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Fertility decline and tax revenues in South Korea

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ABSTRACT

This study investigates the link between taxation and fertility in South Korea, focusing on the historical period surrounding the mid-70s tax reforms. The longstanding decline in fertility rates has been widely discussed in relation to factors such as increasing human capital, women's employment, and rising housing costs, leading couples to postpone or forego childbearing decisions. However, less attention has been paid to how tax policies that influence disposable income and economic planning horizons could indirectly affect fertility choices. While taxation is crucial for funding social security systems, policies that reduce household resources without considering demographic impacts may have unintended consequences on population dynamics. Using a time-series of country-year from the World Bank, we exploit South Korea's major mid-1970s tax reforms as a natural experiment to test the hypothesis that higher tax burdens also contributed to reducing fertility over the subsequent decades. The results suggest considerable negative effect of the mid-1970s tax reforms on fertility in South Korea. This macro-analysis shows tax policies can influence population dynamics, but lacks insight into how tax changes affected childbearing decisions at the household level. Future micro-level studies could reveal mechanisms linking tax policies and fertility behavior. Still, this study highlights potential demographic impacts of taxation policies. Policymakers should consider such consequences when modifying tax systems, especially policies related to family resources and child affordability.

1. Introduction

According to the United Nations World Population Outlook, the global fertility rate will drop to 2.2 in 2050, close to the international alert line, causing long-term dilemmas for global population growth (United Nations, 2022). A consistently low fertility rate will cause various economic and social issues such as a low working-age population, pressure on social security, lack of innovation, and obstructing economic growth. Particularly, in South Korea, the fertility rates have declined dramatically over the past several decades, falling from over 6 children per woman in 1960 to less than 1 child per woman today (Lee and Choi, 2015). During this same period, tax revenues have risen substantially as the South Korean government has expanded their social programs and public services expenditure (Kwack and Lee, 1992). While taxation is crucial for funding social security and welfare programs that benefit the population, high tax rates could potentially contribute to low fertility rates in South Korea. Taxation represents an important factor that may influence fertility by reducing disposable income available to families (Whittington et al., 1990).

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Economic theory suggests that as the tax burden rises, the cost of raising children increases, which can deter couples from having more children (Milligan, 2005). In the 1960s and early 1970s, South Korea had a relatively low tax burden with tax revenues comprising only around 10%–15% of GDP (Kwack and Lee, 1992). The tax system was relying heavily on trade taxes and industrial taxes, with limited personal and corporate income taxes. However, significant tax reforms were enacted between 1974 and 1976 under the Tax System Improvement Act, which rationalized and expanded direct taxation (Kwack and Lee, 1992; Choi, 1997). The 1976 tax reforms expanded the value-added tax (VAT), which increased from 10% to 20%, broadening the tax base. Additionally, the top personal income tax rate was increased substantially from 25% to 62% for incomes over 20 million. More importantly, corporate income tax rates were increased and loopholes closed (Kwack and Lee, 1992). These reforms significantly increased tax revenues as a percentage of GDP, which rose from 14% in 1975 to 19% by 1980. Therefore, the shock of the mid-70s on VAT and income tax provides an opportunity to use a synthetic control approach to estimate the impact of the rising tax burden on fertility rates during this critical period. As tax increases will cause a reduction in disposable income, economic theory predicts the tax hikes would decrease fertility. This implies that the synthetic control method can construct an appropriate "control South Korea" to compare against the real Korea in a comparative case study to isolate the effect of tax policy changes. This will shed light on the role of taxation in Korea's demographic transition between 1960 and 2022, adopting a more historical and longitudinal perspective of the evaluation of taxation and fertility in South Korea. This stimulates that South Korea entrapped in low fertility due to the dramatic demographic changes that occurred over the past 60 years, where the tax revenues have increased steadily over this period as Korea has transitioned from a developing to advanced economy. From a broader perspective, this study focuses on socio-economic literature and investigates further the impact of tax policy on fertility over the period 1960–2022 in South Korea. Whereas, the tax revenue as a percentage of GDP per capita is the key independent variable, and the fertility rate as the average number of children per woman is the outcome variable. Using time series data, this study will shed light on the long-run association between taxation and fertility for South Korea. The findings will contribute to research on tax policy effects on family formation and population dynamics (Kohler and Ortega, 2002).

The paper is organized as follows. In Section 2 reviewed the past literature with a particular focus on the South Korean context. In Section 3, we describe the data. In Section 4, we outline the methods. In Section 5, we present descriptive statistics. In Section 6, we discuss the results. Finally, conclusions are drawn in Section 7.

