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Socio-economic and Policy Determinants of Low Fertility in OECD Countries (2014–2023): Implications for South Korea

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Abstract

Low fertility rates pose significant demographic and economic challenges across many OECD countries, including South Korea. This study examines how economic, social, and policy-related factors collectively influence fertility decisions by employing fixed-effects regression models on panel data from 2014 to 2023. The findings confirm that higher unemployment rates and economic uncertainty negatively affect fertility, whereas family benefit expenditures and childcare support exhibit positive, statistically significant relationships with birth rates. Multidimensional Scaling (MDS) analysis further reveals distinct clusters among OECD countries, highlighting a group of Nordic nations that sustain relatively high birth rates alongside robust female labor force participation and comprehensive family policies. In contrast, South Korea stands out with a notably low fertility level and comparatively underdeveloped support structures, underscoring the urgent need for targeted policy interventions. Based on these results, the study proposes a comprehensive policy framework that integrates employment stability, enhanced childcare services, and culturally supportive environments to promote sustainable fertility outcomes. The study's implications underscore not only the importance of aligning macro-level policies with micro-level sociocultural contexts, but also the particular relevance of such insights for addressing persistent low fertility rates in South Korea.

Keywords: *Low Fertility, Panel Data Analysis, Family Policies, OECD Countries*

Introduction

Research Background and Motivation

The global decline in fertility rates has emerged as a significant issue with profound implications for demographic structures and economies worldwide. Particularly since the 2000s, OECD countries have experienced persistent declines in birth rates, exacerbating challenges such as labor shortages and population aging (d'Addio & d'Ercole, 2005; Sobotka, 2008). The expansion of women's economic participation, operational mechanisms of family policies (such as family benefits and parental leave), financial burdens related to housing and education, urbanization, and shifting cultural values are highlighted as critical factors contributing to low fertility rates (Kögel, 2006; Freedman & Berg, 2020a).

In particular, South Korea has recently garnered international attention for recording the world's lowest total fertility rate. Unique features of Korea include the combined impacts of increased female employment rates, substantial childcare and educational costs, and a culture of long working hours, differing notably from other developed countries (Park, 2019). Moreover, cases

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exist among advanced countries where fertility rates rebound or maintain stability despite high GDP per capita, indicating that economic indicators alone may insufficiently explain low fertility trends (Coleman, 2008).

This study comprehensively analyzes various policy and socio-economic factors influencing low fertility, based on panel data from 33 OECD countries spanning 2014 to 2023. It quantitatively assesses the direction and magnitude of effects specific variables have on fertility rates, thereby presenting policy implications and identifying potential limitations.

Research Questions and Objectives

The central research questions addressed by this study are:

What are the key policy and socio-economic factors explaining low fertility rates in OECD countries, and what is their relative influence?

How do variables such as female labor participation rate, GDP per capita, urbanization rate, access to infertility treatment, and childcare expenditure correlate significantly with fertility rates?

What distinctive features does South Korea exhibit compared to other OECD countries, and what are the policy implications?

Based on these questions, the objectives of this research are:

Firstly, to comprehensively assess the impact of diverse factors, including economic, labor, childcare, and urbanization issues, on low fertility using panel data from 33 OECD countries (2014-2023).

Secondly, to apply methods such as the Fixed Effects Model to control for country-specific and annual differences, thus highlighting the effectiveness and statistical significance of each independent variable.

Thirdly, to utilize the analysis outcomes to discuss potential policy combinations that could effectively enhance fertility rates in South Korea and other severely affected countries, with specific attention to multidimensional policy suggestions including prevention of career disruption for women, childcare support, and housing policies.

Structure of the Paper

This paper comprises six chapters. Chapter 1 introduces the research background, motivation, questions, and objectives. Chapter 2 (Literature Review) reviews the major theories and previous research trends regarding determinants of low fertility, summarizing key findings and policy trends focused on OECD countries. Chapter 3 (Data and Methodology) details the panel data utilized in this study (33 OECD countries, 2014-2023), defines the dependent variable (total fertility rate) and primary independent variables (female economic activity, GDP per capita, etc.), and describes the panel regression analysis methods applied.

Chapter 4 (Results) presents descriptive statistics of the key variables and the results of panel regression analyses, also visualizing inter-country differences through multidimensional scaling (MDS) analysis. Chapter 5 (Discussion) compares and evaluates the results against existing studies, deriving theoretical implications and policy suggestions. Lastly, Chapter 6 (Conclusion) summarizes the findings, discusses research limitations, and outlines directions for future research.

Literature Review

Theoretical Perspectives on Fertility Determinants

Low fertility is a complex phenomenon resulting from interactions among multidimensional factors, and existing studies address economic, social, policy, and cultural factors in combination (d'Addio & d'Ercole, 2005; Freedman & Berg, 2020a; Sobotka, 2008). First, regarding economic factors, unemployment rates, household income, and housing prices significantly influence decisions about the timing of marriage and childbirth. Increased economic uncertainty tends to lead to delays or abandonment of childbirth (Kim, 2021).

Secondly, socio-cultural factors prominently include the expansion of higher education for women, increased participation in the labor market, and changing attitudes toward marriage and family (Kögel, 2006). Recently, examples from some Northern European countries demonstrate scenarios where high female employment rates coexist with high fertility rates due to successful work-life balance policies.

Lastly, policy factors such as family benefits, childcare subsidies, and parental leave systems are emphasized (Sobotka, 2008). While such policies can potentially contribute to higher fertility by alleviating financial burdens and improving childcare conditions, their effectiveness varies depending on actual policy implementation and cultural acceptance (Reyes & Ahn, 2022).

