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# Economic Growth and Fertility Rebound: Evidence from Developing Countries

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## Abstract

**Purpose:** This study examines the relationship between fertility rate and economic growth in developing countries. It explores the inverse J-shaped relationship between total fertility rates and GDP per capita and the U-shaped relationship between total fertility rates and female labor force participation. **Methodology:** The study utilizes panel data from 117 developing countries from 2000 to 2022. The Generalized Method of Moments (GMM) is employed to derive empirical results. **Result**: The empirical results support the inverse-J-shaped and U-shaped relationships. The findings suggest that a fertility rebound could be possible if income levels and female labor force participation are sufficiently high. Furthermore, we have identified the GDP per capita threshold that marks the turning point in fertility trends within developing countries. **Conclusion:** Policymakers can use this information to tackle the issue of declining fertility rates. The observed inverse-J-shaped and U-shaped relationships suggest that economic growth alone may not be adequate to sustain fertility rates. Consequently, strategies aimed at raising income levels become crucial. This can be achieved through targeted investments in women's education and training, which enhance job prospects and increase income levels, thereby contributing to a sustainable fertility rate.

**Keywords:** Fertility rate, Economic Growth, U-shaped relationship, Inverse J-shaped relationship, GMM Model, Developing countries.

**JEL Classification Code:** J1, O15, O40

## 1. Introduction

The global average fertility rate has been on a steady decline, decreasing from 5.8 births per woman in 1965 to 2.42 births per woman in 2022 (World Bank, 2022). The initial decline in fertility was observed in developed nations, where the fertility rate among OECD countries has fallen below the replacement level of 2.1 children per woman. Numerous scholars posit that fertility rates could rebound if income levels reach sufficiently high thresholds (Lacalle-Calderon et al., 2017; Luci-Greulich and Thevenon, 2014; Myrskyla et al., 2009). However, the link between economic growth and fertility rate reversal remains ambiguous. For instance, despite rising income levels, fertility rates in several developed countries continue to decline, presenting a complex challenge for policymakers aiming to sustain fertility rates (Becker, 1981; Becker and Lewis, 1973; Hwang and Lee, 2014;

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Sobotka et al., 2011).

Similarly, Fertility rates are declining rapidly in developing nations, with some countries already falling below the replacement level (UN Population Division, 2022). If this downward trend persists, it could lead to significant challenges, including demographic imbalances and concerns over human sustainability (Lee and Mason, 2010). Consequently, the implementation of corrective policies is imperative to ensure sustainable fertility levels. Strategies that address income disparities, improve access to childcare, and promote gender equity in labor markets may provide effective solutions to stabilize fertility rates and mitigate potential socioeconomic consequences (Bongaarts, 2016; Gauthier, 2007).

Recently, Nakagaki (2018) confirmed the U-shape and inverse J-shape fertility relationship in developed East Asian countries. He suggested that fertility recovery could be possible if the female labor force participation and GDP per capita are increasing enough. However, Nakagaki focuses only on OECD and 13 South Asian countries. Thus, this study tries to examine the U-shape and inverse J relation. Fertility decline is slower up to the threshold point making a longer inverted U shape but once it reaches that critical point it rebounds at a faster pace making an inverse J pattern, with a large set of panel data in developed countries.

The objective of this paper is to explore the relationship between fertility, female labor participation, and income levels in developing countries. While extensive research is available on this topic in the context of developed nations, studies focusing on developing countries are limited. This gap motivated to conduct in-depth research demonstrating how the reversal of fertility trends is interlinked with economic growth in developing countries.

The paper first examines the J-shaped relationship between fertility rates and GDP per capita, and the U-shaped relationship between total fertility rate and female labor force participation utilizing data from 117 developing countries between 2000 and 2022. Second, it identifies the threshold level of per-capita GDP at which fertility rebound occurs. The study employs the Generalized Method of Moments (GMM) to derive empirical findings. This method provides robust results by addressing issues such as endogeneity, autocorrelation, heteroskedasticity, and unobserved heterogeneity. The findings of this paper are expected to benefit academicians, researchers, planners, and policymakers by offering insights into the growth-fertility nexus and highlighting a new dimension for further exploration.

