



Economic Theory

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**HUMAN CAPITAL ACCUMULATION
AND SUB-REPLACEMENT FERTILITY
IN AN EU-ADJACENT ECONOMY**

Abstract

This article examines sub-replacement fertility in Türkiye as an economic outcome of large-scale human capital accumulation under institutional constraints. Over the past two decades, Türkiye has experienced rapid growth in tertiary education participation, particularly among women, while simultaneously converging toward persistent sub-replacement fertility levels comparable to those observed in several European economies. Rather than treating education as an individual-level characteristic, the study conceptualizes human capital accumulation as a structural transformation that reshapes labor market incentives, household decision-making, and reproductive outcomes. Using a descriptive–analytical approach based on official statistical data, the article documents the changes in fertility levels, timing of childbearing, parity distribution, educational differentials, household structure, and regional variation. The results demonstrate that sub-replacement fertility in Türkiye is structural rather than cyclical and is most pronounced among women with higher levels of education. The original scientific contribution of the study lies in demonstrating that sub-replacement fertility consti-

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tutes an unintended demographic externality of human capital accumulation in an EU-adjacent economy where institutional arrangements insufficiently support the reconciliation of education, employment, and parenthood. The findings highlight the structural limitations of conventional pro-natalist policies and underscore the necessity of aligning education, labor market, and family policy frameworks.

Key Words:

economy, European Union, female labor market participation, higher education expansion, human capital accumulation, institutional constraints, sub-replacement fertility, Türkiye.

JEL: I23, J13, J18, J24.

1 table, 9 figures, 30 references.

Problem Statement and Literature Review

In economic analysis, fertility is commonly interpreted as a household outcome shaped by income constraints, labor supply incentives, and the expected returns to human capital investment. Building on the foundations of household economics and human capital theory (Becker, 1960; Becker & Lewis, 1973), a substantial body of research emphasizes that fertility decline in advanced and emerging economies is increasingly driven by structural changes in education systems, labor markets, and life-course organization rather than by short-term macroeconomic fluctuations (Adserà, 2004; Goldstein et al., 2009; Sobotka, 2017; Torche, 2019). Within this framework, sub-replacement fertility is closely associated with delayed family formation, prolonged educational trajectories, and rising opportunity costs of childbearing, particularly for women.

Comparative evidence further indicates that the relationship between education and fertility is highly sensitive to institutional context. Studies show that similar levels of female educational attainment generate markedly different fertility

outcomes depending on labor market flexibility, employment stability, childcare provision, and family policy design (Adserà, 2011; Esping-Andersen & Billari, 2015; Doepke et al., 2023). This institutional perspective has become central to European demographic and economic research, which conceptualizes fertility decline as a structural response to mismatches between human capital accumulation and institutional support for work–family reconciliation.

Against this backdrop, Türkiye represents a particularly informative case for European-oriented economic analysis. Over the past two decades, the country has experienced a rapid quantitative expansion of higher education institutions and participation, especially among women, while simultaneously entering a regime of persistent sub-replacement fertility. Comparative research shows that Türkiye's fertility trajectory has converged toward levels observed in several European economies, despite substantial differences in income levels and welfare-state capacity (OECD, n.d.; Sobotka et al., 2012). This parallel development raises a central analytical question: Should sub-replacement fertility in Türkiye be interpreted primarily as a demographic or cultural phenomenon, or as an economic outcome of large-scale human capital accumulation under institutional constraints?

The existing literature on fertility dynamics in Türkiye emphasizes postponement of marriage and childbearing, pronounced regional heterogeneity, and the limited effectiveness of pro-natalist policy interventions (Özgören et al., 2018; Yüceşahin & Özgür, 2008). While education is routinely included as a background variable in these studies, it is less frequently examined as a structural transformation with independent economic consequences. Recent contributions to the broader fertility literature caution that treating education solely as an individual attribute risks underestimating its macro-level effects on fertility through compositional change, labor market segmentation, and institutional strain (Lutz et al., 2006; Neels et al., 2017).

