world's lowest fertility rates, but the speed of decline in the fertility rate has been much faster than in other countries. As shown in Figure 3.2 and Table 3.1, the average total fertility rate of OECD member countries was 1.68 in 2014, and

the speed of decline of other countries seems to have been quite gentle. However, the total fertility rate of Korea was 1.21, which is much lower than in other developed countries that have already experienced a low fertility rate. Since this rapid decline in the fertility rate is unprecedented around the world, this low fertility phenomenon will definitely lead to a decrease in the total number of births in the short run, leading to a severe shortage of labour and an ageing population in the long term.

Figure 3.2 Total Fertility Rate in OECD Member Countries (1960-2014)



Data Source: OECD (2016), *Fertility rates*

Note: South Korea (KOR), France (FRA), Japan (JPN), New Zealand (NZL), Sweden (SWE), Unite States (USA), OECD Average (OAVG)

Table 3.1 Total Fertility Rate in OECD Member Countries (1960-2014)

(Unit: persons)

	Korea	France	Japan	New Zealand	Sweden	United States	OECD Average
1960	6	2.74	2	4.24	2.2	3.65	3.28
1970	4.53	2.48	2.13	3.17	1.94	2.48	2.76
1980	2.82	1.95	1.75	2.03	1.68	1.84	2.17
1990	1.57	1.78	1.54	2.18	2.14	2.08	1.91
2000	1.47	1.87	1.36	1.98	1.55	2.06	1.67
2010	1.23	2.02	1.39	2.17	1.98	1.93	1.75
2014	1.21	1.98	1.42	1.92	1.88	1.86	1.68

Data: OECD (2016), *Fertility rates*

B. Determinants of the Low Fertility Rate

In this section, the determinants of the low fertility rate are divided into two categories - the demographic and values factors and the economic and social factors. The independent variables in each category, which are expected to change the fertility rate, are chosen on the basis of the literature review in section II.

1. Demographic and Values Factors

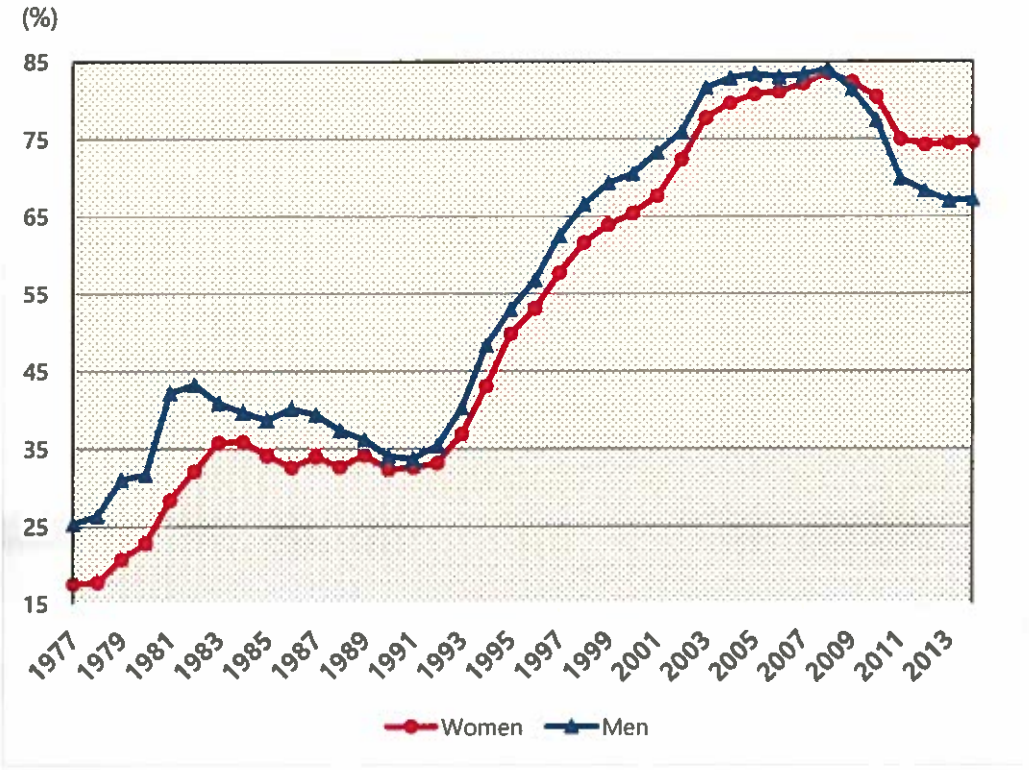
1) The entry rate into tertiary education of women

The level of education of Korean women has developed rapidly, as can be observed by examining the trend of the entry rate into tertiary education.[11] As shown in Figure 3.3, in 1977 women's entry rate into tertiary education after graduating from high school was only 17.5%, as compared to 25.3% for men. However, in 1996, it was 53.1% for women and 56.8% for men,

[11] The entry rate into tertiary education is the ratio of students who enter tertiary education after they graduated from high school to the total number of high school students graduated.

which constitute increases of approximately 300% and 220% respectively. The entry rate into tertiary education has risen dramatically since the 1990s. Eventually, it reached 82.4% for women and 81.5% for men in 2009, when the entry rate of women exceeded that of men for the first time. Furthermore, in 2014, it was 74.63% for women and 66.9% for men, and the gap between women and men has been widening.

Figure 3.3 Entry Rate into Tertiary Education in South Korea (1977-2014)



Data Source: Korean Educational Statistics Service (2016), *Entry rates into tertiary education*

Thus, the level of educational attainment has progressed relatively faster for women than for men, and women are now jumping over men. As the education level is closely related to changes in values and labour force participation, and as the improvement in women's education

is directly connected to changes in their recognition in society, in the family, and in their own life style, it is one of the main factors affecting the fertility rate.

2) The age at first marriage of women

As shown in Table 3.2, the average age at first marriage of Korean women was 24.1 years old in 1985, and it has increased by approximately 0.1 to 0.4 every year. It was recorded as 29.8 years old in 2014, having increased by 5.7 over 30 years. The rise in the average age at first marriage of women leads to a rise in the average age of women at their first childbirth, because this is a feature of Korean society.

Table 3.2 Average Age at First Marriage of Women in South Korea (1985-2014)

	1985	1990	1995	2000	2005	2010	2011	2012	2013	2014
Age	24.1	24.78	25.32	26.49	27.72	28.91	29.14	29.41	29.59	29.81

Data Source: Statistics Korea (2016), *Average age at first marriage of women*, National Archives of Korea (2016), *Average age at first marriage of women*

To explain, most births in South Korea take place inside of marriage, which is different from other OECD member countries. In 2014, about 97.9% of total births in South Korea occurred inside of marriage, and the share of births outside of marriage was only 1.9%.[12] As shown in Table 3.3, the share of births outside of marriage was 46.7% in New Zealand, 54.6% in Sweden, and 40.2% in the United States. All of these countries have a much higher rate than South Korea. In particular, in the case of Sweden and France, the share of births outside of marriage is more than half of total births. Thus, since most births in South Korea occur within a marriage, the older average age at first marriage leads to the older average age at which women

[12] Statistics Korea (2014), *Share of births outside of marriage*

have their first child, and consequently influences the fertility rate.

