

A Comprehensive Analysis Revealing Contributing Factors Behind Declining US Birth Rates*

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The United States has been experiencing a steady decline in their birth rates, as suggested by Kearney, Levine, and Pardue’s (2020) article ‘The Puzzle of Falling US Birth Rates since the Great Recession’. Through the analysis of multiple different factors, such as age and education, we notice a continual decline in birth rate starting from the year 2007. We discover how different social, cultural, and economic shifts play a part in this worrying trend. This paper demonstrates how socioeconomic trends have affected Americans to shift their priorities, and how this change represented through data has played a key role in the irreversible downward trajectory of US birth rates.

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*Code and data are available at: https://github.com/rex009x/us_birth_rates/tree/master/data. Selected aspects of the original paper that underpins this paper were reproduced and a record of this is available at: <https://doi.org/10.48152/ssrp-nsc2-4v21>

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1 Introduction

The United States has been experiencing heavy fluctuations in birth rates for nearly half a century with constant decline since 2007. The birth rate of a country is representative of its socioeconomic state, political state, and future prosperity. Furthermore, it determines the decision-making and distribution of government resources, education, health care services, and urban planning. This alarming issue leaves many seeking an explanation as to what exactly is causing this phenomenon. While people may point fingers at the ever changing societal norm, evolving ideology on family structure, or to no fault but the government, this paper aims to expose the possible explanations to the plummeting birth rate in the United States of America.

The nation's birth rate has fallen significantly since 2007, dropping about 23% by 2022, measured by the number of births per 1000 women (Alex Fitzpatrick 2023) and that birth rates tend to fall based on the economy. 2007 marks the start of the most severe economic crisis the world has ever faced, spanning the years 2007 until 2009. The events of this crisis have had long lasting damage on the economy, with unemployment doubling and the crash of the housing market (Weinberg 2013). These poor economic conditions and the unusually slow recovery of the economy would play a large role in the decision to have children, as an unpredictable economic environment makes people feel less secure about raising a family, thus contributing to the recorded decline in birth rates. This is just one of various factors that we will be exploring in this paper to observe any trends and correlations between societal and economic shifts and the dwindling birth rate in the US.

Throughout the rest of this paper, we will be delving into the statistics with regards to birth rates in the US and observe any trends we can find. In the data and results sections of this paper, we examine, analyze, and reproduce the information reported by the authors by downloading and cleaning the data sets provided in the replication package. After that, we will look into the results sections to look for trends and other insights that can be uncovered from our research, and finally discuss and summarize all of our findings in the conclusion.

2 Data

2.1 Data Source and Collection

The data for this paper was acquired through the replication package of Kearney, Levine, and Pardue's (2020) article "The Puzzle of Falling US Birth Rates since the Great Recession" available through the American Economic Association (AEA), with the aid of data available from Centers for Disease Control, and Prevention (CDC) Natality data (Economic Research 2022) and CDC SEER U.S. Population Data (Disease Control, Prevention, and Sciences 2022). The data sources were accessed on February 12th, 2024 and acts as the foundation of this paper. The data sources themselves are a collaborative effort including but not limited to

the U.S. Census Bureau, the National Cancer Institute, SEER Data, CDC, and the National Center for Health Statistics (NCHS). The United States census is legally mandated by the United States Constitution which occurs every 10 years. The data consists largely of **numeric** values representing years, birth rates by race and ethnicity, marital status, education, age, and birth parity, or **character** values representing US states.

All data collection and analysis was done using statistical tools and data visualization program R (R Core Team 2023) and Rstudio IDE (RStudio Team 2020) to help streamline the workflow. The analysis was done using the R program and the following supporting packages **tidyverse** (Wickham et al. 2019), **haven** (Wickham, Miller, and Smith 2023), **ggplot2** (Wickham 2016), **here** (Müller 2020), **ggthemes** (Arnold 2024), and **dplyr** (Wickham et al. 2023). We will provide more comprehensive details about the data cleaning, and analysis in the following subsections.

2.2 Variables of Interest

Although the data contains an abundance of information, we are mainly concerned with US birth rates per year, the total female population, and various other factors including age, mother’s level of education, and birth parity. As this paper focuses on birth rates in the US over the course of time, we have all the necessary and sufficient information required to proceed processing the data for our analysis.