2. Existing literature

2.1. Fertility decline and future of labor market

The rapid decline in fertility is widely considered detrimental to economic growth in many countries. In South Korea, fertility rates have experienced a dramatic decline over the past several decades, with the scale of this trend being severely concerning. In 1960, South Korea's fertility rate was 5.9 live births per woman over her lifetime. This figure declined to 2.8 by 1980, and as of February 2024, the average number of children born to a woman in her reproductive years is 0.78, as reported by the Korean government (The World Bank, 2023) . Experts predict that it may take many years for the country to achieve the 2.1 rate necessary to maintain a stable population without migration. If this were to become a global challenge, it would be a cause of global concern, requiring urgent strategies for the labor market moving forward. There are many socioeconomic factors such as women's education that contribute to the low fertility rate in South Korea. A rapid increase in women's education leads to a decline in fertility rates (Song and Lee, 2022; Del Boca, 2002). This is mainly because, as women attain higher levels of education and participate more actively in economic activities, there is often a trend towards delaying marriage or postponing or skipping childbirth altogether (Lee, 2018).

Park and Lee (2017) highlighted a preference among young Korean male for their spouse to maintain their employment post-marriage. So, marriage rates have experienced a rapid decline among women with lower levels of education, who possess limited economic potential and employment opportunities (Park et al., 2013). Furthermore, research suggests that highly educated women are more inclined to remain in the workforce after childbirth compared to their less educated counterparts (Ma, 2014). Previous research indicates that educational variances in completed fertility are relatively minor in Korea (Yoo, 2014). However, significant disparities may emerge concerning the choice to have subsequent children, particularly among highly educated women who postpone or forego additional childbirth due to challenges reconciling work and familial obligations (Brinton and Oh, 2019). Furthermore, Eun (2003), Kim (2005), and McDonald (2008), indicated that the competitive and volatile labor market environment in South Korea led young individuals to prioritize investing in their own human capital instead of making long-term commitments to marriage and parenthood.

This phenomenon is also influenced by rises in housing prices and financial stability in South Korea. This implies that as housing prices continue to increase, unmarried individuals may face greater challenges in establishing households, while married couples without property ownership may opt to delay or not have children (Eun, 2007). With regards to individual financial stability, Malthus highlighted a positive effect of income on the fertility rate in 1798. He emphasized that an increase in income leads to population growth until the availability of land and food becomes limited, resulting in an economic crisis and a decline in the fertility rate. However, during industrialization and the early 20th century, empirical evidence contradicted the Malthusian view, revealing a negative relationship between the fertility rate and Gross Domestic Product (GDP) (Doepke et al., 2023). This was aligned with (Willis, 1973; Moffitt, 1984) findings that an increase in earnings leads to higher opportunity costs associated with time spent on childcare, which tends to decrease fertility rates. However, the view presented by Doepke et al. (2023) has primarily been disrupted through various family supports and sympathetic social norms policies, including parental leave (Bauernschuster et al., 2016), more flexible work patterns for women (Kleven et al., 2019), and facilitating easier transitions between part-time and full-time employment (Del Boca and Sauer, 2009) among others.

2.2. Uncertainties and risks in contemporary fertility decisions

Although growing evidence suggests that children are often perceived as a form of security against the potential risks of poverty and insufficient support in later life, individual fertility decisions are substantially linked with uncertainties, as the choice to consider and raise a child involves various forms of risks. One dimension of uncertainties that has been argued extensively is child mortality due to cautious considerations of individuals regarding their fertility (Kalemli-Ozcan, 2003; Doepke, 2005; Fioroni, 2010). However, in advanced economies with robust healthcare systems, the precautionary drive for fertility is considered to be less significant. Another dimension of uncertainties is related to individuals' dependency and poverty in old age, where in modern society, individuals attempt to save more to mitigate the risk associated with their old-age dependency (Mason and Lee, 2006). When there are fewer children available in a family, individuals attempt to increase their savings to finance their old-age needs and support. This consequently causes workforce decline in the long run. So, children and savings perform as substitute instruments for old-age social security, which in the long term raises serious fertility challenges. More importantly, income uncertainty and job insecurity have a significant impact on the fertility rate in both poor and modern societies (Buh, 2023; Doepke et al., 2023; Caldwell, 1976, 2005). Willis (1979) particularly highlighted that during industrialization and modernization, the transition from poverty to wealth poses a threat to fertility. In poor societies, resources flow from children, who begin working at an early age, to the older generation, but in modern societies, for securing the social safety nets and pension systems, the flow of resources primarily moves from the older generation to children. Therefore, old-age social security could serve as a preventive to fertility (Cigno, 2016), raising concerns particularly for highly industrialized nations such as South Korea. (Del Bono et al., 2012) emphasized that even a career track has a considerable negative effect on the fertility rate. In addition, it has been extensively discussed that economic recession and general economic uncertainty indices are negatively related to fertility (Matysiak et al., 2021; Gozgor et al., 2021).

