Assessing the Role of Technological Advancement in Shaping Birth Rate Trends in the United States

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Abstract

This paper delves into the intricate dynamics surrounding the fall and rise of birth rate trends in the United States. The multifaceted issue is influenced by social, demographic, economic, technological, and policy-related factors. Birth rates are critical indicators of population growth and societal health, with fluctuations significantly impacting economic stability and public services. Recent trends, including a 2% decline in U.S. birth rates from 2022 to 2023 (National Health Statistics, 2023), highlight ongoing shifts with profound long-term implications. Declining birth rates contribute to an aging population, increasing pressures on social welfare and healthcare systems, while rising birth rates can strain resources for younger generations, such as education and childcare services. This study explores the intersection of technological advancements and their influence on U.S. birth rate trends. Leveraging data from reliable sources, such as the Centers for Disease Control and Prevention (CDC) and the U.S. Census Bureau and utilizing API-based methodologies inspired by Fowler and Groves, this research examines how innovations in reproductive technologies and digital platforms shape demographic behaviors. By integrating diverse data streams, this work seeks to provide a nuanced understanding of the drivers of birth rate trends and their implications for societal and economic planning.

Keywords: Birth Rate, Fertility Rate, API, Web Scraping, Reproductive Technology, Data Collection and Methods

I. Introduction

The fall and rise of birth rates in the United States is a multifaceted issue shaped by a variety of social, demographic, economic, technological, and policy-related factors. Birth rates serve as critical indicators of population growth and societal health, as fluctuations in these rates have significant implications for the economy and public services. According to the National Center for Health Statistics, the number of births in the United States declined by 2% from 2022 to 2023 (National Health Statistics, 2023). This trend continues a pattern of gradual decline observed in recent years, raising questions about the factors driving these shifts and their potential long-term consequences.

Declining birth rates often contribute to an aging population, creating economic pressures as fewer working-age adults are available to support a growing elderly population. This imbalance can strain social welfare systems, healthcare infrastructure, and retirement funds. Conversely, rising birth rates can place pressure on public resources for younger generations, such as education, childcare, and healthcare services, creating a different set of challenges (Kearney, Levine & Pardue, 2022). These competing dynamics underscore the need to understand and address the underlying factors that influence birth rates.

Social and cultural movements, such as the rise of third-wave feminism, have significantly reshaped societal norms and individual priorities, particularly for women. This shift has encouraged greater focus on career advancement, personal development, and delayed family planning, all contributing to declining birth rates. Technological advancements have also played a dual role in this context. On the other hand, the widespread availability of contraceptives, such as birth control pills and intrauterine devices (IUDs), has empowered individuals to prevent

unintended pregnancies and exercise greater control over family planning. On the other hand, innovations in Assisted Reproductive Technology (ART), including in vitro fertilization (IVF) and embryo banking, have expanded opportunities for individuals and couples facing infertility, effectively increasing the chances of planned pregnancies.

The use of ART procedures has steadily grown over the years. According to the U.S Department of Health and Human Services, IVF represents greater than 99% of ART procedures performed, other procedures include frozen embryo transfer, Intracytoplasmic sperm injection, and Laser-assisted hatching (Assistant Secretary for Public Affairs ASPA, 2024). In 2021, 2.3% of infants were delivered through an ART procedure and that percentage continues to rise as more women experience infertility issues and opt-in to receive treatment. It is estimated 1 in 8 women between the ages of 15 and 44 will experience challenges conceiving and will seek out treatment. The causes and risks for infertility vary between women and men. According to the U.S. Department of Health and Human Services, the common causes of infertility among women are diminished ovarian reserves, (27%), ovulation issues, (14%), and tubal factors (10%). However, other contributing factors like health conditions, lifestyle choices, and genetics can also lead to infertility issues.

Public policy is another crucial factor in shaping birth rate trends. Policies that support comprehensive sex education, affordable access to contraceptives, and workplace flexibility for parents tend to correlate with lower and more sustainable birth rates. Conversely, restrictions on reproductive health services or policies incentivizing larger families can lead to higher birth rates in specific demographics. For example, financial incentives for childbirth, tax benefits for families, or extended parental leave can encourage higher fertility rates. At the same time, limited access to reproductive healthcare may result in unintended increases in births.

Our research hypothesis delves into the intersection of technological advancements and their influence on birth rate trends in the United States. Specifically, we aim to explore how innovations in reproductive health technologies, digital platforms, and healthcare accessibility have shaped demographic behaviors over time. This approach considers both the empowering potential of technology and its limitations in addressing societal challenges related to fertility and population growth.

Guiding our methodological approach is the work of Fowler and Groves, particularly their expertise with web data and APIs (Application Programming Interfaces). This philosophy underscores the importance of leveraging structured and efficient tools to access and analyze relevant data. Our primary data sources include credible medical and governmental organizations, such as the Centers for Disease Control and Prevention (CDC) and the United States Census Bureau. The use of APIs has proven invaluable for obtaining structured, reliable, and comprehensive datasets to inform our analysis. By integrating diverse data streams, our research seeks to provide a nuanced understanding of the factors driving the fall and rise of birth rates in the United States and their broader implications for society.

II. Literature Review

When the birth rate is too high or low, it affects all subgroups of the population in different ways, for example, a large number of new births will be a burden on the adult population to support them, and when this group ages to be elderly they will be a burden on governments to support them (Cleland 2008). There are many possible factors that can affect the birth rate. Recessions have been proposed to result in a drop in birth rates, specifically the Great Recession of 2007 (Livingston and Cohn 2010; Percheski and Kimbro 2014; Sobotka and Philipov 2011). Becker (1960) proposes an economic framework for fertility, where the “demand

for children" is driven by the satisfaction that children bring to people weighed against factors such as preferences (e.g. religion, race, age), income, time, expenditure, and means to support each child and other considerations (e.g. contraception, marriage). Kearney, Levine, and Pardue (2022) base their analysis of the declining US birth rates on these factors. These analyses however, did not provide sufficient evidence to explain the decline in birth rates, with the authors stating "For any factor to have explained much of that decline, it would have had to change dramatically around the same time." (Kearney, Levine, and Pardue 2022). Kearney, Levine, and Pardue (2022) then went on to find a correlation between the recent birth cohorts of mothers and the substantial decline. In our reproduction of their paper, we build on their 'shifting priorities' explanation of the cohort effects by considering the other notable events that potentially may have influenced the nature of parenting of these cohorts, namely the Third wave of Feminism and the second half of the Digital Revolution.

The third wave of feminism, which emerged in the 1990s, is marked by its emphasis on intersectionality, the redefinition of feminism, the celebration of diversity, and the deconstruction of traditional societal norms and gender roles. This wave introduced new theoretical frameworks and shifted feminist discourse to include the experiences of women from various backgrounds, including race, class, sexual orientation, and ethnicity (Snyder, 2008). These broader perspectives challenged and expanded the understanding of gender equality by emphasizing the interconnectedness of different forms of oppression. This movement's potential influence on birth rate trends in the United States is significant, as its core principles align with evolving societal priorities, such as delayed parenthood, a preference for smaller family sizes, and the reimagining of traditional family structures.

One of the defining features of the third wave was its focus on gender identity fluidity and sexual liberation. It promoted the idea that individuals could define their own roles, relationships, and family structures without adhering to rigid societal expectations. This redefinition of roles likely contributed to shifts in attitudes toward marriage, childbearing, and the timing of parenthood. For example, the celebration of diverse family configurations—including single-parent families, same-sex families, and blended families—reflects a broader acceptance of nontraditional family units. These cultural changes may have played a role in the decline of birth rates, as people increasingly prioritized personal and professional development over traditional milestones like starting a family.

Empirical studies provide further insights into how women's empowerment impacts fertility decisions. According to *Women's Empowerment and Fertility: A Review of the Literature*, the majority of studies reviewed found an inverse relationship between higher levels of women's empowerment and the number of children women have, empowerment—particularly when measured through spousal communication and women's ability to participate in fertility-related decision-making—positively influences fertility preferences, such as the desire to have fewer children. Women with greater autonomy in household decision-making often exhibit a stronger capacity to balance reproductive goals with personal ambitions, resulting in smaller family sizes (Upadhyay et al., 2014).

However, the relationship between empowerment and fertility is nuanced and context-dependent. Measures of empowerment vary widely across studies, encompassing factors like decision-making power, mobility, and access to education. These measures often influence fertility preferences differently in distinct cultural or regional settings. For instance, empowerment may have a more pronounced effect in communities where traditional gender roles

are deeply entrenched, as it represents a significant shift in societal norms (Upadhyay et al., 2014).