The overarching variable in our measurements is birth rate. Birth rate is measured by the number of births per 1000 women. Using this metric, we graph it in the context of the other variables included in our research we stated above.

Measuring birth rates by age allows us to split the data among different age groups of women. In doing so, we can observe how age affects the decision to have babies among women and how it might have changed over time. Another metric we will be comparing is the mother’s level of education. Women from different education backgrounds would have impacts on fertility rates, and this measurement allows us to observe the differences between these education backgrounds. Lastly, we will be graphing birth parity, which is the measurement of how many children a given woman has. Birth parity would allow us to see the rates of which women have one child, two children and so on, and compare the frequencies of each to each other and over the course of the past few decades.

2.3 Data Processing

The data we acquired through various sources and methods as previously mentioned presents a plethora of data points which we concern ourselves with. In order to produce our desired visualizations, we must first begin by processing our data in preparation. While a portion of the data has already been processed by the authors of “The Puzzle of Falling US Birth Rates since the Great Recession” (Kearney, Levine, and Pardue 2022), the remaining data sets are

abundant. Data that can be so specific such as the population of women the age of 15 who live in Arkansas.

With the consideration of our variables of interest in mind, we can proceed with the processing of the data. As birth rates are the main focal point of this paper, we are interested in the number of births that occur throughout the United States and the total population at any given time frame. The data including US Census Data and NCHS Vital Statistics Natality Birth Data provides this information by listing out the number of women and child births per state by year. Together, we have the sufficient information required to proceed with the visualization for the number of births per 1000 women in the US.

Next, we are interested to find the number of births per 1000 women in regards to the woman's age. As previously mentioned, we have the required data points concerning the population of women but now incorporating another variable of interest being the age. Proceeding, we intend to organize the data into age groups in order to observe the potential generational trends in birth rate. Fortunately, the data is already prepared containing the birth rates per year for each corresponding five-year age group (Kearney, Levine, and Pardue 2022).

Moving onto our next data point of interest, the mother's level of education requires the collection of data that records the population of women according to their levels of education. Utilizing the Current Population Survey (CPS) organized by the U.S. Census Bureau, the data is prepared containing the birth rates for each level of education by year respectively (Kearney, Levine, and Pardue 2022).

Considering births by "parity", referring to the number of children for a given woman, we are interested in the data containing information regarding the number of first, second, third, and fourth+ births in the US. Combining NCHS Natality Microdata and CDC SEER population data, and simply filter for the data points of interest to receive the information required to generate our visualizations.

Similarly to the data processing to acquire the birth rates per year by five-year age groups, gathering NCHS Vital Statistics birth data and CDC SEER population data we organize the data by mother's age and birth cohorts. Data processing and visualization of Figure 5 was completed with the aid of Kimlin Chin's replication (Chin 2022) of Kearney, Levine, and Pardue's (2020) article "The Puzzle of Falling US Birth Rates since the Great Recession".

2.4 Measurement

The measurement of birth rates is nothing short of a difficult task upon consideration of all its nuances. What exactly defines a birth and what parameters determine how it is recorded? This variable of interest becomes slightly cloudy when answering these questions. Do births that occur outside of a hospital count to the total number of births? The bounds of what a birth is becomes even blurrier when we consider miscarriages and related factors.

Age being data of interest proves to be one of the most reliable and sound measurements throughout this analysis. Data collected through government initiated surveys regardless of whether or not it is mandatory, requires proper documented identification. While the exact date of birth remains confidential, the respondent’s year of birth or age suffices for the purposes of this analysis.

Measuring the level of education appears to be simple but is more inconsistent than initial thought. Data acquired through the CPS which is a monthly voluntary survey where U.S. households are selected (Bureau 2022). This is important to note as there may be traces of response bias and other forms of biases. As a result, it is difficult to filter the data from these bias entries and the generated visualizations may be skewed.

The number of children for a given mother or “parity” is a rather straight-forward measurement. Although questions concerning whether legal adoption of a child contributes to this measurement, it is unclear to find an answer. A more concise explanation for the properties of this measurement would greatly benefit the reader’s experience.

