Increased Female Employment Rates and Lower Birth Rates*

An Analysis of Canada's Female Employment Rate and Birth Rate

Xu Qi

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This paper utilizes data from The World Bank to examine the relationship between Canada's female employment rate and birth rate between 2009 to 2019. The analysis shows a negative correlation between the two variables, indicating that as the female employment rate increased, the birth rate falls. This finding is important because it highlights the importance of work-life balance to national fertility rates. These insights can guide the government to formulate appropriate childcare policies, thereby optimizing the country's demographic structure.

1 Introduction

The relationship between a country's female employment rate and birth rate is a topic that has attracted considerable attention and debate among economists, population scientists and policymakers. The relationship is complex and multifaceted, often reflecting broader social and economic dynamics, cultural norms and policy environments. The female employment rate, defined as the proportion of the female population aged 15 and older that is employed, is a crucial indicator of gender equality and economic participation (TheWorldBank 2024). As a developed country with a diversified economy and progressive social policies, the study of this relationship in Canada can shed light on broader discussions about work-life balance, gender equality and demographic trends. Over the past several decades, Canada has seen a significant increase in female labor force participation, mirroring trends in other advanced economies. This shift has been attributed to a variety of factors, including increased educational attainment among women, changes in societal attitudes towards female employment, and the implementation of policies aimed at facilitating work-life balance, such as maternity leave and childcare support (Blau and Kahn 2017).

*Code and data are available at: https://github.com/xuqi2002/female-employment-and-birth-rate.git

At the same time, birth rates have been declining in many developed countries, including Canada. The birth rate, measured as the number of live births per 1,000 population per year, is influenced by myriad factors, including economic conditions, access to contraception and reproductive health services, and personal choices regarding family size and childbearing timing (Sobotka 2017). In the case of Canada, the birth rate has experienced fluctuations over the past few decades, with recent trends showing a gradual decline. This decline in birth rates is a feature common to many advanced economies and is often associated with factors such as increased female educational attainment and labor force participation, urbanization, and changes in family planning preferences (Sobotka 2017).

In this paper, we will examine the relationship between Canada's female employment rate and birth rate through a linear regression analysis. The estimand here is how female employment rate and birth rate are related. We will download data from the Data Bank website of The World Bank (DataBank 2024b). Our respondents of interest are the percentage of the female working-age population, as they represent the potential labor force and have a significant impact on a country's economic growth and development. Based on the analysis, we found that there is a negative relationship between female employment rate and birth rate.

In the data section, we discuss the source of data used in this paper, the strengths and weaknesses of The World Bank, methodologies that follow it, and data terminology. Then we present the data visualization, focusing on the trajectory of female employment rate and birth rate from 2009 to 2019 in Canada. In the model section, we will analyze the trend by creating a linear regression model. In the result section, we will present the result of the model in a graph. Finally, we explore the factors that contribute to this negative relationship between female employment rate and birth date. We will also examine the weakness, and potential next step of this analysis.

2 Data

2.1 Data Description and Methodology

The data used in this paper is obtained from the Data Bank website of The World Bank, it is public data which available through the Data Bank website (DataBank 2024b). The World Bank's Data Bank is a comprehensive database that offers free and open access to a vast collection of global development data. It encompasses a wide array of statistical indicators and data sets covering various aspects of economic and social development. These include, but are not limited to, population demographics, economic performance, health and education statistics, environmental indicators, and much more.

The data in the World Bank's Data Bank comes from a variety of sources, with a significant portion being collected and compiled by the World Bank itself, as well as from specialized agencies of the United Nations (UN), international organizations, national statistical offices,

and other authoritative public and private sector sources. These data are then aggregated and analyzed by the World Bank to identify trends and inform policy recommendations.