From a human capital perspective, higher education influences fertility outcomes by extending educational trajectories, delaying labor market entry, increasing the opportunity costs of childbearing, and heightening sensitivity to employment interruptions (Adserà, 2011; Baudin et al., 2015). Household economic models further emphasize that education reshapes intra-household bargaining power and resource allocation, influencing reproductive outcomes even when fertility preferences remain relatively stable (Doepke & Kindermann, 2019). These mechanisms are particularly salient in institutional environments where career interruptions associated with motherhood carry long-term labor market penalties.

The quantity–quality framework provides an additional economic mechanism linking education to fertility outcomes. As returns to education rise, households substitute child quantity with child quality, intensifying per-child investment (Becker et al., 1990). Empirical studies show that this trade-off becomes especially binding in contexts characterized by competitive education systems and largely privatized investments in children's human capital (Cygan-Rehm &

Maeder, 2012; Hazan & Zoabi, 2011). Broader post-industrial institutional changes further reinforce these dynamics by delaying union formation and compressing the reproductive window.

Despite these advances, the structural role of higher education expansion in shaping sub-replacement fertility outcomes in Türkiye remains insufficiently examined within an explicitly economic framework. The central problem addressed in this article is the growing misalignment between rapid human capital accumulation and institutional arrangements governing labor markets and family life. The study advances the argument that sub-replacement fertility in Türkiye represents a predictable economic outcome of educational massification operating under structural constraints, rather than a temporary demographic fluctuation or a culturally specific deviation.

Accordingly, **the aim of the article** is to provide a descriptive–analytical economic interpretation of sub-replacement fertility in Türkiye by examining how higher education expansion reshapes fertility outcomes across educational groups and regions. By situating Türkiye within an EU-27 comparative context, the study contributes to ongoing debates on how economies undergoing rapid human capital accumulation can reconcile educational expansion with demographic sustainability.

Methodology

This study adopts a descriptive–analytical research design suited to the examination of long-term structural transformations in fertility behavior. Rather than estimating causal effects at the individual level, the analysis integrates economic theory with systematic descriptive evidence to identify persistent and economically meaningful associations between human capital accumulation and fertility outcomes. This methodological choice reflects the study's focus on fertility as a macro-structural phenomenon shaped by institutional context, rather than as a response to short-term economic shocks or isolated individual decisions. Such an approach is well established in demographic and economic research that examines fertility change as a structural process embedded in education systems, labor markets, and family institutions (Billari & Kohler, 2004; Goldstein et al., 2009).

The empirical analysis is based on official statistical data produced primarily by the Turkish Statistical Institute. The data sources include annual birth statistics, age-specific fertility rates, parity distributions, marriage and divorce records, household and family structure statistics, internal migration data, life tables, and population projections. These indicators constitute standard inputs in descriptive fertility research and are widely used in comparative demographic and economic analysis (Preston et al., 2001; Sobotka, 2017). To capture the scale and timing of

human capital accumulation, the demographic data are complemented by detailed measures of educational attainment and the quantitative expansion of higher education institutions. This enables fertility outcomes to be examined in relation to cohort-specific and regional patterns of educational expansion (Barro & Lee, 2013; OECD, n.d.).

The analytical strategy combines longitudinal trend analysis with cross-sectional descriptive comparisons. Fertility dynamics are examined through changes in total and age-specific fertility rates, the timing of childbearing, parity progression, and completed fertility patterns. Educational differentials in fertility are analyzed to assess how human capital accumulation reshapes reproductive outcomes across population subgroups, while regional variation is explored to capture the interaction between education expansion, local labor market conditions, and household structures within a heterogeneous institutional setting. This multi-dimensional descriptive strategy is consistent with applied economic and demographic research that prioritizes pattern identification and institutional interpretation over formal statistical identification (Bongaarts & Feeney, 1998; Lutz et al., 2006).

