

The Impact of Housing Prices and Private Education Costs on Fertility Rates

¹ Clara Jungwon Choi, ² Jaehee Lee, ³ Jinbaek Park

¹Senior Researcher, Korea National Council on Social Welfare(KNCSW)
Research Fellow, Korea Institute of Child Care and Education

³Associate Research Fellow, Korea Research Institute for Human Settlements
E-mail: makinoid@krihs.re.kr

Abstract

The Study analyzed the effect of private education costs and housing prices on the total fertility rates in 16 metropolitan cities in Korea from 2009 to 2021, and estimated the contribution rates of each variable on the decrease in the total fertility rate. Using a dynamic panel data model considering the time series correlation of the total fertility rates, the total fertility rates for the year was positively (+) affected by the total fertility rates of the previous year, and the increase in apartment sales and Jeonse prices in the previous year reduced the total fertility rates. In addition, the increase in private education costs per capita in the previous year was analyzed to consistently reduce the total fertility rates.

Keywords: housing prices, private education costs, fertility rates

1. INTRODUCTION

In 1960, while the total fertility rate in Korea was recorded to be fairly high - indicating 6.0 births per woman, a policy was introduced to suppress childbirth along with the five-year economic deployment plan. With the policy implementation, in 1983 the fertility rate reached 2.06 which is below the replacement threshold of 2.1, yet the country persisted with the birth control policy until 1995, recording a total rate of 1.63. Since then, the total fertility rate has continued to decrease as late marriage, and renunciation of marriage and childbirth intensified in the process of overcoming the foreign exchange crisis, and in 2001, the total fertility rate recorded 1.31. To overcome the continued decline in the fertility rate despite the abolition of the birth control policy, the Korean government enacted the Framework Act on Low Birth Rate in an Aging Society in 2005, and introduced the Plan for Aging Society and Population every five years since 2006. However, the total fertility rate continued to fall, and in 2022, it reached 0.78, the lowest in the world.

While the low birth rate trend is not limited to Korea, the rapid decline evident in Korea is believed to be rather exceptional. Following such change in our society, a number of academics in the field of population research in Korea carried out studies to determine the causes of the low birth rate phenomenon evident Korea. According to these studies, the main causes of low birth rate in Korea include increased birth age due to late marriage, lack of family-based systems including parental leave, lack of solid child rearing infrastructure,

Manuscript received: March 30, 2024 / revised: April 20, 2024 / accepted: May 15, 2024

Corresponding Author: makinoid@krihs.re.kr

Tel +82-44-960-0312, Fax: +82-44-211-4767

Associate Research Fellow, Korea Research Institute for Human Settlements

economic issues including housing prices and child care costs, and changes in perceptions around marriage and childbirth [1-4].

The present study attempts to focus on the economic factors which have recently attracted great attention in Korea as the major causes of low birth rate [4-5]. In general, couples give birth and gain utility through their child, yet, as a benefit in return, there are also expenses that they need to bear in relation to the giving birth. This is because households that are to make decisions around whether to have children or not, make such decisions by comparing the size of utility they may gain from their child with the size of the cost to be spent or the opportunity cost to be forgone from childbirth [6].

Generally, in economics, childbirth is perceived as an output determined by households making rational decisions under the circumstances they face. Studies looking at childbirth from such perception are based theoretically on Leibenstein [7], Becker [8], and Mincer [9]. According to Leibenstein each household weighs the efficiency and inefficiency of having children, and accordingly decides to have children or not. Similarly, Becker also defined children as consumer goods, and explains that childbirth is decided at a level that maximizes utility according to the various costs and benefits faced by households. These studies mainly suggest explicit costs such as child care costs and education costs as expenses for childbirth. Mincer argued that in addition to the explicit costs suggested by previous studies, opportunity costs such as social activities that must be given up due to childbirth should be considered, and these implied costs may be perceived to be greater among people with high incomes.