This paper is further structured as follows: section 2 reviews the Theoretical and empirical studies. Section 3 outlines the model specification and estimation technique. Section 4 consists estimation and interpretation of the result. Finally, section 5 presents the conclusion.

## 2. Literature Review

Several theories address the relationship between fertility and economic growth. Malthus (1888) proposed that rapid population growth in the short term would lead to short-term economic growth, reflecting a pro-cyclical evolution of fertility. Conversely, the Demographic Transition Theory (DTT) posits that as countries transition from pre-industrial to industrialized economies, long-term improvements in economic conditions, such as increased income per capita, shift fertility patterns from high mortality and fertility rates to low mortality and fertility rates (Kirk, 1996).

In recent decades, fertility rates in many developed countries have declined sharply, falling below the replacement level despite continuous economic growth. However, more recently, some developed nations have experienced a fertility rebound, aligning with their economic growth trajectories. The relationship between economic growth and fertility remains uncertain. Some economic theories suggest that an increase in per capita income raises the demand for children. This is explained by the idea that higher income levels enable families to afford the costs associated with bearing and raising children more easily. Many scholars noted that in developed countries, once fertility rates decline to a minimum level, GDP per capita must reach a sufficiently high level for fertility rates to begin reversing. Factors such as advancements in education, technological progress, and the rising cost of education have been identified as key contributors to the decline in fertility rates alongside economic growth. (Luci-Greulich and Thevenon, 2014; Nakagaki, 2018).

Conversely, Becker (1960, 1981) identified a negative relationship between income and fertility in his "New Home Economic Theory." This theory emphasizes the quality-quantity trade-off in the income-fertility relationship. Becker and Lewis (1973) demonstrated that as parental income increases, the cost of raising children also rises, as parents prioritize the quality of their children’s upbringing such as better education and a higher standard of living over having more children. In such cases, the substitution effect outweighs the income effect. Additionally, Hwang and Lee (2014) argued that higher income reduces the demand for children because the opportunity cost associated with child-rearing increases.

Sobotka et al. (2011) demonstrated a negative relationship between unemployment and fertility rates. Based on this finding, a positive relationship between economic growth and fertility can be anticipated, as economic growth creates employment opportunities that support couples in forming families.

Generally, the relationship between income and fertility can be explained through three distinct demographic phases. Initially, the income effect dominates the substitution effect, meaning that increased household income leads to higher fertility. In the second phase, the substitution effect surpasses the income effect, as rising household income prompts parents to prioritize the quality of children (fewer children) over quantity. Finally, after reaching a threshold level of economic growth, the income effect once again dominates the substitution effect. At this stage, significant increases in household income allow couples to maintain high living standards while providing quality education for a larger number of children without financial strain. This reflects a positive relationship between income and fertility after the threshold (Angela and Thevenon, 2010).

Consistent with this argument, Mammen and Paxson (2000) and Luci (2009) suggested that the opportunity cost of having children is higher in economically developed countries. These costs can be mitigated through increased education and skill development for women, which enhance their chances of employment and high earning potential—a process that often accompanies economic growth. As earning potential rises, women are more likely to participate in the labor market.

Galor and Weil (1996) proposed a general equilibrium model highlighting the negative relationship between higher output per worker, increased wages for women, and fertility rates. When women give birth, they face a loss in earning potential, as caregiving responsibilities at home prevent them from joining the workforce. Consequently, with rising economic growth, women may prefer to substitute household responsibilities with labor market work, as direct wages incentivize them to have fewer children. Similarly, Kohler et al. (2002) identified socioeconomic changes, social interactions, institutional settings, and reduced completed fertility as key factors contributing to declining fertility rates in Europe, along with delays in childbearing. The Demographic Transition Theory also emphasizes that fertility decline stems from self-directed shifts in individual choices (Lesthaeghe, 2014).