Birth intervals, another important aspect of fertility, are also shaped by women's empowerment. Empowered women tend to space their births further apart, as they can better manage childbearing alongside professional or educational pursuits. Longer intervals may reflect a deliberate strategy to allocate resources and opportunities effectively, providing benefits to both women and their children. Conversely, some studies indicate that working for pay or delaying first births until later in life can result in shorter birth intervals. This phenomenon may arise from women striving to align their family planning with societal or biological pressures to "catch up" on childbearing (Upadhyay et al., 2014).

Despite these findings, gaps remain in the literature. For instance, the relationship between empowerment and unintended pregnancies or abortion has been explored less frequently, leaving questions about how empowerment shapes these outcomes. Moreover, as empowerment and fertility are both multidimensional and culturally specific constructs, future research must strive to develop standardized yet adaptable measures to ensure cross-contextual applicability (Upadhyay et al., 2014).

In conclusion, the third wave of feminism and its focus on intersectionality, diversity, and redefined gender roles have influenced societal norms that underpin birth rate trends in the United States. The empowerment of women—through increased autonomy, spousal communication, and decision-making power—has been associated with smaller families and longer birth intervals. As global development efforts continue to prioritize gender equality, understanding how these dynamics shape fertility patterns remains essential for crafting effective policies and promoting equitable opportunities for women worldwide. This ongoing inquiry not

only advances gender equity but also contributes to broader societal progress (Upadhyay et al., 2014).

Research Question

1. Do medical technological advancements have an impact on the birth rate in the United States?
2. What factors could be influencing birth rate trends?

Research Hypothesis

Primary Hypothesis:

H_0:Technological advancements such as assisted reproductive technology (ART), do not have a remarkable impact on changes in birth rates in the United States, while any changes in birth rate in the United States are related to economic conditions, policies, and cultural changes.

H_{a1}: Technological advancements such as assisted reproductive technology (ART), do have a significant influence on trends in birth rate in the United States either by boosting the percentage of planned pregnancies or changing demographic behaviors related to family planning.

Secondary Hypotheses:

H_{02}: Empowerment-related factors, such as the third wave of feminism and shift in gender roles, do not have a remarkable impact on birth rate trends in the United States. Changes in social norms around parenthood and family structures do not affect fertility behavior.

H_{a2}: Empowerment-related factors, such as the third wave of feminism and shift in gender roles, do have a significant effect on birth rate changes in the United States by childbearing, reducing family sizes, and changing fertility preferences.

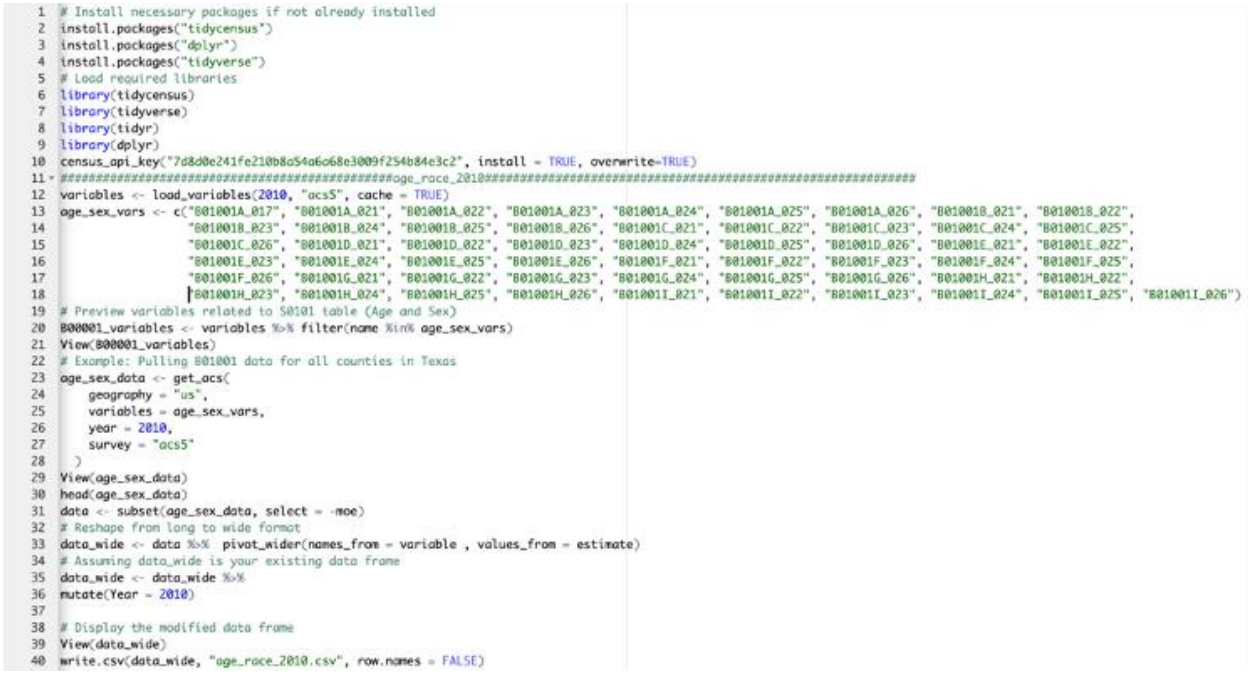
III. Data Methods

Web scraping is a method of automatically extracting data from web pages, typically by using a programming language to instruct on what to do, and then having the program take the necessary steps to collect the web data that can later be structured and analyzed for many purposes. We utilized this method as the data that is needed was only available on websites and things such as APIs or datasets already in place. Web scraping is a time-saving technique because it automates the tedious process of data collection, which, in turn, is less time-consuming and requires less effort than manual entry.

Further, it conveniently comes with the feature of scalability, which allows for fast and concurrent extraction of huge amounts of data from many different sources, and the hassle of using costly data services is also eliminated. The approach is really helpful for case-by-case data, like structured information from tables or unstructured text, and for getting fast and frequently changing information. Scattered data became a major helpful source for statistics, geographic mapping, and predicting a trend, as well. Ethical and legal issues were also a problem, which required adhering to the terms of service of the website to avoid violations.

Moreover, even the websites sometimes revise the layouts thereby breaking the scripts and making constant amendments a necessity as well as the anti-scraping measures which include CAPTCHAs and rate limits. Most of the time it was a matter of adopting techniques such as using proxy servers or captcha-solving tools. Along with the obstacles, web scraping was one

of the most effective and truly efficient techniques for gathering relevant and necessary data for our project.



```r
# Install necessary packages if not already installed
install.packages("tidycensus")
install.packages("dplyr")
install.packages("tidyverse")
# Load required libraries
library(tidycensus)
library(tidyverse)
library(tidyr)
library(dplyr)
census_api_key("7d8d0e241fe210b8a54a6a68e3009f254b84e3c2", install = TRUE, overwrite=TRUE)
##########################################age_race_2010#########################################################################
variables <- load_variables(2010, "acs5", cache = TRUE)
age_sex_vars <- c("B01001A_017", "B01001A_021", "B01001A_022", "B01001A_023", "B01001A_024", "B01001A_025", "B01001A_026", "B010018_021", "B010018_022",
                  "B010018_023", "B010018_024", "B010018_025", "B010018_026", "B01001C_021", "B01001C_022", "B01001C_023", "B01001C_024", "B01001C_025",
                  "B01001C_026", "B01001D_021", "B01001D_022", "B01001D_023", "B01001D_024", "B01001D_025", "B01001D_026", "B01001E_021", "B01001E_022",
                  "B01001E_023", "B01001E_024", "B01001E_025", "B01001E_026", "B01001F_021", "B01001F_022", "B01001F_023", "B01001F_024", "B01001F_025",
                  "B01001F_026", "B01001G_021", "B01001G_022", "B01001G_023", "B01001G_024", "B01001G_025", "B01001G_026", "B01001H_021", "B01001H_022",
                  "B01001H_023", "B01001H_024", "B01001H_025", "B01001H_026", "B01001I_021", "B01001I_022", "B01001I_023", "B01001I_024", "B01001I_025", "B01001I_026")
# Preview variables related to S0101 table (Age and Sex)
B00001_variables <- variables %>% filter(name %in% age_sex_vars)
View(B00001_variables)
# Example: Pulling B01001 data for all counties in Texas
age_sex_data <- get_acs(
    geography = "us",
    variables = age_sex_vars,
    year = 2010,
    survey = "acs5"
  )
View(age_sex_data)
head(age_sex_data)
data <- subset(age_sex_data, select = -moe)
# Reshape from long to wide format
data_wide <- data %>%  pivot_wider(names_from = variable , values_from = estimate)
# Assuming data_wide is your existing data frame
data_wide <- data_wide %>%
mutate(Year = 2010)

# Display the modified data frame
View(data_wide)
write.csv(data_wide, "age_race_2010.csv", row.names = FALSE)
```

Image 1: R Code Census Data

This R script serves the purpose of extraction and evaluation of age and sex demographic data from the U.S. Census Bureau's American Community Survey (ACS) from 2010. First, it carries out the process of installation and loading of the packages that are needed namely, tidy census(), dplyr(), and tidyverse(), which are the main ones for accessing and manipulating

Census data. A Census API key is used to sign in and get the data which is therefore the only means of access to the data.