2.3. Economic and social challenges of low fertility

Fertility decline raises various concerns in the economy and society, including population crisis and workforce shortages, which pose a serious threat to the production of goods and services, the supply chain and cycle. This is because the firms are more interested in establishing themselves in those locations where there is no workforce shortage or concern (Davis et al., 2022). A decline in population growth leads to a reduction in the number of scientists, which has negative effects on innovation, long-run productivity and economic growth (Romer, 1990; Jones, 1995, 2022; Segerstrom, 1998; Aksoy et al., 2019). Therefore, low fertility rates will result in a scarcity of the workforce, especially among highly skilled individuals with innovation capacity (Skirbekk, 2008; Mahlberg et al., 2013; Cooley and Henriksen, 2018).

Women's participation has significant impact on the economic activity, often greater than men contribution (Cebrián et al., 2019). Many studies suggest that women's high engagement in economic activities lead to low fertility rates (Becker, 1960; Chung, 2010; Kim, 2007; Kim et al., 2016; Lee, 2006; Lesthaeghe, 1995; Oh and Park, 2008).

Therefore, given that financial stability and socio-economic factors have a significant impact on the fertility rate, issues affecting individual disposable income such as pension policies, child-care support, and tax breaks could play a crucial role in managing the population crisis. Hart and Galloway (2023) identified that, holding other factors constant, higher wages contribute to higher household income, potentially leading to a positive impact on fertility rates. They particularly indicated that favorable economic circumstances such as tax breaks play a role in the relatively high fertility rates in the Nordic countries. Yet, there are limited prior studies that assessed the impact of tax reductions on fertility using a causal approach, suggesting a minor positive effect depending on government reform design (Bergsvik et al., 2021; Ang, 2015; Milligan, 2005; Riphahn and Wiynck, 2017; Gonzalez, 2013).

2.4. Tax system in South Korea and major reforms in the 1970s

In the 1960s and early 1970s, South Korea's tax system relied heavily on trade taxes and industrial taxes, with limited personal and corporate income taxes (Kwack and Lee, 1992). However, the system was inefficient and inequitable, and there was a dual personal income tax structure that was administratively burdensome. The indirect tax system was even more complicated, with over 50 different excise and turnover tax rates ranging from 0.5% to 300% (Kwack and Lee, 1992). This led to reforms in 1974 and 1976 to streamline and simplify the overall tax structure for greater efficiency, equity, and neutrality (Kwack and Lee, 1992; Yoo, 2000; Choi, 1997). The 1974 reform introduced an integrated personal income tax system that was implemented in 1975. The 1976 reform was even more significant — it introduced a consumption-based value-added tax (VAT) and consolidated multiple indirect taxes into a few excise taxes (Kwack and Lee, 1992; Choi, 1997). The 1976 tax reform expanded the VAT from 10% to 20%, broadening the tax base. It also increased the top personal income tax rate from 25% to 62% for high incomes, raising progressivity. Corporate tax rates rose from 25% to 33%, and loopholes were eliminated (Kwack and Lee, 1992) . These reforms dramatically increased tax revenue over the years where the total tax as a percentage of GDP rose from 14% in 1975 to 19% by 1980 (Kwack and Lee, 1992). The VAT now generates over 20% of tax revenue in South Korea. Other major taxes include income, corporate, defense, and excise taxes (Kwack and Lee, 1992). In summary, the 1974 (implemented in 1975) and 1976 reforms determined the structure of South Korea's modern tax system. By expanding direct taxation and implementing a VAT, they increased revenues while improving efficiency, equity, and simplicity (Kwack and Lee, 1992; Yoo, 2000). In fact, while these mid-1970s tax reforms increased revenues in South Korea, some studies have raised concerns about their distributional impacts and unintended consequences. For instance, Han (1987) argues that the value-added tax (VAT) could exacerbate income inequality. This concern is echoed by Alavuotunki et al. (2017), who found VAT introduction increased inequality elsewhere. Moreover, Kim (2012), Kim and Kim (2005) highlighted that

tax hikes worsen income concentration and regional disparities. The theoretical study by Kim and Yun (1988) examined the historical role of fiscal policy in income distribution and they indicated that while taxes can raise revenue, they should be carefully designed to avoid unequal impacts (Han, 1987; Alavuotunki et al., 2017; Kim, 2012; Kim and Kim, 2005; Kim and Yun, 1988). Although the VAT and income tax increases in the mid-70s marked a major shift in South Korea's tax structure increasing government revenues, they could have produced distributional concerns ultimately influencing fertility.

3. Data and variables

This study utilizes data from the World Development Indicators compiled by The World Bank, which contains a comprehensive set of time series indicators for circa 218 countries, including South Korea, over the period 1960–2022. However, not all these countries contain the series for the whole period and, therefore, we had to restrict the pool to 106 countries (more details below). These countries represent the donor pool for the construction of the synthetic Korea.

The main variables used in the analysis are the fertility rate (births per woman) and total tax revenue as a percentage of GDP. The fertility rate is the key outcome variable, measuring the average number of children born per woman in a given country and year. Tax revenue captures the overall tax burden, including taxes on income, payroll, property, goods and services, etc. Higher tax revenue as a share of GDP indicates a higher tax burden.