Myrskyla et al. (2009) observed an inverse relationship between socioeconomic growth and fertility rates around 1975. However, the authors later identified an inverse J-shaped fertility curve in 2005, where the human development index was used as an explanatory variable and the total fertility rate as the dependent variable. Similarly, Lacalle-Calderon et al. (2017) illustrated Inverse J shapes the relationship between fertility and economic growth If economic growth crosses a certain level of threshold.

Myrskyla et al. (2011) argued that fertility rates could increase along with improvements in the human growth index, provided that advancements in gender equality accompany human growth in developed countries. Similarly, McDonald (2013) claimed that higher income positively impacts fertility rates, particularly when accompanied by increased female labor force participation.

Numerous studies have explored the U-shaped and inverse J-shaped relationships between fertility rates and economic growth in developed nations. Hence, this study investigates this relationship particularly, in the context of developing countries. The next section outlines the model specification and estimation technique.

## 3. Research Methodology

The study utilizes panel data to examine the relationship between fertility rate and economic growth in developing countries. First, it explores the J-shaped relationship between total fertility rates and GDP per capita, and later a U-shaped relationship between total fertility rates and female labor participation by using 117 developing countries (The list of 117 developing countries illustrated in Appendix ) data from 2000 to 2022. This study followed the empirical model of previous studies (Luci-Greulich and Thevenon, 2014; Nakagaki, 2018). Hence, the empirical model for estimation is developed as follows:

$$TFR_{it} = \alpha_0 + \alpha_1 PGDP_{it} + \alpha_2 PGDP_{it}^2 + \varepsilon_{it} \quad (1)$$

$$TFR_{it} = \beta_0 + \beta_1 FLP_{it} + \beta_2 FLR_{it}^2 + \vartheta_{it} \quad (2)$$

Where TFR represents the total fertility rate, used as a dependent variable. Where PGDP and FLP stand for the GDP per capita and female labor participation respectively as independent variables. $\alpha_0$ and $\beta_0$ are constant terms. $\alpha_1$, $\alpha_2$, and $\beta_1$, $\beta_2$, are the estimated coefficients. The '$\varepsilon$' and '$\vartheta$' are the error term. Subscript 'i' and 't' represent the number of countries and periods. All the data are extracted from the World Development Indicators (World Bank, 2024). A summary of the variables, proxies, description, and data sources is provided in Table 1.

**Table 1:** Summary of Variables

| Variables | Proxy | Description | Source |
|---|---|---|---|
| Total Fertility Rate | TFR | Fertility rate, total (births per woman) | WDI |
| Economic Growth | PGDP | GDP per capita | WDI |

| | | | |
|---|---|---|---|
| | | (logarithm, PPP, current international dollar) | |
| Labor force participation | FLP | Labor force participation rate, female (% of female population ages 15-64) | WDI |

**Notes:** (i) WDI stands for World Development Indicators, World Bank 2024 (https://databank.worldbank.org/source/world-growth-indicators)

The generalized method of moments (GMM) is a powerful econometric technique used for empirical studies. This method is particularly useful for panel data analysis. This estimation technique allows the number of movement conditions (instrument variables) to exceed the number of parameters, enhancing the efficiency of the estimator. GMM model includes lagged dependent variables as regressors which helps capture the dynamics of the data. GMM model addresses the endogeneity problem that arises from the correlation between regressors and error terms. This method is robust against issues such as heteroskedasticity, autocorrelation, and unobserved heterogeneity (Arellano and Bover, 1995; Blundell and Bond,1998). This study uses a two-step system GMM since it is more efficient and robust to heteroscedasticity and autocorrelation Roodman (2009). A general form of such a model is:

$$Y_{it} = \beta_1 Y_{it-1} + \beta_2 X_{it} + \eta_i + \varepsilon_{it}$$

Where, $y_{it}$ is the dependent variable for country 'i' at time 't', and $y_{it-1}$ represents the lagged dependent variable. $X_{it}$ denotes a set of explanatory variables. $\eta_i$ captures the unobserved country-specific effect, while $\varepsilon_{it}$ is the idiosyncratic error term. The coefficients $\beta_1$ and $\beta_2$ are estimated to determine the potential relationship.