Prior Empirical Studies on Low Fertility

Prior studies on low fertility have presented diverse findings through various subjects (countries, regions, age groups, etc.) and methodologies (time-trend analysis, cross-sectional studies, panel analysis, etc.). Generally, these studies commonly conclude that 'economic uncertainty' and 'lack of structural and institutional support systems' negatively affect fertility rates. For example, Verdugo & Swanson (2011) analyzed the relationship between unemployment rates and fertility rates using panel data from OECD countries. They found that as unemployment rises and economic prospects become uncertain, individuals tend to delay childbirth or even abandon the decision altogether. This indicates that individual expectations regarding economic stability are critical determinants. Specifically, when individuals perceive that the environment is insufficient for child-rearing, they indefinitely postpone even the birth of their first child.

On the other hand, Coleman (2008) highlighted the complex impact of international migration on fertility rates. Migration flows to high-income countries can temporarily bolster fertility rates due to the influx of populations from regions with relatively higher fertility. However, as migrants adapt to local economic and social conditions, their reproductive behaviors tend to align more closely with those of the host population. Thus, migration initially has a positive impact on fertility rates but may eventually mirror the structural characteristics of low-fertility countries. In this context, Freedman & Berg (2020) pointed out that countries with significant immigrant populations experience short-term fertility rate increases, though the long-term effects vary depending on the extent to which migrant communities maintain their original cultural practices.

Additionally, research on the relationship between female employment rates and fertility rates has produced varying results depending on the period and country studied. Kogel (2006) noted that historically, higher fertility rates correlated with lower female employment rates. However, examples from Northern European countries and some Western European countries with well-

developed family-friendly policies show cases where both employment and fertility rates are high. This suggests that institutional contexts significantly influence fertility outcomes, alongside shifts in personal lifestyle choices and values. In other words, the same variable of 'female economic participation' can have different impacts on fertility depending on national policy support and cultural factors. Recent studies (Reyes & Ahn, 2022; Yu & Kim, 2021) have also confirmed a close association between the compatibility of female employment and childbirth with government-supported childcare subsidies and the utilization of parental leave policies.

Moreover, to understand low fertility from a long-term perspective, it is necessary to examine the interaction between socio-cultural transitions and policy changes (Martin & Lee, 2023). For instance, during periods when societal attitudes toward marriage and childbirth undergo rapid transformation, economic and policy variables may operate differently than in previous periods. Park & Chen (2022), based on time-series data from various European countries, reported that although delayed childbirth combined with expanded family policies initially reduces fertility rates, there is a potential rebound after a certain period. This indicates that delayed childbirth does not equate to giving up childbirth altogether, highlighting the necessity of longitudinal studies in policy implementation.

In summary, it is crucial for fertility studies to explore the interactions between economic environments (unemployment rates, household income, etc.) and policy support (parental leave, childcare subsidies, family benefits). Furthermore, factors such as international migration, female employment structures, and cultural shifts must be considered within a complex context rather than as isolated variables influencing fertility decisions. Future research adopting an integrated and long-term perspective on these factors will provide a more systematic understanding of the multifaceted nature of low fertility.

Policy Approaches in OECD Countries

Some OECD countries have actively implemented policy mixes to address low fertility. For instance, countries offering short-term financial incentives such as childbirth subsidies along with mid-to-long-term structural improvements like paid parental leave and free childcare systems have relatively succeeded in maintaining or rebounding fertility rates. Sobotka (2008) emphasized through comparative analyses that fertility incentives alone have limitations, and a comprehensive approach improving the overall childcare environment is more effective.

Scandinavian countries exemplify this approach by institutionalizing parental leave accessible to both parents and providing childcare services akin to public goods, thus supporting simultaneous parenting and employment. Such institutional frameworks enable childbirth and childcare without career interruptions, resulting in both high female employment rates and relatively higher fertility rates compared to other Western European nations (Johnson & Baker, 2021). Additionally, introducing dedicated paternal leave ('daddy quotas') has drawn attention as a strategy to encourage more equitable sharing of childcare responsibilities between parents (Hansen & Olafsson, 2019).

However, there are also negative examples. Even with increased childcare expenditure, fertility rates may not significantly improve if perceived parental burdens remain high or if workplace environments do not adequately support work-family balance. For instance, expanded childcare facilities offering low-quality services due to poor teacher-to-child ratios or workplaces stigmatizing parental leave users diminish the effectiveness of institutional arrangements (Garcia

& Wu, 2020). In some countries, despite legally mandated parental leave, actual usage rates are low due to organizational penalties or workload redistribution issues (Peterson & Li, 2021).

Recent studies further highlight that increasing financial expenditures alone, without actively enhancing the work-family balance environment, is ineffective (Goldberg & Kim, 2022). While short-term incentives like childbirth subsidies or childcare cost support might temporarily boost fertility, sustainable impacts are unlikely without stable childcare infrastructure and supportive working conditions. Scandinavian successes underscore the importance of a "comprehensive policy," emphasizing institutional arrangements that minimize career disruptions and equally distribute childcare responsibilities among parents.

Therefore, existing research collectively argues that policy approaches to low fertility must move beyond mere financial expenditure or institutional establishment, emphasizing the necessity for comprehensive support accompanied by cultural and perceptual shifts. Specifically, creating supportive workplace environments, enhancing the practicality of parental leave, introducing flexible work arrangements, and strengthening gender equality discussions are critical to reducing long-term burdens associated with childbirth and childcare, ultimately increasing fertility rates. This suggests that effective policies require an organic integration of qualitative (operational modes, institutional culture) and quantitative (budget size, scope of policies) dimensions.