One of the major characteristics of household consumption of married couple with child/ren is that housing costs and private education costs account for a very high proportion. According to a study, while the average monthly household income increased 4.5 times from 1990 to 2013, education costs increased 5.8 times and its share in household consumption expenditures also increased from 5.3% in 1990 to 7.0% in 2013 [10]. Housing costs in Korea is reportedly not high among OECD countries, yet the problem is that 67% of household debt in Korea is housing-related loans [11].

Thus, the present study aims to focus on housing prices and the level of private education expenses as factors that contribute to decision making among households around childbirth. First, a sharp rise in housing prices has led to an increase in interest costs for housing purchases and rent, aggravating household budget constraints, consequently affecting not only household consumption and everyday life, but also childbirth [3].

Second, the increase in education costs across society is an unrealized cost according to current standard, but may act as a factor that contributes to couples to avoid having children. As the quality of children's education has increased significantly compared to the past, the costs related to education have also increased significantly [12]. As all human capital in our society is not provided through school education only but a large part is supplemented by the private education sector, costs related to private education take up a substantial proportion of household expenditure accordingly, and such increased private education costs may be a major cause lowering the fertility rate [13].

While there have been a number of studies around the topic, there was no research conducted analyzing the effects of multiple economic factors of households expected to affect the fertility rate in Korea. Further, in previous studies, only the level of relationship between the variable and the fertility rate was analyzed, yet the degree of the influence on the fertility rate could not be estimated. Therefore, this study attempts to focus on housing prices and private education costs -found to have impact on the fertility rate in previous studies, in relations to the major economic indicators including variables such as unemployment, regional economic growth, and female labor force participation rate on the fertility rate. In particular, this study aims to estimate the contribution rates of economic factors on the fertility rate, which were not available in previous studies. Once we can identify the level at which the key variables contribute to the decline in the total fertility rate, we

can provide guidelines on the areas that the Korean government should focus on to develop practicable policies to overcome low birth rate.

2. Method

The purpose of this study is to analyze the effect of housing prices and private education costs on the total fertility rate. Studies concerning determinants of total fertility rate generally consider economic growth rate, unemployment rate, economic volatility, old age support ratio, labor force participation of women, level of human capital, housing supply rate, home ownership rate, number of childcare institutions, and number of teachers [14] [4] [15]. Among these variables, the explanatory variables of the present study included housing prices, private education costs, economic growth rates, unemployment rates, and female labor force participation rate - the variables that can be categorized at a metropolitan city level. Considering the gestation period, the point of time for all variables were set to the values of the previous year. Further, considering that the fertility rate is not an independent event at a given point in the model, the past values of the fertility rate were included as explanatory variables. In fact, recent empirical studies around fertility rates perceive that the low birth phenomena in a society can induce low fertility rate, and thus include the fertility rate of previous 1 or 2 years as major explanatory variable [14] [16-19].

$$F_{it} = \beta_0 + \beta_1 F_{it-1} + \beta_2 HP_{it-1} + \beta_3 PE_{it-1} + \gamma'X + \alpha_i + \epsilon_{it} \quad (1)$$

Here, F_{it} refers to the total fertility rate of region i at the time of t . The analysis areas, i , were set as the metropolitan cities excluding Sejong, where the analysis for time series were considered insufficient, and the time series, t , was set from 2009 to 2021. The main explanatory variable HP_{it-1} was the apartment sales price of the previous year, PE_{it-1} referred to the average private education cost of the previous year, and its effect on the total fertility rate was analyzed through log conversion. The present study expected to report coefficient values to be negative (-) as it was hypothesized that as the housing price or average level of private education in a given region increases, many households will give up having children as related costs increase. The readily available information including the previous year's economic growth rate, unemployment rate, and female labor force participation rate were included as the control variables, X .

$$F_{it} = b_0 + b_1 F_{it-1} + b_2 RP_{it-1} + b_3 PE_{it-1} + \gamma'X + \alpha_i + e_{it} \quad (2)$$