The script illustrates the variables in the age and sex demographics, which are different codes identifying the population groups divided by age ranges and gender. Maybe the get_acs() function will fetch data on the national level for all U.S. counties from the ACS 5-year estimates for 2010. In the first place, the pulled data is viewed and then cleaned with, for example, unnecessary columns such as margin of error being discarded. The data is then converted to wide format from the long form using the pivot_wider() function, which makes it easier for analysis, and another column is added to mark the year of the dataset. Finally, the cleaned data is exported as a CSV file with the name of age_race_2010.csv which is then made available for use. This is a step-by-step and effective way of acquiring and processing demographic data which can then be

```
##################################

# Load required package
library(zoo)
library(tidyr)
library(dplyr)
library(scales)
library(readr)
library(ggplot2)

dc <- read_csv("/Users/vinay/Downloads/Combined Dataset(Combined Data)-2.csv")
View(dc)
dc$Years <- as.numeric(dc$Years)

start_year <- min(dc$Years)

time_series_data <- ts(data = dc,start = start_year,frequency = 1)

View(time_series_data)

# Linear interpolation for missing values
time_series_data_interp <- na.approx(time_series_data)

# Spline interpolation for smoother predictions
time_series_data_spline <- na.spline(time_series_data)

View(time_series_data_spline)

birth_data <- time_series_data_spline

birth_data <- data.frame(birth_data)

birth_data$Live_Birth_Deliveries <- as.integer(birth_data$Live_Birth_Deliveries)
birth_data$Total_ART <- as.integer(birth_data$Total_ART)
birth_data$Total_Embryo_Transfers <- as.integer(birth_data$Total_Embryo_Transfers)
birth_data$Total_Pregnancies <- as.integer(birth_data$Total_Pregnancies)
birth_data$Live_Born_Infants <- as.integer(birth_data$Live_Born_Infants)
birth_data$Procedures_Per_Million_15_44 <- as.integer(birth_data$Procedures_Per_Million_15_44)
birth_data$Hisp_Births <- as.integer(birth_data$Hisp_Births)
birth_data$Black_Births <- as.integer(birth_data$Black_Births)
birth_data$Nhw_Births <- as.integer(birth_data$Nhw_Births)

View(birth_data)
```

used for statistical analysis or mapping of the area. We use the same process for extracting data from 2010 to 2022.

Image 2: R Code for Aggregated Birth Rate

This R script processes time series data related to birth statistics. The process begins by loading necessary libraries, including `zoo`, `tidyr`, `dplyr`, `scales`, `readr`, and `ggplot2`, for data manipulation, visualization, and interpolation. The dataset is imported using `read_csv()`, and the `Years` column is converted to a numeric format for proper handling. The starting year of the dataset is determined using the `min()` function. A time series object is created from the dataset using the `ts()` function, setting the frequency to 1 (annual data) and starting from the earliest year to handle missing values, two interpolation methods are applied: linear interpolation

```
##################################

# Load required package
library(zoo)
library(tidyr)
library(dplyr)
library(scales)
library(readr)
library(ggplot2)

dc <- read_csv("/Users/vinay/Downloads/Combined Dataset(Combined Data)-2.csv")
View(dc)
dc$Years <- as.numeric(dc$Years)

start_year <- min(dc$Years)

time_series_data <- ts(data = dc,start = start_year,frequency = 1)

View(time_series_data)

# Linear interpolation for missing values
time_series_data_interp <- na.approx(time_series_data)

# Spline interpolation for smoother predictions
time_series_data_spline <- na.spline(time_series_data)

View(time_series_data_spline)

birth_data <- time_series_data_spline

birth_data <- data.frame(birth_data)

birth_data$Live_Birth_Deliveries <- as.integer(birth_data$Live_Birth_Deliveries)
birth_data$Total_ART <- as.integer(birth_data$Total_ART)
birth_data$Total_Embryo_Transfers <- as.integer(birth_data$Total_Embryo_Transfers)
birth_data$Total_Pregnancies <- as.integer(birth_data$Total_Pregnancies)
birth_data$Live_Born_Infants <- as.integer(birth_data$Live_Born_Infants)
birth_data$Procedures_Per_Million_15_44 <- as.integer(birth_data$Procedures_Per_Million_15_44)
birth_data$Hisp_Births <- as.integer(birth_data$Hisp_Births)
birth_data$Black_Births <- as.integer(birth_data$Black_Births)
birth_data$Nhw_Births <- as.integer(birth_data$Nhw_Births)

View(birth_data)
```

using `na.approx()` and spline interpolation for smoother predictions using `na.spline()`. These interpolations fill in gaps in the time series data to ensure continuity for analysis.

The resulting smoothed data is assigned to `birth_data`, converted into a data frame for further processing, and columns such as `Live_Birth_Deliveries`, `Total_ART`, `Total_Embryo_Transfers`, and others are cast as integers for consistency. The dataset contains variables representing birth-related metrics, including live birth deliveries, pregnancies, and births categorized by race (e.g., Hispanic, Black, and non-Hispanic White births). Finally, the processed dataset is viewed for validation and analysis, providing clean and interpolated time series data for visualization or modeling.

IV. Results

Birth Trend

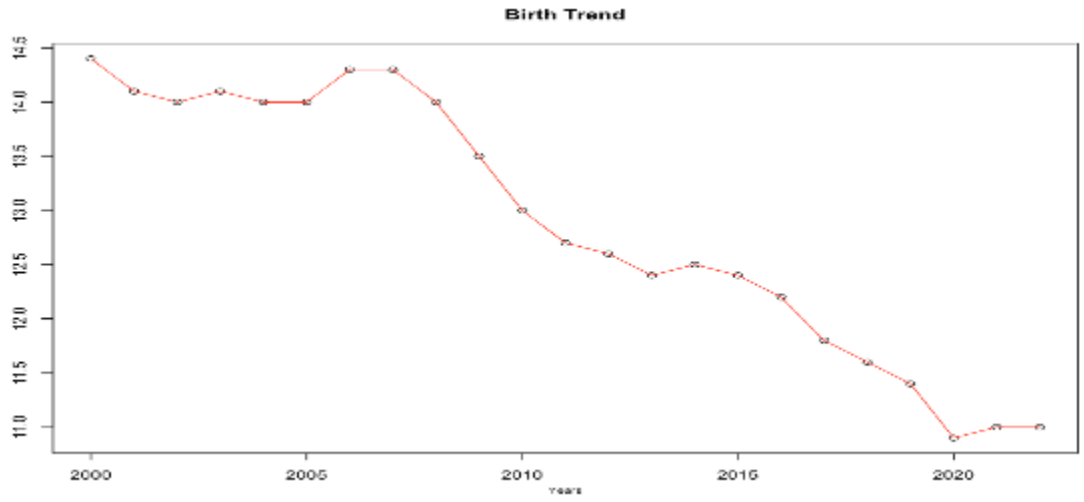


Figure 1. Birth Trend

The visual representation in *figure 1* on Birth Trend from 2000 to 2022 examines the crude birth rate for the United States, births per 1,000 people. We see in the year 2000 the birth rate is at 14.4 the subsequent years after that show a gradual decline. However, in 2006 there was a slight spike in the birth rate which remained constant at 14.3 from 2006- 2007. According to

Kearney, Levine, and Pardue (2021), the significant decline in US birth rates in 2007 was due to the 2007 Great Recession which subsequently shifted cultural attitudes and lifestyles for example, delaying childbirth. Figure 1 signifies the social impacts of this decline such as economic and demographic shifts.