3 Results

Figure 1 is the replication of Figure 1 from ‘The Puzzle of Falling US Birth Rates since the Great Recession’ by Kearney, Levine, and Pardue (2022), and showcases the trajectory of US birth rates spanning from 1980 to 2020, focusing on births per 1000 women aged 15 to 44. The peak occurred in 1990, reaching 70.9 births per 1000 women, closely followed by 2007 with 69.3 births per 1000 women. In contrast, 2020 marked the lowest point with only 55.8 births per 1000 women which is nearly a 21.3% decrease in births since 1990. From 1980 to 2007, the birth rate experienced moderate fluctuations, with a maximum variance of 7.3 births per 1000 women. However, following the year 2007, the birth rate seems to display a consistent a downward trend, declining by 13.5 births per 1000 women or a 19.5% decrease between 2007 and 2020.

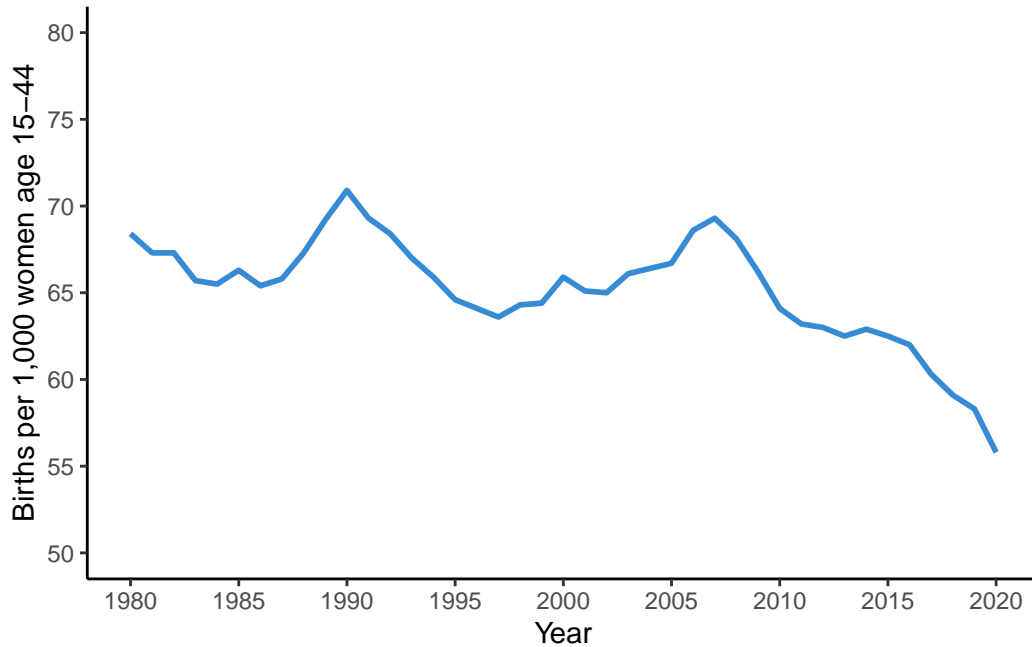


Figure 1: Trend in US Birth Rates from 1980 - 2020

Next, Figure 2 is the replication of Figure 2 (a) from the original paper. Concerning itself with examining the trends in birth rates by five-year age groups, we can observe insightful results.

Looking at the 15 - 19 years old age group, there has been a consistent decline in birth rates, punctuated by a brief period of growth from 1986 to 1991, peaking at 61.8 births per 1000 women in 1991 before steadily declining to its lowest recorded rate of 15.3 births per 1000 women in 2020.

The 20-24 years old age group remained relatively stable from 1980 to 2007, reaching a peak of 116.5 births per 1000 women in 1990. However, similarly to the previous age group, it experiences a consistent decline from 2007 onward, reaching a low of 62.8 births per 1000 women in 2020.

Again, the 25-29 years old age group displays stability until 2007, with the highest birth rate of 120.2 births per 1000 women recorded in 1990. Despite a gradual decline post-2007, it retained a relatively higher birth rate compared to younger age groups, hitting a low of 90.0 births per 1000 women in 2020.

In contrast, the 30-34 years old age group witnessed a steady increase in birth rates over time, starting from 61.9 births per 1000 women in 1980 and peaking at 102.7 births per 1000 women in 2016.

