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Total Fertility Rate relations in South Korea, evaluating the correlation of factors with the TFR of South Korea: Approach with Regression Analysis

Jinwoo Lim

North London Collegiate School Jeju

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ABSTRACT

South Korea's low fertility rate poses significant economic challenges, as it reduces workforce numbers, lowers productivity, and increases dependency. This study examines the economic factors and policy interventions that may impact total fertility rates. Using linear regression models, the analysis tests the hypothesis that tax credits, parental leave duration, and health expenditure have a positive correlation with fertility, while childcare costs, housing price index, youth unemployment, and contraception rate have a negative correlation. Results show that fertility rates are most strongly associated with health expenditure priorities and contraceptive availability, while the association of family benefits such as childcare support and parental leave policies remains limited once long-term demographic patterns are taken into account.

Introduction

The World Bank (2024) reports that South Korea achieved the lowest total fertility rate (TFR) worldwide at 0.72 in 2024. A low fertility rate creates economic challenges because it diminishes workforce numbers, reduces productivity levels, and increases the number of dependents. The low birth rate in South Korea is expected to lead to a transformation of the world's most aged society by 2070. The demographic imbalance creates pension and healthcare systems, while damaging economic stability and placing excessive financial and social burdens on younger citizens. Economic barriers are the primary cause of South Korea's demographic crisis, as they persistently affect the population. The combination of expensive housing costs with high childcare expenses, unstable youth employment, and mandatory private education expenses has led young Koreans to delay or give up on marriage and childbearing. The existing structural conditions persist despite multiple decades of government support through pro-natalist fiscal policies, which offer direct subsidies, childcare vouchers, and tax benefits to families with children. The success rate of these policies remains unknown. The research paper examines the

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economic factors and policy interventions influencing changes in South Korean fertility through an analysis of recent fertility rate data and variables that affect fertility rates. The study evaluates South Korean government initiatives by analyzing standardized regression coefficients to identify which programs produce measurable fertility outcomes.

Literature Review

The research suggests that South Korea's declining birth rates are partly attributed to high youth unemployment rates. The NCFR study "Deconstructing the Fertility Decline in South Korea" reveals that 40% of young people between 15 and 29 years old remain unemployed, while 25% of this group pursue education or vocational training. The high rate of economic inactivity among youth leads to lower marriage and family creation because jobless young people show a reduced likelihood of getting married and having children. The combination of youth unemployment with economic instability leads to decreased family formation rates, which, according to research experts, continues to lower birth rates.

The expenses associated with childcare create a significant obstacle that prevents South Korean families from having more children. The Financial Times survey reveals that South Korean preschool children attend private "cram" schools, which results in ₩332,000 ($228 USD) monthly childcare expenses for an average child, while some families spend up to ₩1.5 million. The combination of increasing child-rearing expenses and education costs creates substantial financial challenges, leading many couples to postpone or abandon childbearing. The research by Jang et al. (2021) indicates that increasing housing costs relative to income levels lead couples to delay marriage and reduce their childbearing plans, while high childcare and education expenses exacerbate these effects.

Research shows that fiscal policy creates long-term effects on birth rates through its impact on employment and childcare expenses. The mid-1970s tax reforms of Kim and Yum (2024) in Fertility Decline and Tax Revenues in South Korea resulted in higher household tax obligations, which reduced available income and made people less likely to have children. The research shows that tax policy structures and amounts determine both direct family expenses and overall affordability, which includes childcare costs. The research by Bijaya et al. (2024) demonstrates that extended parental leave periods, along with increased family benefit funding from the government, lead to higher birth rates, yet ongoing living expenses and widespread contraceptive use diminish these positive effects. The research indicates that South Korea faces a fertility crisis due to multiple factors that combine economic instability with fiscal challenges and restrictive social policies.