Table 3.3 Share of Births Outside of Marriage in OECD Member Countries (2011-2014)

(Unit: %)

	2011	2012	2013	2014
Korea	2.1	2.1	2.1	1.9
France	55.8	56.7	-	-
New Zealand	47.6	47.7	47.3	46.7
Sweden	54.3	54.5	54.4	54.6
United States	40.7	40.7	40.6	40.2

Data Source: OECD (2016), *Share of births outside of marriage*

3) The crude divorce rate

The crude divorce rate is the number of divorce cases per 1000 population. As shown in Table 3.4 and Figure 3.4, for reasons such as the decline in the expectation of children; changes in values regarding self-realization, gender inequality, and household chores; and financial problems, the crude divorce rate increased from 0.9 ‰ in 1985 to 3.4 ‰ in 2005 (Jung, 2007). Since then, it has moderated somewhat, and remained at 2.3 ‰ until 2014. At the same time, the number of marriages has decreased due to an increase in preferences for celibacy and changes in values with respect to marriage. As I mentioned before, since births in South Korea happen inside marriage, the increase in the divorce rate and decrease in the marriage rate contribute to the low fertility rate.

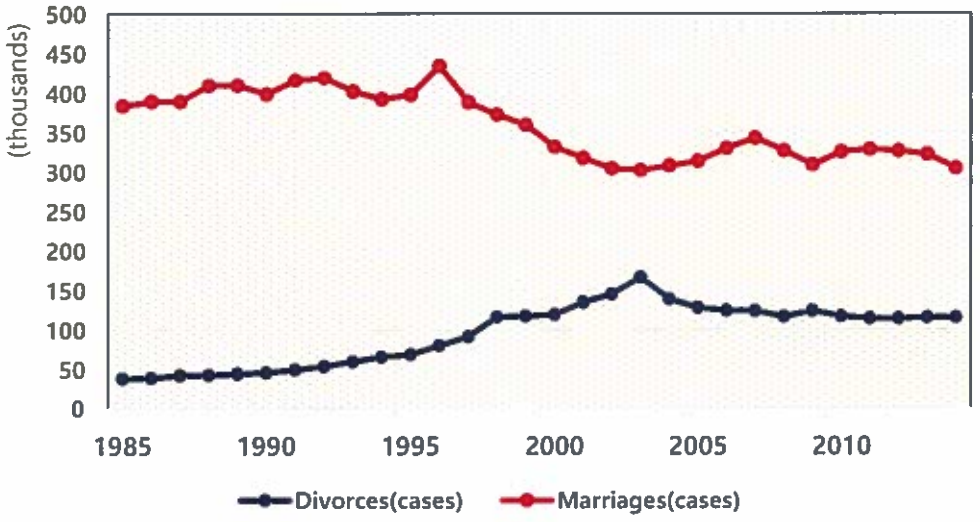
Table 3.4 Crude Divorce Rate in South Korea (1985-2014)

(Unit: ‰)

	1985	1990	1995	2000	2003	2010	2014
Crude Divorce Rate	0.9	1.1	1.5	2.5	3.4	2.3	2.3

Data Source: Statistics Korea (2016), *Crude divorce rate*

Figure 3.4 The Number of Marriages and Divorces in South Korea (1985-2014)



Data Source: Statistics Korea (2016), *Marriages and divorces (cases)*

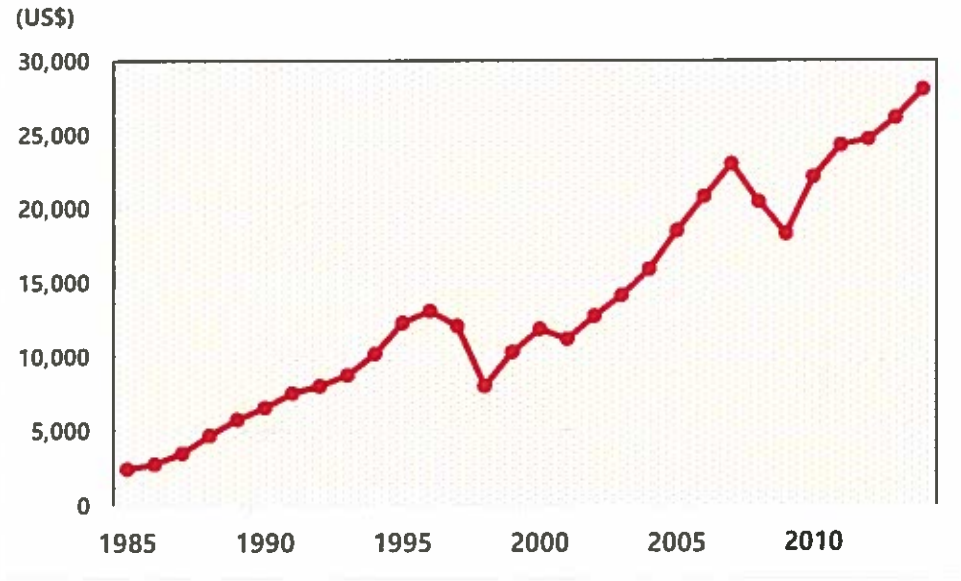
2. Economic and Social Factors

1) The nominal gross national income (GNI) per capita

Income is one of the most important factors affecting fertility rates. An increase in income may have two different consequences. On the one hand, it is possible that the total fertility rate is increased by an increase in the desire to have children. On the other hand, as income increases the desire to improve the quality of children may rise rather than the number of children, so that parents invest more money in fewer children to upgrade the quality of their children.

As Figure 3.5 shows, due to rapid economic growth, the nominal gross national income per capita in South Korea has increased sharply since 1985. It has increased more than 11 times over 30 years, from $2,400 (US dollars) in 1985 to $28,000 in 2014.

Figure 3.5 Nominal Gross National Income in South Korea (1985-2014)



Data Source: Statistics Korea (2016), *Nominal gross national income (GNI) per capita*

2) The female employment rate

The ability to earn money by participating in economic activity raises women's demand to share household chores, and leads to a reduced burden on women of childbirth. Thus, this has direct and indirect effects for both women themselves and their families. The purpose of women's economic activity is different for each individual or each family, but it has gradually changed from earning one's living to self-realization as society has progressed. However, the rise in the female employment rate may result in a low fertility rate if the work environment for women is such that the ability to balance work and child-rearing is poor.

As women's labor force participation rate has increased in many developed and developing countries, South Korea has also experienced an increasing trend in the female employment rate over time. As shown in Table 3.5, it has increased from 40.9% in 1985 to 49.5% in 2014. In the 25-29 age group, in which most births occur, it has almost doubled from 35.3% in 1985 to 68.8% in 2014.

