Fertility Decline in Unstable Times

A Data-Driven Analysis of how Economic and Social Influences affects Birth Rates in Europe

Abstract

This is an amateur study developed as part of a university project, aimed at exploring whether the perception of uncertainty about the future is a widespread sentiment across the population. In pursuing this question, the analysis focused on indicators such as the birth rate, under the assumption that it might reflect why younger generations are increasingly reluctant to take on the responsibility of starting a family, and whether this reluctance is truly driven by uncertainty or if other factors are at play.

The study highlights a clear decline in birth rates and identifies several meaningful correlations, ultimately suggesting that the phenomenon is likely the cumulative outcome of economic and medical progress, along with shifting socio-cultural norms.

Introduction

In recent decades, declining birth rates have sparked growing concern among demographers, economists, and policymakers. This amateur study, born as a university project, seeks to explore whether the widespread perception of uncertainty about the future plays a significant role in this demographic shift. While discussions on fertility often focus on economic or political contexts, this work attempts to go a step further, investigating whether the perceived instability of the future is a shared experience across different populations, and to what extent it influences the decision to start a family.

Using birth rate as a proxy variable, this research investigates how broader societal changes, ranging from economic fluctuations to shifts in gender roles, may be contributing to the reluctance of newer generations to embrace parenthood. Although birth rate does not directly measure voluntary childlessness, it remains a powerful indicator of generational trends and collective priorities. This paper does not aim to provide a definitive causal model, but rather to identify potential relationships that may help explain the complexity behind fertility decline. It offers a visual and statistical overview of possible connections, raising questions about the influence of both structural and psychological factors on reproductive choices.

Methodology

The research was conducted using Python and various libraries for data analysis and statistics. To initially guide the direction of the study, a key reference was

Roser, M. (2014), The Global Decline of the Fertility Rate.

Data were sourced from publicly available repositories such as Our World in Data and The World Bank. Each dataset was structured to clearly associate values with both country and year. During the data cleaning process, significant gaps were identified, particularly in certain countries from earlier periods, likely due to the delayed adoption of systematic data collection. In cases where missing data could not be imputed meaningfully, the respective countries were excluded from the analysis. For datasets with partial gaps, a one-directional forward/backward filling method was applied, copying adjacent values. This approach was chosen after a preliminary inspection showed many variables followed consistent increasing or decreasing trends, and using mean or median imputation would have disrupted the chronological progression reflected in the data.

After data cleaning, reshaping, and merging, it was possible to perform comparative analysis across variables using Python's plotting libraries. Statistical measures such as correlation coefficients were calculated, and the variables were normalized on a decimal scale to facilitate visual comparisons, especially where some variables had significantly larger magnitudes than the primary variable of interest, the birth rate.

Both scatter plots and line charts were employed: scatter plots helped reveal potential patterns and correlations, while line charts were particularly useful for identifying peaks or trend shifts around key socio-economic events. Notable reference points included: 1980 (Birth control & HIV/AIDS), 1990 (Social campaigns), 2008 (Subprime crisis), 2010 (EU debt crisis), and 2020 (COVID-19 pandemic).

Study Variables

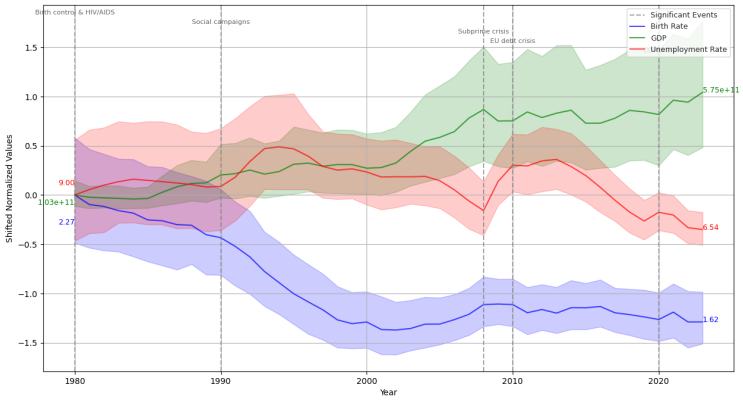
Due to the inability to use the Childlessness rate, owing to a high lack of observations and discrepancies in how such data is recorded across different countries, the main variable chosen was the birth rate. Although this does not directly indicate the portion of people who decide not to have a family or children, the calculation method for this statistic indirectly accounts for that group. It includes them in the overall average with women who choose to have children, thus providing a fairly clear picture of the true trend of our research, despite relying on a "proxy" variable. Other key variables include GDP, the unemployment rate, the percentage of women in the labor force, and the portion of GDP allocated to healthcare spending. All these variables have been studied within a time frame that includes observations from 1980 to 2023.