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Data Source

The data used in this study are drawn primarily from the World Bank (1990–2024) and the OECD Family Database (2000–2024). Additional statistics on childcare costs and housing affordability were obtained from the OECD Tax-Benefit (TaxBEN) model and national statistical agencies, including KOSIS (Korea) and e-Stat (Japan). These datasets provide consistent, cross-nationally comparable information on fertility-related policy variables and macroeconomic indicators.

Variables of Investigation

Dependent Variable

Table 1. Following Dependent Variables

Dependent Variables	Explanation of the variable
Total Fertility Rate (TFR)	The average number of children born per woman, measured annually.

Independent Variables

Table 2. Following Independent Variables

Independent Variables	Explanation about variables
Income Tax Rate	Income tax is a government levy on the earnings of individuals and businesses
Parental Leave Duration (weeks)	The statutory number of weeks of paid leave available to parents after childbirth.
Current Health Expenditure (% of GDP)	National expenditure on health as a share of GDP, reflecting investment in social infrastructure.
Contraception Rate	Proxy for family planning practices and childbearing decisions. Percentage(%) of women aged 15–49 using contraception
Childcare Cost	Net cost of childcare after subsidies and tax benefits. Percentage(%) of disposable household income

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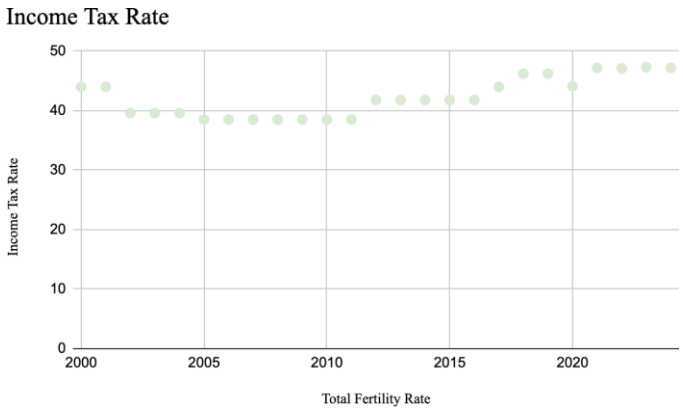
Housing Price Index (HPI)	Ratio of housing prices to income, indicating affordability.
Female Unemployment Rate	The percentage of the female population aged 24 -40 who are unemployed. Indicator of labor market stability for female cohorts considering marriage and family formation.

Hypothesis:

It is expected that tax credits, parental leave duration, and health expenditure will show a positive correlation with fertility, while childcare cost, housing price index, youth unemployment, and contraception rate will demonstrate a negative correlation with fertility. This paper conducts two-tailed tests to study whether the regression coefficient corresponding to each independent variable is significantly different from 0.

Raw Data Plots:

Fig 1. Raw data plot of each independent variable against time (t)