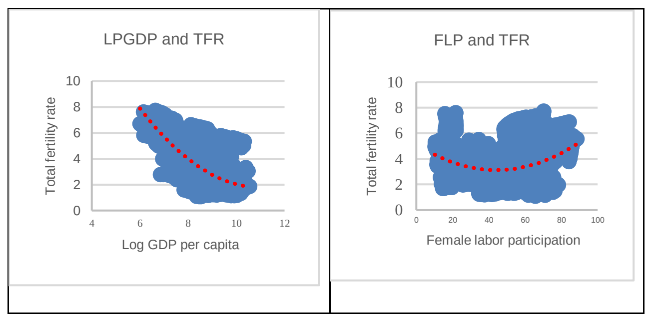
**Table 2:** Descriptive Statistics and Correlation Matrix

| Variable | TFR | PGDP. | FLP |
|---|---|---|---|
| Mean | 3.5 | 7389.1 | 52.55 |
| Std. Dev | 1.56 | 6174.31 | 17.06 |
| Min | 1.08 | 403.98 | 10.24 |
| Max | 7.73 | 38355.1 | 88.52 |
| TFR | 1.00 | | |
| PGDP | -0.62 | 1.00 | |
| FLP | -0.40 | 0.33 | 1.00 |
| Obs. | 2691 | 2691 | 2691 |

**Note:** The TFR, PGDP, and FLP represent the total fertility rate, GDP per capita, and female labor participation. The data set includes 117 developing countries from 2000 to 2022.

Table 2 provides an overview of the descriptive statistics for total fertility rate, GDP per capita, and female labor force participation, based on 2691 observations from 117 developing countries spanning the period 2000–2022. The mean of TFR is 3.5, with a standard deviation of 1.56, indicating moderate variation across countries. TFR ranges from a minimum of 1.08 to a maximum of 7.73, reflecting significant differences in fertility rates among the sampled countries. PGDP shows substantial variability, with a mean value of 7,389.1 and a standard deviation of 6,174.31. The minimum value of PGDP is 403.98, while the maximum reaches 38,355.1, highlighting disparities in income levels across developing economies. Similarly, FLP exhibits a mean of 52.55%, with a standard deviation of 17.06, ranging from 10.24% to 88.52%, which demonstrates notable variation in female labor force participation rates.

The correlation matrix suggests significant relationships among the variables. TFR is negatively correlated with both PGDP (-0.62) and FLP (-0.40), indicating that countries with increasing GDP per capita and female labor participation tend to have lower fertility rates. Conversely, PGDP exhibits a positive correlation with FLP (0.33), suggesting that as GDP per capita increases, female labor participation tends to improve. These correlations underline potential interdependencies between economic growth and fertility patterns in developing countries.




**Note:** LPGDP, FLP, and TFR stand for Log GDP per capita, female labor participation, and total fertility rate respectively.

**Figure 1:** The Scatter Plots

Figure 1 illustrates the relationship between total fertility rates, Log GDP per capita, and female labor force participation in developing countries. The left panel shows an inverse J-shaped relationship, where TFR decreases sharply with rising LPGDP, reflecting the demographic transition, and levels off at higher income levels. The right panel reveals a U-shaped relationship between TFR and FLP, where TFR initially declines as FLP increases, indicating reduced fertility with higher female workforce participation, but rises slightly at very high FLP levels, suggesting improved work-family balance. These patterns highlight the socio-economic and demographic transitions in developing nations.

## 4. Result and Discussion

The diagnostic tests, including AR(1) and AR(2), confirm the absence of autocorrelation, and the Hansen and Sargan test p-values indicate the validity of instruments. The robust findings across models support the study's objective of understanding fertility dynamics in relation to economic growth and female labor force participation in developing countries. These results emphasize that PGDP and shifts in FLP are critical factors influencing fertility behavior.

