

The Third Demographic Transition? The Technological-Relational Revolution and the Fertility Declines of the 21st Century

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Abstract

The steep post-2008 fertility declines remain poorly understood. We offer a novel perspective by contextualizing them with the expansion of the internet. We suggest that its revolutionary changes in human relating deeply impacted family formation. Drawing on psychological need theory, we theorize that pathways to fulfill the human need to relate have been altered, triggering the fertility declines. We use fixed-effect regression to estimate the association between the internet expansion and the TFR between 2003 and 2023 across 32 European countries. Indeed, results show a curvilinear association between the proportion of people using the internet daily and the TFR. Increases of up to 55% of people using the internet daily are associated with a slight increase in TFR from 1.61 to 1.63. Further increases, however, predict a steep linear TFR decline. Future versions of this study will test additional indicators through which daily internet usage and TFR may be linked.

INTRODUCTION

Birth rates declined sharply in many high-income countries (HICs) over the past 15 years. In Australia, for instance, the total fertility rate (TFR) dropped from 1.98 in 2008 to 1.63 in 2022. Similar declines are evident in other English-speaking countries, Scandinavia, and South-East and East Asian societies (*Human Fertility Database*, n.d.). In the media, the birth rate declines of the 2010s and 2020s have been called a ‘demographic timebomb’ (“Global Fertility Has Collapsed, with Profound Economic Consequences,” n.d.). Policymakers fear the potential collapse of social security systems due to fewer economically productive individuals supporting an increasing number of elderly dependents. Demographers, well aware that birth rates have been subjected to social change continuously throughout human existence, more balancedly point out both challenges and opportunities inherent in falling births rates (Myrskylä et al., 2024). Nonetheless, the recent declines have stirred much attention also within population science, for various reasons. The number of individuals with unfulfilled fertility desires is growing (Guzzo & Hayford, 2023), and persistent unmet desires for children correlate with poor mental health (Gameiro & Finnigan, 2017). Also, the fact that established demographic theories cannot explain the current sustained birth rate declines (Hellstrand et al., 2021, 2022), adds further complexity and intrigue to the issue. It highlights the need for interdisciplinary approaches to studying fertility change.

In this paper, we aim to investigate the fertility declines of the 21st century from a novel perspective, leaning on human basic psychological need theory while contextualizing the declines in light of the technological revolutionary changes in human communicating and relating that occurred over recent decades. We ask whether the fertility declines of the 21st Century are linked to the massive and ongoing rise in virtual connectivity and communications, and its ramifications for human relating. Not only did a substantial portion of human interacting shifted from the personal to the virtual realm, via messengers, social media, online gaming etc. Also, human romantic and sexual relating, important prerequisites of human reproduction, massively shifted toward virtual worlds, via digital sexualities and online dating. At the same time, a diversification of sexual identities and romantic relationships (e.g. ethical non-monogamic lifestyles) occurred (England et al., 2016; Lewczuk et al., 2022; Scoats & Campbell, 2022).. We theorize that, in consequence, the pathways to the fulfilment of the human need to relate and belong, an essential motivator of human behaviour (Vansteenkiste et al., 2020) have fundamentally changed during this ‘relational revolution’ of the 21st Century, which features exponential increases in electronic communications. We hypothesize that these are replacing the reproductive process as a pathway to achieving belonging, thereby contributing to the fertility declines. Discovering whether the birth rate declines are associated with these technological and relational changes underway in the (as we henceforth call it) ‘*relational revolution*’ of the 21st Century can aide in understanding the decline’s contextual embeddedness and social driving forces

To address our research question, we use data from various sources to estimate the association between changes in society’s level of virtual interconnectedness and its total fertility rate between 2003 and 2023 in 32 European countries, using country level fixed effects panel regression models. First findings indeed point at a strong and highly significant association between the percentage of people who use the internet daily and the TFR, net of other important economic and social indicators. Future versions of this study will include additional measures to test the specific pathways through which daily internet usage connects to the TFR.

BACKGROUND

Fertility rates first declined below population replacement levels (replacement = TFR of 2.1 or lower) across HICs in the 1970s, fell until the late 1990s, when rates levelled out, roughly speaking (*Human Fertility Database*, n.d.; Roser, 2024). This 20th Century decline was labelled the ‘second demographic transition’ (Lesthaeghe, 2014) and attributed to modern contraception, value change toward individuals’ self-actualization, first birth postponement caused by women’s increasing tertiary education and labour force involvement; work-family incompatibilities, gender inequalities, and, later on, economic crises and uncertainty (Balbo et al., 2013; Gustafsson, 2001; Kravdal & Rindfuss, 2008; Sobotka et al., 2011). While TFRs reached lowest-low levels (TFR of 1.3 or less) across Central- and South European and South-East Asian countries in the 1990s and 2000s, they remained around replacement across Scandinavia, France, and the English-speaking countries (*Human Fertility Database*, n.d.; *Is Lowest-Low Fertility in Europe Explained by the Postponement of Childbearing? - Sobotka - 2004 - Population and Development Review - Wiley Online Library*, n.d.). The current declines of the 2010s and 2020s have a new quality. Astonishing to demographers, they started to occur most prominently among HICs that exhibited the highest and stable fertility rates pre-decline such as Scandinavian and English-speaking countries (Berrington et al., 2022; Hellstrand et al., 2021; *Human Fertility Database*, n.d.; *The Causes and Consequences of Declining US Fertility • The Aspen Institute Economic Strategy Group*, n.d.). They also keep falling more steeply and in more countries than ever before.