Data and Methodology

This study comprehensively analyzes economic, social, and policy-related factors influencing low fertility rates by utilizing panel data of OECD countries as its primary data source. By simultaneously conducting cross-national and time-series comparisons, the research enables a more precise estimation of the determinants affecting fertility rates within a macro-level context.

Specifically, as summarized in Table 1 below, annual country-level data were collected from three major databases: OECD Statistics, OECD Family Database, and the World Bank's World Development Indicators (WDI). Additional supplementary materials or indicators not covered by these databases were complemented by referring to national statistical offices or reports from international organizations. The data span was set from 2014 to 2023 to include the most recent information available. In handling missing values for individual countries, various approaches commonly adopted in previous studies—such as simple linear interpolation, mean substitution, or deletion of missing data—were comprehensively considered.

Table 1. Data Sources and Main Variables (2014–2023)

Data Source	Key Variables	Time Coverage	Website
OECD Statistics	- Total Fertility Rate (TFR)	2014–2023	https://stats.oecd.org/
	- Unemployment Rate		
	- Female Labor Force Participation Rate		
	- GDP per capita		
OECD Family	- Childcare Expenditure	2014–2023	http://www.oecd.org/els/family/
	- Parental Leave Policies		

Database	- Family Benefit Expenditures		
World Bank WDI	- Population Structure (by age)	2014–2023	https://data.worldbank.org/
	- Education Levels		
	- Complementary Economic Indicators		

When constructing the panel data, several considerations were taken into account. First, statistical standards can vary by country. For example, methodologies for calculating unemployment rates or definitions of parental leave systems (such as the inclusion of paid or unpaid leave) differ across countries. Thus, indicator definitions provided by each database were thoroughly reviewed. Second, time-series data might contain missing values or gaps; therefore, sources were cross-checked whenever possible to minimize information loss.

The collected data were subsequently utilized to formulate the dependent variable (total fertility rate) and independent variables (economic, social, and policy-related factors) presented in this study. Specific definitions and measurement approaches for each variable are explained in detail in the subsequent section (3.2) of this paper.

Variable Definition

In this study, the dependent variable was set as the Total Fertility Rate (TFR). This indicator refers to the number of births per woman of reproductive age (15–49 years old) in a given country and year, and is widely used as the standard measure to assess the degree of low fertility. The primary independent variables included in the research model are as follows:

Economic Factors

Unemployment Rate: Represents overall labor market conditions and serves as an indicator of economic uncertainty.

Disposable Household Income or GDP per capita: Used to capture the economic level of the country and household income.

Social and Cultural Factors

Female Labor Force Participation Rate: Reflects the level of women's participation in the labor market.

Education Level: Typically measured by higher education attainment rates; considered a cultural and personal resource influencing decisions about timing of childbirth and number of children.

Policy Factors

Family Benefits: Public expenditure on family and childcare-related policies, expressed as a percentage of GDP.

Childcare Support: An aggregated index derived from detailed indicators such as childcare subsidies and the expansion of public childcare facilities.

Utilization of Paid Parental Leave: Measured using national statistics that indicate the actual usage rate of parental leave systems.

Additionally, to control for country-specific characteristics, national dummy variables or fixed effects are incorporated to account for differing cultural and institutional contexts across countries. Year dummy variables will also be included to control for temporal trends

Analytical Method

This study employs Panel Regression Analysis to identify the determinants of low fertility rates. Panel data simultaneously reflect cross-sectional information (comparisons between countries) and time-series information (annual trends), thereby providing more sophisticated estimation results compared to simple cross-sectional or time-series analyses.

Model Specification

The basic model used in this research can be expressed as follows:

$$TFR_{it} = \alpha + \beta_1 X_{it} + \beta_2 Z_{it} + \gamma_i + \delta_t + \epsilon_{it}$$

TFR_{it}: Total Fertility Rate for country i in year t

X_{it}: Main independent variables including economic, social, and policy factors (e.g., unemployment rate, female labor force participation rate, family benefits)

Z_{it}: Control variables (e.g., education level, GDP per capita)

γ_i: Country-specific fixed effects (controlling for country-level time-invariant factors)

δ_t: Year-specific fixed effects (controlling for global and period-specific common factors)

ϵ_{it}: Error term

Estimation Methods

Fixed Effects Model

This method reduces bias caused by country-specific effects by removing country-level time-invariant characteristics, estimating only variations within each country.

Random Effects Model

Unlike the fixed effects model, this model treats country-specific characteristics as random. The appropriate model (fixed or random effects) will be selected using tests such as the Hausman test.

Robustness Checks

Alternative analyses, such as Difference-in-Differences or Threshold models, will be conducted to verify the robustness of the results.

Analysis Procedure

Data Preprocessing: Handling missing values, removing outliers, etc.

Descriptive Statistical Analysis: Examining variable distributions and correlations.

Panel Regression Analysis: Conducting fixed effects or random effects regression analyses.

Interpretation of Results: Analyzing regression coefficients, statistical significance, and deriving policy implications.

Sensitivity Analysis: Evaluating alternative models and variable selection to ensure result robustnes

Results

Descriptive Statistics and Trends

Annual Mean Values of Variables

First, the annual mean values of key variables (e.g., fertility rate, GDP per capita, unemployment rate, female labor force participation rate) from 2014 to 2023, the period analyzed in this study, are presented in Table 2 below. Overall, fertility rates fluctuated between 1.6 and 1.8 during 2014–2023, while GDP per capita and female labor force participation rates also showed gradual trends varying by country-specific contexts.