ART Procedure Trend

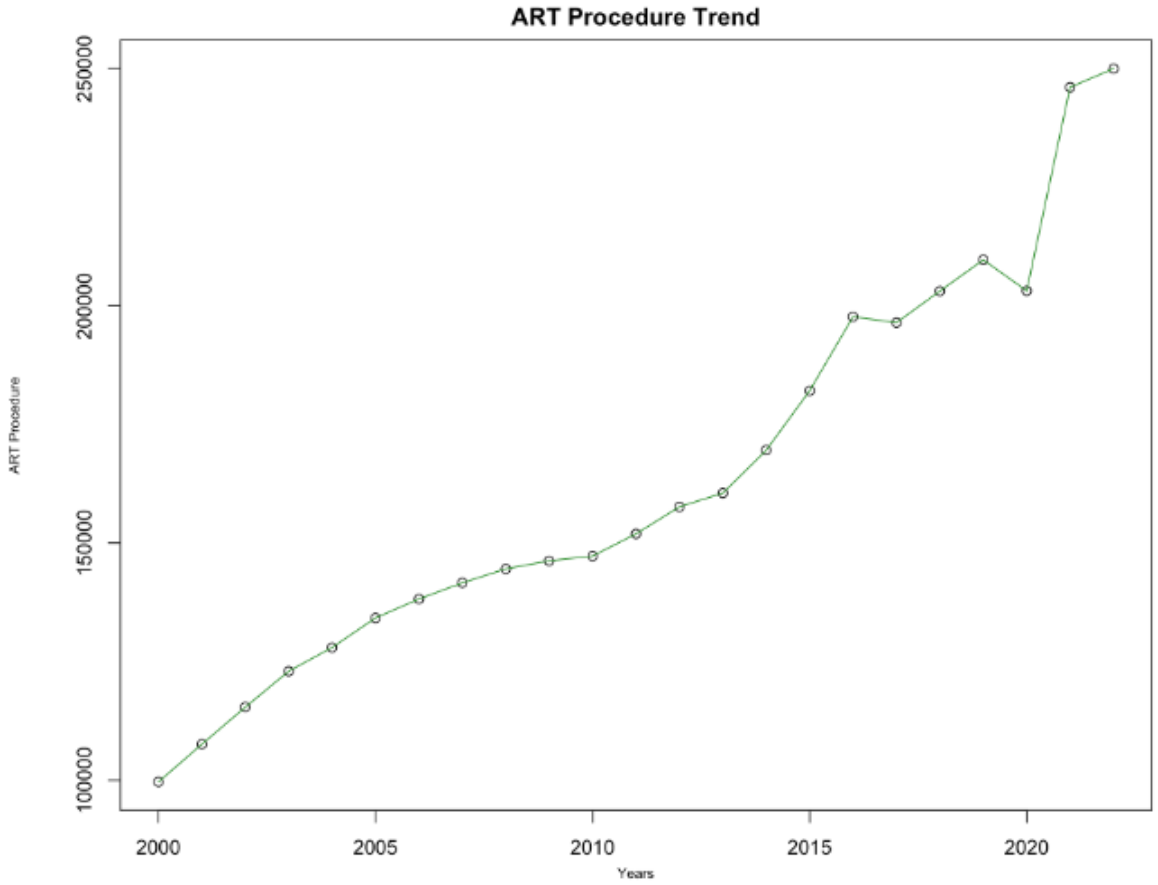


Figure 2. ART Procedure Trend

The visual representation in *figure 2. ART Procedure Trend* from 2000 to 2022 examines the number of ART Procedures (Assisted Reproductive Technologies) that women have undergone by 100,000. Overall the trend is positive showing an increase by 100,000 each year. However, we see a slight decline in 2019 due to the global pandemic Covid-19 which resulted in countrywide closures in ART clinics.

Number of Pregnancies

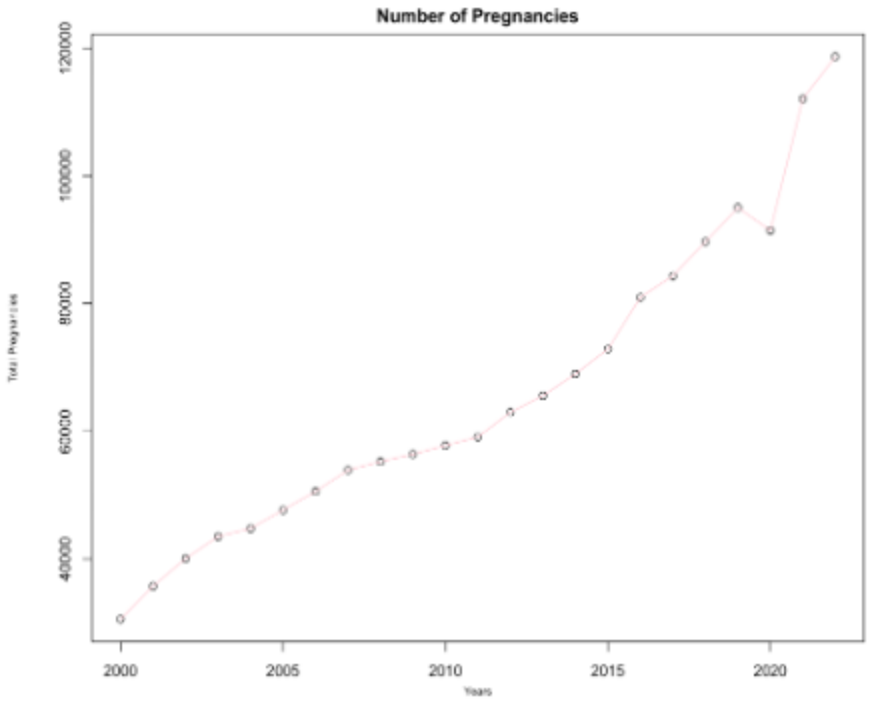


Figure 3. Number of Pregnancies

The visual representation in *figure 3. Number of Pregnancies* showcases the steady increase in the number of pregnancies achieved by Assisted Reproductive Technology (ART) in the United States between 2000 and 2022. The chart shows a, rising from about 40,000 to more than 120,000. This is a mark of improvement in ART and increasing use in infertility treatments. However, in 2019 a significant drop was experienced because of the early disruption of health services and economic uncertainties leading to the COVID-19 pandemic. Localized policy adjustments and temporary impact on clinic operations may have also played a role (Centers for Disease Control and Prevention [CDC], n.d.). The trend rebounded sharply in 2020, indicating quick adjustment by the ART industry to changing conditions.

Total Embryo Transfers

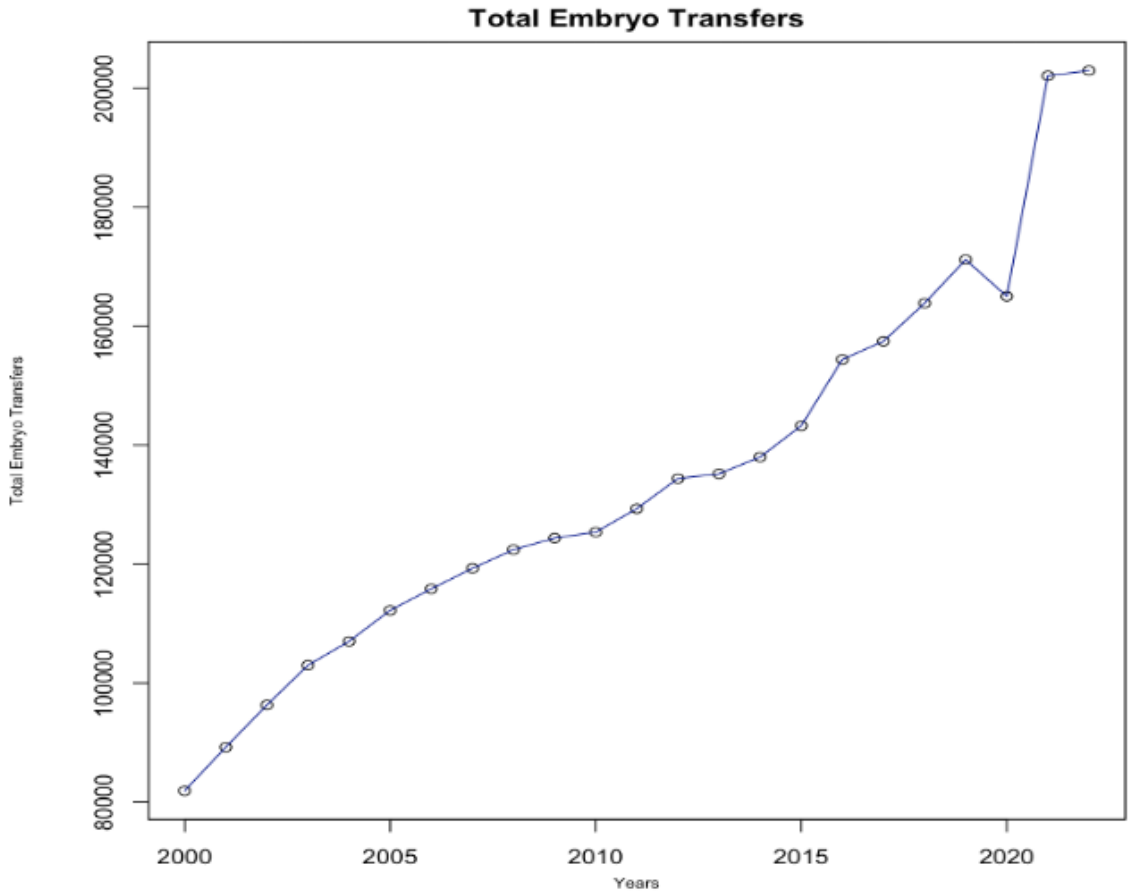


Figure 4. Total Embryo Transfers

The visual representation in *figure 4. Total Embryo Transfers* examines a steady increase in the number of embryo transfers in the United States from 2000 to 2023, with a particularly sharp increase around 2020. This growth reflects advancements and increased accessibility in assisted reproductive technology (ART), as well as greater social acceptance and demand for fertility treatments. The notable spike around 2020 may be attributed to delayed family planning due to economic or social factors, as well as improvements in ART efficiency and availability (Centers for Disease Control and Prevention, n.d.). This trend highlights the role of ART in

addressing fertility challenges, as more individuals and couples turn to embryo transfers to conceive, contributing to a steady increase in ART utilization over the years.