Demography has developed few own theoretical approaches, borrowing heavily from economic theory to frame demographic change, and relies almost exclusively on quantitative methodologies, facts much criticised in the discipline (Sear et al., 2016; Sigle, 2021). The start of the ‘new’ fertility declines coincided with the Great Recession in 2008. Against this background, demographic studies focused on investigating them in light of economic factors such as growing unemployment, employment precariousness, economic uncertainty, and COVID-19 related disruptions. Yet, socioeconomic factors appear only weakly related to the sustained declines (Hellstrand et al., 2022; Matysiak et al., 2021; *The Causes and Consequences of Declining US Fertility • The Aspen Institute Economic Strategy Group*, n.d.). They also don’t fit with other theoretical explanations such as gender equity-, social policy- or work-family-compatibility-focused approaches, indicated by social democratic countries with extensive public support for families like Finland being decline-forerunners. Next, climate anxiety as a fertility decline driver has been much discussed but evidence remains sparse and inconclusive (Peters et al., 2023; Rackin et al., 2023; Schneider-Mayerson & Leong, 2020). Chemical exposures are a further discussed contributor (Skakkebaek et al., 2022). It would, however, be surprising if fecundity change was so rapid that it caused significant population level fertility declines within a 15-year time span, especially in times of widely available medically assisted reproduction.

Against this background, surprisingly little systematic theorizing on the psychological motivational driving forces underlying human reproduction exists to date in demography, even though it has increasingly been called for (Sear et al., 2016; Sigle, 2021). Indeed, psychological factors recently emerged as a key component of fertility preference formation and change (McAllister et al., 2016; Mynarska & Brzozowska, 2022; Vignoli et al., 2020). Moreover, recent studies suggest rising desires to remain childfree among individuals born after 1985-90, but the deeper reasons for this motivational change remain unknown (Golovina (née Savelieva) et al., 2023). Thus, a paradigm shift in demography away from the socio-economic spotlight towards the deeper-lying psychological motivational factors for

human reproduction seems necessary, especially now, in times of unprecedented yet puzzling changes in fertility behaviours. Further, both the fertility declines and the substantial rise in childfree desires are concentrated among the 1985+ birth cohorts. This indicates a generational shift in childbearing motivations and behaviours rather than a time-period change (Golovina (née Savelieva) et al., 2023; Hellstrand et al., 2021). Findings from social psychology, supported by Twenge’s work, suggest that Millennials (1980-1994) and Gen Z (1995-2012) are uniquely influenced by the rapid technological advancements shaping social interactions (Twenge, 2023). These generations exhibit distinctive attitudes towards casual sex, higher rates of sexual diversity, increased acceptance of ethical non-monogamy (Twenge, 2023; Twenge et al., 2015), and higher rates of non-binary sexual identities and gender- and sexually diverse relationships (England et al., 2016; Twenge, 2023). Twenge links these changes to the technological advancements, in her “Technological Model” (Twenge, 2023). Demography, however, has so far neglected to contextualize the fertility declines considering these transformational social changes in technology and human- and sexual relating that occurred in the 21st Century in parallel to the birth rate decline and are ongoing. Thus, investigating whether and how the technological advancement and the relational changes are linked with the observed birth rate declines, especially among younger generations, appears paramount.

DATA AND METHOD

The data for our study come from various data sources, as listed in table 1. They are macro level indicators (country level) provided by the data sources.

The key dependent variable is the yearly total fertility rate between 2003 and 2023 (TFR), provided by the Human Fertility Database. The key predictor for our study is an indicator of the percent of people who use the internet daily. This measure is also provided in a yearly time series between 2003 and 2023 by Eurostat.

Our sample includes 32 European countries, given data availability.

We estimate stepwise country-fixed effects panel regression models. The first model includes our predictor of interest (daily internet usage) only. The association between daily internet usage and the TFR takes a squared shape over time, which is why a linear and quadratic term of daily internet usage are included in the models. The second model adds various control variables, such as the GDP, the unemployment rate, the proportion of tertiary educated women, childcare availability, housing prices, and temperature measures to control for climate change.