The two datasets that I will be using are: `"Birth rate, crude, per 1000 people"` (DataBank 2024a), and `"Employment to population ratio, 15+, female (%) (national estimate)"` (DataBank 2024c). The two original datasets include data from 265 countries around the world for the period 1960-2022, although data are not available for every country in every year. I processed these two datasets, keeping only Canada's data for 2009-2019, and merged them into one dataset for analysis. The birth rate dataset presents the number of live births per 1,000 people in a given population over one year. The observations recorded in the processed dataset was 11.4 in 2009, and 9.9 in 2019. The female employment rate dataset presents the percentage of a country's female population aged 15 years and older that is employed. The value is expressed as a percentage of the total female population within the same age group. The observations recorded in the processed dataset was 57.958 in 2009, and 58.453 in 2019.

Table 1: A summary table of cleaned data

Year	Birth_Rate_per_1000_people	Female_Employment_Rate
2009	11.4	57.958
2010	11.2	57.802
2011	11.0	57.696
2012	11.0	57.896
2013	10.9	58.141
2014	10.9	57.687
2015	10.7	57.591
2016	10.6	57.517
2017	10.3	57.892
2018	10.1	58.028
2019	9.9	58.453

Table 1 presents the overview of the cleaned dataset. There are 11 observations which are years from 2009 to 2019. The variables in the dataset include `Year`, `Birth_Rate_per_1000_people` and `Female_Employment_Rate` (in percentage).

In this paper, the analysis is carried out using the statistical programming language `R` (R Core Team 2023), with the help of extra packages including `arrow` (Richardson et al. 2024), `dplyr` (Wickham et al. 2023), `ggplot2` (Wickham 2016), `here` (Müller 2020), `kableExtra` (Zhu 2021), `knitr` (Xie 2014), `modelsummary` (Arel-Bundock 2022), `readr` (Wickham, Hester, and Bryan 2024), `tibble` (Wickham, Müller, and Hester 2021), and `tidyverse` (Wickham et al. 2019).