Successful ART Births

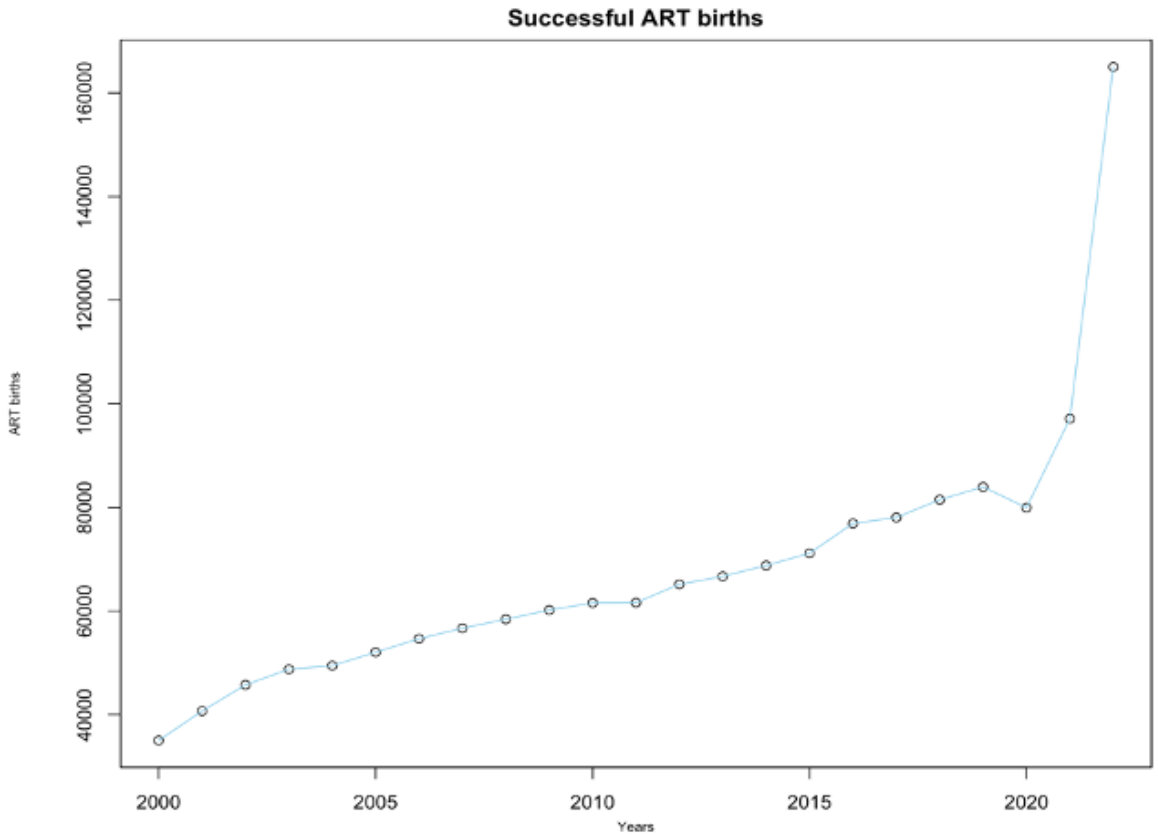


Figure 5. Successful ART Procedure

In the visual representation in *figure 5. Successful ART births* examine the number of infants successfully delivered with Assisted Reproductive Technology from the years 2000 to 2022. The chart shows a consistent increase starting from approximately 40,000 successful ART births in 2000, reaching around 80,000 by the early 2010s. In recent years, particularly from 2020 onward, there has been a noticeable sharp increase, peaking above 160,000 successful ART births by 2023. This significant rise indicates an increased reliance on ART treatments, along

with potential improvements in technology and treatment protocols, as ART has become a more widely accepted and accessible option for addressing infertility (Centers for Disease Control and Prevention, n.d.).

Crude Birth Rate

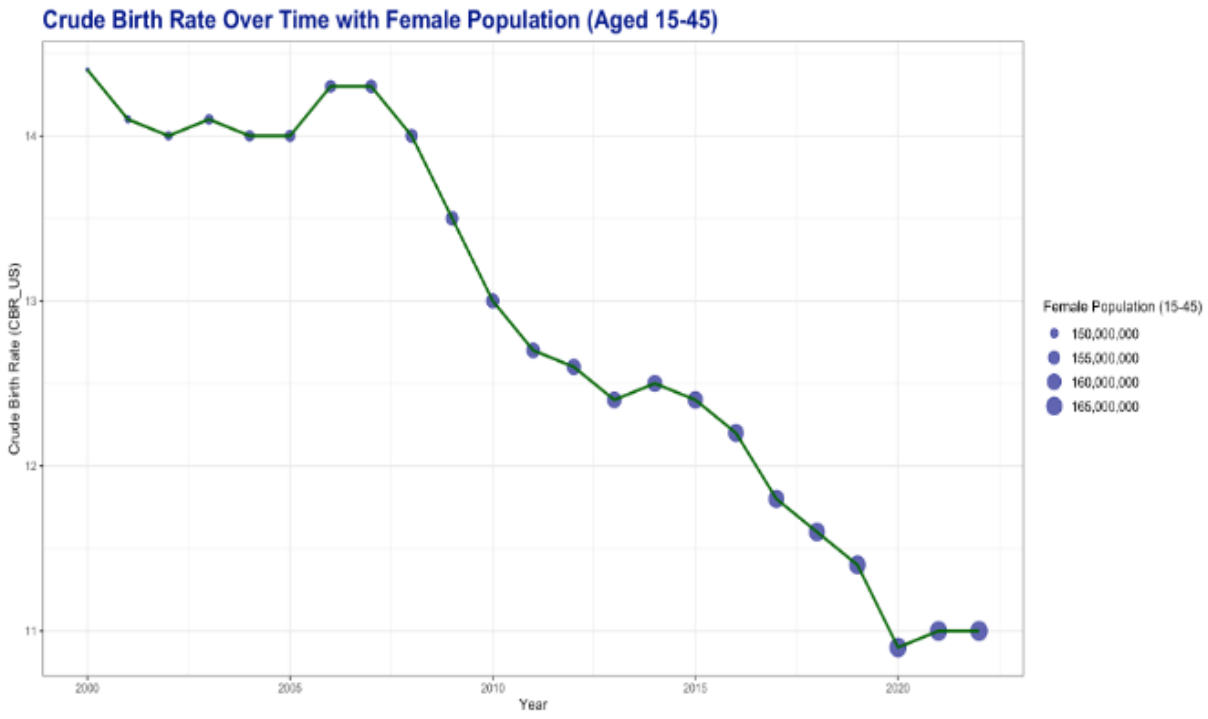


Figure 6. Crude Birth Rate over time with Female Population

This visual representation in *Figure 6 Crude Birth Rate over time with Female Population (aged 15-45)* showcases the population and birth rate over time. The figure illustrates the relationship between the female population and the crude birth rate, as the female population increases there is an inverse relationship happening between the crude birth rate as it declines. However in 2006-2007, there was a slight increase in the birth rate, similarly, the female population also increased; In the year 2007, social and economic conditions had a positive impact on crude birth rates, such as a steady economy, low unemployment, and growing consumer confidence, encouraged people to form families (Mathews & Hamilton, 2020). The

rise in birth rates also contributed to immigration from higher-fertility countries (Passel & Cohn, 2008). Furthermore, the millennial generation has added to birth rate numbers as they enter their peak childbearing years (Pew Research Center, 2010). Access to fertility treatments, like in vitro fertilization (IVF), also played a role, especially in the case of older age individuals and those faced with infertility challenges (Centers for Disease Control and Prevention, n.d.). This increase was temporary since it was followed by a drastic decline from the financial crisis of 2008 and economic uncertainty that linked a large component to the decision-making process concerning family planning.