The 35-39 years old age group also experienced steady growth, with birth rates ranging from a low of 40.5 births per 1000 women in 1980 to a high of 52.8 births in 2019.

Lastly, the 40-44 years old age group displayed minimal change, remaining relatively steady over the years, with slight increases noted annually. The lowest birth rate was recorded in 1980 at 8.1 births per 1000 women, rising to 12.0 births per 1000 women in 2019.

Observing the data in Figure 2, we find the 25 - 29 years old age group consistently led in birth rates until being surpassed by the 30 - 34 years old age group in 2016. Conversely, the 40-44 years old age group consistently exhibited the lowest birth rates. However, with declining births in the 15-19 years old age group and a stable, increasing trend in the 40-44 years old age group, a shift in the age group with the lowest birth rate may soon occur for the first time in 40 years.

Additionally, a noteworthy trend is the steady decline in birth rates among younger age groups from around 2007 onward, while the older age groups have experienced the opposite trend.

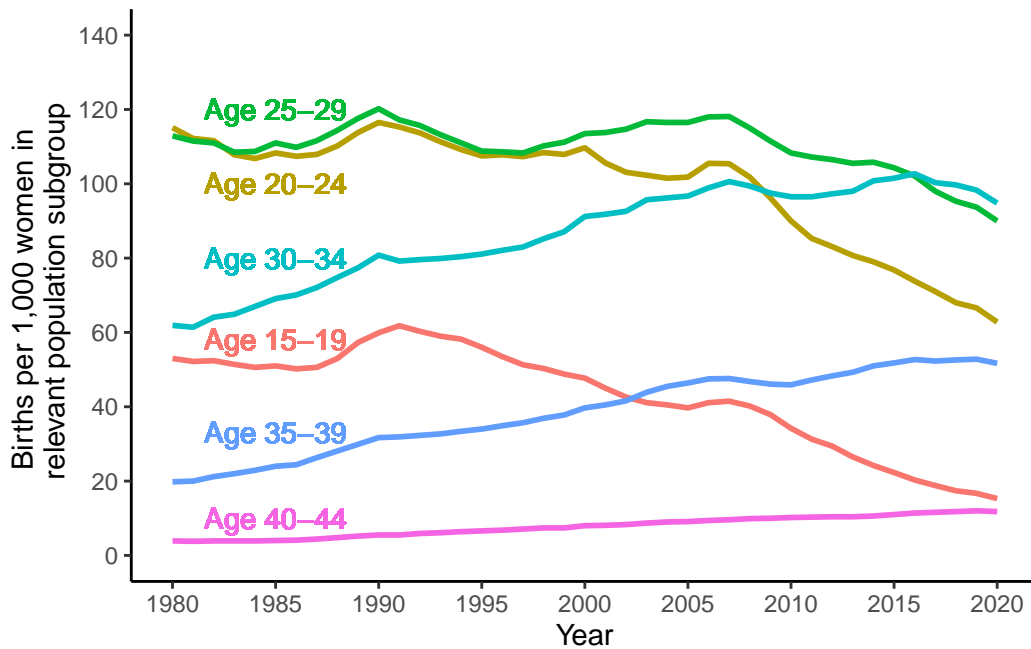


Figure 2: Trends in Birth Rates by Five-year Age Group

Figure 3 is the replication of Figure 2 (d) from the original paper, and examines US birth rate trends concerning the mother's level of education, focusing on the period from 1992 to 2019 and women aged 20 to 44.

The subgroup with the highest birth rate consistently comprises mothers without a high school degree. Peaking in 2006 at 125.0 births per 1000 women, this subgroup witnessed its lowest

birth rate of 89.0 in 1996. Notably, it also exhibited the most fluctuations, maintaining relative stability from 1992 to 2005 with a slight downturn from 1994 to 1997. Then, it experienced rapid growth in 2006, sustaining similar birth rates over the following three years before declining. From 2010 to 2019, the birth rate returned to levels observed from 1992 to 2005.

Mothers who have graduated high school are the sub-group with the most stable birth rate. This sub-group experienced its highest birth rate in 2008, with 77.4 births per 1000 women. Conversely, the lowest birth rate of 68.0 births occurred in 1997.

