The Effect of Female Labor Participation on Fertility Rate in 10 of the Top Developed Countries in The World.

Noah Dechasa

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1. **Introduction**

There has been a trend in fertility rate declin across the world over the years while female participation in the labor force has seen an increase. The figures below show the steady global decline in fertility rate in figure 1 and inversely an increase in female participation in the labor force in Figure 2 (Chaney Skadsen 2017). Chart, line chart

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There have been many studies dedicated to understanding the impact of female labor participation on fertility rate and this paper analyzes the role of female labor participation on fertility rate in developed countries.

The relationship between these two factors has been seen to not only change in different time periods but also in different countries. For example, (Chaney Skadsen 2017) while there was no discernible relationship between female labor force participation and fertility rates in the Asian-Pacific region, in the Middle East and North Africa (MENA) female labor force is negatively seen to rise as fertility sharply declines. On the other hand, Sub-Saharan African nations have high rates of female labor force participation and consistently high fertility rates compared to the rest of the globe (Chaney Skadsen 2017).

These patterns and the diversity between nations imply that, in addition to other diverse factors like culture and religion there may be different causal impacts of fertility on female labor participation depending on area and degree of development of each nation (Chaney Skadsen 2017).

The negative relationship between the two provides incentive to investigate whether women in the labor market act as an obstruction to fertility and the possibility of incompatibility between motherhood and employee (Chaney Skadsen 2017). This study investigates if the relationship between these two factors in 10 developed countries of the world varies from the observed world trend.

1. **Literature Review**

With an increased amount of literature around this topic it has been seen to have both a positive and negative relation between female labor participation and fertility rate.

In the study Marianne Sundstrom and Frank P. Stafford (1992) present the central elements in the tax and family policies and use a disaggregated approach to assess their impact on Swedish fertility and female labor force participation. They show that these policies stimulate both fertility and women's paid work by reducing the costs of having children while requiring parents to be employed to collect full benefits.

In the study Nawalin Nazah, Jarita Duasa, and Muhammad Irwan Arifin (2021) examined the panel causality between the variables employing Dumitrescu and Hurlin’s (2012) Granger non-causality test. According to the Hausman test, among the three models in panel ARDL, DFE is the preferred model compared to the PMG and MG results revealed that fertility was negatively significant on female labor participation in the short run but not in the long run. In contrast, female education was positively significant on female labor participation in the long run but not in the short run.

Another interesting research was conducted by Kim and Aassve (2006) on the impact of fertility on Indonesia's male and female labor markets. They looked at how male and female workers in urban and rural regions responded differently. Their findings showed that, in both rural and urban regions, female workers reduced their weekly work hours by 1.1 for every additional birth, but only male laborers in rural areas saw an increase in their weekly work hours of 0.9 for every additional birth. Instead of employment-related factors, the cost of childcare in rural and urban locations differs significantly. The economic theory that claims that a rise in fertility is likely to alter the ideal time allocation within the household supports the involvement of both men and women.

1. **Methodology**

This research intends to analyze a fixed-effects model of fertility rate to better understand the link between fertility rate and female labor force participation. The fixed effect is used because the Hausman test found that the fixed effect is a better model for this panel dataset with the p-value < 0.05. A list of 10 countries and 8 series was taken from the world bank data base. The data time taken spans from 2001 to 2016. The data taken had no missing data and no data was in need to be destringed or dropped. There was a few that were dropped but that was irrelevant that like Timecode. But there was a lack of data on policy engagement concerning mothers at work that might affect not only the dependent variable but also the key independent Variable.

When necessary, calculations are made to study the distribution of all the numerical variables using the mean, median, standard deviation, minimum, and maximum values. The properties of each state and time are then specifically identified and controlled by using a fixed-effects model. A time variable must also be under control for as we investigate the previous literature papers on this topic, time has quite an effect on the type of relation these two variables have.