Consistent with the study's theoretical framework, the emphasis is placed on economically meaningful patterns rather than econometric estimation. Fertility outcomes are interpreted as responses to changing opportunity costs, labor market incentives, and institutional constraints associated with expanded educational attainment. The analysis does not aim to establish causal effects at the individual level; instead, it seeks to document structural regularities that emerge when large-scale human capital accumulation unfolds within institutional environments that insufficiently support the reconciliation of education, employment, and parenthood. This methodological orientation aligns with institutional economic research that treats demographic behavior as an outcome of structural and policy regimes rather than as a sequence of isolated micro-level choices (Esping-Andersen, 2009; Adserà, 2011).

Research Results

The descriptive evidence indicates that Türkiye has entered a regime of persistent sub-replacement fertility. As shown in Table 1, the total fertility rate declined steadily to 1.48 children per woman by 2024 and has remained below the population replacement threshold for more than a decade. The simultaneous decline in the absolute number of live births confirms that this pattern reflects a long-term structural shift rather than short-term cyclical volatility.

Table 1

Number of live births and total fertility rate in Türkiye, 2001-2024

| Year | Number of births | Total fertility rate | Year | Number of births | Total fertility rate |
|------|------------------|----------------------|------|------------------|----------------------|
| 2001 | 1 323 341 | 2.38 | 2013 | 1 297 505 | 2.11 |
| 2002 | 1 229 555 | 2.17 | 2014 | 1 351 088 | 2.19 |
| 2003 | 1 198 927 | 2.09 | 2015 | 1 336 908 | 2.16 |
| 2004 | 1 222 484 | 2.11 | 2016 | 1 316 204 | 2.11 |
| 2005 | 1 244 041 | 2.12 | 2017 | 1 300 258 | 2.08 |
| 2006 | 1 255 432 | 2.12 | 2018 | 1 257 071 | 2.00 |
| 2007 | 1 289 992 | 2.16 | 2019 | 1 191 709 | 1.89 |
| 2008 | 1 295 511 | 2.15 | 2020 | 1 119 755 | 1.77 |
| 2009 | 1 266 751 | 2.10 | 2021 | 1 085 450 | 1.71 |
| 2010 | 1 261 169 | 2.08 | 2022 | 1 040 860 | 1.63 |
| 2011 | 1 252 812 | 2.05 | 2023 | 961 566 | 1.51 |
| 2012 | 1 294 605 | 2.11 | 2024 | 937 559 | 1.48 |

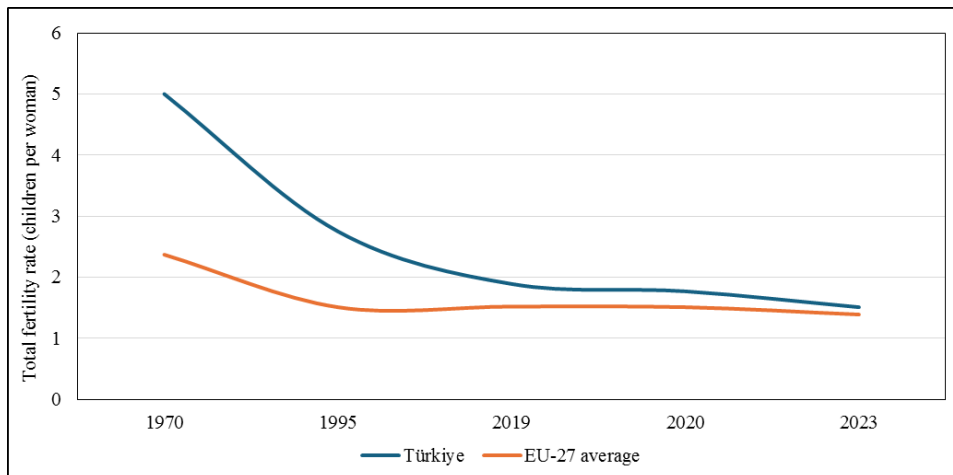
Source: Turkish Statistical Institute (TÜİK) (2025).

When placed in a comparative perspective, Türkiye's fertility transition closely mirrors aggregate patterns observed in the European Union (EU-27). Figure 1 compares total fertility rates in Türkiye and the EU-27 average and reveals a clear convergence toward similar sub-replacement levels. Despite substantial differences in income levels and welfare-state capacity, the alignment of fertility trajectories suggests that fertility decline reflects shared structural mechanisms associated with post-industrial economic organization rather than country-specific cultural dynamics.