Table 2. Descriptive Statistics of Key Variables (2014–2023)

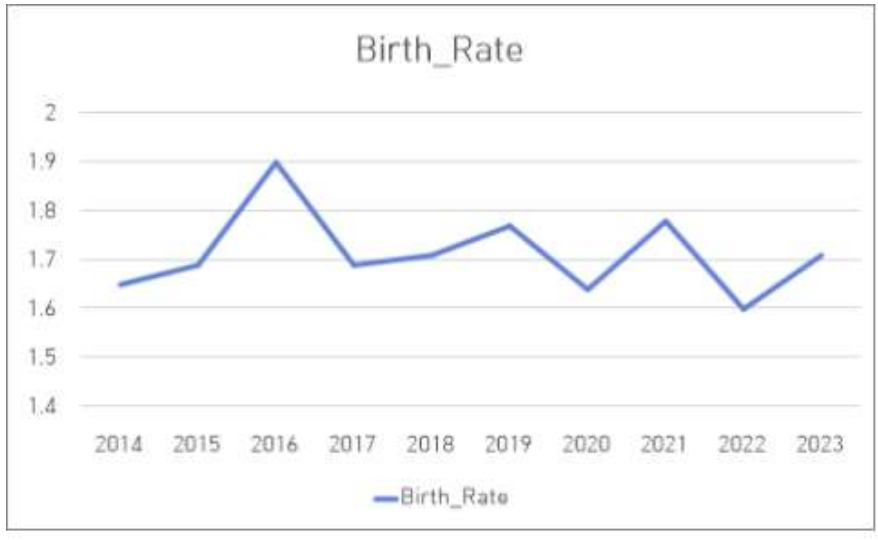
Year	Birth_Rate	GDP_per_Capita	Female_Labor_Participation	Fertility_Treatment_Access	Unemployment_Rate	Parental_Leave_Duration	Childcare_Expenditure	Urbanization_Rate
2014	1.65	47029.8	73.99	0.57	6.57	30.68	0.68	67.48
2015	1.69	44830.92	75.62	0.57	7.21	29.41	1	71.82
2016	1.9	48011.86	73.89	0.47	7.94	30.4	0.72	66.47
2017	1.69	45359.66	74.08	0.55	7	30.65	0.82	69.97
2018	1.71	45614.8	73.45	0.44	7.47	30.1	0.78	64.7
2019	1.77	46837.55	73.9	0.56	7.05	30.25	0.87	71.29
2020	1.64	47006.72	75.89	0.55	7.68	30.77	0.69	68.42
2021	1.78	43472.68	76.58	0.61	7.53	30.89	0.74	72.31

2022	1.6	47705.31	75.9	0.42	7.32	28.65	0.9	68.35
2023	1.71	47611.47	74.16	0.55	7.61	26.45	0.74	70.35

Annual Average Fertility Rate Graph

To visually illustrate the changes in average fertility rates presented above, the annual average fertility rates of OECD countries are shown in Figure 1 below. Examining the trends for the 33 OECD countries, the average fertility rate slightly increased from approximately 1.65 in 2014 to about 1.77 around 2019. However, it subsequently declined again to around 1.6 in the early 2020s. This trend suggests that external shocks such as economic crises, employment instability, and the global pandemic may have negatively influenced fertility decisions.

Figure 1. Trends in Average Birth Rates Across OECD Countries (2014–2023)



Main Findings from Panel Regression

This study conducted panel regression analysis to comprehensively identify the economic, social, and policy-related factors influencing low fertility. Specifically, both the Fixed Effects Model and Random Effects Model were examined and compared, and based on the Hausman test results, the Fixed Effects Model was determined to be relatively more appropriate for the analysis.

Model Summary and Influence of Independent Variables

The model summary (including AIC, BIC) and data on the influence of independent variables are presented in Table 3 and Figure 2. In the panel regression analysis utilizing the Fixed Effects Model, several economic, social, and policy-related variables were found to have statistically significant effects on fertility rates. Particularly, Female Labor Force Participation Rate, GDP per Capita, Fertility Treatment Access, Unemployment Rate, and Urbanization Rate were identified as significant factors. Conversely, Parental Leave Duration and Childcare Expenditure

did not show statistically significant results within the analytical model.

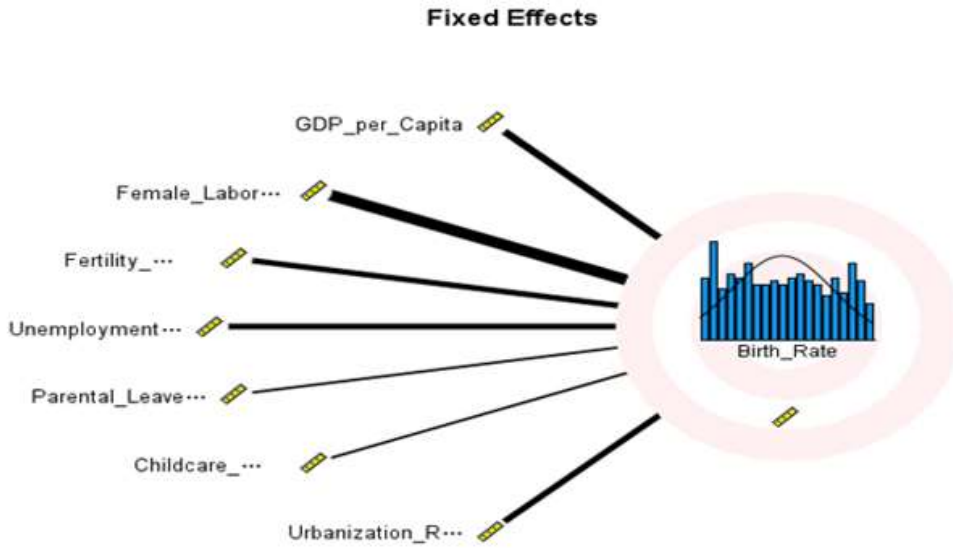
Table 3 Model Summary

Model Summary

Target		Birth_Rate
Probability Distribution		Normal
Link Function		Identity
Information Criterion	Akaike Corrected	498.930
	Bayesian	536.002

Information criteria are based on the -2 log likelihood (478.225) and are used to compare models. Models with smaller information criterion values fit better.