Table 3.5 Female Employment Rate in South Korea (1985-2014)

(Unit: %)

	1985	1990	1995	2000	2005	2010	2011	2012	2013	2014
Total	40.9	46.2	47.6	47.0	48.4	47.8	48.1	48.4	48.8	49.5
20 - 24	51.6	61.7	62.9	56.3	57.2	48.7	48.2	48.9	47.5	49.5
25 - 29	35.3	41.8	47.0	53.7	63.0	66.2	67.8	68.0	68.0	68.8

Data Source: Statistics Korea (2016), *Female employment rate*

3) The ratio of educational cost to household consumption expenditure

As is recognizable from the entry rate into tertiary education, the zeal for children's education in South Korea is exceedingly high. Even though the burden of simple support in the form of the necessities of life such as food, clothing, and shelter has declined due to the decrease in the number of children caused by low fertility, the high zeal for children's education and the attention paid to the welfare of children have increased the educational costs and child rearing expenses. Hence, the burden of children on household budgets has intensified in reality. In particular, as the increase in educational costs increases the ratio of child rearing expenses to total household consumption expenditure, it is a huge financial burden for households, which contributes to low fertility.

As shown in Table 3.6, the ratio of educational costs to household consumption

expenditure was 8.23% in 1990, and it has increased steadily every year. Educational costs accounted for 13.79% of household consumption in 2009. Their importance has eased off gradually since then; it was recorded as 11.33% in 2014.

Table 3.6 Ratio of Educational Costs in South Korea (1990-2014)

	1990	1995	2000	2005	2009
Total Household Consumption (₩)	603,126	1,125,165	1,483,852	1,925,602	2,179,875
Educational Cost (₩)	49,653	114,872	166,181	227,126	300,706
Ratio of Educational cost (%)	8.23	10.21	11.20	11.80	13.79
	2010	**2011**	**2012**	**2013**	**2014**
Total Household Consumption (₩)	2,312,540	2,404,259	2,485,245	2,507,009	2,566,896
Educational Cost (₩)	306,868	303,712	298,707	292,359	290,758
Ratio of Educational cost (%)	13.27	12.63	12.02	11.66	11.33

Data Source: Statistics Korea (2016), *Total household consumptions and educational costs*

Note: 1) '₩' refers to 'Won', the currency of South Korea.

2) Ratio of Educational Costs (%) = {(Educational Costs) / (Total Household Consumptions)} * 100 (%)

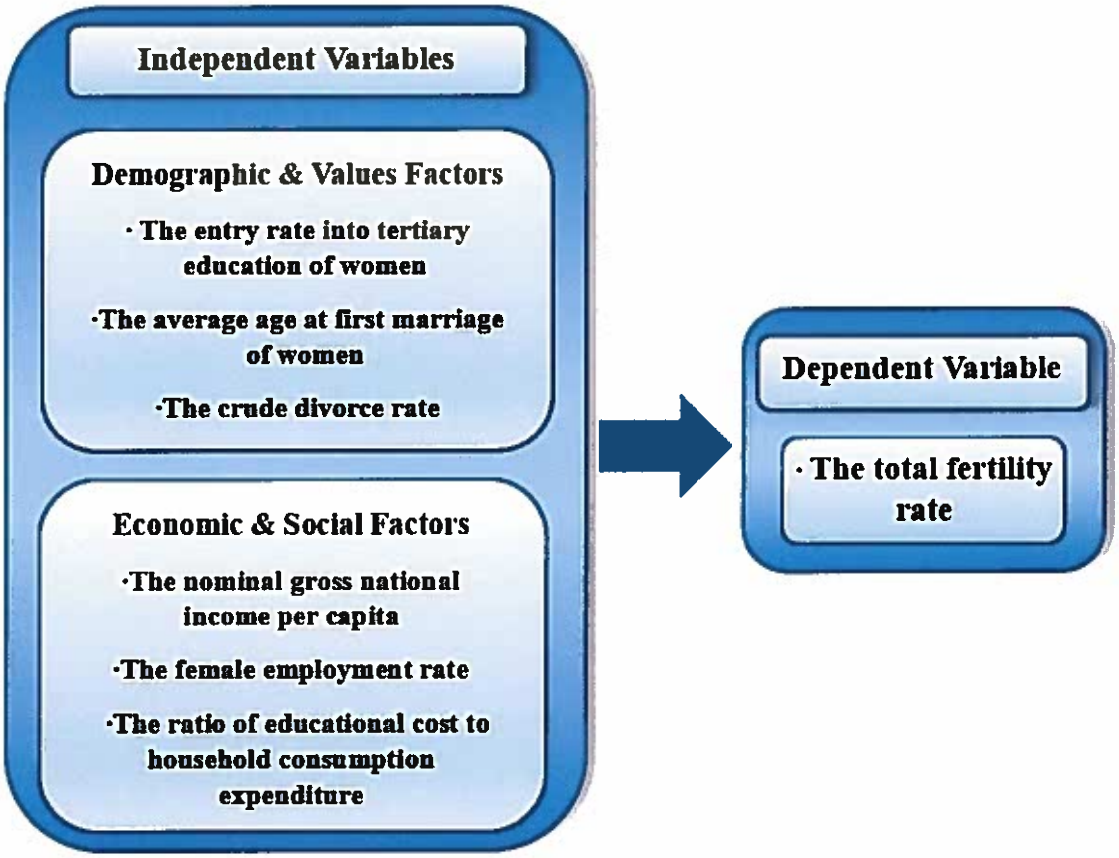
3) Educational costs include both private and public expenditure.

IV. Analysis

A. The Model

The causes of low fertility are various and they interact in a complex manner. In this study, the factors causing a low fertility rate are divided into two categories - demographic and values factors, and economic and social factors - to estimate the total fertility rate regression model. Certainly, the factors affecting the fertility rate are numerous. Among them, I select independent variables for which data are measurable and obtainable. To identify the causes of low fertility, the independent variables are selected as shown in Figure 4.1. In this section, firstly, I investigate the characteristic of each independent variable through descriptive statistics

Figure 4.1 The Model



and correlation analysis. Secondly, univariate regression analyses are conducted to examine how each variable affects the dependent variable, the total fertility rate. Lastly, multiple regression analysis is conducted to estimate the best total fertility rate regression model.

B. Data

The time scope of this study is the 30 years from 1985 to 2014, while the spatial scope is South Korea. The independent variables for each category that are expected to change the fertility rate, and that are able to be expressed quantitatively, are chosen on the basis of the literature review in section II. Accordingly, the demographic and values factors include three variables: the entry rate into tertiary education of women (FENTRY), the average age at first marriage of women (FAGE), and the crude divorce rate (DIVORCE). The economic and social factors include three variables: the nominal GNI per capita (PGNI), the female employment rate (FEMP), and the ratio of educational cost to household consumption expenditure (EDU).

One problem with the data is that the ratio of educational cost to household consumption expenditure is only obtainable from 1990. Thus, the five missing values from 1985 to 1989 are replaced with the linear trend for that point. To be specific, the existing series is regressed on a time trend (from 1990 to 2014) and the five missing values are replaced with their predicted values.[13]

The dependent variable is the total fertility rate (TFR). The data on the total fertility rate are obtained from the OECD website. The data on the crude divorce rate, the nominal GNI per capita, the female employment rate, and the ratio of educational cost to household consumption

[13] The five missing values are replaced by using a function, 'Linear trend at point' in a statistical software package, SPSS.

expenditure are obtained from KOSIS website, and the data on the entry rate into tertiary education of women are obtained from the Korean Educational Statistics Service website. In the case of the age at first marriage of women, the data from 1985 to 1989 are collected from the National Archives of Korea website, while the data from 1990 to 2014 are collected from KOSIS website. More detailed information on the data sources can be found in the Appendix.