Table 1: Indicators and Their Data Sources

Variable	Source
Total Fertility Rate	Human Fertility Database
% of individuals using the internet daily	EU survey on the use of information and communication technologies, Eurostat
Ln(GDP)	Maddison Group Project
Average annual surface temperature	World Bank Climate Change Knowledge Portal
Unemployment rate	World Bank Development Indicators
% women 25-29 with tertiary education	Eurostat

% of population with housing cost burden over 40 % of disposable household income	Eurostat
% of children aged from aged from 3 years until compulsory school age that attend child care for 30+ hours a week	Eurostat

PRELIMINARY RESULTS

First analyses show a strong and significant correlation between the percent of daily internet users and the total fertility rate (TFR) across 32 European countries between 2003 and 2023. Figure 1 shows trends in the TFR (red lines) and trends in daily internet usage (blue lines). Countries with the highest proportion of daily internet usage (Scandinavia, English speaking, Netherlands) display the steepest fertiltiy declines.

Figure 1: Trends in the total fertiltiy rate (TFR) and percent of daily internet users across Europe from 2003 to 2023

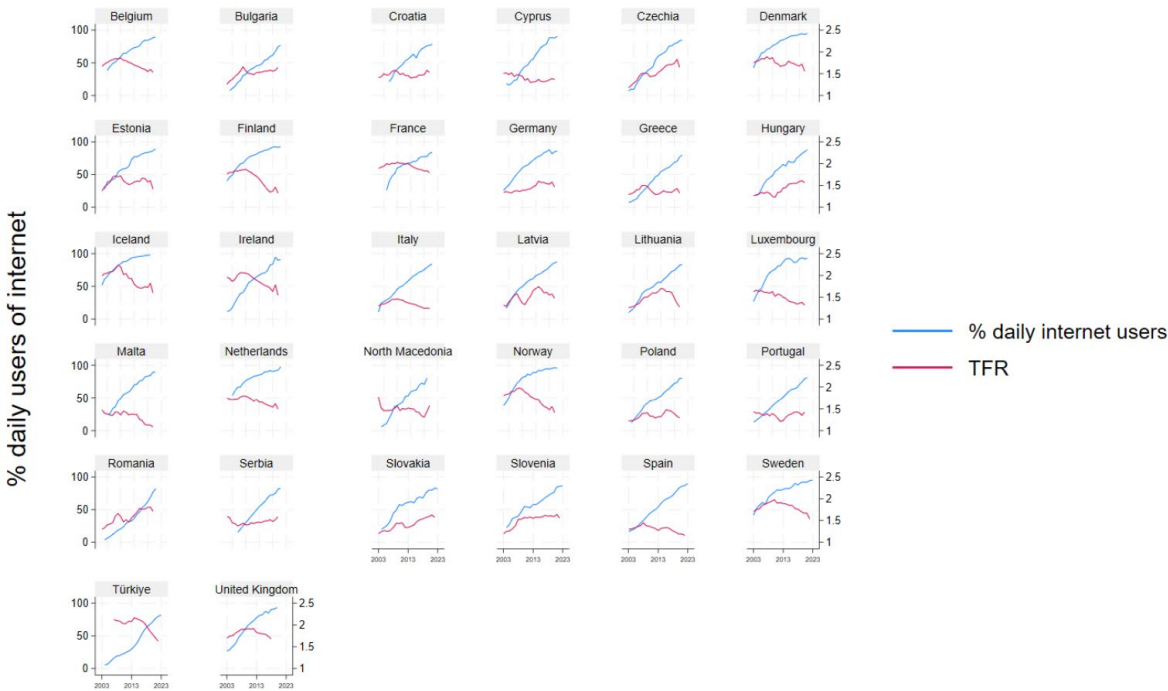


Figure 2 depicts the predicted association between daily internet usage and the TFR across the 32 European nations between 2003-2023, based on a panel regression model with country-level fixed effects. The blue line shows the predicted association from the resitrected model 1, which only regresses the TFR on the daily internet usage measure and country level fixed effects, which net out all stable country-level characteristics. It shows a strong and highly significant curvilinear relationship between the population proportion with daily internet usage and the TFR. While increases in daily internet usage of up to 55% percent of the population are associated with a slight increase in the TFR, the TFR steeply declines with further increases in the proportion using the internet daily in these 32 countries. The red line shwos the same assocition from the full model, which controls for all additional economic,

social and climate country level characteristics described above. The main finding does not change, if at all, the association between the TFR and daily internet usage gets stronger after netting out these other factors.

Figure 2: Predicted marginal effects of the percent population using the internet daily on the TFR across 32 European nations between 2003 and 2023.