Similar to the previous sub-group, mothers with some college education have maintained a relatively stable birth rate, while showing a slightly positive trend over the years. The lowest birth rate can be attributed to the year 1994, with 49.4 births per 1000 women, and the highest birth rate was recorded in 2015, at 65.5 births. This is also the sub-group that has historically had the lowest birth average rate.

Lastly, the college graduates sub-group has also remained stable, showcasing a slight declining trend from 2016 onward. This sub-group's birth rate peaked in 2000 76.7 births per 1000 women. The lowest recorded birthrate was 59.4 in 2019.

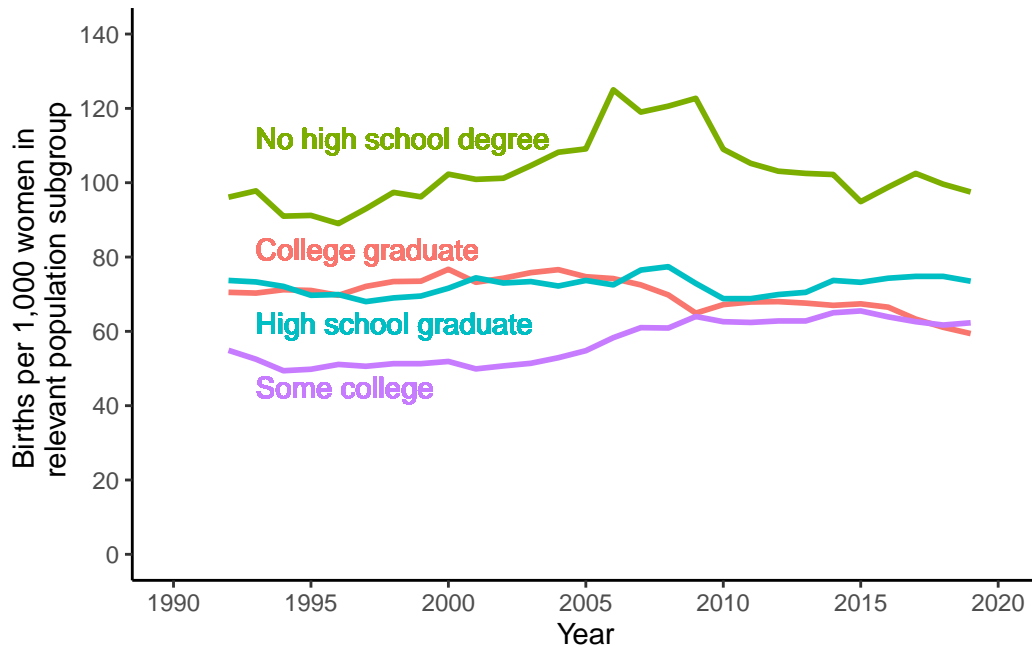


Figure 3: Trends in Birth Rates by Mother's Level of Education (ages 20-44)

Figure 4 replicates figure 2 (f) from Kearney, Levine, and Pardue (2022), and breaks down the trends in birth rates by parity.

In this case, all subgroups representing first, second, third, and fourth or more births exhibit nearly identical patterns, maintaining a stable birth rate. However, there is a notable distinction: the fourth or more birth subgroup shows slight growth from around 1995 to 2019, while all other parity groups witness a decline in births per 1000 women from approximately 2007 to 2019.

Consistently, the first birth subgroup boasts the highest number of births per 1000 women, followed by the second birth subgroup. Conversely, the fourth or more birth subgroup, despite displaying a positive trend from 1995 to 2000, consistently records the lowest number of births per 1000 women each year, followed by the third birth subgroup.