Independent Variables	Visual Plots
Income Tax Rate	

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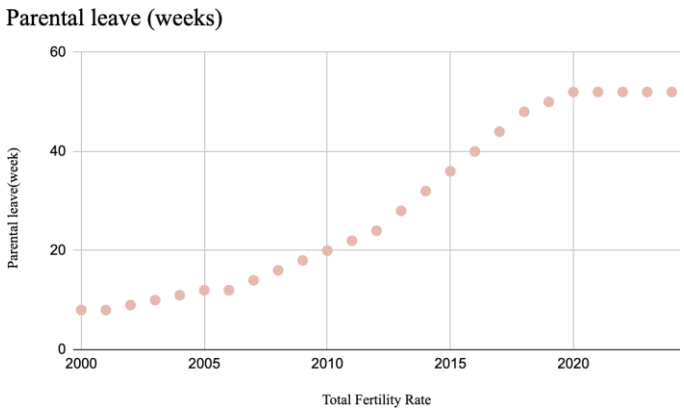
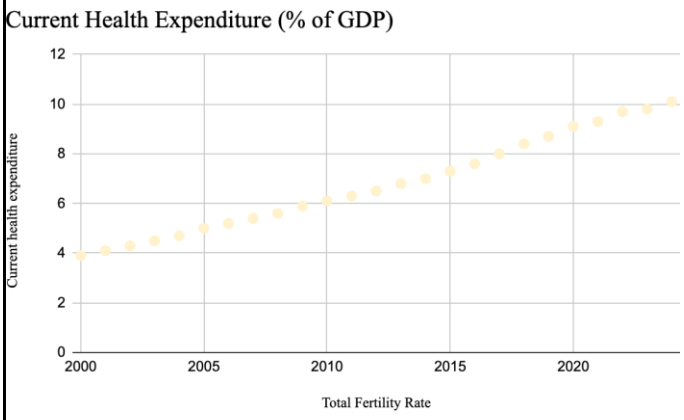
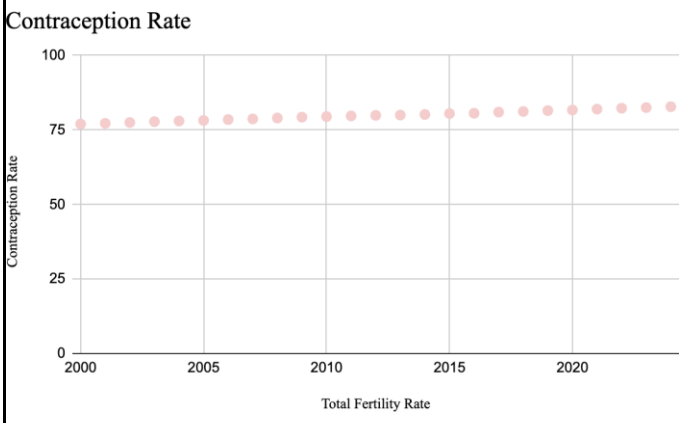
Parental Leave Duration (weeks)	
Current Health Expenditure (% of GDP)	
Contraception Rate	

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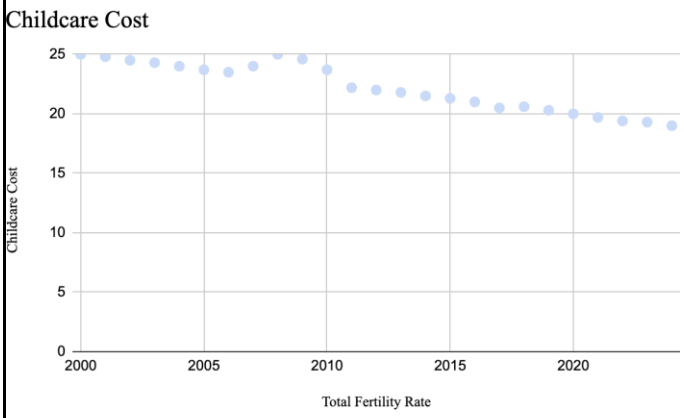
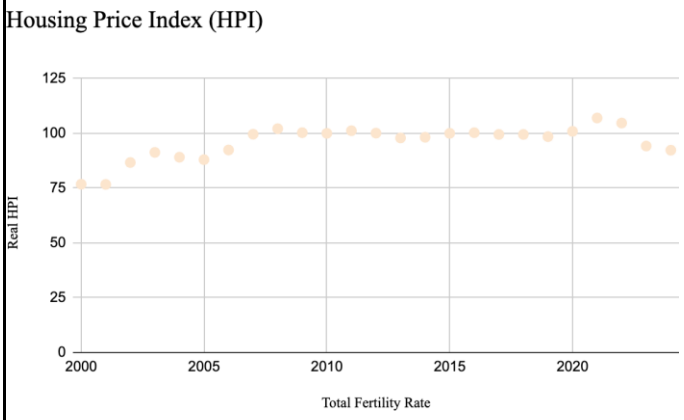
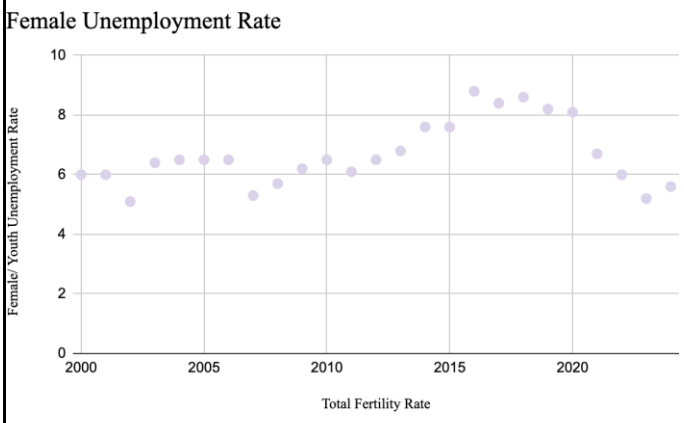
Childcare Cost	
Housing Price Index (HPI)	
Female Unemployment Rate	