To isolate the effect of taxes on fertility, the analysis controls for several other factors that prior research has found to influence fertility decisions: i) Employment — Labor force participation rate (total % of population ages 15+) and ratio of female to male participation rate (%); ii) GDP per capita growth — Annual % change in GDP per capita; iii) Education — Female primary school enrollment rate (%); iv) Age dependency ratio — % of working-age population; vi) Mortality rates — Crude death rate (per 1000 people), neonatal mortality (per 1000 live births), and adult female mortality (per 1000 females 15-60 years old); vii) Population — Total population and annual population growth rate (%); viii) Contraceptive prevalence — Any method, % of married women ages 15–49.

Employment variables like female workforce participation capture the opportunity cost of childbearing, as higher women's wages imply greater foregone earnings from time spent on childcare (Willis, 1973; Moffitt, 1984). The expansion of women's education and labor market opportunities has been linked to fertility declines in many countries (Doepke et al., 2023). Therefore, we include both overall participation and the female–male ratio to account for gender-specific effects.

GDP per capita growth controls for broader economic conditions that may influence fertility separate from tax policy changes (Doepke et al., 2023). Periods of recession have been associated with fertility declines, while at higher income levels fertility may rise with income (Malthus, 1798).

Education measures like female primary enrollment help account for the role of human capital in determining fertility trends. Higher educational investments in children raise the cost of childrearing, leading parents to substitute quality for quantity of children (Becker, 1960; Galor et al., 2009). Increased education also empowers women to make choices affecting fertility.

Age dependency ratio controls for population age structure effects on fertility demand. Higher old-age dependency may increase desired fertility if children provide old-age support (Cain, 1983).

Mortality rates account for uncertainty and insurance effects related to child survival (Trinitapoli and Yeatman, 2018). Lower child mortality reduces the need to hedge against child death, decreasing desired fertility.

Population growth and total population capture potential fertility effects from population pressures and density (Doepke et al., 2023).

Contraceptive prevalence proxies for access to family planning techniques that facilitate fertility reduction (Doepke et al., 2023).

These variables, therefore, provide reasonable proxies and controls for studying the relationship between taxes and fertility over time within selected countries. The final sample includes an unbalanced panel of 106 countries over 1960–2022 after excluding countries missing more than 40% of data. Gaps in the time series were filled using linear interpolation and extrapolation of within-country trends. Figure A.1 in the Appendix section shows the (unconditional) correlation between the fertility rate and tax revenue for all the observations (country-year) in the initial and final pool of countries. In both cases, we observe a similar negative correlation indicating that the reduction of countries did not change the overall negative association between and taxation. Moreover, Figure A.2 in the same Appendix plots the original and interpolated data for South Korea as an example, showing interpolated values that align smoothly with the trends.

4. Methods

We first descriptively analyze the association between fertility rate and taxation in South Korea using a Prais–Winsten regression with correlated panels corrected standard errors (PCSEs) (Beck and Katz, 2011). The model includes a time trend and control variables for employment, GDP growth, education, age dependency, mortality rates, population, population growth, and contraceptive prevalence. We estimate the following model:

$$\text{Fertility}_t = \beta_0 + \beta_1 \text{Tax}_t + \beta_2 \text{Trend}_t + \mathbf{X}_t \boldsymbol{\gamma} + \epsilon_t \tag{1}$$

where Fertility is the fertility rate, Tax is the tax revenue as a percentage of GDP, Trend is a time trend, $\mathbf{X}$ is the set of control variables, and εt is the error term. Standard errors are computed using PCSE to account for autocorrelation and cross-sectional dependence. This descriptive model provides a preliminary view of the association between taxes and fertility for South Korea over

Table 1
Summary Statistics, South Korea, 1960–2022.

	(1) 1960–1975		(2) 1976–2022		(3) Diff Cols (2)-(1)	
	mean	sd	mean	sd	b	t
Birthrate_fem	4.8	0.7	1.6	0.6	3.2***	(16.8)
Taxrev_gdp	10.4	1.4	13.9	1.1	−3.5***	(−8.6)
Age dep ratio	84.5	3.7	45.2	10.3	39.2***	(22.2)
Lbr	54.0	3.5	59.5	5.2	−5.5***	(−4.7)
Lbr_fem_male	46.9	7.0	64.7	5.7	−17.8***	(−9.0)
Enrpri_fem	85.5	8.3	98.5	1.0	−12.9***	(−6.0)
Human capital	1.9	0.2	3.1	0.5	−1.2***	(−14.7)
Migration share	0.6	0.1	1.4	1.0	−0.8***	(−5.3)
Death rate	9.3	2.1	5.7	0.7	3.6***	(6.8)
Mort rate_neo	25.3	2.6	6.6	6.1	18.7***	(16.9)
Mort rate_fem	236.4	40.7	81.3	49.7	155.2***	(12.2)
GDP growth	9.8	3.0	6.3	4.1	3.5***	(3.6)
Pop tot	30.04M	3.18M	45.41M	5.02M	−1.5e+07***	(−14.2)
Pop growth	2.4	0.4	0.8	0.5	1.6***	(11.9)
Contraceptive	17.5	11.4	74.2	11.6	−56.7***	(−16.8)
Observations	15		48		63	

the full 1960–2022 period. In the appendix, we replicate this regression approach for the full sample of 106 countries and stratified by country income group for exploring heterogeneity around the globe.