This convergence has unfolded alongside a rapid expansion of higher education in Türkiye. Figure 2 documents the sharp increase in the number of universities and total higher education enrollment since the early 2000s. Although the institutional scale differs from that of the EU-27, the pace of educational expansion has been exceptionally rapid. The simultaneity of declining fertility (Table 1; Figure 1) and expanding tertiary education (Figure 2) points to a strong temporal alignment between large-scale human capital accumulation and fertility decline, consistent with economic interpretations emphasizing rising opportunity costs and delayed life-course transitions.

Figure 1

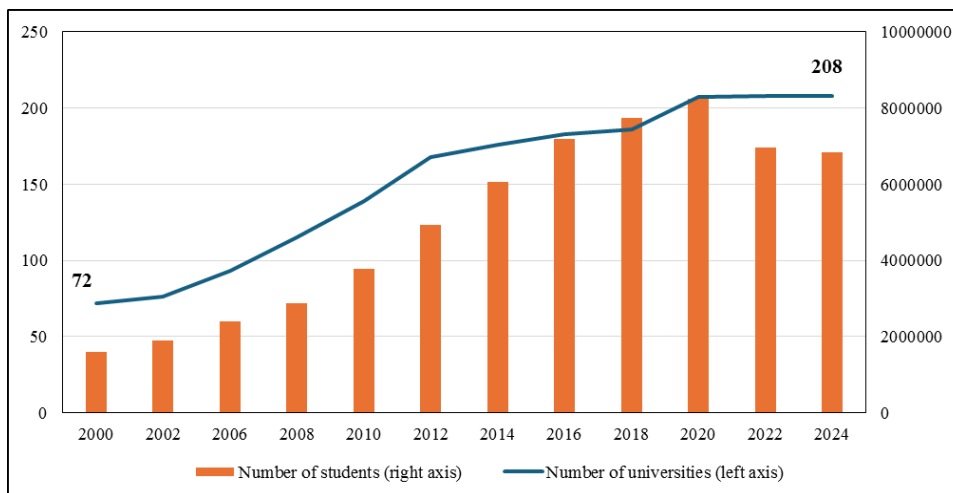
Total fertility rates, 1970-2023: Türkiye and EU-27 average



Source: OECD (n.d.).

Figure 2

Number of universities and total higher education enrollment in Türkiye

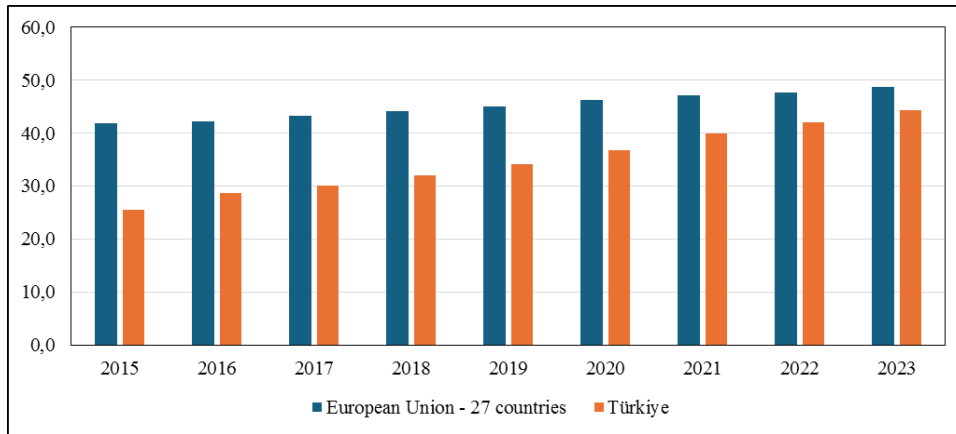


Source: Council of Higher Education (YÖK) (n.d.).