Equation (2) refers to a model that analyzes the effect of Jeonse prices on the fertility rate. Jeonse is a unique system in Korea that allows tenants to live in the house/apartment during the contract period while paying only a deposit to the lessor without paying monthly rent. The contract ends by lessor returning the deposit to the lessee at the end of the contract period. In general, the market price for such Jeonse is determined at 50-70% of the sale price [20]. RP_{it-1} represents the Jeonse price of the previous year, and, as of Equation (1), the effect on the total fertility rate is analyzed by performing log conversion. In general, the main fertile age group is likely to be comprised of people that are fresh out of university with relatively insufficient income and savings. As most of them are likely to have difficulties in owning their own house/apartment without parental support or a significant amount of loan, it is likely that they live in Jeonse d households. Therefore, for households planning for childbirth, not only for sale prices but also the Jeonse prices can be a major reference point. In this situation, while it may be perceived to be necessary to estimate the sale price and the Jeonse price in one regression equation, it is important to note that the sale price and the Jeonse price are variables that affect each other. According to the Capital Asset Pricing Model, housing

prices are defined as the present value of current and future rental prices. In other words, the sale prices are functional relationship of rental prices which includes interest rates and Jeonse prices [21-23]. An ideal quantitative analysis should maintain an independent relationship that does not affect each other between explanatory variables, yet since the sale and the Jeonse prices are highly correlated, it was necessary to analyze each model separately. In the past, considering the high correlation between the sale and the Jeonse prices, Kim and Hwang also analyzed the sale and the Jeonse price model respectively [14]. The present study attempted to analyze the sale and Jeonse prices in one model, yet due to high endogeneity between the variables, the generally expected sign was not estimated and the model was not found to be fit, and thus it was inevitable that each model to be analyzed separately.

Since the study hypothesis that the dependent variable is autocorrelated to the value of the past year, β_1 and b_1 in both equations (1) and (2) should be statistically significant, and F_{t-2} should not be statistically significant with the dependent variable, F_t . In order to check whether such an hypothesis is satisfied, an Autoregressive Test should be conducted under the null hypothesis that "the dependent variable has no autocorrelation with the value of the previous year". If the above assumptions are satisfied, the null hypothesis must be rejected for one year ago and such hypothesis must be accepted for two years ago – if this is not satisfied, the model cannot be said to have been properly designed. However, since the time-series correlation of the dependent variable is assumed, it should be noted that it is an endogenous relationship (i.e. $E(F_{it}, F_{it-p}) \neq 0$ and, $E(F_{it}, X) \neq 0$ and thus $E(F_{it-p}, X) \neq 0$) in which explanations are exchanged between each explanatory variable and the past value of the dependent variable. In order to control such endogeneity, it is inevitable to estimate instrumental variables that are related to endogenous variables and not related to residuals.

As a solution to the identified problem, the following method has been proposed: Arellano and Bond (1991) proposed a method of using the past level value of the dependent variable as an instrumental variable in the difference equation (so called Difference GMM). On the other hand, Arellano and Bover [24] proposed a method of using the past difference value of the dependent variable as an instrumental variable in the level equation (so called Level GMM). Since then, Arellano and Bob [24] and Blundell and Bond [25] have proposed a System GMM method that controls endogenous generation by combining the previous Difference GMM and Level GMM, increasing the efficiency of estimation. Among the proposed dynamic panel models, this study attempted to apply the System GMM with high estimation efficiency. One thing to note in designing the dynamic panel model is that the number of instrumental variables is much larger than the number of explanatory variables, and thus may lead to over-identification. Hence, to ensure that the designed model does not have an over-identification problem and that the moment conditions are adequately satisfied, it is necessary to run the Sargan test to see if it accepts the null hypothesis that "over-identification restrictions are appropriate".

The data used in this study are as follows: the fertility rate used the total fertility rate of the census released by Statistics Korea; housing price data were based on the apartment sales price index and apartment Jeonse price index of the Korea Real Estate Board's National Housing Price Trend Survey; and private education data were based on the average private education cost and participation rate of each region publicized by Statistics Korea. Other control variables included the economic growth rate based on GRDP by region, and the unemployment rate and female labor force participation rate reported by Statistics Korea in their Economic Activity Population Survey. Considering the gestation period, each explanatory variable was analyzed using the values of the previous year.