2.2 Data Visualization

2.2.1 Trend of Female Employment Rate

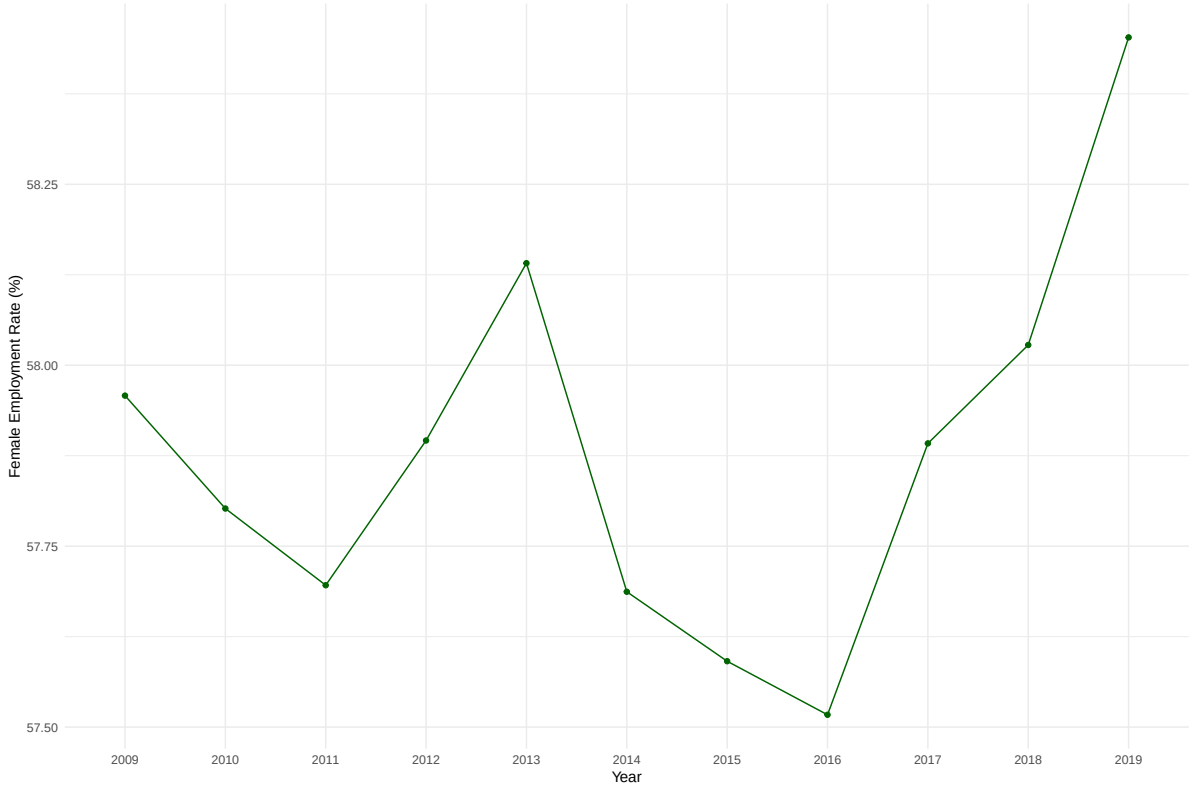

Figure 1: Canada's female employment rate from 2009 to 2019.

Figure 1 shows the trend in the female employment rate in Canada from 2009 to 2019. The line graph indicates an overall upward trajectory in the rate of female employment during this decade. The female employment rate was initially 54.616% in 2009. After that, there is a sharp decrease until 2011. From 2011 to 2016, there are some volatility, with the female employment rate experiencing both increases and decreases but generally trending downwards during this period. After 2016, the rate begins to rise again, with reaching the peak in 2019 with 58.453%. This figure suggests that more women are participating in the Canadian labor force over time, though social, economic and policy changes may have influenced the rate's variability throughout these years.