B.1 Descriptive Statistics

Descriptive statistics are calculated to investigate the properties of each variable, as shown in Table 4.1. During the past 30 years, the average of the total fertility rate is 1.40. The minimum value is 1.08 (in 2005), and the maximum value is 1.76 (in 1992). The average of the entry rate into tertiary education of women is 59.45%. It ranges from 32.4% (in 1990), to 83.5% (in 2008). The average age at first marriage of women is 26.61 years, while the average of nominal GNI per capita is $13,598.03 (US dollars). The minimum value of GNI per capita is $2,400 (in 1985), and the maximum value is $28,070.7 (in 2014). As I discussed earlier, the total fertility rate has decreased continuously, while all the independent variables have been rising.

Table 4.1 Descriptive Statistics

Variable	N	Mean	Median	SD	Min	Max	CV
TFR	30	1.40	1.43	0.21	1.08	1.76	0.15
FENTRY	30	59.45	64.65	19.81	32.40	83.50	0.33
FAGE	30	26.61	26.39	1.80	24.10	29.81	0.07
DIVORCE	30	1.99	2.30	0.74	0.90	3.40	0.37
PGNI	30	13598.03	12170.50	7469.62	2400.00	28070.70	0.55
FEMP	30	46.88	47.65	2.07	40.90	49.50	0.04
EDU	30	10.96	11.24	1.44	8.23	13.79	0.13

Note: 1) Values in the table are rounded to the nearest hundredth.

2) FENTRY, FAGE, DIVORCE, EDU, PGNI, and FEMP refer to the entry rate into tertiary education of women, the age at first marriage of women, the crude divorce rate, the ratio of educational cost to household consumption expenditure, the nominal GNI per capita, and the female employment rate respectively.

B.2 Correlation Analysis

The results of a correlation analysis are shown in Table 4.2 and Figure 4.2.[14] Most of the independent variables that are considered in this study show a strong correlation with the total fertility rate. Each of the six independent variables has a negative correlation with the total fertility rate to varying degrees. Furthermore, the shape of the scatter plots of the two independent variables, the entry rate into tertiary education of women (FENTRY) and the age at first marriage of women (FAGE), seems to be a diagonal line against the total fertility rate, while the dots in the scatter plots of other variables are more spread out. Thus, these two independent variables have a stronger negative correlation with the total fertility rate than the other variables.

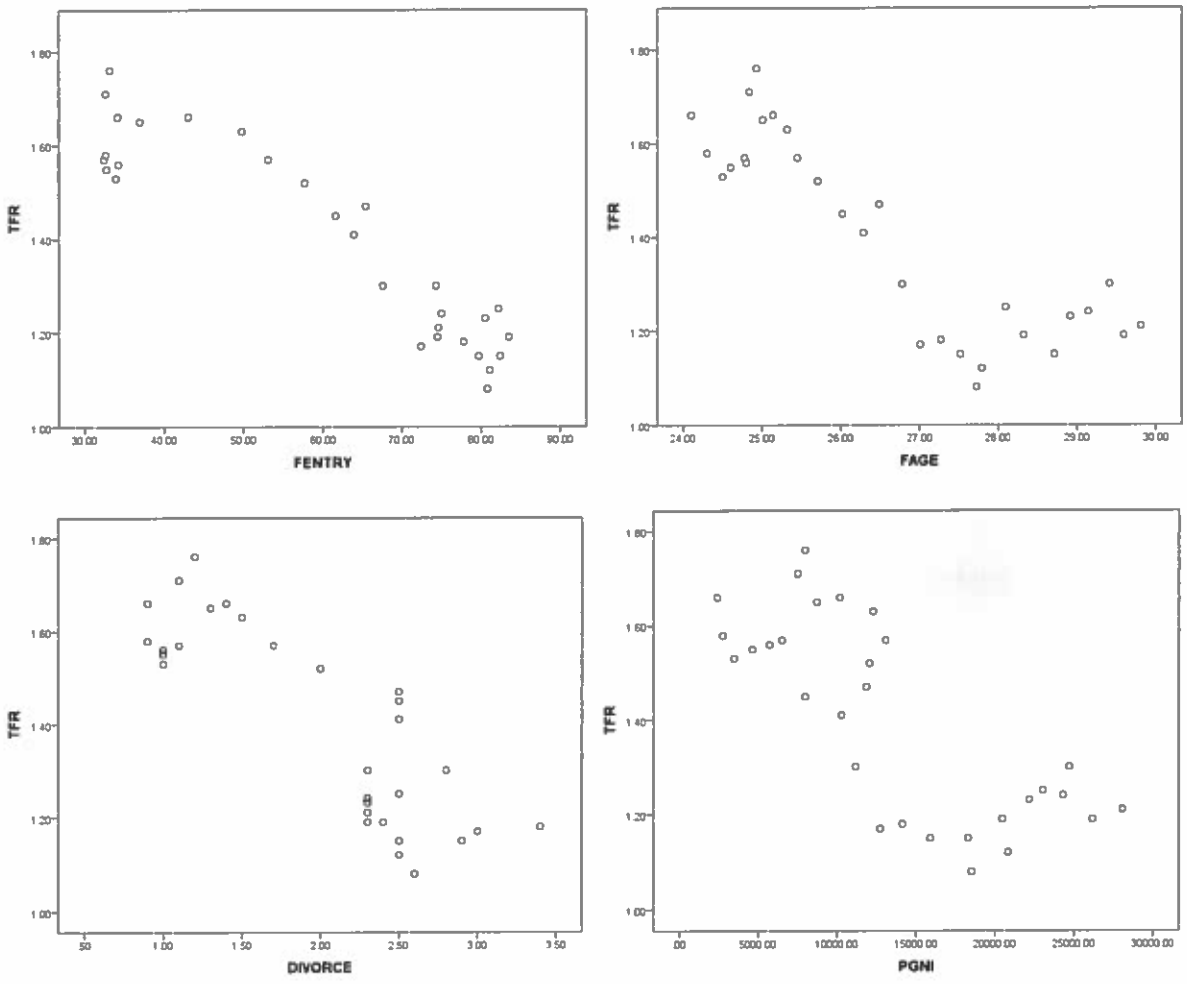
[14] The correlation analysis is conducted by the statistical software package SPSS.