Crude Birth Rate vs Median Household Income over time

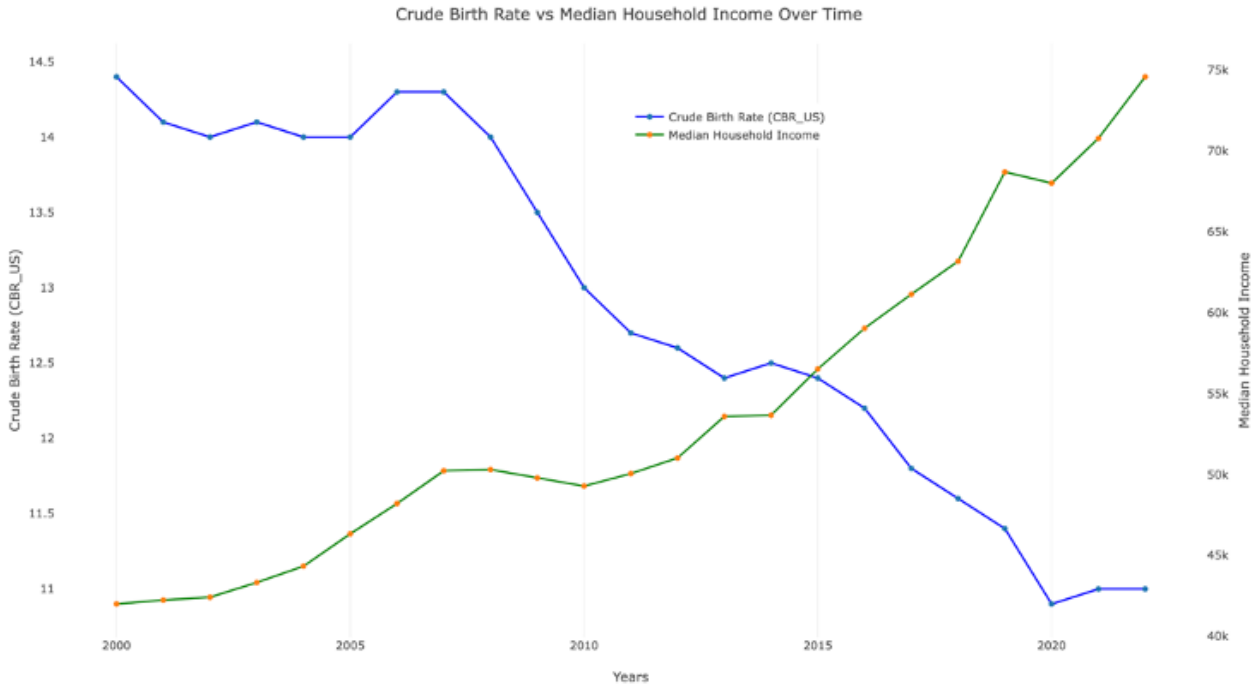


Figure 7. Crude Birth Rate vs Median Household Income

This visual representation in *Crude Birth Rate vs Household Income Over Time* examines the relationship between the birth rate and median household income. From 2000 to 2007 crude birth rates declined gradually before a short stabilization due to the increased household income,

and economic stability which led to family formation during this period (Mathews & Hamilton, 2020). Since the following year, 2008, the crude birth rate (CBR) sharply kept falling due to the financial crisis and economic recession; however, the graph shows gradual increase in median household income is continuous. trends suggest that the post-crisis economic recovery and rising incomes do not necessarily translate into increased birth rates, this could be attributed to changing priorities in society, or the delay of family planning decisions (Pew Research Center, 2010). By 2020, the crude birth rate reached its lowest level despite median income having its highest record. Thus, it illustrates the complex interaction between economic factors and fertility behaviors.

Fertility Trend By Race

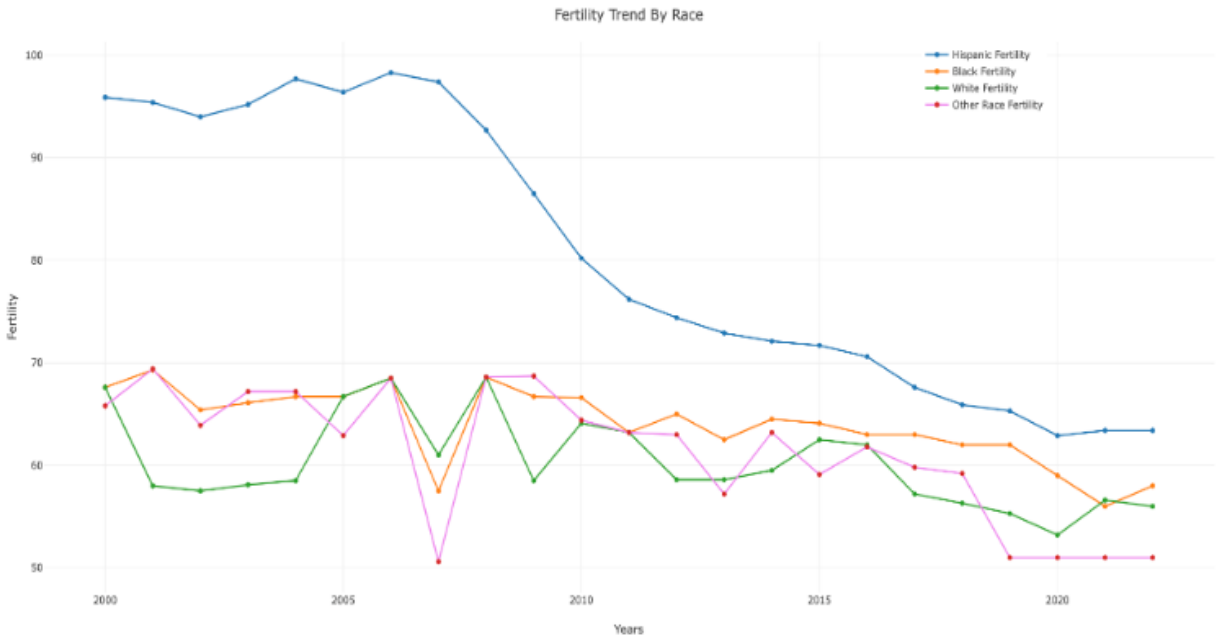


Figure 8. Fertility Trend by Race

This graph demonstrates fertility rate from the year 2000 to the year 2022, a breakdown of fertility patterns by race is presented in the graph. It shows that there has been a remarkable drop in childbearing tendencies among all races. The highest Hispanic birth rates that were recorded, saw the highest plunge, falling from roughly to nearly 63 percent. Fertility among Blacks was relatively constant though a slight dip was noticed, Whites on the other hand experienced the most variation in fertility within the studied years. Category “Other races” was more volatile than that with rates of around 50 to 60. This has been noted especially among Hispanics and could be attributed to various reasons such as current society changes, more education, and contraception as well as the landscape of families changing.

Birth Trend by Race

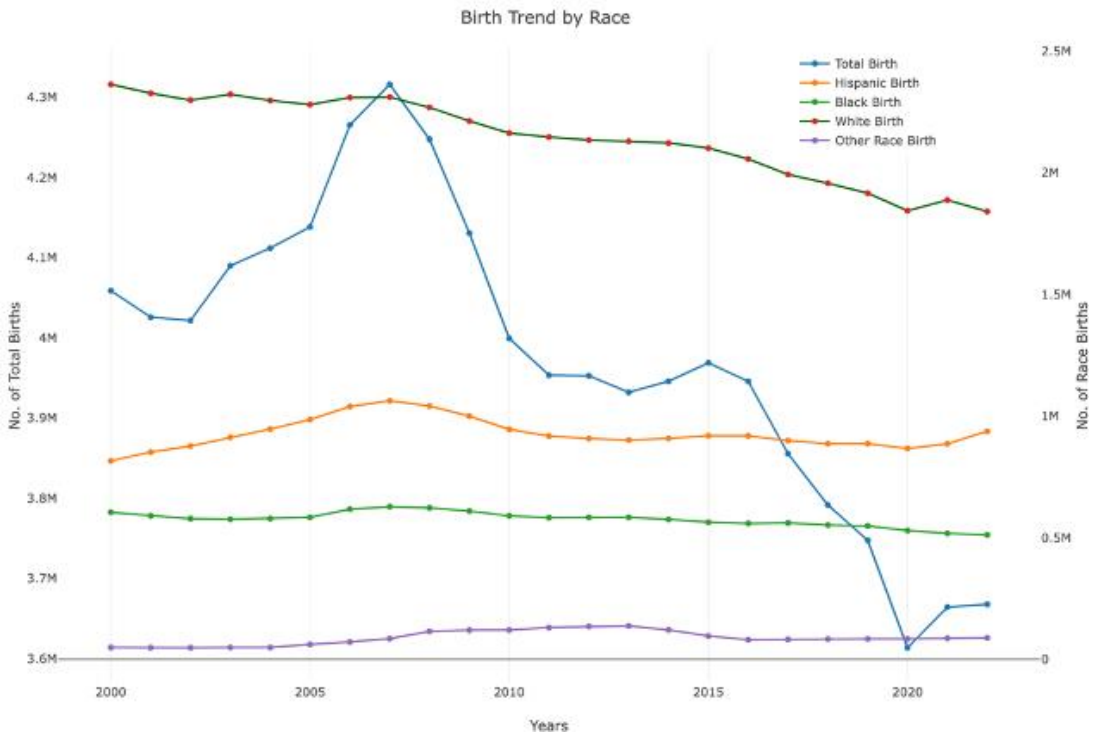


Figure 9. Birth Rate by Race

The graph demonstrates that there has been a general decrease in birth rates among various racial groups in the United States between the years 2000 and 2023 for both social and socioeconomic

reasons. The Great Recession of 2007 brought with it, a recession that resulted in a financial crisis and unwanted births. Most affected were the White and Hispanic groups, while COVID-19 in the year 2020 also contributed to a decline as children were not sought at that time. On top of this more women have gone back to school and begun working while also having easy access to contraception which has made the birth rate drop since most women are marrying late to focus on their careers. These factors combined with the cultural notions of the younger generation of smaller families particularly among the younger and second-generation immigrants in the United States have resulted in birth rates among the various races in the United States becoming uniform.