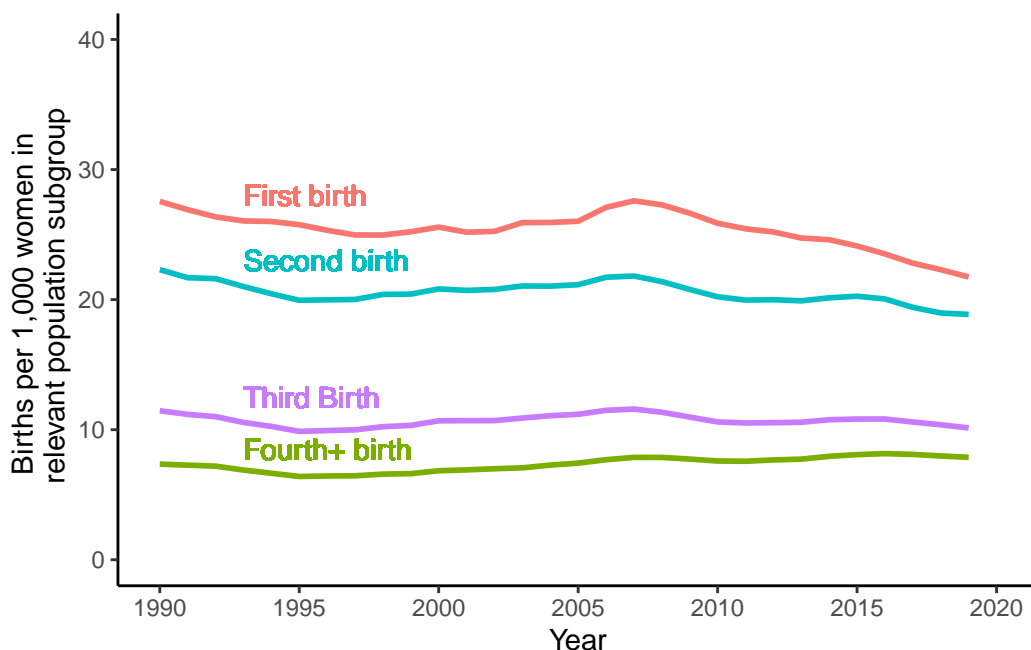


Figure 4: Trends in Birth Rates by Parity (ages 15-44)

Lastly, Figure 5 from the original paper is replicated in Figure 5, and showcases children ever born based on the mother's age and birth cohort.

All cohorts exhibit a consistent pattern of increasing children ever born as the mother ages. In particular, the first three spanning 1968-1972, 1973-1977, and 1978-1982 are nearly identical, especially from the ages of 15 to 26. After the mother reaches an age of 26 years old, there are only marginal differences among these cohorts.

In contrast, while the latter three cohorts still generally follow the same trend of an increasing number of children ever born as the mother ages, it must be noted that the children ever born are steadily declining with each subsequent cohort. Thus, the most recent cohort of

1993-1997 records the lowest number of children ever born among all six cohorts. There is also a more significant variance between children ever born after the mother reaches an age of approximately 17 years old in the three most recent cohorts.