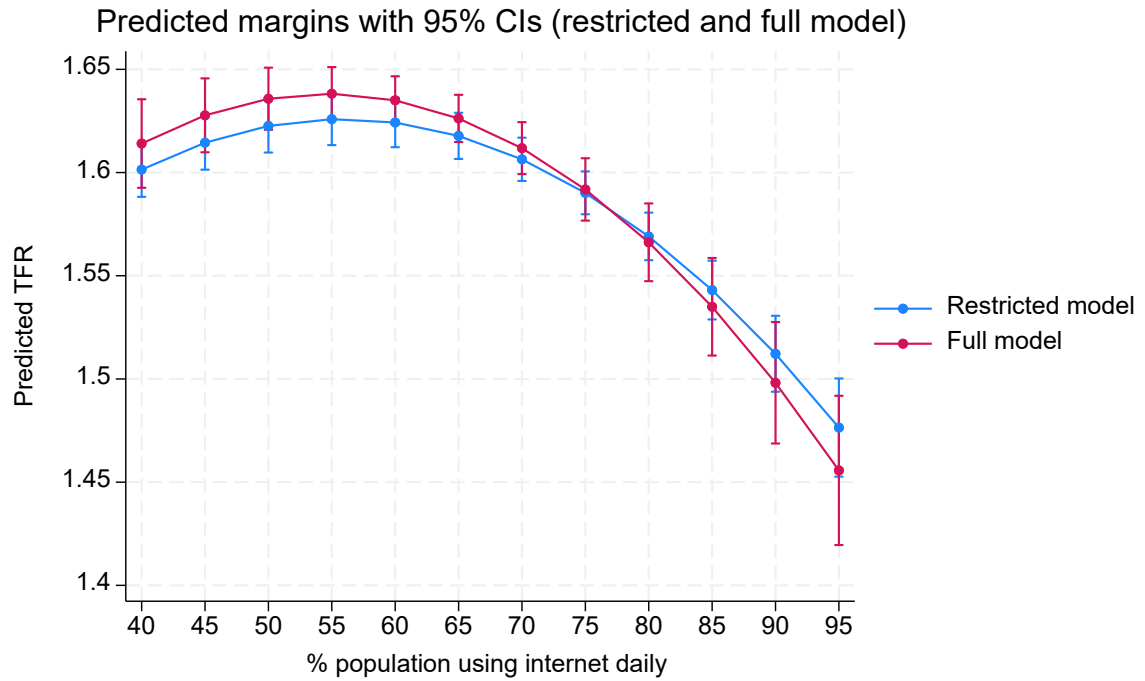


Table 2 shows coefficients from the corresponding models. Next to the population using the internet daily indicators, only the indicator for the percent of people with housing cost burden over 40 percent of their disposable household income shows statistical significance.

Table 2: Panel regression results from stepwise country-level fixed effects models, without (model 1) and with (models 2 and 3) control variables.

	Restricted model Model 1	Full model Model 2	Model 3
% population using internet daily	0.01***	0.01***	0.01***
% population using internet daily (squared)	-0.00***	-0.00***	-0.00***
Ln(GDP)		0.08	0.06
Average annual surface temperature		-0.01	-0.01
Unemployment rate		-0.00*	-0.00**
% women 25-29 with tertiary education		0.00	0.00
% of population with housing cost burden over 40 % of disposable household income		-0.01***	-0.01***
% of children aged from 3-compulsory school age that attend child care for 30+ hours a week			0.00*
Constant	1.32***	0.68	0.85

Number of observations	626	548	521
Number of countries	32	32	32
rho	0.82	0.84	0.86
Prob > F	<0.001	<0.001	<0.001
R-squared:			
Within countries	0.20	0.29	0.31
Between countries	0.20	0.07	0.02
Overall	0.01	0.11	0.05

* p<0.1, ** p<0.05, *** p<0.01

CONCUSION AND OUTLOOK

Since 2008, the total fertiltiy rate (TFR) declined steeply across many high income countries. This phenomenon occurred especially in socieites that had displayed fertility levels close to replacement before and remains poorly understood, as it does not fit common theories. In this paper, we aim to investigate the fertility declines of the 21st century from a novel perspective. We contextualize the declines considering the revolutionary technological changes in human communicating and relating that occurred over recent decades. Leaning on human basic psychological need theory, we theorize that pathways to fulfil the human need to belong and relate have been massively altered, triggering fertility declines. Indeed, analyses indicate a strong curvilinear association between the proportion of people using the internet daily and the TFR. Increases of up to 55% of people using the internet daily are associated with increases in the TFR from 1.61 to 1.63. Further increases predict a steep lienar decline of the TFR down to 1.45 when 95% of people use the internet daily. Future versions of this study will test additional indicators to better understand the mechanisms through which daily internet usage and the TFR are linked.

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