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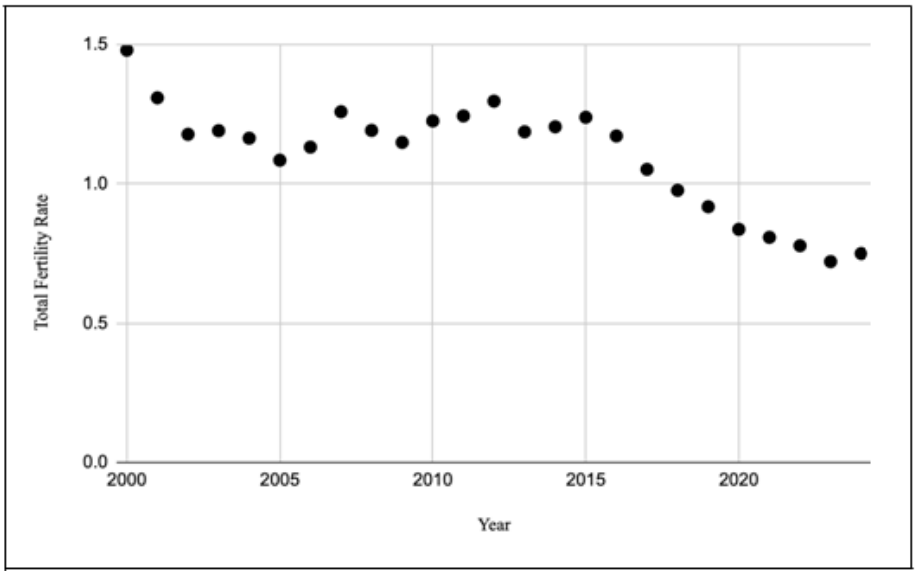
Fig 2. Raw data plot of the dependent variable against time (t)



Raw Data Plots Observation:

The raw data plots from Fig 1, present distinct patterns between variables because parental leave duration and health expenditure continued to grow but childcare expenses and housing prices either declined minimally or remained steady after their first increase. The total fertility rate decreased while female unemployment rates experienced irregular patterns and contraception usage rates remained steady at elevated levels. The total fertility rate declined even though leave and healthcare policies expanded because economic and social elements proved stronger than supportive measures. Fig. 2, which represents the trend of the total fertility rate of South Korea from 2000 to 2024, shows a fluctuation until 2013 and a rapid decline thereafter until 2024.

Research Methodology

The research paper analyzed data using linear regression models with the total fertility rate and other independent variables above to estimate the correlation between the TFR and these variables, respectively. I staggered the analysis in three stages, described as follows:

2. Simple single variable regression: The analysis begins with a series of bivariate regressions between TFR and each independent variable (tax credit, parental leave duration, health expenditure, contraception rate, childcare cost, housing price index, and youth unemployment rate). This step identifies the direction (positive or negative) and magnitude of each factor's individual association with fertility. I present the coefficients from the regression analysis in Table 3.