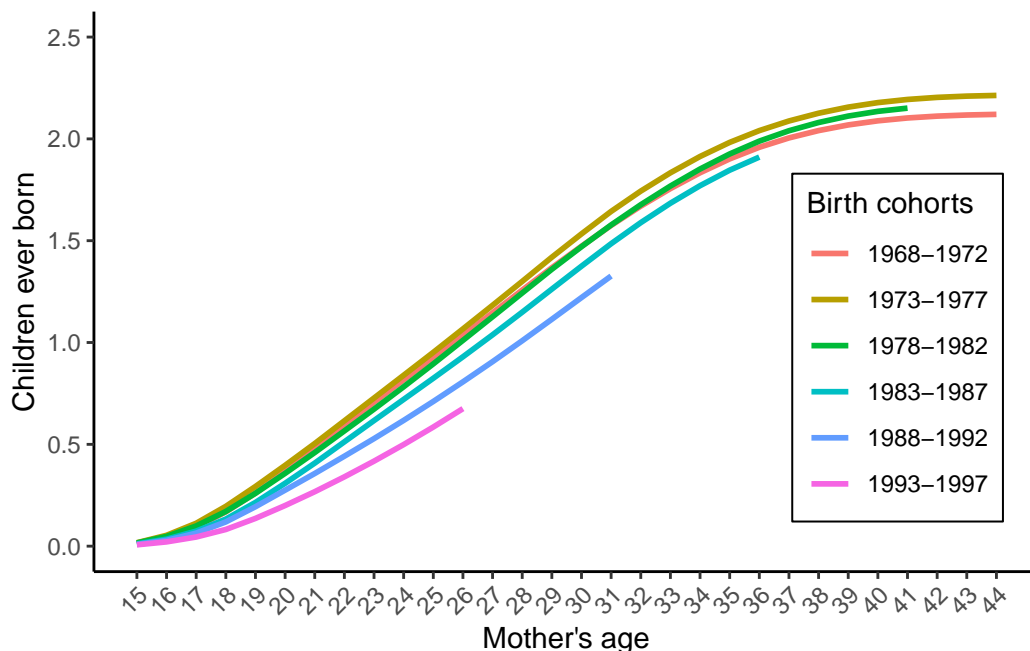


Figure 5: Children Ever Born by Mother's Age and Birth Cohort

4 Discussion

4.1 Leave the World Behind: A Shift in Priorities and the Evolving Social Norms

The most likely explanation that acts as the root cause for the decline in US births is the shift in priorities across cohorts of women (Kearney and Levine 2022). While there are many who can speculate and point fingers at specific events that occurred pre- or post-2007 such as the “inevitable” financial crisis more commonly known as “The Great Recession”. Fertility is procyclical: there exists a relationship between the current economic state and fertility rate (Cherlin et al. 2013). This alone would suffice as the reasoning for such drop in fertility but instead the shifting priorities of young adults adopting a new and modern take on life is the overarching explanation to the downward trajectory of US birth rates.

The social norm defines the boundaries or limits of how you should live your life. Walk the line of the social norm and you should expect to live the most ideal life, or so they say. The recent generations are an example of societies attempt at keeping pace with technological progression

and redefining a social norm while challenging the bigger question at hand: “What is the meaning of life?” Should everyone have a similar goal in life? Does there exist a single task in the bucket list that every human shares? These are questions that young adults have been asking while being raised in a constantly evolving social landscape. Concerning parenthood, when men and women are asked the question “How does one’s life change when you have children”, the most common answer is that your life becomes restricted now that you have to take on a new responsibility as a parent or idea that you have to give up your freedom (Preston 1986). While this goal of this paper is not to convince to not have children, instead it aims to convey the perspective of young adults who have the choice of whether or not they wish to become parents of the next generation.

DINK is an acronym for “dual income, no kids” and refers to couples who choose to not have children. While not being too unpopular of an ideology, is such decision considered selfish through the lens of the social norm? Nearly 48% of DINKs are spending the money that they are “saving” for not having any children towards travel. 33% say that they enjoy the financial freedom of not having children. With 32% of DINK couples stating that the cost of living today is too high to have children and 26% say they cannot financially support a child right now. A high 68% of DINK couples do not plan to ever have children and do not expect to regret such decision (Zagame 2024). With these statistics, can you really blame them? Regardless of whether or not these values become normalized into society, the declining birth rates in the US are a product of the shift in priorities for young adults.

4.2 Weaknesses

While we were able to find very interesting trends and connections with our data, there are still a few weaknesses within our data. Some ethical concerns and biases are likely present as the data is based on a survey of women. One of these concerns is that it does not take into account those who identify as LGBTQ+. The data we used in our analysis range from 1980 to 2020, but it wasn’t until 2021 that the options to identify as LGBTQ+ was added to the census (Lydia Anderson and Scherer 2021). Due to these options not being included, it could lead to these people classifying themselves differently. Since the data is based on those who identify as female, it’s likely that there are those are pregnant to not be counted.

Another weakness within the data is from the education graph. In the graphs, the options are no high school degree, high school graduate, some college, and college graduate. The data could potentially be slightly skewed by the “some college” section, as this could include students, but also those who did not complete college and dropped out, in which case it would be more appropriate to group them in the “High school graduate” section. Another weakness with this data is the lack of any options beyond college graduate. People that may have completed masters or PHD programs are also included in this section, when they could be their own separate sections, or a new section that accounts for post graduate programs.

4.3 Next Steps

Some next steps that can be taken is the inclusion of those who identify in minority groups. This would include their inputs in the graphs, and instead of birth rate being measured by births per 1000 women, it would be birth per 1000 people to account for the minority groups. Other steps that can be taken is to consider other factors, such as ethnic backgrounds, seeing which demographics have a higher birth rates. Another variable of interest to be considered in the future is if people are immigrants, as people from those groups are potentially not documented in the data. Lastly, an improvement to the education graph as stated before in the weakness, combine the “Some college” group with “High school graduate” and splitting up “College graduate” to account for those who have completed programs, such as a masters, after college.