Preliminary Results

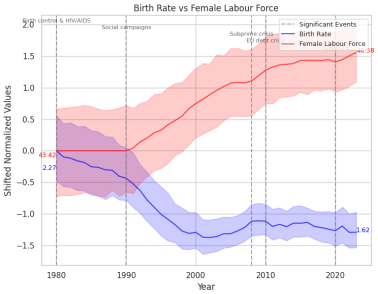
An initial preliminary analysis focusing solely on the birth rate, GDP, and unemployment rate revealed negative correlations between the main variable and the comparison variables, although the relationships were weak. A more interesting finding, however, was the behavior of the trend during key turning points. While the economic variables experienced sudden shifts, as expected, it was also curious to observe a noticeable shift in the birth rate trend. The lack of conclusive information, however, led to the introduction of additional study variables to deepen the analysis.

Plot Overview

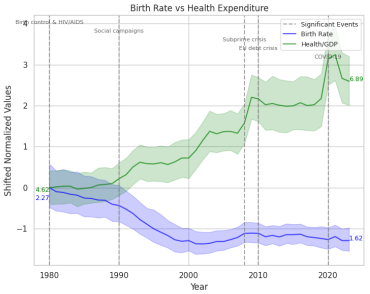
Birth Rate vs GDP and Unemployment Rate

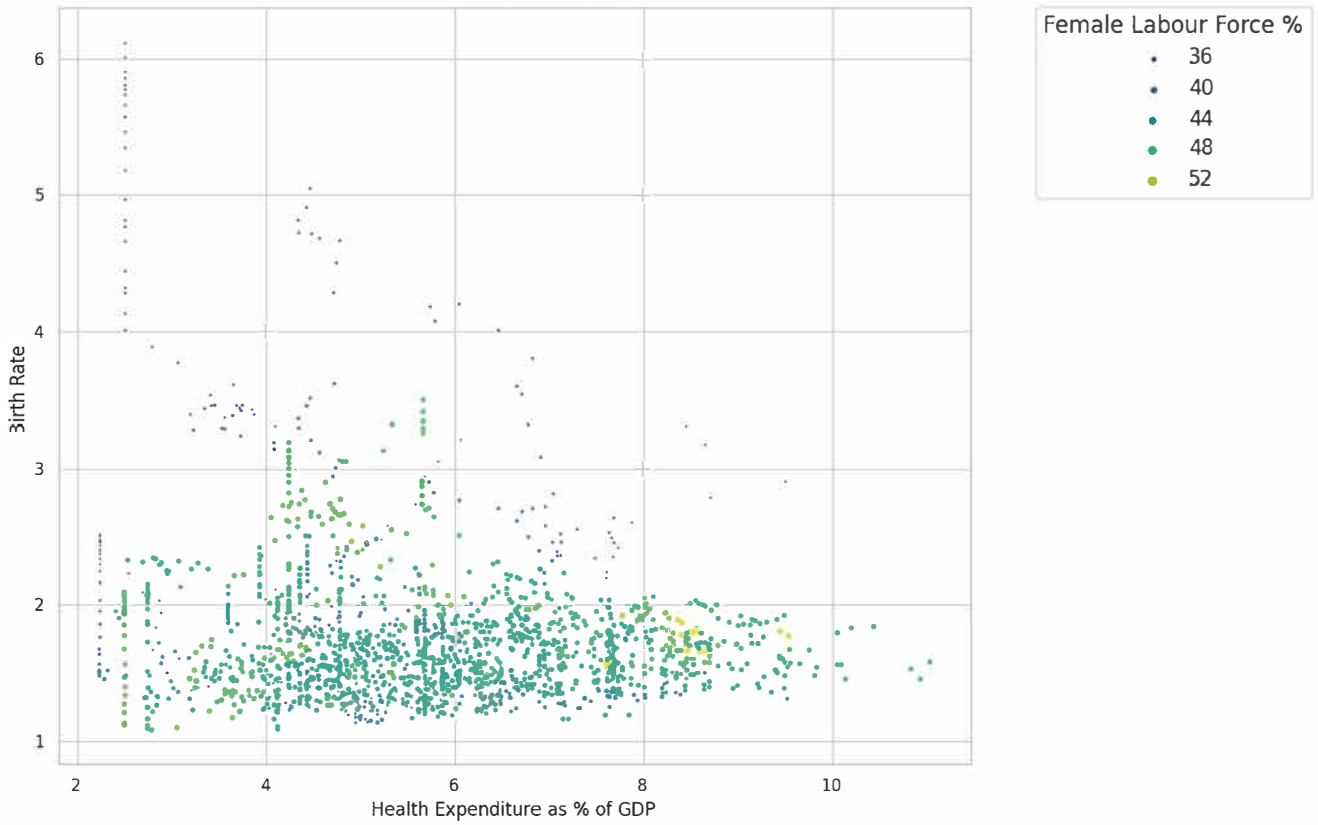


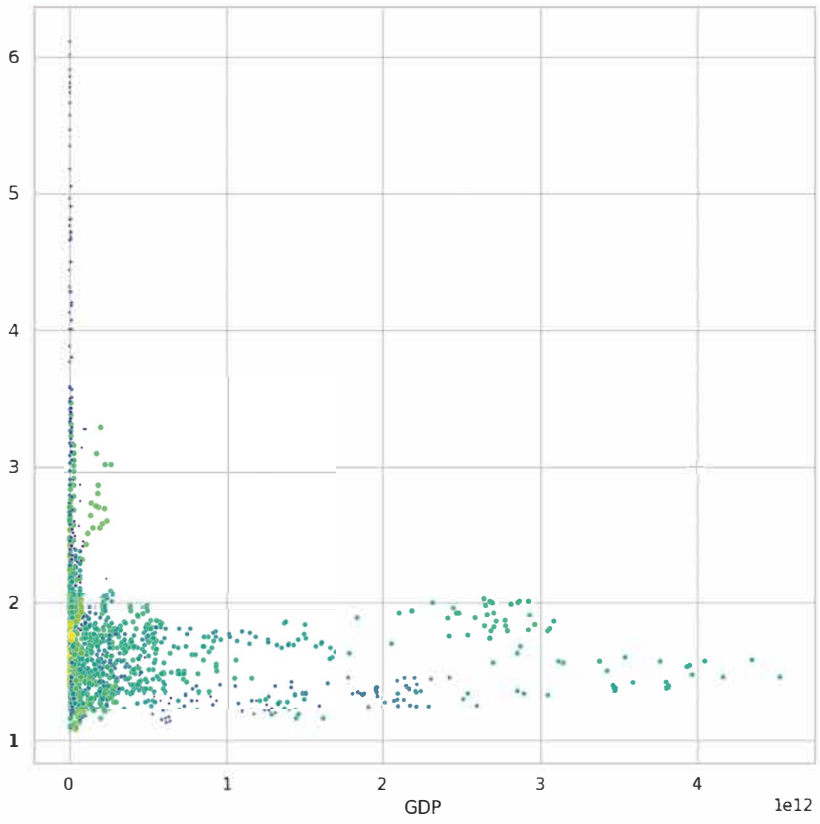
Birth Rate vs Female Labour Force



Birth Rate vs Health Expenditure







The two scatter plots reveal distinct but related patterns regarding fertility rates across countries. The first shows a weak negative correlation between public health spending and birth rates: nations investing more in healthcare (6–10% of GDP) tend to have lower fertility (1.2–2.0), while those with lower spending (2–4%) exhibit a broader range of birth rates, sometimes exceeding 4. This aligns with demographic transition theory, where better healthcare reduces infant mortality and leads families to have fewer children. Additionally, color patterns indicate that lower fertility is often associated with higher female labor force participation.

The second scatter plot highlights a clearer negative relationship between GDP per capita and birth rates: countries with lower GDP generally have higher fertility, particularly in the bottom economic quartile. However, even among low-GDP nations, those with greater female labor force participation tend to show reduced birth rates. This suggests that women's workforce engagement correlates negatively with fertility, regardless of a country's economic standing.

Conclusions

This study has investigated the decline in European birth rates from 1980 to 2023, aiming to assess the extent to which economic and social determinants have contributed to this long-term demographic trend. The results offer insights that help address the guiding research questions.

First, the analysis reveals a weak negative correlation between economic development, measured through GDP per capita and fertility rates. This suggests that increased material prosperity does not necessarily lead to higher birth rates. On the contrary, it may coincide with declining fertility, potentially due to evolving personal aspirations, transformations in family structures, and shifting societal values that often accompany economic affluence.