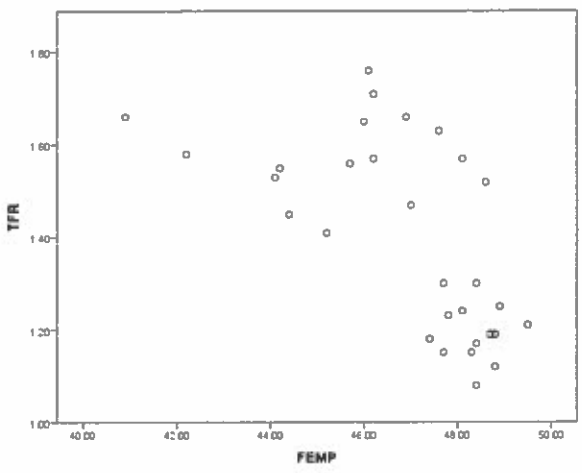
Table 4.2 Pearson Correlation Coefficients with variable TFR

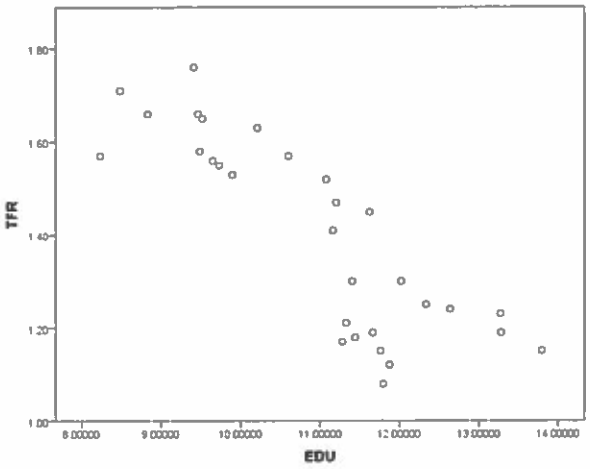
	FENTRY	FAGE	DIVORCE	PGNI	FEMP	EDU
Pearson Correlation	-.924**	-.857**	-.842**	-.759**	-.628**	-.839**
Sig. (2-tailed)	.000	.000	.000	.000	.000	.000

Note: **. Correlation is significant at the 0.01 level (2-tailed).

Figure 4.2 Scatter Plots







To be specific, the ranking of the strength of the Pearson correlation coefficients between each independent variable and the total fertility rate is as follows:[15]

(2) $FENTRY(-0.924) > FAGE(-0.857) > DIVORCE(-0.842) > EDU(-0.839) > PGNI(-0.759) > FEMP(-0.628)$

An interesting fact is that the top three variables in the ranking are demographic and values factors, while the bottom three variables turn out to be the economic and social factors. Another fact to notice is, as I mentioned before, that a rise in the female employment rate may result in a low fertility rate when the work environment is poor. The Pearson correlation coefficient of the female employment rate and the total fertility rate is -0.628, which suggests that a rise in women's labor force participation rate does not contribute to an increase in the total fertility rate.

C. Univariate Linear Regression Analysis

As a second step, each of the six independent variables is included in a univariate linear regression model to find out how each variable affects the dependent variable, the total fertility

[15] The ranking criterion is how big the absolute value of the Pearson correlation coefficient is.

rate, when other factors are ignored. As shown in Table 4.3, the coefficients of all the independent variables are statistically significant (at both the $\alpha = 0.01$ and $\alpha = 0.05$ significance levels, since the P-value < 0.000). The ranking of the value of R^2, which is the coefficient of determination and shows the explanatory power of the model, is as follows:

(3) $FENTRY(0.854) > FAGE(0.735) > DIVORCE(0.709) > EDU(0.704) > PGNI\_100(0.577)$[16] $> FEMP(0.395)$

The ranking of the value of R^2 is exactly same as in the ranking of the strength of the Pearson correlation coefficients because the R^2 values are the squares of the Pearson correlation coefficients. Also, the ranking of the values of the adjusted R^2 is same as the ranking of the R^2 values.

[16] PGNI_100 refers to the nominal GNI per capita divided by 100.

Table 4.3 The Coefficients of Models 1-6

Model	(1)	(2)	(3)	(4)	(5)	(6)
(Constant)	1.984 (41.445)[a]	4.065 (13.407)[a]	1.879 (30.527)[a]	1.692 (31.631)[a]	4.386 (6.273)[a]	2.739 (16.591)[a]
FENTRY	-.010 (-12.815)[a]					
FAGE		-.100 (-8.805)[a]				
DIVORCE			-.240 (-8.265)[a]			
PGNI_100				-.002 (-6.175)[a]		
FEMP					-.064 (-4.273)[a]	
EDU						-.122 (-8.170)[a]
N	30	30	30	30	30	30
R^2	.854	.735	.709	.577	.395	.704
Adjusted R^2	.849	.725	.699	.561	.373	.694
F	164.231 (.000)[b]	77.530 (.000)[b]	68.309 (.000)[b]	38.127 (.000)[b]	18.255 (.000)[b]	66.744 (.000)[b]

Note: 1) a. Numbers in parenthesis are t statistics.

b. Numbers in parenthesis are P-values of F statistics.

2) The dependent variable in Model 1, Model 2, Model 3, Model 4, Model 5 and Model 6 is TFR.

According to Table 4.3, the estimated Model 1, in which the independent variable is the entry rate into tertiary education of women, is as follows:

(4) Model 1: $TFR = 1.984 - 0.010FENTRY$

This regression model implies that if the entry rate into tertiary education of women increases by

1 percentage point, the total fertility rate will decrease by 0.010 children per woman. The estimated Model 2 (FAGE), Model 3 (DIVORCE), Model 4 (PGNI_100), Model 5 (FEMP), and Model 6 (EDU) can be interpreted in a similar fashion. For example, Model 2 implies that if the age at first marriage of women increases by one year, the total fertility rate will decrease by 0.100 children per woman. Overall, this univariate linear regression analysis tells us that each of the six independent variables is negatively related to the total fertility rate.

D. Multiple Linear Regression Analysis

D.1 Model Analysis

To examine the influence of the demographic and values factors and the economic and social factors on the total fertility rate, three multiple linear regression models are estimated. Model 7 includes only the three demographic and values factors as independent variables; Model 8 includes only the three economic and social factors as independent variables; and Model 9 includes all six independent variables. The results of the multiple linear regression analysis are shown in Table 4.4.

Table 4.4 The Coefficients of Model 7, Model 8 and Model 9

Model	(7)	(8)	(9)
(Constant)	2.393 (4.886)[a]	2.724 (3.325)[a]	6.024 (5.791)[a]
FENTRY	-.008 (-2.258)[a]		-.023 (-6.730)[a]
FAGE	-.019 (-.837)[a]		-.159 (-5.101)[a]
DIVORCE	-.018 (-.301)[a]		.190 (3.542)[a]
PGNI_100		-0.0006 (-1.085)[a]	.004 (4.852)[a]
FEMP		-.005 (-.278)[a]	-.025 (-2.207)[a]
EDU		-.091 (-3.978)[a]	.110 (4.920)[a]
N	30	30	30
R^2	.858	.737	.948
Adjusted R^2	.842	.706	.934
F	52.464 (.000)[b]	24.263 (.000)[b]	69.354 (.000)[b]

Note: 1) a. Numbers in parenthesis are t statistics.

b. Numbers in parenthesis are P-values of F statistics.