This study utilizes a synthetic control method to estimate the impact of the 1974/1976 tax reforms in Korea on fertility rates over the period 1960–2022. Since the 1974 reform was implemented in 1975. We took the year 1975 as a reference for the pre-post introduction of income and VAT tax reforms. The synthetic control approach allows us to construct an appropriate comparison or "control" Korea that matches pre-reform characteristics and fertility trends of the real Korea (Abadie et al., 2010, 2015).

We then can compare post-reform fertility rates between real Korea and synthetic Korea to estimate the causal effect of the rising tax burden. The synthetic control is built as a weighted average of control countries that did not experience the policy change (Abadie et al., 2010). More specifically:

Let Y_{it} be the fertility rate (births per woman) in country i at time t. For treated country Korea, Y_{1t}, t = 1960, …,T. Let T_0 indicate the reform year, 1975. The data consist of T_0 pre-reform periods and $T - T_0$ post-reform periods.

The synthetic control method chooses weights $W_2, \ldots, W_J$ for countries 2 through J such that:

$$\sum_{j=2}^{J} W_j Y_{jt} \approx Y_{1t} \text{ for } t = 1960, \ldots, T_0 \tag{2}$$

Subject to $\sum_{j=2}^{J} W_j = 1$ and $W_j \geq 0$ for $j = 2, \ldots, J$ (Abadie et al., 2010).

This constructs the synthetic control (Y_{1t}^{SC}) that best reproduces the pre-reform fertility trend of Korea.

The effect of the tax increase on fertility in year t is then estimated as:

$$\hat{\tau}_{1t} = Y_{1t} - Y_{1t}^{SC} \text{ for } t = T_0 + 1, \ldots, T \tag{3}$$

We use data from J=106 countries over 1960–2022, with reform in 1975 (T0), to construct the donor pool. Control variables included in predictor matching are employment, GDP growth, education, age dependency, mortality rates, population, population growth, and contraceptive prevalence.

This synthetic control approach isolates the impact of rising taxation on fertility in Korea for 1960–2022 by providing a counterfactual control case. Significance of results can be assessed with placebo studies on unaffected countries (Abadie et al., 2010; Abadie, 2021).

5. Descriptive statistics

Table 1 presents summary statistics for key variables related to fertility, taxation, and other economic and demographic indicators in South Korea. The table divides the 1960–2022 period into two sub-periods: 1960–1975 when fertility was relatively high, and 1976–2022 when fertility declined substantially.

Several key patterns emerge from comparing means across the two sub-periods. The birth rate for females fell dramatically from 4.8 to 1.6 children per woman. Tax revenues as a share of GDP exhibit some changes between the two periods, with higher figures in the latter. The age dependency ratio declined from 84.5 to 45.2 as population aging accelerated. Female labor force participation rose. Enrollment of females in primary education neared 100% in the later period. Mortality rates, especially for infants and mothers, declined. Population growth slowed. And contraceptive use surged from 17.5% to 74.2% of women.

The differences in means tests indicate statistically significant changes at the 1% level for most indicators. The comparisons highlight the rapid demographic and economic changes occurring in South Korea accompanying the fertility decline after 1975. The

Table 2
PCSE regression results, South Korea, 1960–2022.

	(1) Model 1	(2) Model 2
taxrev_gdp	−0.0548***	−0.0541***
	(0.0140)	(0.0144)
_cons	1.0695	1.5433
	(1.7526)	(2.8462)
Obs	63	63
N	1	1
R2	0.9975	0.9975
Rho	0.0092	0.0098
Trend	No	Yes
Controls	Yes	Yes

PCSE Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

descriptive statistics provide context for analyzing the relationships between taxation, fertility, and other outcomes in the regression analysis and synthetic control method. Also, in the main analyses, we control for these factors to reduce potential confounding.

Overall, Table 1 documents substantial shifts in South Korea's fertility, mortality, education, labor force participation, and other key indicators between the high and low fertility regimes. This motivates the paper's analysis of how taxation and socioeconomic factors relate to the fertility decline. Also, in the main analyses, we control for these factors to reduce potential confounding.

6. Results

Table 2 presents the output from the Prais–Winsten regressions described in the methods section. The models examine the association between tax revenue as a percentage of GDP (*taxrev_gdp*) and fertility rates in South Korea from 1960–2022.

The coefficients on *taxrev_gdp* are negative and statistically significant in both specifications. The magnitude of the association is similar across models, with a 1 percentage point increase in taxes as a share of GDP associated with a 0.05–0.06 decrease in fertility. This represents a non-negligible effect given South Korea's fertility rate has fallen from 6 to less than 1 over the period.