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$$TFR_t = \alpha + \beta_i X_i$$

The TFR_t model above is a linear function of each independent variable separately, where TFR_t is the total fertility rate in year t , X_t represents each independent variable, β_t is the estimated regression coefficient capturing the marginal effect of each independent variable on TFR_t , and α is the intercept, which is not critical in this research.

2. Augmented Models with time controls: To account for long-term demographic shifts and secular decline in fertility, the regressions are augmented with a time variable (t). This adjustment removes the influence of general downward trends in TFR, thereby isolating the de-trended effect of each explanatory variable. This helps determine whether policies such as childcare subsidies or tax credits are correlated with the TFR in the short term, beyond any structural decline.

3. Multiple regression with all variables: The final stage of analysis employs a multiple regression model, combining all independent variables simultaneously. This enables comparison of the relative strength of coefficients after controlling for overlapping effects between variables. The significance of the regression coefficients (beta values) is used to compare the strength of the association with TFR across the variables. This step helps identify which policy instruments (e.g., tax relief vs. childcare cost reduction) have the most significant correlation with fertility outcomes.

Data Analysis

Table 3 presents the results from the first stage of analysis. The paper runs separate regressions of TFR on each independent variable for the period (2000-2024).

Table 3. Regression coefficients from the individual regression of TFR on the independent variable

Reg results of TFR on Independent Var	Childcare Cost	Housing Price Index	Current Health Expenditure (% of GDP)	Contraception Rate	Female Unemployment Rate	Parental Leave (Week)	Income Tax Rate
Coefficient	0.0765	-0.0103	-0.0863	-0.0937	-0.0166	-0.00936	-0.0400
t-value	6.19	-2.10	-7.72	-6.92	-0.438	-6.70	-4.31

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p-value	0.000	0.0465	0.000	0.000	0.665	0.000	0.000
R-square	0.620	0.161	0.721	0.675	0.00831	0.661	0.447
No. of Observation	25	25	25	25	25	25	25

Reference t-values for N=25 for a two-tailed test of significance for the coefficients:

- 90% CI = 1.711 ; 95% CI = 2.064 ; 99% CI = 2.797

Most coefficients in Table 3 align with economic intuition, except for childcare costs, current health expenditures, and parental leave. However, childcare cost shows a positive coefficient (0.0765), indicating that higher childcare costs are associated with higher TFR, which is counterintuitive. This result is statistically significant (t = 6.19 > 2.064 at 5% level of significance), suggesting a strong effect. Similarly, current health expenditure (% of GDP) exhibits a strong negative impact on TFR (t = -0.0863), which is significant at the 1% level (t = -7.72). This is also counterintuitive, as one would expect that more health expenditure on social health infrastructure must be associated with a fertility increase. A plausible reason could be omitted variables: rising childcare costs might coincide with government subsidies or benefits that indirectly encourage childbirth, confounding the relationship.

Parental leave duration shows a negative and significant effect (-0.00936, t = -6.70), which is opposite to the expected positive direction. A plausible reason is reverse causality: parental leave policies expanded as fertility fell, so the policy increase is correlated with lower fertility over time rather than driving it upward.

On the other hand, the housing price index has a negative coefficient (-0.0103), which matches expectations (higher housing costs discourage fertility). The effect is marginally significant (t = -2.10< -2.064 at 5% level of significance). Similarly, the contraception rate shows a strong negative impact on TFR (-0.0937), highly significant at the 1% level (t = -6.92). This aligns with the idea that more contraceptive use is associated with fertility decline. Income tax rate also shows a negative and significant effect (-0.0400, t = -4.31), consistent with the idea that higher taxation reduces disposable income and discourages family expansion. Lastly, the female unemployment rate shows a weak, but insignificant effect (t = -0.438 < 1.711). The insignificance might be due to relatively stable female employment in Korea or offsetting mechanisms (e.g., government policies). Next, I present results from two-variable linear regressions, including time with each independent variable.