2.2.2 Trend of Birth Rate

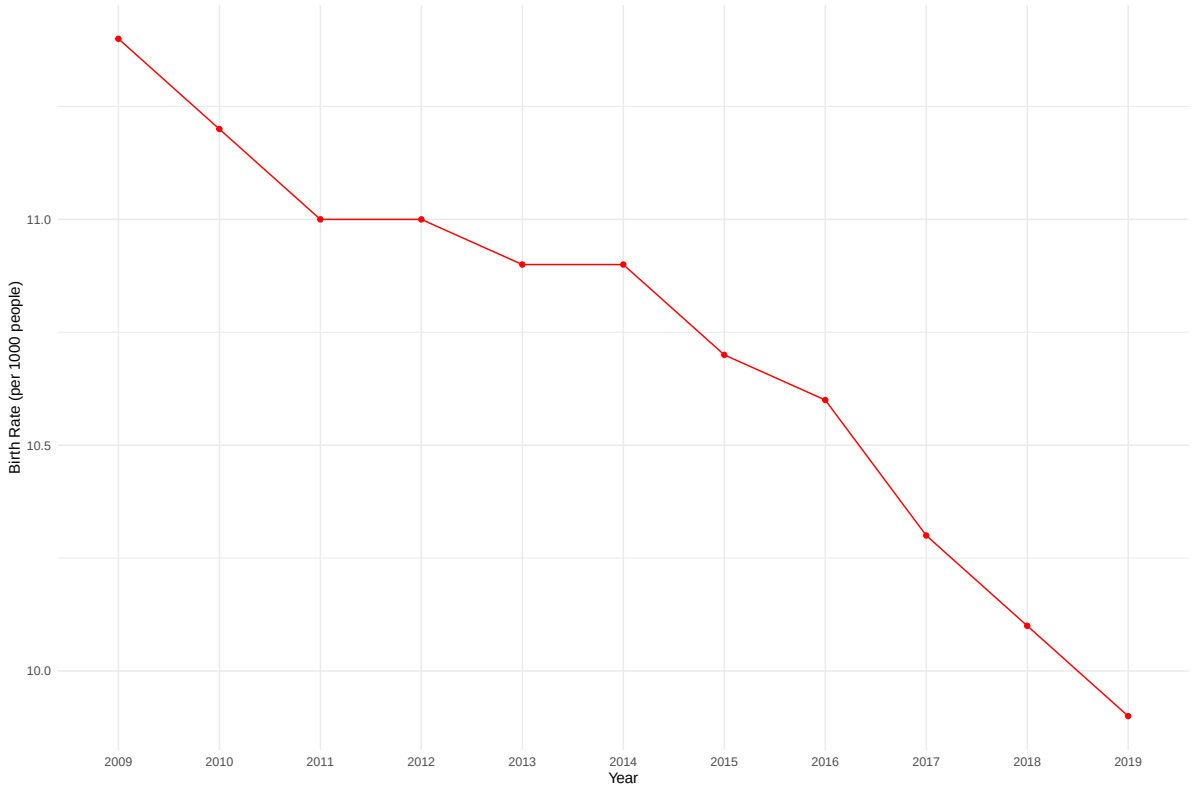

Figure 2: Canada's birth rate from 2009 to 2019.

Figure 2 presents a line graph showing the trend of Canada's birth rate for a decade from 2009 to 2019, which is a clear downward trend. Starting at 11.4 births per 1,000 people in 2009, the birth rate consistently declines year over year, reaching its lowest point after a decade in 2019, with only 9.9 newborns per 1000 people. Such a descending trend may suggests various social and economic changes, such as shifts in societal norms regarding family size, economic incentives or disincentives for having children, or other demographic changes within the country. The consistent downward trajectory suggests that these factors are persisting over time, contributing to a sustained reduction in the number of births.

3 Model

After conducting basic analysis on the dataset, we have observed a negative correlation between the female employment rate and the birth rate, indicating a potential linear relationship. To gain further insights, we will be implementing a linear regression model.

Here is the equation of the linear regression model.

$$Yij = \beta 0 + \beta 1 Xij + \varepsilon ij$$

where:

- Y is the Birth Rate
- X is the Female Employment Rate
- Y_{ij} is the Birth Rate for observation j in year i.
- X_{ij} is the Female Employment Rate for observation j in year i.
- β_0 is the intercept/constant term, which represents the expected value of Birth Rate when the Female Employment Rate is equal to zero.
- β_1 is the slope coefficient or the estimated change in Birth Rate for a one-unit increase in the Female Employment Rate.
- ϵ_{ij} is the error term or the deviation of the actual value of Birth Rate from the predicted value based on the regression equation.

The purpose of a linear regression model in this case is to estimate the values of 0 and 1, so that the model fits the data well, and predicts the expected value of the newborn birth rate for different values of the female employment rate. The statistical significance of 1 can be assessed using a t-test, which tests whether the estimated coefficients are significantly different from zero. If the p-value of the t-test is less than the selected level of significance, we can conclude that there is a significant relationship between the female employment rate and the newborn birth rate.