ART vs Pregnancies

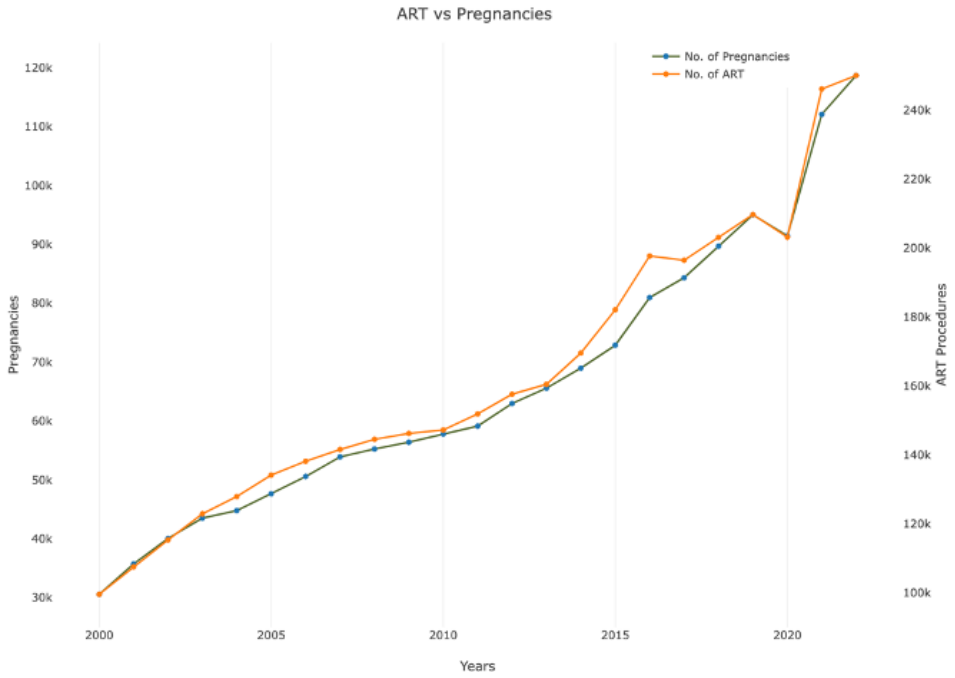


Figure 10. ART vs. Pregnancies

The period between 2000 and 2020 witnessed a significant upsurge in the number of ART procedures which can in part be explained by the development of innovative technologies such as enhanced success rates of IVF and cryopreservation techniques, postponed childbearing due to occupational and economic reasons, and the rising incidence of infertility associated with environmental and occupational factors. Besides, the assimilation of ART into the health care systems was facilitated by increased insurance coverage and reduced stigma towards ART.

Urbanization vs Birth Rate

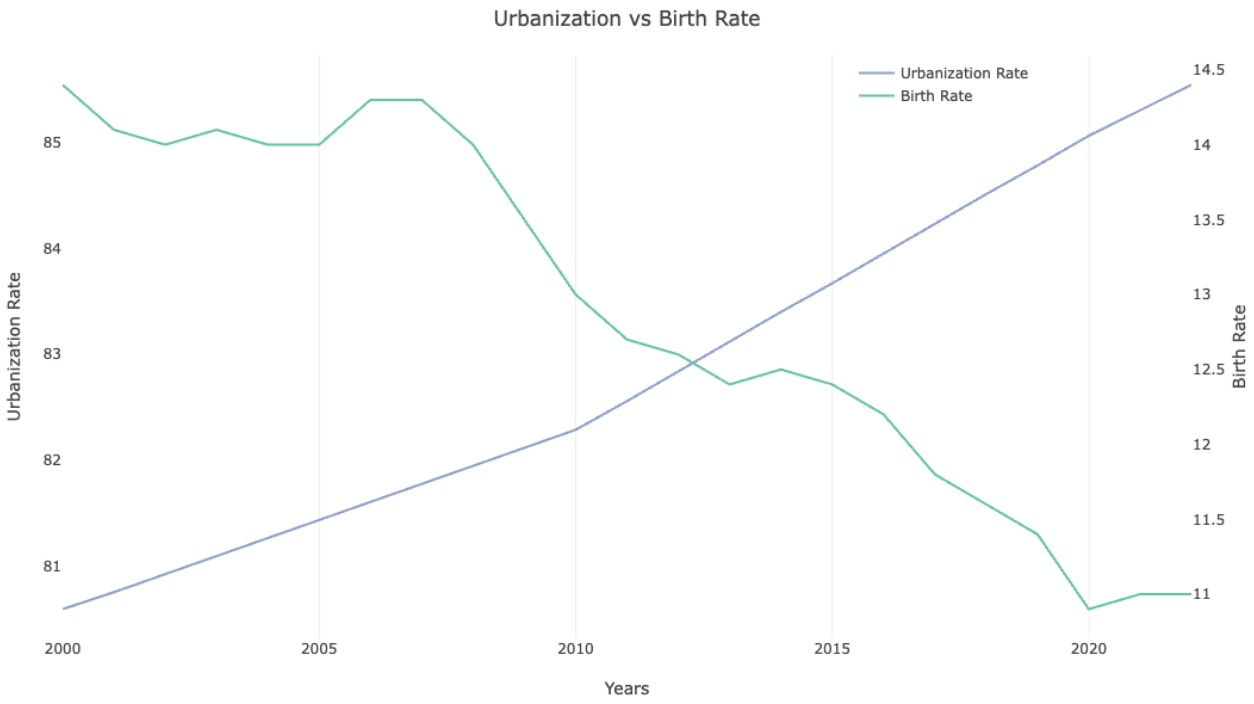


Figure 11. Urbanization vs Birth Rate

Urbanization has taken place over the last twenty years, while birth rates have kept recording a constant decline. This inverse relationship clearly demonstrates the well-known correlation between urbanization and fertility rates. It is manifested in the fact that urbanization provides increased facilities to men and women, especially women, concerning education and employment opportunities. This creates a conducive setting for falling late into marriage and

adopting a preference for smaller family sizes, where the high cost of living and smaller accommodation spaces add to discouraging reproduction. Increasing cultural settings have shifted gradually in such highly urbanized societies and promote career and personal development rather than taking care of a family at an early stage.