2) The dependent variable in Model 7, Model 8 and Model 9 is TFR.

First of all, as shown in Table 4.4, Model 9 has the biggest value of the adjusted R^2, 0.934. This value is quite high; Model 9 explains about 94.8% of the variation in the total fertility rate. The values of the adjusted R^2 for Models 7 and 8 are 0.842 and 0.706 respectively. Thus, the demographic and values factors may better explain the total fertility rate than the economic and social factors. Although model 8 has the smallest adjusted R^2, all three models

explain more than 70% of the variation in the total fertility rate, which is relatively high. Furthermore, the F statistics for a test of overall significance are statistically significant at the $\alpha = 0.01$ significance level.

The results for Model 7 reveal that the coefficients of the entry rate into tertiary education of women, the age at first marriage of women and the crude divorce rate have negative signs. This means that all the variables of the demographic and values factors are still negatively related to the total fertility rate. This result is in agreement with the results of the univariate linear regression analysis. However, as shown in Table 4.4, the coefficients of the age at first marriage of women and the crude divorce rate are not statistically significant at the $\alpha = 0.05$ significance level. Therefore, the null hypothesis that the coefficients of these independent variables are zero cannot be rejected; thus, there is not a strong statistical basis to trust the results for this model.

In the case of Model 8, it appears that the nominal GNI per capita, the female employment rate, and the ratio of educational cost to household consumption expenditure have negative effects on the total fertility rate. However, as in Model 7, the coefficients of two variables, nominal GNI per capita and the female employment rate, are not statistically significant at the $\alpha = 0.05$ significance level. As a result, there is no statistical basis to trust these coefficient estimates. Furthermore, compared with Model 7, Model 8 has a smaller adjusted R^2. Thus, Model 7, which includes only the demographic and values factors, has better explanatory power than Model 8, which includes only the economic and social factors.

In Model 9, which includes all the independent variables, the coefficients of the entry rate into tertiary education of women, the age at first marriage of women and the female employment rate affect the total fertility rate negatively, while the crude divorce rate, nominal GNI per capita,

and the ratio of educational cost to household consumption expenditure are positively related to the total fertility rate. The coefficients of all the independent variables are statistically significant at the $\alpha = 0.05$ significance level. However, the positive signs of the coefficients of the crude divorce rate, nominal GNI per capita and the ratio of educational cost to household consumption do not correspond to the results of correlation analysis and the univariate regression analysis, nor to my expectaions.

As shown in Table 4.5, the standardized coefficients indicate how big an impact each independent variable has on the dependent variable.[17] The ranking of the standardized coefficients is as follows:[18]

(5) $$FENTRY(-2.148) > PGNI\_100(1.471) > FAGE(-1.359) > EDU(0.820) > DIVORCE(0.667) > FEMP(-0.247)$$

The top variable is the entry rate into tertiary education of women, which is a demographic and values factor, and the bottom variable is the female employment rate, which is an economic and social factor.

Note that the Breusch-Pagan-Godfrey test for test for heteroskedasticity is conducted for Model 9. The null hypothesis that the error variances are all equal cannot be rejected (F-statistic = -1.6103, P-value = 0.9908). Therefore, the residuals do not suffer from heteroskedasticity. Also, the Breusch-Godfrey Serial Correlation LM Test is conducted to test for autocorrelation. The value of the F-statistic is 0.0029, and its P-value is 0.9569. Thus, there is no serial correlation.

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[17] The standardized coefficients (also known as beta coefficients) are the estimates standardized so that the variances of the dependent and independent variables are 1. This transformation allows us to ignore the independent variables' scale of units when the coefficients are compared.

[18] The ranking criterion is how big the absolute value of standardized coefficient is.

Therefore, Model 9 has good statistical properties.[19]

Table 4.5 The Standardized Coefficients (Beta) of Model 7, Model 8 and Model 9

Model	(7)	(8)	(9)
FENTRY	-.722		-.2.148
	(-2.258)[a]		(-6.730)[a]
FAGE	-.161		-1.359
	(-.837)[a]		(-5.101)[a]
DIVORCE	-.063		.667
	(-.301)[a]		(3.542)[a]
PGNI_100		-.236	1.471
		(-1.085)[a]	(4.852)[a]
FEMP		-.049	-.247
		(-.278)[a]	(-2.207)[a]
EDU		-.627	.820
		(-3.978)[a]	(4.920)[a]

Note: 1) a. Numbers in parenthesis are t statistics

2) The dependent variable in Model 7, Model 8 and Model 9 is TFR.

However, as I discussed earlier, these results are quite different from the results of the univariate regression analysis, and from those for Model 7 and Model 8. In particular, the signs of the coefficients of the crude divorce rate, nominal GNI per capita and the ratio of educational cost to household consumption are positive, which does not correspond to the previous results or my prior expectations. A possible explanation for this is multicollinearity between the independent variables of model 9. To examine multicollinearity, firstly, Pearson correlation coefficients between the explanatory variables are presented in Table 4.6.

[19] Both the Breusch-Pagan-Godfrey test and the Breusch-Godfrey Serial Correlation LM Test are conducted by the software package Eviews.

Table 4.6 Pearson Correlation Coefficients between Variables

	TFR	FENTRY	FAGE	DIVORCE	PGNI	FEMP	EDU
TFR	1						
FENTRY	-.924** (.000)	1					
FAGE	-.857** (.000)	.900** (.000)	1				
DIVORCE	-.842** (.000)	.915** (.000)	.740** (.000)	1			
PGNI	-.759** (.000)	.843** (.000)	.959** (.000)	.640** (.000)	1		
FEMP	-.628** (.000)	.733** (.000)	.740** (.000)	.648** (.000)	.821** (.000)	1	
EDU	-.839** (.000)	.924** (.000)	.850** (.000)	.788** (.000)	.769** (.000)	.614** (.000)	1

Note: 1) **. Correlation is significant at the 0.01 level (2-tailed).

2) Numbers in parenthesis are P-value of t statistics

As shown in Table 4.6, the Pearson correlation coefficients between independent variables are quite high. For example, the Pearson correlation coefficient between the variables age at first marriage of women (FAGE) and nominal GNI per capita (PGNI) is 0.959 (P-value < 0.000). Also, the entry rate into tertiary education of women (FENTRY) and the ratio of educational cost to household consumption expenditure (EDU) are highly correlated with each other, with a Pearson correlation coefficient of 0.924 (P-value < 0.000). Thus, the independent variables are highly correlated.

To investigate the multicollinearity in more detail, two additional collinearity statistics, the Tolerance and the Variance Inflation Factor (VIF) are presented in Table 4.7. Although there is disagreement about the acceptable levels of VIF, a value of 10 is most commonly used as the maximum acceptable level (Hair, Anderson, Tatham, & Black, 1995). The VIF is the reciprocal of Tolerance, so the acceptable level of Tolerance is higher than 0.1. As shown in the Table 4.7, the Tolerance values for the independent variables are lower than 0.1 and the values of VIF of are higher than 10 except for the female employment rate (FEMP). Taking all these facts into consideration, it is obvious that multicollinearity exists in Model 9. Thus, various methods to solve this problem are tried.