A comparative perspective on educational attainment further reinforces this interpretation. Figure 3 presents tertiary education attainment rates among women aged 25–34 in Türkiye and the EU-27 average. While Türkiye continues to lag behind the EU-27 in absolute attainment levels, the rate of increase has been markedly faster. This rapid compositional change implies that aggregate fertility outcomes in Türkiye are increasingly shaped by cohorts whose educational profiles resemble those prevalent in EU-27 economies, amplifying convergence in reproductive behavior.

Figure 3

Female tertiary education attainment (% , ages 25–34): Türkiye and EU-27

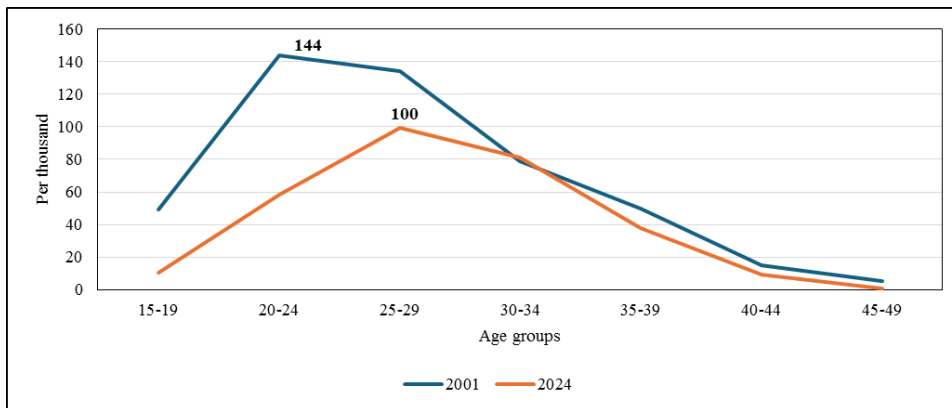


Source: Eurostat (n.d.-a).

Fertility timing has adjusted in parallel with these changes. As shown in Figure 4, age-specific fertility rates in Türkiye have shifted toward older age groups, with peak fertility now concentrated among women aged 25–29, closely approximating the age pattern observed in the EU-27 (Figure 5). The sharp decline in adolescent fertility reflects prolonged educational enrollment and delayed transitions into marriage and parenthood. Figure 6 documents the steady rise in the mean age at first birth in Türkiye, narrowing the gap with the EU-27 average over time (Figure 7). From an economic perspective, these timing shifts indicate postponed fertility associated with extended human capital investment and delayed labor market stabilization.

Figure 4

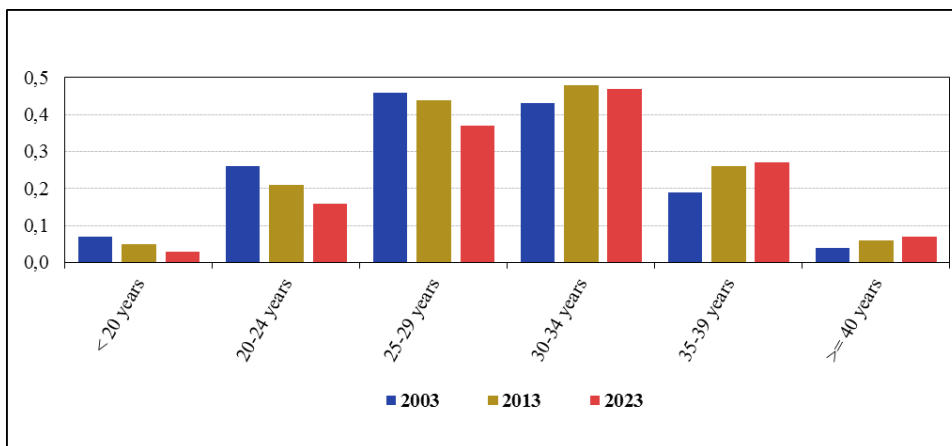
Age-specific fertility rates: Türkiye



Source: Turkish Statistical Institute (TÜİK) (2025).