References

- Alex Fitzpatrick, Kavya Beheraj. 2023. “The Birth Rate Ticked up in 2022. Can the Reversal Last?” <https://www.axios.com/2023/10/04/birth-rate-fertility-rate-decline-data-statistics-graph-2022>.
- Arnold, Jeffrey B. 2024. *Ggthemes: Extra Themes, Scales and Geoms for 'Ggplot2'*. <https://CRAN.R-project.org/package=ggthemes>.
- Bureau, United States Census. 2022. “Current Population Survey (CPS).” <https://www.census.gov/programs-surveys/cps.html>.
- Cherlin, Andrew., Erin. Cumberworth, S. Philip. Morgan, and Christopher. Wimer. 2013. “The Effects of the Great Recession on Family Structure and Fertility” 650 (1): 214–31. <https://doi.org/10.1177/0002716213500643>.
- Chin, Kimlin. 2022. “Declining Birth Rates in the US: An Analysis of Potential Factors.” <https://doi.org/10.48152/ssrp-srs6-t802>.
- Disease Control, U. S. Centers for, Division of Cancer Control Prevention National Cancer Institute, and Population Sciences. 2022. “U.s. Country Population Data - 1969-2020.” <https://seer.cancer.gov/popdata/download.html>.
- Economic Research, National Bureau of. 2022. “NCHS Vital Statistics Natality Birth Data.” <http://wonder.cdc.gov/natality-current.html>.
- Kearney, Melissa S., and Phillip B. Levine. 2022. “The Causes and Consequences of Declining US Fertility.” https://www.economicstrategygroup.org/wp-content/uploads/2022/08/Kearney_Levine_081222.pdf.
- Kearney, Melissa S., Phillip B. Levine, and Luke Pardue. 2022. “The Puzzle of Falling US Birth Rates Since the Great Recession.” *Journal of Economic Perspectives* 36 (1): 151–76. <https://doi.org/10.1257/jep.36.1.151>.
- Lydia Anderson, Joey Marshall, Thom File, and Zachary Scherer. 2021. “New Household Pulse Survey Data Reveals Differences Between LGBT and Non-LGBT Respondents During COVID-19 Pandemic.” <https://www.census.gov/library/stories/2021/11/census-bureau-survey-explores-sexual-orientation-and-gender-identity.html>.
- Müller, Kirill. 2020. *Here: A Simpler Way to Find Your Files*. <https://here.r-lib.org/>.
- Preston, Samuel H. 1986. “Changing Values and Falling Birth Rates.” *Population and Development Review* 12: 176–95. <http://www.jstor.org/stable/2807901>.
- R Core Team. 2023. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. <https://www.R-project.org/>.
- RStudio Team. 2020. *RStudio: Integrated Development Environment for r*. Boston, MA: RStudio, PBC. <http://www.rstudio.com/>.
- Weinberg, John. 2013. “The Great Recession and Its Aftermath.” <https://www.federalreservehistory.org/essays/great-recession-and-its-aftermath>.
- Wickham, Hadley. 2016. *Ggplot2: Elegant Graphics for Data Analysis*. Springer-Verlag New York. <https://ggplot2.tidyverse.org>.
- Wickham, Hadley, Mara Averick, Jennifer Bryan, Winston Chang, Lucy D’Agostino McGowan, Romain François, Garrett Golemund, et al. 2019. “Welcome to the tidyverse.” *Journal of Open Source Software* 4 (43): 1686. <https://doi.org/10.21105/joss.01686>.

Wickham, Hadley, Romain François, Lionel Henry, Kirill Müller, and Davis Vaughan. 2023. *Dplyr: A Grammar of Data Manipulation*. <https://dplyr.tidyverse.org>.

Wickham, Hadley, Evan Miller, and Danny Smith. 2023. *Haven: Import and Export 'SPSS', 'Stata' and 'SAS' Files*. <https://CRAN.R-project.org/package=haven>.

Zagame, Kristina. 2024. “Survey: 48.” <https://www.marketwatch.com/guides/insurance-services/dink-survey/>.