Secondly, the relationship between periods of economic crisis and fertility decline appears inconsistent. Although some demographic changes align temporally with major downturns no consistent or statistically significant patterns emerge across countries. This suggests that economic crises may influence reproductive behavior in varied and context-specific ways, without representing a universally predictive factor.

Additional variables, including female labor force participation and public health expenditure as a share of GDP, also show weak negative correlations with birth rates. These findings are in line with demographic theories that link increased gender equality, greater access to healthcare, and shifting career priorities with postponed parenthood and lower fertility. While the statistical strength of these associations is limited, their direction aligns with broader socio-cultural transformations observed over recent decades.

Overall, no single economic or social factor emerges as the principal driver of fertility decline. Instead, the evidence supports the idea that falling birth rates are caused by a mix of structural, cultural, and personal changes, such as changing gender roles, new views on family, and different life priorities.

It is also important to recognize the limitations of a purely quantitative approach. While statistical tools are valuable in detecting patterns and correlations, they fall short in capturing the nuanced motivations, lived experiences, and existential factors that shape reproductive decisions. Therefore, interdisciplinary research that integrates insights from sociology, psychology, and cultural studies remains essential to fully understand the multifaceted nature of this phenomenon.

Lastly, the time frame under study (1980–2023) encompasses not only the aftermath of the oil crisis and the post-Cold War period, but also the dawn of the new millennium, a period marked by both uncertainty and optimism about the future. As such, it is plausible that many of the societal shifts underway will manifest their demographic consequences more clearly in the decades to come. Ongoing observation and future research will be crucial to discerning whether current patterns represent a transitional phase or a more enduring demographic realignment.

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