4 Result

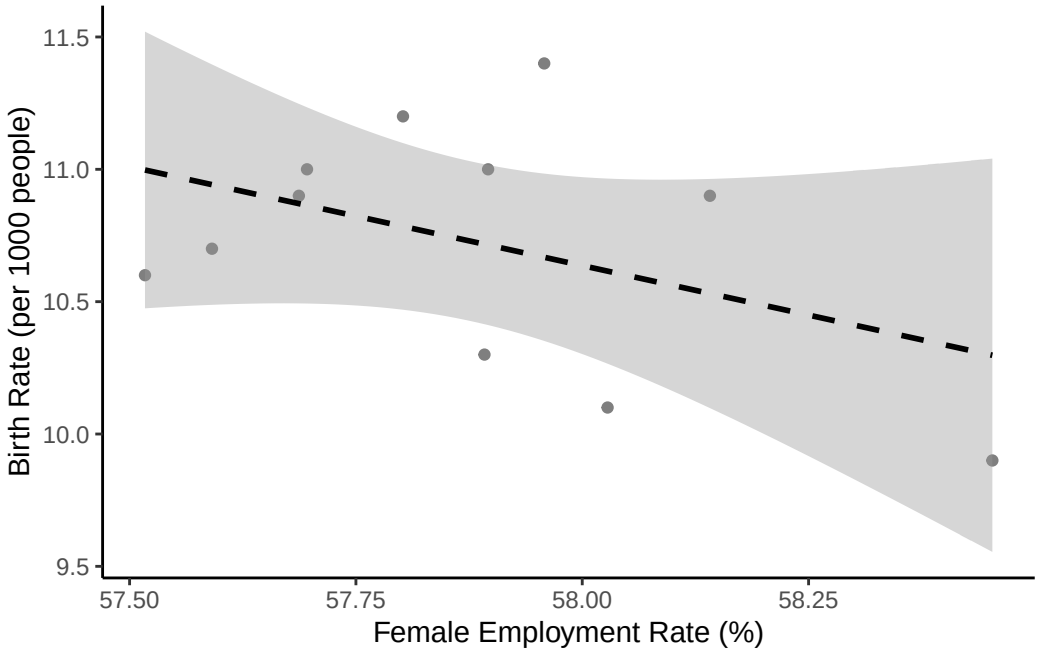

Figure 3: The model shows the relationship between Female Employment Rate and Birth Rate

Figure 3 illustrates a fitted graph of the linear regression model, showing the relationship between the Female Employment Rate (on the x-axis) and the Birth Rate per 1,000 people (on the y-axis). The dashed line indicates the trend as estimated by the linear regression model. The grey shaded area around the dashed line represents the confidence interval for the regression line, giving a visual indication of the uncertainty around the estimated relationship. The plot suggests a negative relationship between the two variables: as female employment rate increases, the birth rate rate decreases. The regression line confirms this trend, with a negative slope that is statistically significant. Overall, this figure provide strong evidence of the negative association between female employment rates and birth rates. With the confidence interval indicating the range, we can be reasonably sure that the true regression line lies in this area.

Table 2: T-Value and P-Value of Regression

	t_value	p_value
(Intercept)	1.786750	0.1076225
Female_Employment_Rate	-1.431875	0.1859783

Table 2 and Table 3 are summaries of the linear regression model, they provide several key

Table 3: Summary of the linear regression model

	Female_Employment_Rate
(Intercept)	54.01
	(30.23)
Female_Employment_Rate	−0.75
	(0.52)
Num.Obs.	11
R2	0.186
R2 Adj.	0.095
AIC	17.1
BIC	18.3
Log.Lik.	−5.531
RMSE	0.40

pieces of information about the relationship between the female employment rate and the birth rate:

- The intercept is approximately 54.01, suggesting that when the female employment rate is 0, the birth rate is predicted to be around 54 births per 1000 people. However, this interpretation of the intercept may not be meaningful if a female employment rate of 0 is not feasible or outside the range of the data.
- The coefficient for Female Employment Rate is approximately -0.75, with a standard error of 0.52. This suggests that for each one percent increase in the female employment rate, the birth rate is expected to decrease by 0.75 births per 1000 people.
- The R-squared value is 0.186, meaning that approximately 18.6% of the variability in the birth rate is explained by the model. This is a relatively low value, indicating a weak fit of the model to the data.
- The t-value for the Female Employment Rate coefficient is approximately -1.43, indicating the estimate is -1.43 standard deviations away from 0. The negative sign shows that the relationship is negative.
- The p-value for the intercept is approximately 0.1076, suggesting that the intercept is not statistically significant at the common alpha levels

In summary, this linear model suggests a negative relationship between the Female Employment Rate and the Birth Rate, but neither the intercept nor the slope is statistically significant. Given the low R-squared value, this model also does not appear to be a particularly strong predictor of the birth rate based on the female employment rate. This implies that while the model estimates a negative effect of the increased Female Employment Rate on Birth rate, we

do not have sufficient evidence to claim a statistically significant relationship from this sample of data.

5 Discussion

5.1 Evolution of Female Employment in Canada

As we have analyzed above, the trend of the female employment rate in Canada has been marked by significant growth, with fluctuations.This reflect broader economic cycles and policy changes. Over the past few decades, Canada has witnessed substantial changes in the labor market, particularly concerning female labor force participation.