Table 4.7 Collinearity Statistics of Model 9

	Tolerance	VIF
FENTRY	.022	44.746
FAGE	.032	31.170
DIVORCE	.064	15.558
PGNI_100	.025	40.368
FEMP	.182	5.485
EDU	.082	12.212

First of all, a time trend ($t = 1, 2, \ldots, 30$) is added to the original model, Model 9 to remove long-term trends under the assumption that the data are trend-stationary; then the multiple regression is re-estimated. The estimated coefficients of the new Model 10 are shown in Table 4.8. The coefficients of the entry rate into tertiary education of women, the age at first marriage of women and the female employment rate have negative signs and are statistically significant at the $\alpha = 0.05$ significance level. On the other hand, the coefficients of the crude divorce rate, nominal GNI per capita and the ratio of educational cost to household consumption

expenditure have positive signs, but none of them are statistically significant at the $\alpha = 0.05$ significance level. Thus, even if a time trend is added, the signs of the coefficients of the independent variables are the same as in Model 9. However, Model 10 has a higher adjusted R^2 than Model 9. Thus, Model 10 explains the total fertility rate better than the original model.

Secondly, if the data are instead difference stationary, an alternative approach would be to estimate a model in first-differences. The Augmented Dickey-Fuller test is conducted to test non-stationarity of the dependent variable, the total fertility rate. The value of the ADF test statistic is -1.6103, and the P-value is 0.7639. Therefore, the null hypothesis that the total fertility rate has a unit root cannot be rejected, implying it may be difference-stationary. The re-estimated multiple regression model in first differences, Model 11, is shown in Table 4.8. The results show that the entry rate into tertiary education of women (FENTRY), the age at first marriage of women (FAGE), and the female employment rate (FEMP) affect the total fertility rate negatively, while the crude divorce rate, nominal GNI per capita and the ratio of educational cost to household consumption expenditure have a positive effect on the total fertility rate. Each coefficient sign is still the same as in the original model, Model 9. However, none of the coefficients are statistically significant at the $\alpha = 0.05$ significance level except that of the variable PGNI, the nominal GNI per capita. In addition, the F test indicates the model is not significant at the $\alpha = 0.05$ significance level.

Lastly, the range of the data is reduced from 1990 to 2014. This is because the variable EDU, the ratio of educational cost to household consumption expenditure, is only available from 1990, as mentioned earlier; so, the data for this variable from 1985 to 1989 are estimated. As this process could influence the results, the multiple regression analysis is repeated with a sample that does not include any estimated values. The resulting model, Model 12, is shown in Table 4.8.

Compared to the previous results, there is no change in the signs of the coefficients of the independent variables.

After that, the same methods, adding a time trend and estimating the model in first-differences, are tried with the reduced sample. The estimated Model 13 and Model 14 are shown in Table 4.8. The results show that Models 13 and 14 also have a positive sign for the coefficients of the crude divorce rate, the nominal GNI per capita, and the ratio of educational cost to household consumption expenditure, and have a negative sign for the coefficients of the entry rate into tertiary education of women, the age at first marriage of women and the female employment rate. In addition, none of the coefficients are statistically significant at the $\alpha = 0.05$ significance level in Model 14.

After comparing all these models, one can conclude that Model 10 is a better model in than the original multiple regression model, Model 9. This is because Model 10 has higher value of R^2 than Model 9 (as shown in Table 4.8), and this implies that Model 10 can explain the total fertility rate better than can Model 9. Also, the time trend in Model 10 has a significant coefficient (P-value = 0.023). As a result, Model 10 is selected as the preferred total fertility rate regression model.

Table 4.8 The coefficients of Models 9-14

Model	(9)	(10)	(11)[c]	(12)	(13)	(14)[c]
(Constant)	6.024 (5.791)[a]	9.527 (5.559)[a]		5.125 (4.163)[a]	8.138 (2.891)[a]	
FENTRY	-.023 (-6.730)[a]	-.016 (-3.959)[a]	-.011 (-1.852)[a]	-.021 (-6.730)[a]	-.019 (-4.097)[a]	-.014 (-1.918)[a]
FAGE	-.159 (-5.101)[a]	-.280 (-4.917)[a]	-.120 (-1.625)[a]	-.125 (-5.101)[a]	-.240 (-2.353)[a]	-.107 (-1.281)[a]
DIVORCE	.190 (3.542)[a]	.041 (.524)[a]	.027 (.309)[a]	.132 (3.542)[a]	.069 (.819)[a]	.042 (.415)[a]
PGNI_100	.004 (4.852)[a]	.020 (1.676)[a]	.003 (2.467)[a]	.031 (4.852)[a]	.020 (1.446)[a]	.003 (2.219)[a]
FEMP	-.025 (-2.207)[a]	-.030 (-2.887)[a]	-.017 (-1.220)[a]	-.025 (-2.207)[a]	-.018 (-1.134)[a]	-.014 (-.751)[a]
EDU	.110 (4.920)[a]	.056 (1.867)[a]	.051 (1.386)[a]	.110 (4.920)[a]	.074 (2.149)[a]	.063 (1.446)[a]
t (Time trend)		.048 (2.448)[a]			.039 (1.187)[a]	
N	30	30	29	25	25	24
R^2	.948	.959	.347	.956	.960	.358
Adjusted R^2	.934	.946	.176	.942	.943	.145
F	69.354 (.000)[b]	73.208 (.000)[b]	2.033 (.102)[b]	65.734 (.000)[b]	57.823 (.000)[b]	1.676 (.184)[b]

Note: 1) a. Numbers in parenthesis are t statistics

b. Numbers in parenthesis are P-values of F statistics.

c. Model 11 and Model 14 are in first-differences.

2) The dependent variable in Model 9, Model 10, Model 11, Model 12, Model 13 and Model 14 is TFR.

D.2 The Preferred Total Fertility Rate Regression Model

The best total fertility rate regression model is as follows:

$$(6)\quad TFR = 9.527 - 0.016FENTRY - 0.280FAGE + 0.041DIVORCE + 0.020PGNI\_100 \\ -0.030FEMP + 0.056EDU + 0.048t$$

Note that the Breusch-Pagan-Godfrey test is conducted to test heteroskedasticity for this model. The value of the F-statistic is 0.3489, and the P-value is 0.9218. Thus, the residuals do not suffer from heteroskedasticity. Also, the Breusch-Godfrey Serial Correlation LM Test is conducted. The value of the F-statistic is 1.0795, and P-value is 0.3106. Thus, there is no serial correlation. Therefore, the statistical properties of this model are good.[20]

This model implies that if all the other variables are held fixed, the total fertility rate will decrease by 0.016 children per woman as the entry rate into tertiary education of women (FENTRY) increases by 1 percentage point, and the total fertility rate will decrease by 0.280 if the age at first marriage of women (FAGE) increases by one year. This model also tells us that if the female employment rate (FEMP) increases by 1 percentage point, then the total fertility rate will decrease by 0.030. The coefficients of the crude divorce rate (DIVORCE), nominal GNI per capita (PGNI) and the ratio of educational cost to household consumption expenditure (EDU) are not statistically significant at the $\alpha = 0.05$ significance level as shown in Table 4.8. Thus, there is no statistical basis to trust these coefficient estimates.