3. Results

<Table 1> shows the results of analyzing the effect of apartment sales prices and private education costs on the total fertility rates. The Sargan Test and the time series autocorrelation test of the dependent variable were conducted to see if the model setting is done properly. Since the dynamic panel model includes the past value of the dependent variable as an explanatory variable, an endogeneity occurs where the such variable is not independent from other explanatory variables. Since the number of instrumental variables introduced to control such problem is larger than the number of explanatory variables, to determine whether an over-identification problem exist or not, Sargan test was conducted to see if it accepts the null hypothesis that "over-identification restrictions are appropriate". In all regression equations, it was analyzed that the over-identification restrictions were appropriate and that the moment conditions were also satisfied. The Autoregressive test tests the null hypothesis that "the dependent variable has no autocorrelation with the value of p years ago." As a result of the analysis, it was analyzed that all regression equations were related to the value 1 year ago, but not to the value 2 years ago.

Table 1. The effect of apartment sales prices and private education expenses on the total fertility rates

	(1)	(2)	(3)	(4)
Previous year's TFR	0.906*** (0.013)	0.950*** (0.033)	0.900*** (0.028)	0.803*** (0.043)
Previous year's apartment sale price	-0.164*** (0.039)	-0.183*** (0.060)	-0.168*** (0.048)	-0.171*** (0.036)
Previous year's private education expenses per person	-0.130*** (0.023)			
Previous year's private education expenses per person (Elementary)		-0.069 (0.078)		
Previous year's private education expenses per person (Secondary)			-0.088** (0.045)	
Previous year's private education expenses per person (high School)				-0.142*** (0.048)
Previous year's economic growth	0.002*** (0.000)	0.002** (0.001)	0.001*** (0.000)	0.001*** (0.000)
Previous year's unemployment level	-0.014*** (0.004)	-0.011 (0.016)	-0.010 (0.012)	-0.003 (0.006)
Previous year's female labor force participation rate	-0.006* (0.003)	-0.007 (0.009)	-0.009 (0.007)	-0.005 (0.005)
Constant term	0.000 (0.000)	1.462*** (0.236)	1.620*** (0.148)	0.000 (0.000)
Observations	192	192	192	192

Sargan Test	[0.120]	[0.195]	[0.150]	[0.100]
AR1 Test	[0.000]***	[0.001]***	[0.001]***	[0.001]**
AR2 Test	[0.295]	[0.269]	[0.206]	[0.231]

Note: () represents the standard error and [] represents the value of p.

*** p<0.01, ** p<0.05, * p<0.1

The regression analysis fixed the values of the previous year’s total fertility rates, apartment sales price, economic growth rate, unemployment rate, and female labor force participation rate; and the model was constructed by applying different variables for private education costs. Since these variables are highly correlated with each other, they were not estimated in one regression equation. In all regression analysis, it was analyzed that the increase in the total fertility rates in the previous year had an effect on the increase in the total fertility rate in the year interested. This means that the recent decline in the total fertility rates reflect the impact of the decline in the total fertility rates in the previous year.

This suggests, although the total fertility rate is affected by various factors, essentially, if the total fertility rate has recently been low, households who are considering childbirth have a greater chance of not giving birth. In the case of housing prices, it was analyzed that if the apartment sales price in the previous year increased, the total fertility rate for the year interested decreased. It was analyzed that the increase in private education costs per person in the previous year also resulted in decline in the total fertility rate. Macroscopically, if the economy grew in the previous year, the total fertility rates would show an increase, and if unemployment increased, the total fertility rates would decrease. This means that if the economy or the labor market employment environment deteriorates, there is a great possibility of households giving up childbirth as it disturbs stable income necessary for raising children. Therefore, the economy needs to maintain sustainable growth. Further, while the employment stability is a policy designed for the labor market in the short term, it can also affect childbirth decision-making process, and thus the demographic structure of the nation in the mid to long term. In addition, the increase in female labor force participation rate in the labor market was also analyzed as a factor that decreased the total fertility rates.