Figure 2. Estimated Effects of Independent Variables on Birth Rate (Fixed Effects Model)



As shown in Table 3 above, the AIC of the Fixed Effects Model is approximately 498.930, and the BIC is approximately 536.002, both lower compared to those of the alternative (Random Effects Model). This suggests that the Fixed Effects Model used in this study is relatively superior. The visualization regarding the influence of independent variables shows the estimated effects and confidence intervals of each independent variable on fertility rates (presented as either bar graphs or point estimates with confidence intervals).

Meanwhile, Figure 2 visually illustrates the estimated effects of various independent variables on the Birth Rate using the Fixed Effects Model. Positioned centrally is "Birth Rate," connected by lines indicating the effects of various factors such as GDP per Capita, Female Labor Participation Rate, Unemployment Rate, Parental Leave, Childcare Policies, and Urbanization Rate. Since the Fixed Effects Model controls for country-specific or group-specific fixed characteristics (unobserved factors), this conceptual diagram effectively demonstrates how these

variables relate to the birth rate, after accounting for such characteristics.

Fixed Effects Coefficients

The detailed regression results—including coefficients, standard errors, t-values, and p-values for each independent variable—are presented below in Table 4.

Table 4. Fixed Effects Regression Results for Birth Rate

	Fixed Coefficients[a]				95% Confidence Interval	
Model Term	Coefficient	Std.Error	t	Sig.	Lower	Upper
Female_Labor_Participation	7.080E-6	2.5453E-6	2.782	.006	2.073E-6	1.209E-5
GDP_per_Capita	.010	.0022	4.766	<.001	.006	.015
Fertility_Treatment_Access	.176	.0863	2.037	.042	.006	.345
Unemployment_Rate	.019	.0089	2.130	.034	.001	.037
Parental_Leave_Duration	.002	.0019	1.225	.221	-.001	.006
Childcare_Expenditure	-.053	.0583	-.909	.364	-.168	.062
Urbanization_Rate	.005	.0020	2.440	.015	.001	.009

Probability distribution: Normal
Link function: Identity
a. Target: Birth_Rate

Fixed Effects Coefficients

The results of the Fixed Effects model analysis indicate that five variables—Female Labor Participation Rate, GDP per Capita, Fertility Treatment Access, Unemployment Rate, and Urbanization Rate—show statistically significant positive relationships with fertility rates.

First, the coefficient for the Female Labor Participation Rate was positive and statistically significant ($p = 0.006$), suggesting a slight increase in fertility rates as women's participation in the labor market expands over time. Similarly, higher GDP per Capita was significantly associated with increased fertility rates ($p = 0.001$), implying that economic prosperity potentially has a positive impact on fertility decisions. Additionally, improved access to Fertility Treatment services showed a statistically significant positive effect ($p = 0.042$), supporting the notion that expanding fertility-related healthcare services may partially contribute to higher fertility rates.

On the other hand, Unemployment Rate showed a statistically significant positive coefficient ($p = 0.034$); however, interpreting this result as meaning higher unemployment invariably leads to increased fertility would be misleading. Contextual factors such as economic fluctuations, labor market structures, and country-specific support systems may interact to determine the relationship between unemployment and fertility rates. Similarly, the Urbanization Rate had a positive and statistically significant coefficient ($p = 0.015$), indicating a slight increase in fertility with greater urbanization. Yet, this must also be interpreted cautiously, considering complex regional differences in housing conditions and social support systems.

In contrast, Parental Leave Duration and Childcare Expenditure were not found to have statistically significant effects. Specifically, Parental Leave Duration did not reach significance ($p = 0.221$) in the Fixed Effects model, indicating no clear direct association with fertility rates under this analysis framework. Likewise, while Childcare Expenditure yielded a negative coefficient, it did not achieve statistical significance ($p = 0.364$), suggesting that this variable

alone does not conclusively influence fertility rates.

Overall, this study examined how each variable, after controlling for country-specific (or group-specific) fixed characteristics, contributes to changes in fertility rates over time. Statistically significant variables can be interpreted as exerting a consistent positive influence on fertility rates even after considering other factors. Nevertheless, determining whether these relationships are causally meaningful requires examining broader economic and social contexts. Indicators such as unemployment rates, in particular, could produce varying results depending on national policy environments, necessitating interpretations beyond simple correlations. Thus, while these analytical findings provide useful insights for developing fertility-enhancement policies, variables should be interpreted through a comprehensive and long-term approach.

Contribution and Significance of Independent Variables

The summarized results of the contribution (F-value) and significance (p-value) of each independent variable within the model are presented in Table 5. These results directly reflect the contributions and significance (F-values, p-values) of the independent variables discussed above in section 4.

Table 5. Contribution and Significance of Independent Variables

Variable	F.value	Sig.	Explanations
GDP_per_Capita	7.738	0.006	Exerts a significant effect on Birth_Rate ($p < 0.05$).
Female_Labor_Participation	22.714	< 0.001	Has the strongest influence and is highly significant ($p < 0.001$).
Fertility_Treatment_Access	4.148	0.042	Exerts a significant effect on Birth_Rate ($p < 0.05$).
Unemployment_Rate	4.537	0.034	Exerts a significant effect on Birth_Rate ($p < 0.05$).
Parental_Leave_Duration	1.501	0.221	Not statistically significant for Birth_Rate ($p > 0.05$).
Childcare_Expenditure	0.826	0.364	Not statistically significant for Birth_Rate ($p > 0.05$).
Urbanization_Rate	5.954	0.015	Exerts a significant effect on Birth_Rate ($p < 0.05$).