In the early 1990s, Canada's female employment rate began to rise sharply, reflecting a trend towards greater gender equality and the increased need for dual-income households in the face of economic pressures (Fortin 2005). This upward trajectory continued into the 2000s, albeit with periodic fluctuations that can be linked to macroeconomic conditions such as recessions and recoveries. For instance, during the economic downturn in 2008-2009, Canada, like many other countries, experienced a decrease in employment rates. However, it is notable that the impact on female employment was less pronounced than on male employment, which some scholars attribute to the concentration of women in less cyclical sectors such as healthcare and education (Goldin 2014).

Following the recovery from the recession, female employment rates in Canada resumed an upward trend. The participation of women in the workforce has been supported by several factors, including higher educational attainment among women and government policies aimed at encouraging female labor participation, such as subsidized child care and parental leave policies (Blau and Kahn 2017). These policies have not only enabled more women to join and remain in the workforce but also to progress into more skilled and higher-paid roles.

Despite these gains, the trend has not been without its challenges. Women, particularly those with young children, still face significant barriers to full-time employment, leading to a persistent gender gap in full-time employment rates (Morissette and Ostrovsky 2005). The part-time work, often undertaken by women, has implications for wage equity and career advancement opportunities. Moreover, the rise in female employment has not been uniform across all sectors or demographics; for example, immigrant women and women in rural areas often have lower employment rates than their urban counterparts (Hou and Coulombe 2010).

In conclusion, the trend of Canada's female employment rate reflects a complex interplay of economic forces, social change, and policy interventions. While significant progress has been made, ongoing challenges remain, necessitating a continuous commitment to fostering a labor market that supports gender equality and enables all Canadians to contribute to and benefit from economic growth.

5.2 Evolution of Birth Rate in Canada

As we have analyzed above, Canada's birth rate has a declining trend. It is not just happened in the past decade but over several decades, a pattern consistent with many other developed countries. The decline in birth rates reflects significant changes in individual and societal choices and is shaped by the broader social and economic context.

Since the late 1960s, the birth rate of Canada has been on a downward slope, a trend described by the demographic transition theory, which links reductions in birth and death rates to societal advancements and improved living standards (Kirk 1996). This transition often accompanies increased urbanization, greater access to education, and improved healthcare, particularly in women's reproductive health services. By the 1990s, the birth rate in Canada had fallen to below-replacement levels, which is the rate required to replace the population without immigration (Milan 2018). The factors contributing to the decline are manifold. Increasing female participation in higher education and the workforce has been associated with delayed childbearing and reduced family size (Beaujot and Kerr 2007). The rising cost of living, particularly in urban centers where most of the population resides, and concerns about work-life balance have also led many individuals and couples to opt for fewer children.

Another factor influencing the birth rate is the shifting pattern of immigration. Immigrants tend to have higher birth rates upon arrival in Canada, but these rates often converge to the national average within a generation (Ng and Nault 1997). This demographic effect adds complexity to the analysis of birth rate trends. Moreover, social attitudes towards marriage and parenthood have evolved. With increased acceptance of cohabitation and non-traditional family structures, the link between marriage and childbearing has weakened, further affecting birth rates (Le Bourdais and Lapierre-Adamcyk 2004). Government policies also play a role in shaping birth rates. In Canada and other developed countries, policies such as subsidies for child and parental leave provisions aim to alleviate the financial burden of child-rearing, potentially influencing decisions around having children.

Looking for the future, the continued decline in birth rates will have significant implications for Canada's demographic structure, including an aging population and the reated economic problems. Policymakers must aviod these implications, considering the adequacy of retirement systems, healthcare services, and labor force planning.

5.3 Impact of Female Employment on Birth Rate

Although the regression analysis in this paper does not strongly support a negative correlation between the female employment rate and birth rate, this relationship has been agreed by many demographers, economists and policymakers, especially as many developed countries are experiencing changes in fertility patterns and the structure of the labor force.