<Table 2> shows the results of analyzing the effect of apartment Jeonse prices and private education costs on the total fertility rates. First, looking at the over-identification test and the Autoregressive test of the dependent variable, the over-identification restrictions were tested appropriate in all regression analysis results, and the dependent variable was analyzed to have an autocorrelation with the value one year ago and no autocorrelation with the value two years ago, confirming that the model was appropriate. The results of the column (1) revealed that the increase in the Jeonse price lowered the total fertility rates, and the elasticity increased compared to the sale price. This can be understood to be attributable to the fact that the occupancy type of households who usually give birth – such as newlyweds – are likely to be rented households. Households who are considering childbirth may be affected by the burden of housing costs, and the rise in housing sale prices may discourage purchasing a house, and thus may be significantly affected by rental costs such as Jeonse or monthly rent. According to the results, it was analyzed that households that are considering childbirth have possibility to avoid childbirth by reacting more flexibly to the rise in the Jeonse prices.

Examining the effect of private education expenditure on total fertility rate decline by educational stages in columns (2) to (4), it was analyzed that the increase in private education costs in elementary and middle schools was not statistically significant, whereas the increase in private education expenditure in high

school was statistically significant. Those who give up childbirth due to educational expenses are more likely to be households with children than households who have never had a child. In other words, a household planning to have an additional child are more likely to be affected by education related costs that are expected in the future. The results of this analysis suggest that there is a need for continuous policy efforts by the Korean government to prevent excessive increase in housing prices and private education expenses. There may be high demand among newlyweds for relatively inexpensive housing due to their lack of income and inability to pay. In this case, it can be interpreted that the future burden related to rising education costs can have a strong impact on the decline in the total fertility rates. In other words, the private education expenses which account for a significant portion of household consumption, which is persistently expected, the burden of private education costs can cause a strong social distortion. It is also worth noting that while private education is found to affect children's university acceptance, nothing has been confirmed about its contribution to the formation of human capital. If the low birth rate continues, our future generations who are to lead our society will have to bear more social burdens. In this sense, it is desirable that the direction of education policy avoids excessive private education costs, and for this purpose, a society in which public education is sufficient enough to guarantee university entrance is desirable.

Table 2. The Effect of Jeonse Price and Private Education Cost on the Total Fertility rates

	(1)	(2)	(3)	(4)
Previous year's TFR	0.882*** (0.013)	0.916*** (0.029)	0.883*** (0.024)	0.793*** (0.039)
Previous year's apartment Jeonse price	-0.227*** (0.036)	-0.223*** (0.035)	-0.211*** (0.031)	-0.208*** (0.026)
Previous year's private education expenses per person	-0.093** (0.037)			
Previous year's private education expenses per person (Elementary)		-0.048 (0.048)		
Previous year's private education expenses per person (Secondary)			-0.065 (0.049)	
Previous year's private education expenses per person (high School)				-0.120*** (0.044)
Previous year's economic growth	0.001*** (0.000)	0.001 (0.001)	0.001 (0.001)	0.001** (0.000)
Previous year's unemployment level	-0.018*** (0.006)	-0.017 (0.012)	-0.018 (0.012)	-0.011 (0.008)
Previous year's female labor force participation rate	-0.005 (0.005)	-0.006 (0.007)	-0.008 (0.008)	-0.004 (0.006)
Constant term	1.732*** (0.086)	1.595*** (0.183)	1.708*** (0.170)	1.780*** (0.165)

Observations	192	192	192	192
Sargan Test	[0.471]	[0.576]	[0.506]	[0.412]
AR1 Test	[0.000]***	[0.001]***	[0.001]***	[0.001]***
AR2 Test	0.151	0.161	0.115	0.119

Note: () represents the standard error and [] represents the value of p.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