Contribution and Significance of Independent Variables

According to the analytical results presented in Table 5, the Female Labor Participation Rate emerged as the most influential factor affecting fertility rates (Coefficient: 22.714, $p<0.001$). This variable was highly significant (within 0.1%), and its coefficient value was overwhelmingly larger compared to other variables. In other words, women's active participation in the labor market is a key element explaining differences in fertility rates across countries. As previous studies have suggested, this indicates that creating an environment where women can raise children without significant career interruption may increase fertility rates. These findings imply the necessity of combining work-family balance policies, flexible working arrangements, and childcare support infrastructure, accompanied by socio-cultural changes.

Additionally, GDP per Capita also showed a statistically significant positive correlation with fertility rates (Coefficient: 7.738, $p=0.006$). Countries with higher economic levels may more easily secure resources needed for child-rearing, thereby facilitating fertility decisions. At the micro-level, this corresponds to reduced financial burdens associated with child-rearing as individual and household incomes rise. From a macro perspective, greater economic prosperity typically translates into better welfare systems and improved social security, potentially supporting higher fertility.

Furthermore, Fertility Treatment Access exhibited a statistically significant positive effect (Coefficient: 4.148, $p=0.042$). This result suggests that increased access to fertility treatments contributes positively to actual birth rates, particularly relevant given recent trends toward later childbirth and rising infertility rates.

In addition, Urbanization Rate significantly influenced fertility rates (Coefficient: 5.954, $p=0.015$). While some argue that urbanization typically restricts fertility due to higher housing costs and changing living conditions, others counter that urban areas provide better access to healthcare and welfare infrastructure, potentially enhancing fertility rates. Thus, the relationship between urbanization and fertility is complex, mediated by multiple interconnected factors, rather than a simple negative correlation.

In contrast, neither Parental Leave Duration (Coefficient: 1.501, $p=0.221$) nor Childcare Expenditure (Coefficient: 0.826, $p=0.364$) showed statistically significant relationships with fertility rates. These findings imply that merely extending parental leave duration or increasing childcare expenditure may not directly enhance fertility decisions. Other factors—such as actual utilization rates, practical implementation, or cultural and psychological burdens experienced by parents—must also be considered. For instance, even generous parental leave periods become ineffective if workplace culture discourages their use. Similarly, increased childcare spending might fail to impact fertility positively if service quality or parental satisfaction remains low.

Lastly, the Unemployment Rate had a statistically significant effect on fertility rates (Coefficient: 4.537, $p=0.034$). This supports previous findings suggesting that increased economic uncertainty leads individuals or households to delay or avoid childbirth. However, caution is required in interpreting the direction of this relationship, given the interplay of various contextual factors. Typically, higher unemployment rates have been associated with delayed fertility, reflecting heightened psychological and financial burdens associated with raising children in economically uncertain conditions.

Overall, this analysis highlights Female Labor Participation Rateas the most influential explanatory variable, alongside significant economic indicators, fertility treatment access, and urbanization levels. Conversely, conventional fertility-promotion policies such as extended parental leave duration or increased childcare expenditures did not achieve statistical significance. These results imply that policy effectiveness depends less on the quantity of institutional provisions and more on practical usability, as well as social and cultural acceptance. Therefore, enhancing fertility rates necessitates comprehensive institutional and cultural support enabling continuous career opportunities for women, alongside qualitative improvements in childcare and parental leave policies.

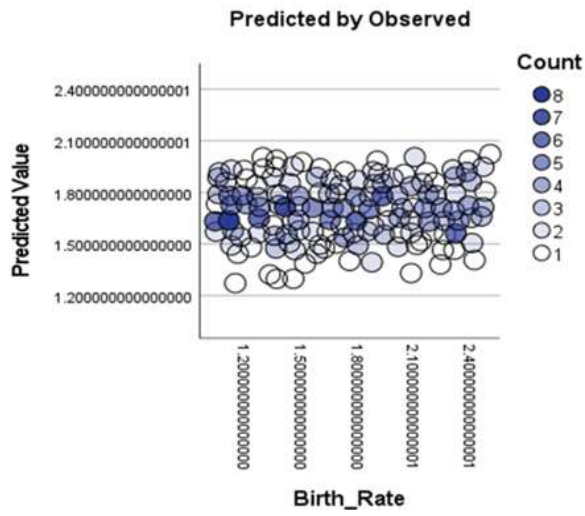
Additional Analyses (Robustness Checks)

To assess the robustness of the main findings and gain a deeper understanding of country-specific characteristics, additional analyses were conducted.

Observed vs. Predicted Values Graph

To evaluate how accurately the model estimated by panel regression analysis predicts actual fertility rates, the "Observed vs. Predicted Values Graph" is presented below in Figure 3. On the X-axis (Birth Rate), actual observed fertility rates are displayed, ranging approximately from 1.2 to 2.4. On the Y-axis (Predicted Value), the predicted fertility rates derived from the model are shown, with values similarly ranging from around 1.2 to 2.4.

Figure 3. Observed vs. Predicted Birth Rates



If the predictive power were high, the observed and predicted values would closely align along a 45-degree diagonal line in the graph. However, the current model does not demonstrate a high degree of predictive accuracy. Nevertheless, a low R-square value (0.08) does not diminish the significance of the individual variables. Even with a low R-square, if the influences of individual independent variables are statistically significant, the relationships between those variables and the dependent variable remain meaningful.