Figure 5

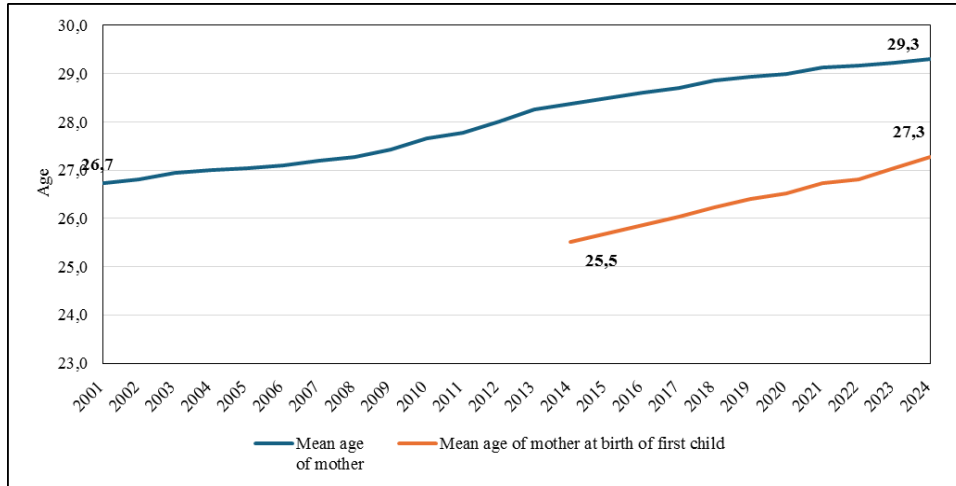
Age-specific fertility rates: EU-27



Source: Eurostat (n.d.-b).

Figure 6

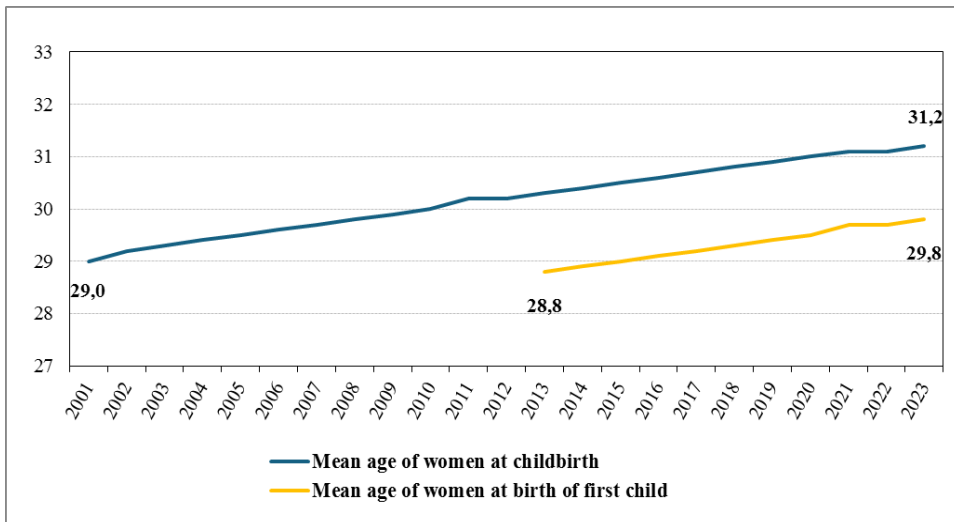
Mean age at birth: Türkiye



Source: Turkish Statistical Institute (TÜİK) (2025).

Figure 7

Mean age at birth: EU-27 average



Source: Eurostat (n.d.-c).