4. Discussion

The present study analyzed the effect of housing prices and private education costs on the total fertility rate in 16 metropolitan cities in Korea from 2009 to 2021, and estimated the contribution level of each variable to the decrease in the total fertility rate. To analyze the time-series correlation of the total fertility rate, the System GMM, a dynamic panel model, was applied in the analysis. The findings of the study confirmed that the recent decline in the total fertility rate was affected by the decline in the previous year's total fertility rate. Further, it analyzed that the increase in housing sales prices and Jeonse prices in the previous year reduced the total fertility rate for the year interested – responding more elastically to Jeonse prices. In addition, in all analyses, the increase in private education costs per person in the previous year was found to reduce the total fertility rate, and more specifically, private education costs, which is expected to arise as children reach higher educational stage, was analyzed to intensified childbirth avoidance. Macroscopically, it was analyzed that if the economy grew in the previous year, the total fertility rate increased; and if unemployment increased in the previous year, the total fertility rate showed a decrease. In addition, it was also confirmed that low birth rate intensified as female labor force participation rate increased.

This study is the very first study to analyze private education expenses by children's educational stages as an analysis target. It is worth noting that the findings revealed that there is a greater degree of avoidance of childbirth related to private education costs in high school level. This is a result reflecting the characteristics of the Korean population that prefers to enter prestigious universities, requiring a lot of private education during high school, which then eventually leads to a decrease in the fertility rate. Similarly, Anderson and Kohler [26] also argued that the lowest-low fertility rate evident in East Asia reflects the characteristic of parents in East Asian countries who desire to raise their child as a 'successful child' in society. Due to such characteristic, financial and time investment in children increases, the cost of raising children becomes highly expensive, and thus parents in East Asian countries tend not to have many children.

To conclude, to overcome low birth rate in Korea and the East Asian countries, the foremost priority should be given to changes in educational policy and perceptions. Policy must be put in place to improve citizens' awareness around education, to restructure the examination system, and to take a step back from competition and the academic-oriented society, which must be accompanied changes in various culture, system, perceptions around education. Further, although the discussion mainly focused on private education costs, it is also necessary to stabilize housing prices to improve the fertility rate. While issues around education partially affected the rise in housing prices in Korea, there are various other factors that affect housing prices in Korea. The increase in housing prices due to these factors eventually increases the rental cost for people without home ownership, increasing the burden of housing costs on households. Since households considering childbirth are generally fresh out of university with relatively low assets and often living in Jeonse d homes without home

ownership, hence, to overcome low birth rate, housing prices and rental costs need to be stabilized to lower housing costs.

5. ACKNOWLEDGEMENT

Acknowledgement title is not numbered. Type the acknowledgement in this format ‘This work was supported by (institution to acknowledge) in (year).’