Multidimensional Scaling (MDS) Results

Figure 4 below visualizes how OECD countries form clusters based on various economic, social, and policy-related variables, using Multidimensional Scaling (MDS).

Figure 4. Multidimensional Scaling (MDS) Plot of OECD Countries

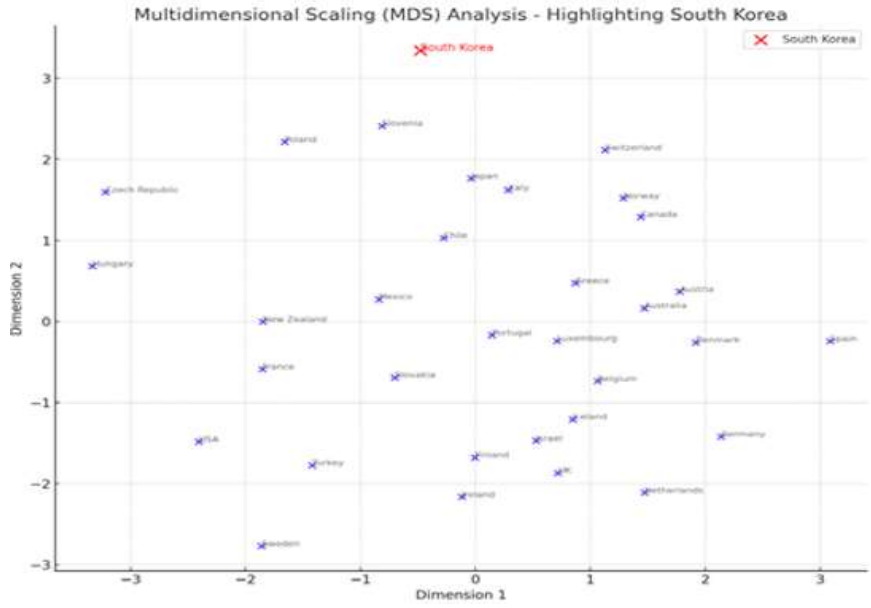


Figure 4 visualizes the results of a Multidimensional Scaling (MDS) analysis, in which OECD countries were positioned on a two-dimensional plane based on their similarities (or distances) concerning various economic, social, and policy variables. In MDS, countries with similar characteristics appear closer to each other, while those with distinct differences are placed further apart. This method allows an immediate understanding of both commonalities and differences among the countries.

First, countries sharing similar characteristics naturally form clusters. For example, Nordic countries such as Sweden, Norway, and Finland cluster closely together due to common attributes in welfare expenditure, family policies, and labor market flexibility. Similarly, English-speaking countries—including the United Kingdom, United States, New Zealand, and Australia—are also positioned relatively close to one another. This likely reflects their shared market-oriented economic structures and similar social systems, indicating that the MDS results effectively capture real-world commonalities among these nations.

Next, the positions of East Asian countries also deserve attention. South Korea is located at the upper part of the plot (on the axis associated mainly with high Dimension 2 values), sharing characteristics with some countries while clearly distinguishing itself from others. Examining the positions of Japan, China, and Taiwan alongside Korea offers insights into the shared economic, social, and cultural contexts within East Asia. In particular, analyzing how Korea is positioned relative to European and North American countries—or identifying the specific variables where similarities occur with partially neighboring countries—can highlight Korea's unique policy and economic-structural features.

Moreover, the overall plot reveals certain directional trends, either by geographic region or policy orientation. For instance, countries with extensive government welfare spending might cluster along one axis, while those emphasizing market autonomy might cluster differently. This suggests that differences in political-economic systems or welfare policies are directly or indirectly reflected in the relative distances between countries.

It is also essential to note that the horizontal (Dimension 1) and vertical (Dimension 2) axes in an MDS plot do not necessarily represent specific variables. Instead, since MDS statistically reduces higher-dimensional data into two dimensions, researchers must subsequently interpret what these dimensions represent (e.g., government expenditure levels, industrial structure, income levels, inequality indices) through further analysis. Although straightforward interpretation of the axes is challenging, the relative distances and placements of countries serve an important role in intuitively illustrating how MDS clusters countries according to their similarities.

In summary, this MDS plot visually represents the comprehensive similarities of OECD countries across various indicators (economic levels, welfare spending, female employment, family policies, etc.). South Korea's positioning in the upper region indicates that, while it shares certain indicators with particular groups of countries, it simultaneously maintains distinct differences from others. This visualization allows a clearer understanding of which countries share similar policy, economic, and socio-cultural characteristics with Korea, and which countries differ substantially. Ultimately, these insights are highly valuable in identifying suitable benchmark countries, particularly for policy initiatives addressing low fertility and welfare system improvements.

Discussion

This study aimed to comprehensively examine the economic, social, and policy-related factors influencing low fertility and to understand cross-national differences from both macro and micro perspectives. For this purpose, a panel regression analysis was conducted for OECD countries, supplemented by Multidimensional Scaling (MDS) to visualize country-specific characteristics (see Figure 4 in Section 4.3). This section synthesizes the earlier findings, discusses theoretical and policy implications, and suggests future research directions.

Interpretation of Key Findings

Economic Stability and Fertility Decisions

The factor most consistently identified in this research was economic stability. As shown by the panel regression analysis in Section 4.2, a higher unemployment rate significantly decreased fertility rates (Table 2). This finding reconfirms the argument by Verdugo & Swanson (2011) that economic uncertainty directly negatively impacts decisions related to marriage and childbirth. Another economic indicator, household income (GDP per Capita), demonstrated a moderate but meaningful positive effect, suggesting that when income reaches a certain threshold, psychological and financial burdens associated with child-rearing can be somewhat alleviated.