**Table 3:** GMM Results

| Variables | Difference GMM | | | System GMM | | |
|---|---|---|---|---|---|---|
| (Dependent: TFR) | Model 1 | Model 2 | Model 3 | Model 1 | Model 2 | Model 3 |
| PGDP | -0.17* | | -0.20** | -0.32** | | -0.21** |
| | (-1.68) | | (-2.14) | (-2.32) | | (-2.17) |
| PGDP2 | 0.009* | | 0.010* | 0.017** | | 0.011** |
| | (1.73) | | (1.85) | (2.18) | | (2.03) |
| FLP | | -0.22* | -0.30* | | -0.24** | -0.25** |
| | | (-1.84) | (-1.75) | | (-2.23) | (-2.38) |
| FLP2 | | 0.002* | 0.003* | | 0.002** | 0.005** |
| | | (1.87) | (1.74) | | (2.11) | (2.30) |
| Constant | | | | 3.20** | 0.15** | 3.37** |
| | | | | (2.44) | (2.58) | (2.37) |
| AR (1) test (p-value) | 0.03 | 0.03 | 0.04 | 0.04 | 0.03 | 0.04 |
| AR (2) test (p-value) | 0.45 | 0.43 | 0.47 | 0.47 | 0.46 | 0.38 |
| Sargan test (p-value) | 0.14 | 0.16 | 0.17 | 0.15 | 0.16 | 0.16 |
| Hansen test (p-value) | 0.23 | 0.28 | 0.20 | 0.24 | 0.27 | 0.28 |
| Observations | 2,457 | 2,457 | 2,457 | 2,574 | 2,574 | 2,574 |
| Number of Country | 117 | 117 | 117 | 117 | 117 | 117 |

**Notes:** (i). The result is estimated with a dynamic panel estimator (two-step system GMM) using internal instruments. (ii). t-statistics are provided in parentheses. (iii). ***, ** and * significant at 1%, 5% and 10 % significance levels, respectively

Table 3 presents the results of the Generalized Method of Moments (GMM) estimation, examining the patterns of total fertility rates in developing countries. The models incorporate both the difference GMM and system GMM approaches, addressing endogeneity concerns by using internal instruments. The coefficients of PGDP and its squared term $PGDP^2$ validate the inverse J-shaped relationship between economic growth and fertility rates, as hypothesized. In System GMM Model 1, the negative and significant coefficient of PGDP (-0.32**) and the positive and significant coefficient of $PGDP^2$ (0.017**) indicate an inverse J relation in fertility rate in sample countries. Similarly, the coefficients of FLP and its squared term $FLP^2$ demonstrate the U-shaped relationship. For example, in System GMM Model 2, the negative coefficient of FLP (-0.24**) and the positive coefficient of $FLP^2$ (0.002**) reveal that initial increases in female labor participation reduce fertility rates, but beyond a certain level, fertility rates increase. The above result is consistent with the findings of previous authors (Luci-Greulich and Thevenon, 2014; Myrskyla et al., 2009; Nakagaki, 2018).

Our second purpose is to find the turning point of the fertility trend. The turning point occurs where the slope of this function is zero: Estimation of TFR based on equation (1).

$$\frac{d(TRF)}{d(LPGDP)} = \alpha_1 + 2.\alpha_2 . LPGDP = 0$$

Solving for LPGDP

$$LPGDP = -\frac{\alpha_1}{2.\ \alpha_2} = -\frac{-0.32}{2 \times 0.017} = 9.5$$

The turning point for fertility trends occurs at a log GDP per capita (LPGDP) of approximately 9.5, which corresponds to an actual GDP per capita (PGDP) of approximately 14500 PPP (current international dollar). The average PGDP is approximately 7,390 PPP reported in Table 2. It indicates that most of the developing countries in the sample are positioned below the critical income threshold, suggesting a continued declining trend in fertility rates. Only a few countries, approaching the upper range of the GDP distribution may experience stabilization or reversal in fertility patterns, consistent with the hypothesized inverse j-shaped relationship between income and fertility.