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Table 4. Multivariable regressions of TFR with each independent variable and time trend (t). In panel A, the paper presents the coefficient and t-stat of the independent variable. In panel B, the paper presents the corresponding estimates for time(t) from each regression.

Reg results of TFR on Independent Var & Time	Childcare Cost	Housing Price Index	Current Health Expenditure (% of GDP)	Contraception Rate	Female Unemployment Rate	Parental Leave (Week)	Income Tax Rate
PANEL A							
Coefficient (Independent Variables)	0.0137	0.0061	-0.461	-0.552	0.0439	-0.005	-0.0111
t-value	0.319	1.50	-5.18	2.02	1.95	-0.767	-1.08
PANEL B							
Coefficient (time)	-0.0182	-0.0260	0.0996	0.108	-0.0242	-0.0103	-0.0182
t-value	-1.527	6.14	4.23	1.68	-7.28	-0.672	-3.94
R-square	0.661	0.691	0.846	0.712	0.709	0.668	0.676
No. of Observation	25	25	25	25	25	25	25

- Reference t-values for N=25 for a two-tailed test of significance for the coefficients:
- 90% CI = 1.711 ; 95% CI = 2.064 ; 99% CI = 2.797

When time is controlled, coefficients shift notably. For instance, childcare cost flips from a positive and significant effect (0.0765) to a near-zero, insignificant effect (0.0137, t = 0.319). This suggests the strong effect in Table 3 could have been primarily driven by time trends.

Similarly, the housing price index becomes positive (0.00611, t = 1.50), losing the initial negative effect. This indicates that after accounting for time, the housing effect is weaker and not statistically significant. Health expenditure remains strongly negative (-0.461, t = -5.18), consistent and robust across both models. The contraception rate remains negative and significant (-0.55, t = 2.02 > 1.711), although the magnitude is slightly reduced. The duration of parental leave loses its significance (-0.005, t = -0.767), reinforcing the earlier suspicion that the negative effect is time-driven. Income tax rate remains negative but smaller (-0.0111, t = -1.08),

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losing significance compared to Table 3. Overall, the time trend reduces spurious correlations and reveals that mainly health expenditure and contraception rate remain robustly significant.

The above results are intuitive because TFR is affected by multiple variables simultaneously. Therefore, it is key to run a regression model with all variables to see the standalone effect of each variable, while controlling for the others.

Table 5. All Independent variables together: The variable association with TFR remains robust and consistent

Reg results of TFR on Independent Var:	Coefficient	t-value	No. of Observation	R-square
Childcare Cost	0.0148	0.44	25	0.9103
Housing Price Index	0.00160	0.35	25	0.9103
Current Health Expenditure (% of GDP)	-0.741	-3.45	25	0.9103
Contraception Rate	0.0123	0.04	25	0.9103
Female Unemployment Rate	-0.00404	-0.12	25	0.9103
Parental Leave(Week)	0.00517	0.38	25	0.9103
Income Tax Rate	0.0292	2.01	25	0.9103

- Reference t-values for N=25 for a two-tailed test of significance for the coefficients:
- 90% CI = 1.711 ; 95% CI = 2.064 ; 99% CI = 2.797

The multiple regression model in Table 5 evaluates how all independent variables affect Total Fertility Rate (TFR) through simultaneous analysis. The model demonstrates exceptional fit because it explains more than 90% of fertility variations through the seven variables (R^2 = 0.9103). The variable current health expenditure (% of GDP) maintains its statistical significance ($t = -3.45 > |2.064|$) with a strong negative coefficient (–0.741) which shows that higher national health spending leads to ongoing fertility reduction. The income tax rate shows a positive relationship with fertility at a marginally significant level (t = 2.01) which could stem from how

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redistributive policies affect families. The structural variables explain South Korea's fertility patterns because the t-values of childcare cost and housing price index and parental leave and female unemployment rate remain below 1.71. The results demonstrate that structural and fiscal elements continue to drive South Korea's fertility patterns after accounting for controlling multicollinearity and time dependent effects.