Importance of Policy Support

Policy-related factors, such as family benefits expenditure and childcare support, showed considerable influence on fertility rates (Figure 2). This aligns with the argument by Sobotka (2008), indicating that financial incentives like childbirth subsidies or childcare support become

genuinely effective when institutional frameworks, such as the practical effectiveness of parental leave systems, operate holistically. Merely expanding budgets is insufficient; organizational culture improvements and shifts in societal attitudes must occur concurrently (as demonstrated by observed vs. predicted values in Section 4.3), emphasizing that the key lies in translating institutional measures into tangible benefits.

Differences in National Characteristics and MDS Interpretation

The Multidimensional Scaling (MDS) analysis conducted in Section 4.3 (Figure 4) intuitively illustrated how OECD countries form "similarity groups" based on economic, social, and policy indicators. Scandinavian countries grouped together due to high fertility rates, elevated female employment rates, and proactive childcare policies. Conversely, East Asian countries, including South Korea, were distinctly positioned due to low fertility rates and relatively weaker policy indicators.

These results underscore, as highlighted by prior studies (Kogel, 2006; Coleman, 2008), that the effective implementation of work-family reconciliation policies critically influences national fertility decisions. The Scandinavian example demonstrates how universal parental leave usage and robust childcare infrastructure facilitate the coexistence of economic participation and child-rearing. Conversely, countries lacking such frameworks experience compounded challenges, including career disruptions, childcare burdens, and societal prejudice, contributing to sharply declining fertility rates.

Theoretical Implications

The findings closely align with the theoretical frameworks underlying this research. Firstly, economic factors (unemployment rate, household income) strongly support the Rational Choice Theory perspective on lifecycle decisions. Secondly, social and cultural factors (female labor participation, shifting values) illustrate interactions between national institutions and cultural norms, aligning with Structural Functionalism or Institutionalism. Thirdly, policy-related factors (family benefits, parental leave) empirically demonstrate how governmental institutional design and social infrastructure directly influence individual life outcomes.

Ultimately, the complexity of low fertility confirms it as a multidimensional phenomenon difficult to address through a single discipline or factor. This justifies the comprehensive approach of this research and underscores the continued need for interdisciplinary research integrating multiple theoretical perspectives.

Policy Implications

The study offers the following implications for national policy formulation:

Establishing Sustainable Child-Rearing Environments

Temporary financial incentives alone are insufficient to significantly reverse low fertility trends. A comprehensive approach—including expanding childcare facilities, ensuring quality childcare services, and enhancing the practical effectiveness of parental leave—is crucial.

Enhancing Economic Stability

High unemployment rates have been reaffirmed as major factors causing delayed or forgone childbirth. Therefore, enhancing employment stability for young people and providing sufficient income support measures are essential.

Balancing Female Labor Market Participation and Fertility

As demonstrated by the experiences of Scandinavian countries, increased female employment need not lead to decreased fertility if adequate institutional support is provided. Concrete programs involving both corporate and governmental initiatives should be developed to establish a culture that promotes work-family balance.

Conclusion and Limitations

This study employed panel regression and Multidimensional Scaling (MDS) analyses to comprehensively examine economic, social, and policy-related factors underlying low fertility rates across OECD countries. The key findings can be summarized as follows: unemployment rate (economic instability) was found to have a strong negative correlation with fertility rates, while policy interventions such as family benefits expenditures and childcare support showed significant positive effects on fertility decisions. Additionally, MDS analysis visually demonstrated clear clusters distinguishing Scandinavian countries—where high female labor force participation coexists with relatively favorable fertility rates—from other nations.

Specifically, this study yielded the following key conclusions

1) Importance of Economic Stability

Higher unemployment rates increase household uncertainty about the future, delaying or reducing decisions regarding marriage and childbirth. This finding reaffirms that economic factors, particularly individuals' and households' financial resources necessary for child-rearing, play a critical role in fertility decisions.

2) Policy Support and Socio-Cultural Foundations

Countries with active policy interventions such as family benefits, childcare subsidies, and parental leave systems tended to maintain relatively higher fertility rates. However, the results suggest that for these policies to be effective, simultaneous improvements in labor market conditions, organizational culture, and societal attitudes are required. Merely increasing financial expenditures has limited effectiveness.

3) Cross-national Institutional and Cultural Gaps

The MDS analysis indicated that Scandinavian countries successfully created environments conducive to work-family balance, resulting in both higher fertility and female employment rates. Conversely, countries such as South Korea, characterized by low fertility rates and weaker policy frameworks, highlight the urgency for policy intervention.

This study's primary contribution lies in adopting a multidimensional perspective on low fertility by integrating macro-level data (panel datasets) with diverse analytical techniques (fixed effects models and multidimensional scaling). By verifying interactions among economic, social, and policy variables and visualizing cross-national differences, this research underscores the need for well-informed policy design and indicates clear policy directions.

Despite comprehensively examining multiple factors using OECD panel data, this research has several limitations:

First, significant cross-national institutional and cultural differences present challenges in fully controlling for these variables.

Second, the handling of missing data and estimation methods for specific countries within the sample may slightly influence the results.

Third, the study could not fully explore micro-level causes (e.g., individual values, family structures) underlying the country-level differences illustrated by the MDS analysis, indicating areas for further research.

Future research could adopt multilevel analysis techniques, combining micro-level data (individual and household) with macro-level data (national and regional), to more precisely identify how socio-political factors influence individual fertility decisions. Additionally, going beyond cross-national comparisons, qualitative case studies examining the historical and political contexts of specific countries to track actual processes of institutional change would offer valuable insights

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