The observed inverse J-shaped relationship between total fertility rates (TFR) and GDP per capita in developing countries can be explained by the demographic and economic transition frameworks. In the early stages of development, fertility rates remain high due to agrarian-based economies, limited access to healthcare, and the reliance on larger family sizes for economic security (Caldwell, 1976). However, as GDP per capita increases, improvements in education, healthcare, and income levels reduce fertility rates a phenomenon supported by Becker's (1960) theory, which links economic development to lower fertility through increased opportunity costs of childbearing and enhanced family planning. Beyond a certain income threshold, fertility rates stabilize, as observed in the positive coefficient of GDP squared. This stabilization could be attributed to cultural preferences, policy interventions promoting work-family balance, and increased urbanization that limits space and resources for large families (Myers, 2014). For instance, wealthier households may prioritize "quality over quantity," focusing on fewer children but higher investments in education and well-being (Doepke, 2005). Particularly, investment in technical and vocational education enhances capacity building and efficiency (Shah, 2023).

The U-shaped relationship between TFR and FLP can be attributed to the dual role of women in economic and reproductive activities. At lower levels of labor participation, women are primarily engaged in informal or agricultural sectors with limited economic opportunities, and fertility rates remain high due to cultural norms and lack of access to reproductive healthcare (Goldin, 1995). As female labor participation increases, the opportunity costs of childbearing rise, leading to a decline in fertility. This trend aligns with the economic theories of labor supply, where women delay or limit childbearing to pursue education and careers (Heckman, 1974). However, the positive coefficient of FLP squared suggests that beyond a certain threshold, higher female labor force participation coincides with policies that support work-life balance, such as maternity benefits, childcare facilities, and flexible work hours (Brewster and Rindfuss, 2000). These factors enable women to combine work and family responsibilities, potentially increasing fertility rates. Furthermore, societal shifts, such as greater gender equality, may lead to a reassessment of family roles, allowing for higher fertility alongside greater labor participation (Esping-Andersen, 2009).

The empirical results of this study highlight significant policy implications for developing countries, particularly in addressing the dual objectives of sustaining economic growth and managing fertility trends. The inverse J-shaped relationship between total fertility rates and GDP per capita suggests that as economies grow, fertility rates tend to decline, stabilizing at higher income levels. This underscores the importance of policies that promote equitable economic growth, ensuring access to quality education, healthcare, and family planning services. Investing in human capital, particularly in women's education, can accelerate fertility declines by enhancing awareness of reproductive health and increasing women's participation in the labor market (Canning and Schultz, 2012).

The U-shaped relationship between the total fertility rate and female labor force participation calls for policies that support gender-inclusive labor markets. At lower levels of labor participation, governments should focus on creating economic opportunities for women, particularly in formal and non-agricultural sectors, to reduce economic reliance on larger families. Simultaneously, as female labor participation rises, policies must address the trade-offs between work and family life. Introducing comprehensive maternity benefits, affordable childcare facilities, and flexible work arrangements can help women balance career aspirations with family responsibilities, mitigating potential declines in fertility associated with economic growth (Thevenon, 2011).

Moreover, the positive coefficient of GDP squared and FLP squared suggests the need for targeted interventions in high-income or high-labor-participation contexts to avoid potential fertility stagnation. Pro-family policies, such as parental leave and child allowances, can encourage higher fertility rates without compromising women's labor force participation (Luci-Greulich and Thevenon, 2014). Such measures can also address long-term demographic challenges, such as aging populations and shrinking workforces, by maintaining a balanced fertility rate.

## 5. Conclusion

This study examines the dynamic relationship between fertility rates and economic growth in developing countries. Specifically, it investigates the inverse J-shaped relationship between total fertility rates and GDP per capita, as well as the U-shaped relationship between total fertility rate and female labor force participation. Using annual panel data from 117 developing countries spanning 2000 to 2022 and employing the Generalized Method of Moments (GMM), the study provides robust empirical evidence supporting these relationships. Additionally, the study identifies a threshold level of income per capita that marks the turning point in fertility trends for these countries.