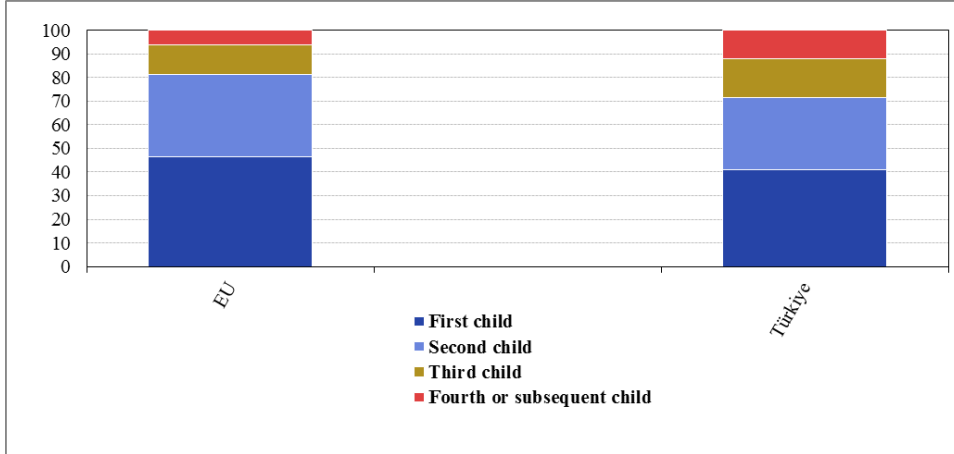
These timing adjustments also increase exposure to economic uncertainty during the reproductive life course, as delayed childbearing coincides with periods of employment instability and career establishment. In institutional contexts where labor market entry is increasingly competitive and family-policy support remains limited, postponed fertility raises the risk that intended births are not fully realized. As a result, shifts in fertility timing contribute not only to later childbearing but also to lower completed fertility, reinforcing sub-replacement outcomes through economically mediated life-course constraints.

Beyond shifts in aggregate timing, the postponement of childbearing has important economic implications for completed fertility outcomes. Delayed entry into parenthood shortens the effective reproductive window, increasing the likelihood that intended births are foregone rather than merely postponed, particularly in institutional settings characterized by employment uncertainty and limited support for work–family reconciliation. As educational trajectories lengthen and labor market entry is deferred, the costs associated with career interruptions rise, especially for highly educated women facing steeper wage penalties and reduced employment stability following childbirth. In this context, postponed fertility becomes structurally linked to lower parity progression, reinforcing sub-replacement fertility even in the absence of substantial changes in stated fertility preferences. The convergence of fertility timing patterns between Türkiye and the EU-27 thus reflects not only a synchronization of life-course schedules, but also a shared economic environment in which delayed transitions into stable employment and family formation constrain the realization of intended family size.

Changes in parity distribution provide additional evidence of structural convergence. Figure 8 shows that first-order births account for an increasing share of total births in both Türkiye and the EU-27, while third and higher-order births have declined substantially. This pattern suggests that fertility decline is driven not only by postponed timing but also by constrained parity progression, reducing completed fertility across cohorts. Such dynamics are consistent with quantity–quality trade-offs in household decision-making under rising returns to education and increased costs of childrearing. In this context, higher-order births become increasingly sensitive to economic constraints, as the marginal cost of additional children rises with education-related investments and labor market commitments. The declining progression beyond the first child indicates that fertility limitation operates primarily through parity reduction rather than childlessness alone. Consequently, structural shifts in parity distribution play a central role in sustaining sub-replacement fertility as a stable demographic outcome in both Türkiye and the EU-27.

Figure 8

Distribution of live births by parity: EU-27 and Türkiye



Source: Eurostat (n.d.-a).