Analysis Discussion

The three stages of analysis exhibit distinct patterns as indicated by the regression results. The single-variable regression analysis (Table 3) reveals that current health expenditure (coefficient = -0.0863, $p < 0.001$) and contraception rate (coefficient = -0.0937, $p < 0.001$) are the most significant negative predictors of total fertility rate (TFR). The variables demonstrate strong explanatory power as indicated by their R^2 values of 0.721 and 0.675, respectively. The analysis reveals that longer parental leave periods in South Korea did not result in increased birth rates (coefficient = -0.00936, $p < 0.001$, $R^2 = 0.661$). The positive relationship between childcare cost (coefficient = 0.0765, $p < 0.001$, $R^2 = 0.620$) may stem from higher-income families, who both spend more on childcare and have more children.

The introduction of time trends in Table 4 shows that health expenditure and contraception rate maintain their negative and statistically significant relationships (coefficient = -0.461, t = -5.18 and coefficient = -0.552, t = 2.02), which proves their stability during Korea's extended period of fertility reduction. The time-controlled model reveals that parental leave and income tax rate lose their statistical significance because their associations primarily stem from general demographic changes rather than independent factors.

The full multiple regression model in Table 5 produces a significant increase in explanatory power ($R^2 = 0.9103$) because it incorporates all variables to explain most of the variation in fertility. The model shows that current health expenditure strongly reduces fertility (-0.741, t = -3.45) and income tax rate becomes positively linked to TFR (0.0292, t = 2.01) because tax revenue distribution and pronatalist policy funding might be responsible for this relationship. The variables childcare cost (0.0148, t = 0.44), parental leave (0.00517, t = 0.38), and female unemployment (-0.00404, t = -0.12) become insignificant in this model, which supports the idea that deeper structural factors influenced their initial relationships. The study demonstrates that health expenditure priorities most heavily influence South Korean fertility rates and contraceptive availability, but family benefits such as childcare support and parental leave policies have minimal impact after accounting for long-term demographic patterns.

Conclusion

The research shows that South Korea's decreasing birth rate from 2000 to 2024 depends on two

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main factors, which are the percentage of GDP spent on health care and the rate of population contraception use. The research shows that parental leave policies, childcare expenses, and income tax rates lose their significance when analyzed with time trends and multiple variables, potentially because these factors appear to stem from basic structural elements. The research demonstrates that standard family support programs have yet to stop population decline.

Healthcare spending and birth control methods have a stronger effect on birth rates. The study demonstrates that Korean birth rates result from permanent population changes, and the impact of policy decisions may be smaller due to a correlated increase in expenditure and cost of living.

Research Limitation & Future Direction

The research contains multiple restrictions that affect its findings. The research design hinders the establishment of cause-and-effect relationships between government policies and fertility outcomes because it employs regression analysis to demonstrate correlations rather than establish direct relationships. The negative relationship between parental leave and fertility rates could stem from the fact that governments implemented extended leave policies because birth rates were already decreasing, instead of the policies directly causing lower birth rates. The research faces limitations because it depends on available data, which also affects its overall quality. The research utilized World Bank and OECD data as well as information from national statistical agencies, but had to use approximations for childcare costs and tax credits due to inconsistent or missing data in different years. The measurement problems in this study could lead to biased results, potentially masking actual policy outcomes. The models lack direct inclusion of cultural elements, social factors, and gender norms, which strongly influence birth rates.

Research needs to tackle these knowledge gaps through two distinct approaches. The direct impact of government interventions on fertility rates becomes more apparent through difference-in-differences analysis, which studies particular policy changes such as childcare subsidy expansion. Research comparing South Korea, Japan, and Taiwan would help determine how different cultural values, employment systems, and gender expectations affect fertility rates when similar policies are implemented. The analysis would gain greater depth through the addition of qualitative research on how families perceive starting a family. The study aims to gain a comprehensive understanding of the decline in the South Korean birth rate and identify the policies that show the most potential for population growth.

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