The identified income threshold of approximately 14,500 PPP GDP per capita indicates that the majority of developing countries in the sample fall below this critical threshold, suggesting a continued decline in fertility rates. Only a few countries nearing the upper range of the GDP distribution may experience stabilization or a reversal in fertility trends, consistent with the hypothesized inverse J-shaped relationship between income and fertility.

The findings highlight critical policy implications for developing nations. Policymakers should prioritize economic growth to reduce higher fertility rates and leverage the inverse J-shaped relationship, while simultaneously, promoting female labor force participation by improving access to education, childcare, and employment opportunities. These strategies could create a virtuous cycle of sustainable economic development, declining fertility rates, and enhanced gender empowerment. Further, this study could be expanded by classifying all developing countries into low-income, lower-middle-income, and upper-middle-income categories. This classification would help capture a more accurate understanding of the growth-fertility nexus, as it reduces data variability.

## References


Angela, L. U. C. I., & Thevenon, O. (2010). Does economic growth drive the fertility rebound in OECD countries? *Documents de travail de l'Ined*, 167 (1), 1-45.

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics, 68*(1), 29-51.

Becker, G. S. (1960). *An Economic Analysis of Fertility. Bureau of Economic Research. Demographic and Economic Changes in Developed Countries*. Princeton, National Bureau of Economic Research.

Becker, G. S. (1981). *A treatise family*. Cambridge, Harvard University Press.

Becker, G. S., & Lewis, H. G. (1973). On the interaction between the quantity and quality of children. *Journal of Political Economy*, *81*(2, Part 2), 279-288.

Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel models. *Journal of Econometrics, 87*(1), 115–143.

Bongaarts, J. (2016). Development: Slow down population growth. *Nature*, *530*(7591), 409-412.

Brewster, K. L., & Rindfuss, R. R. (2000). Fertility and women's employment in industrialized nations. *Annual Review of Sociology, 26*(1), 271-296.

Caldwell, J. C. (1976). Toward a restatement of demographic transition theory. *Population and Development Review, 2*(3), 321-366.

Canning, D., & Schultz, T. P. (2012). The economic consequences of reproductive health and family planning. *The Lancet*, *380*(9837), 165-171.

Doepke, M. (2005). Child mortality and fertility decline: Does the Barro-Becker model fit the facts? *Journal of Population Economics*, *18*(2), 337-366.

Esping-Andersen, G. (2009). *Incomplete revolution: Adapting welfare states to women's new roles*. Polity. Cambridge, UK: Policy Press.

Galor, O. and Weil, D.N. (1996). The gender gap, fertility, and growth. *The American Economic Review, 86*(3), 374-387.

Gauthier, A. H. (2007). The impact of family policies on fertility in industrialized countries: a review of the literature. *Population research and policy review*, *26*(1), 323-346.

Goldin, C. (1995). *Career and Family: College Women Look to the Past* (NBER Working Paper No. 188). National Bureau of Economic Research.

Heckman, J. (1974). Shadow prices, market wages, and labor supply. *Econometrica: Journal of the Econometric Society*, *42*(4), 679-694.

Hwang, J., & Ha Lee, J. (2014). Women's education and the timing and level of fertility. *International Journal of Social Economics, 41*(9), 862-874.

Kirk, D. (1996). Demographic transition theory. *Population studies*, *50*(3), 361-387.

Kohler, H., Billari, F.C. & Ortega, J.A. (2002). The emergence of lowest-low fertility in Europe during the 1990s. *Population and Growth Review, 28* (4), 641-680.

Lacalle-Calderon, M., Perez-Trujillo, M., & Neira, I. (2017). Fertility and economic development: Quantile regression evidence on the inverse J-shaped pattern. *European Journal of Population*, *33*(1), 1-31.

Lee, R., & Mason, A. (2010). Some macroeconomic aspects of global population aging. *demography*, *47*(Suppl 1), 151-S172.

Lesthaeghe, R. (2014). The second demographic transition: A concise overview of its development. *Proceedings of the National Academy of Sciences, 111*(51), 18112-18115.