Model 1 is the base specification without a time trend, while Model 2 adds a linear time trend as a control. This does not substantially change the tax coefficient, suggesting a robust correlation.

With only 1 country (N=1) and 63 annual observations, the very high R-squared values indicate almost perfect fit, as expected given the times series structure and single country. The very low rho values suggest minimal autocorrelation in the residuals.

Overall, these descriptive regressions provide preliminary evidence for a negative ecological association between tax burdens and fertility rates in South Korea over the period of analysis. The synthetic control method in the next section will allow us to make more definitive causal claims.

Fig. 1 shows the results of the synthetic control method examining the impact of the 1976 tax reforms on fertility rates in South Korea over 1960–2022. Prior to the reforms in 1975, the synthetic control tracks very closely to the real fertility rate in South Korea. This provides a plausible counterfactual showing the underlying fertility trend in the absence of the tax changes.

After the tax hikes in 1976, we see divergence between the real and synthetic fertility rates. Fertility declines much more sharply in the real South Korea compared to the synthetic control.

The estimated average treatment effect over the post-treatment period is −1.08 births per woman, although we see some variation in the treatment-effect over-time, with the lowest value around −1.6 in mid 80s (see Fig. 2) and some improvement from the mid-90s, although the overall trend remains negative. In particular, the reduction in the negative effect in the mid-1990s and 2000s coincides with the major tax reforms undertaken in 1994 and 1995. These reforms aimed to establish a more advanced tax system with lower rates and a broader base, similar to the U.S. tax reform in 1986 (Yoo, 2000). By lowering individual income tax rates, adjusting tax brackets, and reducing corporate tax rates, these reforms likely provided relief in tax pressure on individuals and families, which could explain the diminished negative impact on fertility during that period.

Therefore, the observed changes in the treatment effects on fertility over time seem to align with the shifts in South Korea's tax policies.

As shown in Fig. 3, The synthetic control was constructed using a donor pool of 9 countries that best matched South Korea's pre-reform fertility and predictor variables: Malaysia (weight = 0.454); Colombia (0.131); United States (0.107); Costa Rica (0.0770); Lesotho (0.069); Serbia (0.064); Armenia (0.047); Germany (0.037); Canada (0.014). The rest of the countries are however used for placebo tests which we discuss below.

To assess the reliability of our findings, we conducted a placebo test (Fig. 4). This test involved creating placebo treatments for unaffected countries, where synthetic control units were constructed to mimic South Korea's pre-treatment fertility dynamics. By maintaining the same pre-treatment period for each placebo treatment while utilizing the actual treatment period for South Korea, we generated counterfactual outcomes in the absence of the treatment. These synthetic control units served as a critical benchmark for evaluating the uniqueness of South Korea's fertility decline, allowing us to isolate the true effect of the treatment from random variation or selection bias.

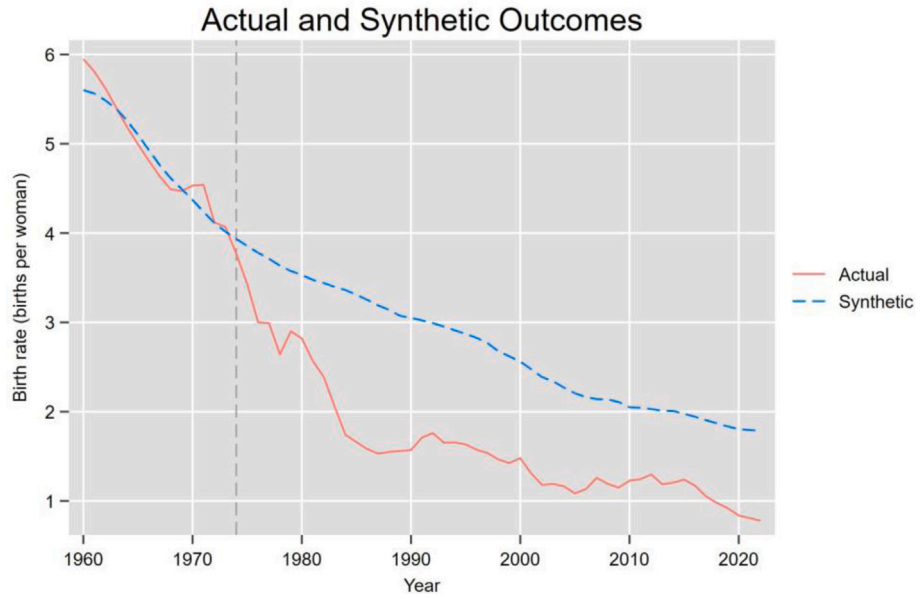

Fig. 1. Synthetic control method results.