Economic theory often posits that increased female labor force participation leads to a decrease in birth rates. This inverse relationship is primarily attributed to the opportunity costs

associated with childbearing and childrearing. When women engage in paid work, the time and economic resources devoted to having children come at the expense of their career advancement and income potential (Becker 2009). Moreover, as women attain higher levels of education and more demanding careers, they may choose to delay marriage and parenthood or opt for smaller family sizes (Bloom 2003).

From a sociological standpoint, the changing norms and values around gender roles and family structures influence both female employment and fertility decisions. The rise in gender equality movements has contributed to a shift in societal expectations, leading to increased acceptance and support for women pursuing careers alongside or instead of traditional roles as primary caregivers (McDonald 2000). Consequently, as women's roles have diversified beyond the domestic sphere, their contributions to household income have become more vital, which can defer or reduce family planning intentions.

However, the relationship is not always like above. The nature of the job market and the availability of family-friendly policies also play significant roles. Countries with supportive policies, such as subsidized childcare and flexible work arrangements, tend to reduce the negative impact of female employment on birth rates. For example, in Canada and some Scandinavian countries, despite high female employment rates, birth rates have not declined as steeply as might be expected, largely due to such supportive policies (Rindfuss et al. 2007).

In conclusion, while it's clear that female employment rates do have an impact on birth rates, the nature of this impact is complex. As societies evolve, the balancing act between employment and childbearing continues to be evolve in response to changing economic conditions, social norms, and policy frameworks.

5.4 Weakness and Next Step

This analysis examining the impact of the female employment rate on the birth rate in Canada and provides valuable insights. However, it has limitations that merit consideration for future research.

One key weakness is having the bias of omitting other variables. The model currently includes only the female employment rate as a predictor, possibly neglecting other factors that can influence the birth rate. Variables such as average age at marriage, access to contraception, cultural norms, economic conditions, immigration patterns, and government family policies could also significantly impact fertility rates. Ignoring these factors could mislead the effect of female employment on the birth rate.

Another limitation is the assumption of a linear relationship between the two variables. The relationship may be more complex and could not captured by a simple linear model. For example, there could be threshold effects where the impact of female employment on the birth rate changes after reaching a certain level of employment rate. In addition, the data set used only 11 observations, which means 11 years. A larger dataset could provide a more detailed

understanding of the relationship. Also, a comparative analysis including other countries could help contextualize the findings within a global framework.

For next steps, the analysis could be expanded to include other aspects that have been identified in the text above. This would allow for a more comprehensive model that can control complicated factors. Using a multivariate regression analysis could provide deeper insights.

References

Arel-Bundock, Vincent. 2022. "modelsummary: Data and Model Summaries in R." *Journal of Statistical Software* 103 (1): 1–23. https://doi.org/10.18637/jss.v103.i01.

Beaujot, Roderic, and Don Kerr. 2007. *Emerging Youth Transition Patterns in Canada: Opportunities and Risks*. University of Western Ontario, Population Studies Centre.

Becker, Gary. S. 2009. *A Treatise on the Family*. Harvard University Press.

Blau, Francine D., and Lawrence M. Kahn. 2017. "The Gender Wage Gap: Extent, Trends, and Explanations." *Journal of Economic Literature* 55 (3): 789–865. https://doi.org/10.1257/jel.20160995.

Bloom, Canning, D. E. 2003. *The Demographic Dividend a New Perspective on the Economic Consequences of Population Change*. Rand.

DataBank. 2024a. "Birth Rate Crude Per 1000 People." *The World Bank*. https://data.worldbank.org/indicator/SP.DYN.CBRT.IN.

———. 2024b. "Data Bank Home Page." *The World Bank*. https://databank.worldbank.org/home.

———. 2024c. "Employment to Population Ratio 15+ Female National Estimate." *The World Bank*. https://data.worldbank.org/indicator/SL.EMP.TOTL.SP.FE.NE.ZS.

Fortin, N. M. 2005. "Gender Role Attitudes and the Labour-Market Outcomes of Women Across OECD Countries." *Oxford Review of Economic Policy* 21 (3): 416–38. https://doi.org/10.1093/oxrep/gri024.