Population vs Fertility Rate

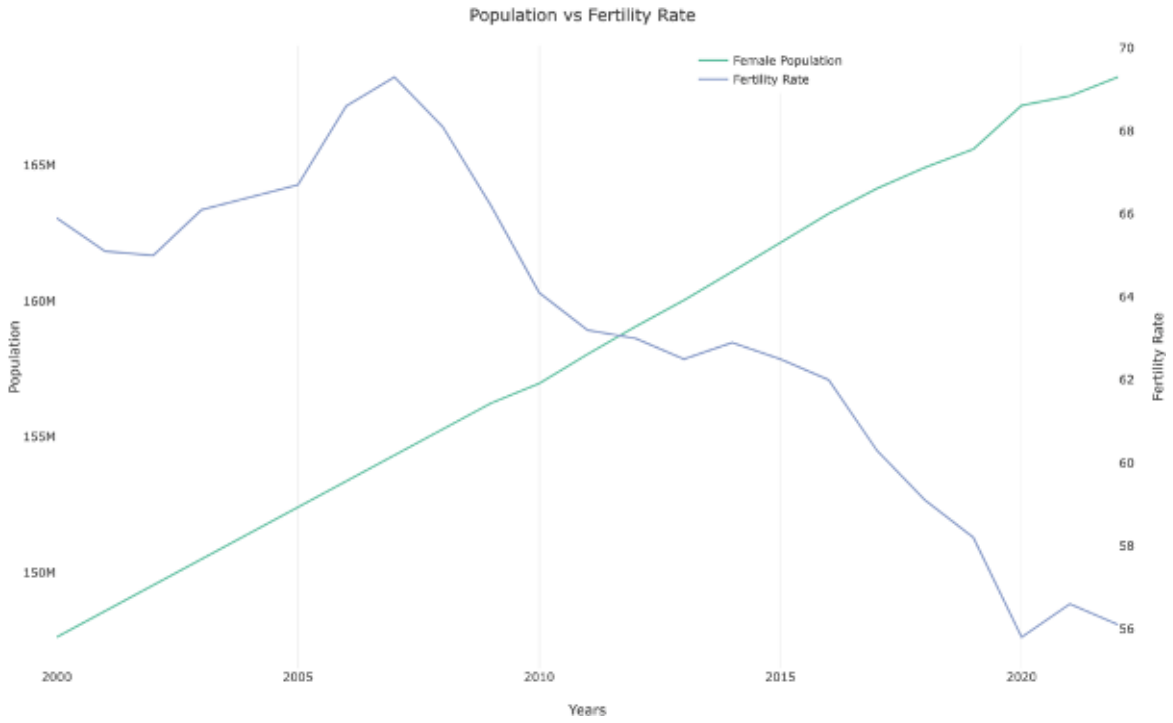


Figure 12. Population vs Fertility Rate

The given chart shows a decreasing number of babies born in the years compared to even increasing women population over the years which is in line with wider demographic and social trends. The decrease in the number of births is attributed to more women getting education, better health services and the family planning methods being easily available to a larger percentage of the society helping them control births. One can also point to urbanization and the advancement of the economy since high costs of living and attention to careers make raising more children less

appealing. At the same time, changes in attitudes towards marriage in which such institutions are encouraged to be established at a later age and a small number of children is preferred is consistent with these economic and educational transformations. These trends highlight the link between sociocultural changes such as economic progress and demographic transition.

Impact of Abortion Legislation

Abortion legislation in the United States is a significant contributor to the effect on birth rates and more generally on the status of individuals and of society. Legislation at the state level increasingly set limits for access to abortion by the imposition of mandatory waiting periods, gestational age limitations, and/or restrictions on public funding in the period 2005-2015. These reduced access to abortion services particularly for the lower socioeconomic and marginalized racial and ethnic groups of people (Redd et al., 2021).

Such a constrictive legal landscape further increased birth rates in groups where abortion care was inaccessible, and more often these births had adverse outcomes. For example, individuals living in states that had a high number of restrictive policies were seen to have greater odds of preterm births (PTB) and low birth weight (LBW) outcomes. On the one hand, these outcomes were often defined by structural inequities because states that had restrictive abortion policies also tended to lack supportive measures such as Medicaid expansion and family leave policies. This environment tends to worsen racial and socioeconomic disparities that tend to disadvantage blacks and those that are less educated (Redd et al., 2021).

Impact of Family Planning

Birth rates in urban areas have generally declined more significantly than in rural regions, influenced by factors like increased educational attainment, career priorities, and access to

reproductive healthcare. Between 2007 and 2017, urban counties saw steeper drops in fertility rates compared to rural areas. Additionally, the mean age at first birth was higher in urban areas, reflecting shifting societal norms and priorities (Center for Disease Control Statistics report 2018).

In 2017, rural and urban counties in the U.S. exhibited distinct patterns in birth rates by age group. Women under 30 in rural areas had higher birth rates compared to their urban counterparts. However, for women aged 30 and older, urban areas recorded higher birth rates. The peak birth rates for rural counties were among women aged 25–29, with 126.4 births per 1,000 women, while in urban counties, the highest rates were observed among women aged 30–34, with 101.7 births per 1,000 women. (Danielle and Brady 2018)

Contraceptive policy:

Before the Right to Contraception Act in 2022, The Affordable Care Act (ACA), enacted in 2010, significantly expanded contraceptive access as part of comprehensive healthcare reforms in the United States. It mandates that most private health insurance plans cover all FDA-approved contraceptive methods, including pills, implants, IUDs, sterilization, and emergency contraception, without additional cost-sharing like copayments or deductibles. This provision ensures that contraception is treated as essential preventive healthcare, making it accessible to a larger segment of the population, especially low-income and uninsured individuals.

The Right to Contraception Act of 117th Congress (2022) defined the term "contraceptive" as any legally approved drug, device, or product designed to prevent pregnancy. It includes oral pills, long-acting reversible options like IUDs, emergency contraception, condoms, injectables, patches, vaginal rings, and barrier methods. These can also serve other

health-related purposes and must comply with federal regulations under the Food, Drug, and Cosmetic Act, (Act117th Congress 2022).

The Right to Contraception Act, introduced in July 2022 after the Dobbs decision, seeks to guarantee universal access to all contraceptive methods, including pills, implants, sterilization, and related services, by prohibiting government restrictions at any level and protecting individuals aiding others in obtaining contraception. The Act passed the House along party lines but failed in the Senate in June 2024 due to a filibuster. While some states had protections before 2022, most statutes and constitutional safeguards emerged after Dobbs, with 11 states which includes Washington, D.C. Florida, New Jersey, Illinois, Massachusetts, Oregon, New Mexico, Rhode Island, Vermont, etc., explicitly protecting contraceptive rights through legislation, ensuring broader access despite federal challenges (Fact sheet 2024).

Mortality Rate

Mortality rate and Birth rate shape the demographic and economic structure of a society. Here, we discuss one of the factors that affect the birth rate, which is the mortality rate. It is important to study the relationship between mortality rate and birth rate and how it impacts the whole society. When birth rates fall, the aging population goes up. In fact, this fall put economic pressure on social welfare, workforce structure, retirement funds, and the healthcare system. Mortality rates are in relation to a growing elderly population. In other words, if the mortality rate and birth rate do not balance, the economy of the society will be affected. This imbalance impacts on birth rate due to the economic pressure on families.

The invention of assisted reproductive technology (ART), such as in vitro fertilization (IVF) and embryo banking reduces some challenges of infertility and aging problems which

enable people to plan for their pregnancies more efficiently. This advancement indirectly connects mortality rates to birth rates by giving planned solutions for individuals who have difficulties with fertility and paves the way for them to have a safe childbirth. (Centers for Disease Control and Prevention [CDC], 2023).

Another important thing that can impact both birth rates and mortality rates is public policies that are supported by healthcare systems such as accessibility and comprehensive reproductive health services. The breeding behavior of a population of a society is shaped by healthcare policies such as the management of family planning, parental health support, and child-subsidized support. These policies can reduce the mortality risks associated with childbirth in case that they are well-organized and supported.

Also, social shifts can indirectly influence mortality rates. One of the main social shifts which happened in 1990th was third-wave feminism. It emphasized the equality of genders which reformed social norms. It means that childbearing patterns have been consciously changed compared to previous decades. This shift influences the mortality rate indirectly by delaying childbirth to a safer or sometimes to a riskier delay in later ages. (childbearing for women above thirty-five is more risky than for younger ages)

Collectively, these trends demonstrate the interconnectedness of demographic, technological, and policy factors in shaping the balance between birth and mortality rates. Thus, demographic trends, social economy, average population age, technological advancement, and public policies are considered the factors that shape mortality and birth rates (CDC, 2023).

V. Conclusion

Our study concluded by assessing the role of technological advancements in shaping birth rate trends, within the United States. Many other past studies focus on socio-economic factors affecting birth rate trends, while our research focuses on how technological advancement has formed birth rate trends in the U.S. We find that there is a positive increase in ART procedures, along with successful results from technological treatments and procedures. In addition, our study concluded by investigating the spacious changes in birth rate trends influenced by multiple factors. Amongst these factors, the third wave of feminism and its focus on intersectionality, diversity, and reinvented gender roles have influenced societal norms that reinforce birth rate patterns in the United States.

The trends in birth rates, Assisted Reproductive Technology (ART) usage, and fertility patterns illustrate significant demographic and social changes. The crude birth rate has persistently declined since 2000, with a slight increase in 2006–2007 due to economic stability, increased immigration, and millennials entering their prime childbearing years. However, this rise was for a short period, since the Great Recession and societal shift changes, such as delayed childbearing and smaller family sizes, resulted in a continuous decline.

Simultaneously, the use of ART, including procedures like In-Vitro Fertilization (IVF), and Embryo Transfers, has seen a prominent increase. This rise shows advancements in medical technology, improved success rates, and greater societal acceptance of ART. While the number of ART procedures declined temporarily during the COVID-19 pandemic, it resulted in sharp increases in pregnancies and successful births assigned to ART by 2023. Fertility trends by race show a constant decline across all groups, with Hispanic birth rates encountering an abrupt drop, affected by education, contraception access, and elaborating cultural norms. Urbanization has

also played an important role, as urban areas show lower fertility rates caused by career priorities, higher living costs, and delayed family planning. Legislative changes, specifically, restrictive abortion policies between 2005 and 2015, impacted birth rates among marginalized groups, aggravating socioeconomic differences. These interwoven factors emphasize the enormous impact of economic, cultural, and technological developments on fertility and demographic trends.

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