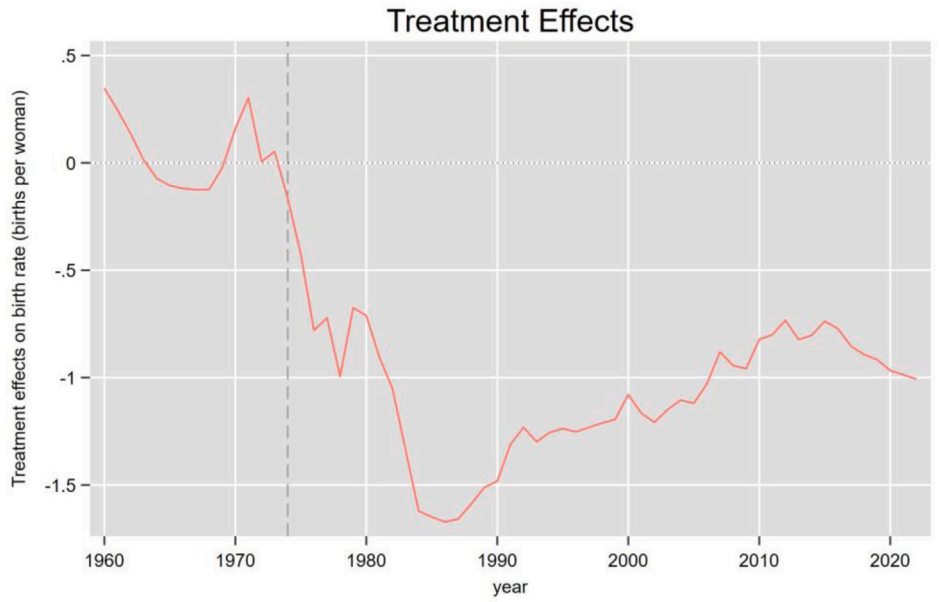

Fig. 2. Effect distribution overtime.

Our analysis of the fertility dynamics in these placebo countries revealed no significant declines akin to those observed in South Korea. This finding suggests that the fertility decline in South Korea was indeed unique to the treatment it received. Consequently, our results support the credibility of our estimated treatment effect, bolstering our confidence in the reliability of the synthetic control method and the validity of our conclusions regarding the impact of tax policy changes on fertility behavior in South Korea. Additionally, we replicated the analyses on a subset of Asian countries, which should have cultural aspects more closely aligned with Korea, yielding similar results. These additional robustness checks are available in the Appendix.

7. Conclusions and discussion

The fertility decline in South Korea stems from a complex interplay of cultural, demographic, and economic drivers. Shifting norms about family size, increased female educational attainment, and rising labor force participation all likely contributed to lower

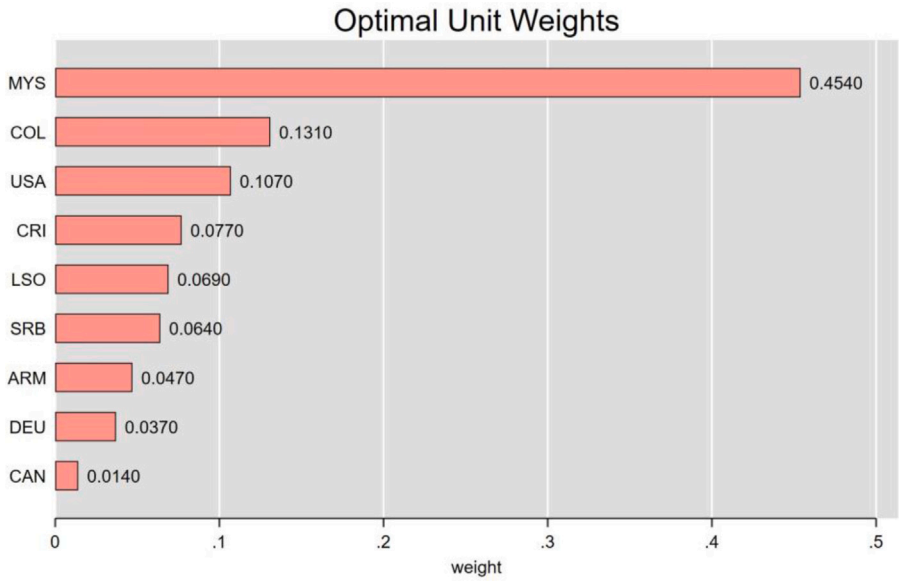

Fig. 3. Units used in the donor pool.