Notice that the signs of the coefficients of the entry rate into tertiary education of women,

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[20] An alternative version of Model 10 in which real per capita GNI replaced nominal per capita GNI was also estimated. However, this model had a lower adjusted R^2 (0.941). Also, the coefficients of DIVORCE, real per capita GNI, and EDU were statistically insignificant in this model.

the age at first marriage of women and the female employment rate are negative. This result corresponds to earlier studies (Mason & Kuhlthau, 1992; Seo, 2009; Lee & Choi, 2012; Choi, 2013). However, in theory an increase in women's labour force participation could result in an increase or a decrease in the fertility rate. As Feyrer, Sacerdote and Stern (2008) suggest, if the wage differential between women and men is huge, or the convention that house work and child care are the responsibility of women remains strong, then the employment rate of women will be negatively related in the fertility rate. However, if women's social status rises, so that the women's share of housework and child care decreases, then an increase in women's employment rate will cause the fertility rate to increase. Thus, the preferred total fertility rate regression model implies that the environment for employed women to balance work and child-rearing is poor in South Korea.

V. Conclusion

The results of the correlation analysis and the univariate linear regression analysis (Models 1-6) show that the entry rate into tertiary education of women, the age at first marriage of women, the crude divorce rate, nominal GNI per capita, the female employment rate, and the ratio of educational cost to household consumption expenditure are all negatively related to the total fertility rate. The top three variables in a ranking of the strength of the Pearson correlation coefficients are demographic and values factors; the bottom three variables are economic and social factors. The results of the multiple linear regression analysis (Model 10, the preferred model) indicate that variables that are related to women such as the entry rate into tertiary education of women, the age at first marriage of women, and the female employment rate are negatively related to the total fertility rate. As the level of education of women has developed and more women have been entering the labour force, the age at first marriage of women has increased in South Korea. This process contributes to the low fertility rate. However, it is not simply the increases in the level of education and the employment rate of women that result in low fertility, but also that the circumstance that make it hard for women to balance work and child-rearing make people choose to have less children.

In many developed countries which are already experiencing or have experienced a low fertility rate, governments have tried to raise the total fertility rate. In the case of Sweden, the low fertility rate issue was encountered beginning in the 1960s, so the Swedish government has implemented various fertility promotion policies since the mid-1970s. These fertility promotion policies targeted gender equality. They tried to eliminate sexual discrimination in their society, and these efforts have resulted in improvements in and stabilization of the fertility rate (Jan, 2005). In the case of France, the total fertility rate was 2.02 in 2010, and they have maintained

relatively a high fertility rate among OECD member countries, but there has been much effort behind this result. The French government has offered generous child-rearing support, and various child care services that help women to manage both work and childcare (Fagnani, 2002; Thévenon, 2009). Finally, the province of Quebec has introduced family policies that differ from those in the rest of Canada. To be specific, Quebec has offered higher child care funding, more options for parental leave from employment, higher replacement salaries for parental leave, and specific provisions for father's parental leave, so that parents can balance work and family obligations (Beaujot, Du, & Ravanera, 2013). These policies have made people more satisfied with child care, and have resulted in an increase in fertility rates. These examples show that if child-rearing support is ensured by policy, then an increase in the female employment rate can be associated with an increase in the total fertility rate.

Although South Korea has experienced low fertility a little later than other developed countries, the speed of the decline in the fertility rate has been much faster than in other countries. In 2001, the total fertility rate of South Korea was 1.17, which was the lowest fertility rate among the OECD member countries. South Korea has continued to have one of the lowest fertility rates in the world since then. Considering these facts, the prolonged low fertility rate trend in South Korea is a matter of concern. If the low fertility rate trend continues, many social problems will begin to arise. The financial burden of supporting an aging population will put a much pressure on young people. Also, the labour market will be strained by the decreasing workforce. Eventually, these problems will lead to a low fertility rate again. Thus, to solve the complicated low fertility problem, a variety of active political supports are required from the Korean government. In particular, considering the results of this study, I suggest that the Korean government focus on support policies that help women to balance work and child-rearing.

This study has a few limitations. A lack of measurable and obtainable data resulted in five missing values that had to be replaced in the independent variable ratio of educational cost to household consumption expenditure. Also, there exists severe multicollinearity among the independent variables. Thus, I believe that if larger ranges of data are accumulated and become available as time passes, a more accurate study can be carried out.

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Appendix: Data Sources

1) Fertility rates in OECD member countries (1960-2014), OECD website, https://data.oecd.org/pop/fertility-rates.htm.

2) Entry rates into tertiary education (1977-2014), Korean Educational Statistics Service website, http://kess.kedi.re.kr/index.

3) Marriages and divorces (1985-2014), Statistics Korea website, http://www.index.go.kr/potal/stts/idxMain/selectPoSttsIdxSearch.do?idx_cd=2922&clas_div=&idx_sys_cd=548&idx_clas_cd=1.

4) Share of births outside of marriage (2011-2014), OECD website, http://www.oecd.org/els/family/database.htm.

5) Average age at first marriage of women (1985-1989), National Archives of Korea website, http://theme.archives.go.kr/next/populationPolicy/statisticsPopup_20.do.

6) Average age at first marriage of women (1990-2014), Statistics Korea website, http://kosis.kr/statHtml/statHtml.do?orgId=101&tblId=DT_1B83A05&vw_cd=MT_ZTITLE&list_id=A23_4&seqNo=&lang_mode=ko&language=kor&obj_var_id=&itm_id=&conn_path=E1#.

7) Educational cost (1990-2014), Statistics Korea website, http://kosis.kr/statHtml/statHtml.do?orgId=101&tblId=DT_1L9I002&vw_cd=MT_ZTITLE&list_id=G_A_4_1_2&seqNo=&lang_mode=ko&language=kor&obj_var_id=&itm_id=&conn_path=E1#.

8) Household consumption expenditure (1990-2014), Statistics Korea website, http://kosis.kr/statHtml/statHtml.do?orgId=101&tblId=DT_1L9I002&vw_cd=MT_ZTITLE&list_id=G_A_4_1_2&seqNo=&lang_mode=ko&language=kor&obj_var_id=&itm_id=&conn_path=E1#.

9) The nominal gross national income(GNI) per capita (1985-2014), Statistics Korea website, http://kosis.kr/statHtml/statHtml.do?orgId=301&tblId=DT_102Y002&vw_cd=MT_ZTITLE&list_id=301_A_A05_B01&seqNo=&lang_mode=ko&language=kor&obj_var_id=&itm_id=&conn_path=E1#.

10) The female employment rate (1985-2014), Statistics Korea website, http://kosis.kr/statHtml/statHtml.do?orgId=101&tblId=DT_1DA7024&vw_cd=MT_ZTITLE&list_id=B17&seqNo=&lang_mode=ko&language=kor&obj_var_id=&itm_id=&conn_path=E1#.