Luci, A. (2009). Female labour market participation and economic growth. *International Journal of Innovation and Sustainable Development*, *4*(2-3), 97-108.

Luci-Greulich, A., & Thevenon, O. (2014). Does economic advancement 'cause'a re-increase in fertility? An empirical analysis for OECD countries (1960–2007). *European Journal of Population*, *30*(2), 187-221.

Malthus, T. R. (1888). *An essay on the principle of population: or, A view of its past and present effects on human happiness*. Reeves & Turner.

Mammen, K., & Paxson, C. (2000). Women's work and economic development. *Journal of Economic Perspectives*, *14*(4), 141-164.

McDonald, P. (2013). Societal foundations for explaining low fertility: gender equity. *Demographic Research*, 28 (34), 981-994.

Meyer, D. R., & Carlson, M. J. (2014). Family complexity: Implications for policy and research. *The ANNALS of the American Academy of Political and Social Science, 654*(1), 259-276.

Myrskyla, M., Kohler, H. and Billari, F.C. (2011). *High development and fertility: fertility at older reproductive ages and gender equality explain the positive link,* (Working paper, No. 30). University of Pennsylvania Scholarly Commons, Pennsylvania.

Myrskyla, M., Kohler, H. P., & Billari, F. C. (2009). Advances in development reverse fertility declines. *Nature*, *460*(7256), 741-743.

Nakagaki, Y. (2018). Fertility, female labor participation and income in East Asia. *International Journal of Development Issues, 17*(1), 69-86.

Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *The Stata Journal*, *9*(1), 86-136.

Shah, B. N. (2023). The influence of foreign aid on public sector efficiency: A panel data analysis. *The Journals of Economics,* *Marketing & Management, 11*(3), 25-35.

Sobotka, T., Skirbekk, V., & Philipov, D. (2011). Economic recession and fertility in the developed world. *Population and Development Review*, *37*(2), 267-306.

Thevenon, O. (2011). Family policies in OECD countries: A comparative analysis. *Population and Development Review*, *37*(1), 57-87.

United Nations Population Division. (2022). *World Population Prospects 2022: Summary of Results*. United Nations Department of Economic and Social Affairs.

World Bank (2022). World Development Indicators, World Bank.

**Appendix:** List of countries in the sample

Afghanistan, Albania, Algeria, Angola, Argentina, Armenia, Azerbaijan, Bangladesh, Belarus, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Burkina Faso, Burundi, Cabo Verde, Cambodia, Cameroon, Central African Republic, Chad, China, Colombia, Comoros, Congo, Dem. Rep., Congo, Rep., Costa Rica, Cote d'Ivoire, Dominican Republic, Ecuador, Egypt, Arab Rep., El Salvador, Equatorial Guinea, Eswatini, Ethiopia, Fiji, Gabon, Gambia, The, Georgia, Ghana, Guatemala, Guinea, Guinea-Bissau, Haiti, Honduras, India, Indonesia, Iran, Islamic Rep., Iraq, Jamaica, Jordan, Kazakhstan, Kenya, Kyrgyz Republic, Lao PDR, Lebanon, Lesotho, Liberia, Libya, Madagascar, Malawi, Malaysia, Maldives, Mali, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Montenegro, Morocco, Mozambique, Myanmar, Namibia, Nepal, Nicaragua, Niger, Nigeria, North Macedonia, Pakistan, Papua New Guinea, Paraguay, Peru, Philippines, Rwanda, Samoa, Sao Tome and Principe, Senegal, Serbia, Sierra Leone, Solomon Islands, Somalia, South Africa, Sri Lanka, St. Lucia, St. Vincent and the Grenadines, Sudan, Suriname, Tajikistan, Tanzania, Thailand, Timor-Leste, Togo, Tonga, Tunisia, Turkiye, Turkmenistan, Uganda, Ukraine, Uzbekistan, Vanuatu, Viet Nam, West Bank and Gaza, Zambia, Zimbabwe.

**Note:** The selection of the country is based on data availability.