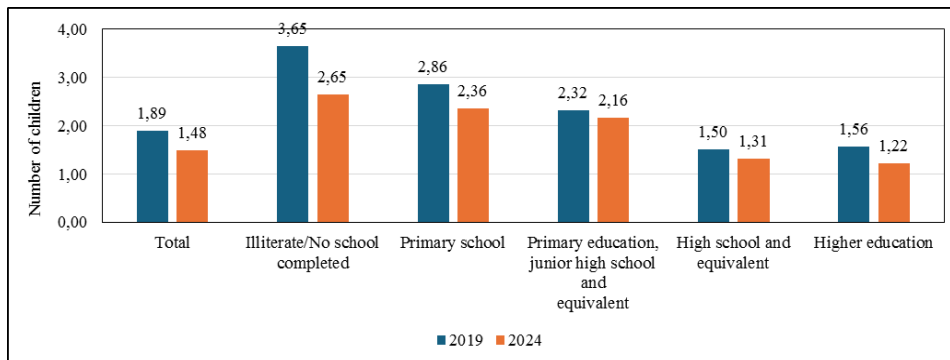
Educational differentials in fertility outcomes further reinforce this interpretation. Figure 9 demonstrates that fertility levels among highly educated women in Türkiye closely resemble those observed among highly educated women in the EU-27. As female tertiary education has expanded rapidly in Türkiye, aggregate fertility outcomes increasingly reflect the reproductive behavior of highly educated cohorts. In the absence of fully developed family-policy regimes that facilitate work–family reconciliation, this compositional shift contributes to sustained sub-replacement fertility at the aggregate level. This convergence highlights the central role of education-related opportunity costs in shaping fertility behavior across institutional contexts. As the share of highly educated women increases, aggregate fertility becomes increasingly anchored to life-course patterns characterized by delayed childbearing and lower parity progression. Without institutional mechanisms that offset these costs, educational expansion continues to exert downward pressure on fertility levels through compositional effects.

Taken together, the empirical patterns indicate that sub-replacement fertility in Türkiye reflects a structural reorganization of demographic behavior associated with large-scale human capital accumulation. The close alignment between Türkiye and the EU-27, despite substantial differences in income levels and institutional capacity, supports the interpretation that fertility decline constitutes an endogenous economic response to educational massification under institutional

constraints. Rather than representing a temporary demographic deviation, Türkiye's fertility transition increasingly mirrors the structural demographic outcomes observed across EU-27 economies.

Figure 9

Fertility by women's education level: Türkiye



Source: Turkish Statistical Institute (TÜİK) (2025).

Conclusions

This article has examined sub-replacement fertility in Türkiye through a descriptive–analytical economic framework that situates fertility decline within the broader process of human capital accumulation. By integrating demographic indicators with evidence on higher education expansion and institutional context, the analysis shows that Türkiye's fertility transition reflects a structural reorganization of life-course trajectories rather than a temporary response to cyclical economic conditions or a culturally specific deviation. The observed convergence of fertility patterns between Türkiye and the EU-27 further supports the interpretation of sub-replacement fertility as an outcome shaped by shared economic mechanisms associated with educational massification.

The findings indicate that the large-scale expansion of higher education has altered fertility behavior through multiple, mutually reinforcing channels. Extended educational trajectories, delayed labor market entry, rising opportunity costs of childbearing, postponed marriage, and changing household structures

have collectively reshaped the economic calculus of family formation. Within this framework, sub-replacement fertility among highly educated women emerges not as an expression of weakened family preferences, but as an adaptive response to institutional environments that provide limited support for the simultaneous pursuit of education, employment, and parenthood.

The study contributes to the fertility literature by reframing sub-replacement fertility as an unintended demographic externality of human capital accumulation in an EU-adjacent economy. By shifting the analytical focus from individual-level educational effects to education as a structural transformation, the article extends existing accounts that emphasize postponement alone and highlights the limitations of conventional pro-natalist policies that rely primarily on financial incentives or normative appeals while leaving the underlying misalignment between education systems, labor markets, and family policy frameworks largely unaddressed.

From a policy-oriented perspective, the results underscore the importance of institutional coordination. In the absence of reforms that facilitate the reconciliation of higher education, stable employment, and family life, particularly for highly educated women, sub-replacement fertility in Türkiye is likely to persist as a stable low-fertility equilibrium. Such an outcome carries important implications for labor supply, population ageing, and long-term economic sustainability, increasingly aligning Türkiye's demographic challenges with those faced by EU-27 economies.

Future research could build on this descriptive framework by extending comparative analyses across EU and EU-adjacent countries to examine how variations in labor market structures, childcare provision, and family-policy regimes mediate the relationship between human capital accumulation and fertility outcomes. The use of micro-level longitudinal data may further clarify how individual educational trajectories interact with institutional constraints over the life course. Such extensions would contribute to a deeper understanding of the conditions under which societies can sustain both high levels of human capital and demographic reproduction.

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