Goldin, Claudia. 2014. "A Grand Gender Convergence: Its Last Chapter." *American Economic Review* 104 (4): 1091–1119. https://doi.org/10.1257/aer.104.4.1091.

Hou, Feng, and Simon Coulombe. 2010. "Earnings Gaps for Canadian-Born Visible Minorities in the Public and Private Sectors." *Canadian Public Policy* 36 (1): 29–43. https://doi.org/10.3138/cpp.36.1.29.

Kirk, Dudley. 1996. "Demographic Transition Theory." *Population Studies* 50 (3): 361–87. https://doi.org/10.1080/0032472031000149536.

Le Bourdais, Céline, and Évelyne Lapierre-Adamcyk. 2004. "Changes in Conjugal Life in Canada: Is Cohabitation Progressively Replacing Marriage?" *Journal of Marriage and Family* 66 (4): 929–42. https://doi.org/10.1111/j.0022-2445.2004.00063.x.

McDonald, Peter. 2000. "Gender Equity in Theories of Fertility Transition." *Population and Development Review* 26 (3): 427–39. https://doi.org/10.1111/j.1728-4457.2000.00427.x.

Milan, A. 2018. *Fertility: Overview, 2012 to 2016*. Statistic Canada.

Morissette, Rene, and Yuri Ostrovsky. 2005. "The Instability of Family Earnings and Family Income in Canada, 1986-1991 and 1996-2001." *Canadian Public Policy / Analyse de Politiques* 31 (3): 273. https://doi.org/10.2307/3552442.

Müller, Kirill. 2020. *Here: A Simpler Way to Find Your Files*. https://CRAN.R-project.org/package=here.

Ng, Edward, and François Nault. 1997. "Fertility Among Recent Immigrant Women to Canada, 1991: An Examination of the Disruption Hypothesis." *International Migration* 35 (4): 559–80. https://doi.org/10.1111/1468-2435.00027.

R Core Team. 2023. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org/.

Richardson, Neal, Ian Cook, Nic Crane, Dewey Dunnington, Romain François, Jonathan Keane, Dragoș Moldovan-Grünfeld, Jeroen Ooms, Jacob Wujciak-Jens, and Apache Arrow. 2024. *Arrow: Integration to 'Apache' 'Arrow'*. https://github.com/apache/arrow/.

Rindfuss, Ronald R., David Guilkey, S. Philip Morgan, Øystein Kravdal, and Karen Benjamin Guzzo. 2007. "Child Care Availability and First-Birth Timing in Norway." *Demography* 44 (2): 345–72. https://doi.org/10.1353/dem.2007.0017.

Sobotka, Tomáš. 2017. "Post-Transitional Fertility: The Role of Childbearing Postponement in Fuelling the Shift to Low and Unstable Fertility Levels." *Journal of Biosocial Science* 49 (S1). https://doi.org/10.1017/s0021932017000323.

TheWorldBank. 2024. "Labor Force Participation Rate, Female." *The World Bank*. https://databank.worldbank.org/metadataglossary/gender-statistics/series/SL.TLF.TOTL.FE.ZS.

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 Grolemund, 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, and Kirill Müller. 2023. *Dplyr: A Grammar of Data Manipulation*. https://CRAN.R-project.org/package=dplyr.

Wickham, Hadley, Jim Hester, and Jennifer Bryan. 2024. *Readr: Read Rectangular Text Data*. https://readr.tidyverse.org.

Wickham, Hadley, Kirill Müller, and James Hester. 2021. *Tibble: Simple Data Frames*. https://CRAN.R-project.org/package=tibble.

Xie, Yihui. 2014. *Knitr: A Comprehensive Tool for Reproducible Research in R*. Edited by Victoria Stodden, Friedrich Leisch, and Roger D. Peng. Chapman; Hall/CRC. http://www.crcpress.com/product/isbn/9781466561595.

Zhu, Hao. 2021. *kableExtra: Construct Complex Table with 'Kable' and Pipe Syntax*. https://CRAN.R-project.org/package=kableExtra.