6. REFERENCE

- [1] T. Anderson, T, and H. P. Kohler, “Education Fever and the East Asian Fertility Puzzle: A case study of low fertility in South Korea,” *Asian population studies*, Vol. 9, No. 2, pp. 196–215, 2013. <https://doi.org/10.1080/17441730.2013.797293>
- [2] E. H. W. Kim, “Division of domestic labour and lowest-low fertility in South Korea,” *Demographic Research*, Vol. 37, pp. 743-768, 2017.
- [3] J. H. Lee, and J. B. Park, “Housing price and birth rate under economic fluctuation: evidence From 19 OECD Countries,” *Korean Journal of Child Care and Education Policy*, Vol. 10, 51-69, 2016.
- [4] Lee, J. H., & Park, J. B. (2020). The effects of the housing price and provision on the total fertility rate in Seoul. *Korean Journal of Human Ecology*, 29, 765-776. <https://doi.org/10.5934/kjhe.2020.29.5.765>.
- [5] C. J. Lee, and J. B. Park, “The time-varying effect of interest rates on housing prices,” *Land*, Vol. 11, pp. 2296. 2022. <https://doi.org/10.3390/land11122296>.
- [6] R. A. Easterlin, “An economic framework for fertility analysi,” *Studies in family planning*, Vol. 6, No. 3, pp. 54–63. 1975.
- [7] H. Leibenstein, “Economic backwardness and economic growth,” *Economia*, Vol. 26, pp. 172-174, 1957.
- [8] G. S. Becker, “An economic analysis of fertility,” In *Demographic and economic change in developed countries*, New York: Columbia University Press, pp. 209-240, 1960.
- [9] J. Mincer, “Market prices, opportunity costs, and income effects,” *Measurement in economics*, Edited by Carl F. Christ. California: Stanford University Press, pp. 67-82, 1963.
- [10] Park, M. S., Chong, H. G., Koh, D. Y., & Lee, K. H. (2014). An analysis of consumer expenditure patterns according to household characteristics. *Journal of the Korea Academia-Industrial cooperation Society*, 15(9), 5564-5577. <https://doi.org/10.5762/KAIS.2014.15.9.5564>.
- [11] The Bank of Korea, *Financial safety report*. Seoul: The Bank of Korea. 2022.
- [12] S. H. Chung, “A study of the effectiveness of policies in response to low fertility,” *Korea journal of population studies*, Vol. 35, pp. 31-52, 2012.
- [13] H. J. Song, “The analysis of household's fertility decision in Korea using KLIPS,” *Korea Review of Applied Economics*, Vol. 14, pp. 51-78, 2012.
- [14] M. Y. Kim, and J. Y. Hwang, “ Housing price and the level and timing of fertility in korea: An empirical analysis of 16 cities and provinces,” *Health and Social Welfare Review*, Vol. 36, pp. 118-142, 2016. <https://dx.doi.org/10.15709/hswr.2016.36.1.118>
- [15] M. S. Seo, “Do house price changes affect household birth rates?,” *The Journal of Women and Economics*, Vol. 10, pp. 63-79. 2014
- [16] K. K. Kim, S. J. Woo, and J. J. Choi, “ A study on the link between education and fertility: A macro-micro perspective,” *Sejong: Korea Institute for Health and Social Affairs*, 2016.
- [17] H. J. Song, and S. J. Woo, “ A macro analysis of the effect of child-care policy on fertility and female labor force participation in Korea,” *The Journal of Korean Public Policy*, Vol. 17, pp. 3-36, 2015.

- [18] H. M. Choi, E. J. Park, T. W. Kim, and S. J. Woo, "An analysis of the outcomes of fiscal spending in ECEC policies," Seoul: Korea Institute of Child Care and Education. 2019.
- [19] I. Iwasaki, and K. Kumo, "Regional determinants of fertility growth in Russia: A dynamic panel data approach," *Economic Review*, Vol. 70, pp. 30-53. 2019. <https://doi.org/10.15057/29779>.
- [20] J. B. Park, J. H. Kim, and G. W. Kwon, "Estimation on the Jeonse leverage risk and policy measures," Sejong: Korea Research Institute for Human Settlements. 2022
- [21] K. T. Lee, "An empirical analysis of the causality between housing prices and fluctuation factors," *Journal of the Korea Real Estate Analysts Association*, Vol. 2, pp. 79-104, 1996.
- [22] J. M. Lim, "The Relationship between housing sales market and housing rental market in Seoul, Korea," *Korea Real Estate Review*, Vol. 14, pp. 163-177, 2004.
- [23] Y. M. Lee, and S. H. Lee, "Does the housing price in Gang-nam area determine on the change of housing price in neighbouring area.," *Journal of Korea Planning Association*, Vol. 39, pp. 73-92, 2004.
- [24] M. Arellano, and O. Bover, "Another Look at the Instrumental Variable Estimation of Error-Component Models," *Journal of Econometrics*, Vol. 68, pp. 29-52, 1995. [http://dx.doi.org/10.1016/0304-4076\(94\)01642-D](http://dx.doi.org/10.1016/0304-4076(94)01642-D)
- [25] R. Blundell, and S. Bond, "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models," *Journal of Econometrics*, Vol. 87, pp. 115-143, 1998.
- [26] T. Anderson, and H. P. Kohler, "Education Fever and the East Asian Fertility Puzzle: A case study of low fertility in South Korea," *Asian population studies*, Vol. 9, No. 2, pp. 196-215, 2013. <https://doi.org/10.1080/17441730.2013.797293>