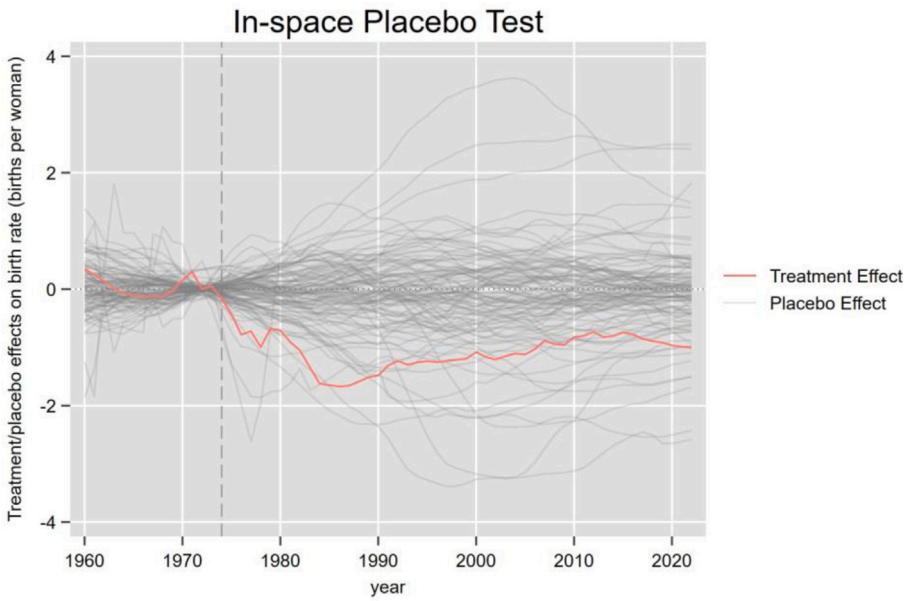

Fig. 4. Placebo test.

birth rates (Bongaarts, 2001; Lee, 2009). At the same time, rapidly rising standards of living due to economic growth facilitated fertility reductions as the quantity–quality trade-off for children came into play (Becker, 1960; Galor, 2012). Disentangling the many factors at work poses empirical challenges.

In this paper, we focus specifically on isolating the causal role of taxation in influencing fertility trends adopting a historical perspective and longitudinal data in combination with causal inference methods for macro-level analyses. Tax policy can affect fertility through several channels. On the one hand, tax revenues allow governments to provide public services like healthcare and education that can encourage lower fertility (Besley and Gouveia, 1994). But taxes also directly reduce household disposable income and increase the implicit costs of raising children (Whittington, 1992). These income and substitution effects imply higher taxes may deter family formation and child-bearing, especially when tax burdens target families (Milligan, 2005).

Our analysis aims to quantify the causal impact of tax policy changes on fertility in South Korea, holding other factors constant. We exploit major tax reforms in 1976 as a natural experiment, comparing fertility trends before and after using a synthetic control

approach. This helps isolate the specific role of taxation from broader demographic and developmental forces (Abadie, 2021). Understanding these mechanisms provides insight into how policy levers like taxes can influence demographic outcomes.

Overall, our findings provide compelling evidence that higher tax burdens led to substantial reductions in fertility rates in South Korea after the mid-1970s reforms. The synthetic control analysis found a large, negative causal impact of the tax changes on births per woman.

These results have several important policy implications. First, they suggest taxation can be an effective policy lever for influencing population dynamics and demographic trends. Countries seeking to manage fertility may be able to utilize tax policies to reduce disposable income and increase child-rearing costs. However, there are risks if fertility declines too rapidly. Extremely low fertility can lead to rapid population aging and shrinking workforces, creating economic challenges. Policymakers should be cautious about large tax hikes and monitor demographic impacts closely.

The results also imply taxes that target families and reduce child affordability are most likely to affect fertility. Policy options like child tax credits may help offset these effects and support family formation (Baughman and Dickert-Conlin, 2003; Milligan, 2005). More family-friendly tax policies could be part of a broader strategy to sustain healthy fertility rates.

Moreover, research to date consistently backs up the idea that investment is negatively impacted by tax uncertainty. For example, some research conducted by the European Commission indicates a positive correlation between corporate tax evasion and the reported substantial ambiguity of a firm's tax position, as well as a mitigating influence of tax planning on investment (Zangari et al., 2017) which can potentially lead to a reduction in job opportunities or discourage entrepreneurship initiatives. At the same time, economic losses and uncertainty emerge as significant deterrents to childbirth in both high and mid-income countries (Aassve et al., 2020). Therefore, another policy option could involve the government implementing planned tax increases with a structured calendarization, ensuring individuals are informed well in advance about the government's revenue-raising intentions. This approach would also offer individuals more flexibility to fulfill their requirements by providing them with alternatives.

Future research should continue investigating these relationships across countries and different settings. However, this study underscores that taxes can have unexpected social consequences beyond generating revenue, which is crucial for social security and welfare of societies but should also be planned very efficiently. Consequently, Korean policymakers today face long-term demographic pressures, partly resulting from past policy choices.

CRediT authorship contribution statement

Joan E. Madia: Data curation, Methodology, Writing – original draft, Formal analysis, Visualization. **Francesco Moscone:** Conceptualization, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Asieh Hosseini Tabaghdehi:** Data curation, Investigation, Writing – original draft, Writing – review & editing. **Jong-Chol An:** Writing – original draft, Writing – review & editing. **Changkeun Lee:** Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.rie.2025.101025.

Data availability

Data is publically available at: https://data.worldbank.org/.

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