Fertility rate using birth per women by country across the time 2001-2016 used as the dependent variable. My key variable is female labor participation (%) using percentage of women aged 15 and above in the labor force. Additionally, I use the labor participation for the male counterpart aged 15 and above and adding unemployment rate (%) for both male and female. While also adding unemployment rate (%) with advanced education (graduate and higher) for both sexes as an independent variable. I did this by determining that unemployment rate, could not only show me what percentage of the labor force is attempting to work, but also the percentage of average highly educated people who are in the labor force but are unemployed for whatever reason. I wanted to find insights if the more educated a person is would they be valuable in the labor force and would sex effect that outcome and how that may affect fertility rate.

It was also seen in existing literature that countries with high GDP had varying effects on the dependent variable so GDP using the current US$ is another independent variable used in this study.

**Equation and tests**

I have built five models. All five models share the same control variables. Model 1 attempts to explain Fertility Rate using standard version only the independent variables and no lagged versions. Model 2 has Female labor participation and its 4 lagged variables to estimate a regression between fertility rate and Female labor participation. Then, model 3 specifies male labor participation and 4 lagged Variables. Model 4 combines models 2 and 3 with Female labor participation, five lagged Female labor participation, male labor participation, and five lagged male labor participation. Lastly, model 5 is a random effect model in standard version. When I specify an equation, I prioritize the number of statistically significant variables and compare each model’s R-Squared. Therefore, this paper specifies model 1 as a final model to estimate Fertility Rate and Female labor Participation:

Fertility rate𝑖𝑡 = 𝛽0 + 𝛽1 Female labor participation 𝑖𝑡 +

𝛽2Male\_labor\_participation 𝑖𝑡 + 𝛽3Female\_Unemployent 𝑖𝑡 +

𝛽4Male\_Unemployment𝑖𝑡+𝛽5Female\_advanced\_Unemployent𝑖𝑡+

𝛽6Male\_advanced\_Unemployment 𝑖𝑡 + 𝛽6GDP 𝑖𝑡 + 𝜀𝑖𝑡

**Omitted Variables/Bias**

The variables picked out for this study were seen to be the most relevant and useful. This doesn’t mean that there weren’t any other variables that could have done a better job at doing the same thing though. Omitted variables for example are policy implementation, government structure and the countries main source of revenue are the few variables that had to be put in the Error term due to lack of data on them for this study. This in turn would make the model biased because of this omission. This bias is problematic inside the model because it contradicts the classical premise that no endogeneity would exist. Additionally, because the omitted variable is now part of the error term, the conventional assumption that the error term has a zero-sum average is broken. When bias exists, the model's distribution is thrown off center, altering the interpretation of the data as well as the rejection or failure to reject the null hypothesis. For these reasons, the validity of this study is lessened. After compiling the results, the final use of these discoveries will be determined.

**Descriptive Analysis**

Table 1 summarizes the statistics for all numerical variables. The Fertility Rate distribution is equally skewed, centered at 1.81, and has a standard deviation of 0.1719152. Fertility Rate has relatively few outliers at the tails. Female labor participation rate distribution is generally symmetric, with a standard deviation of 6.131474. Its standard deviation is relatively minimal, indicating that female work participation converges and is roughly the same with little variance. Male labor participation rates are substantially skewed to the left and right. When compared to the plots of Male labor participation and Female labor participation, this panel data plot shows that most of the countries tend to have a similar range of Fertility rate. Female and male unemployment are right skewed, with standard deviations of 2.085271 and 2.693439, respectively. This demonstrates that male and female unemployment appear to have equal variation throughout the data set. When looking at the advanced educated male and female unemployment rates, both are right skewed with standard deviations of 1.287355 and 1.308886, respectively. Appendix Table 1 shows a graph illustrating these numbers.

**Results**

For models 1-4, I estimate and present fixed effects regression. Table 2 shows the coefficient, robust standard error, R-squared, and observation for each model (Appendix). At the 10% significance level, a final equation model 1 has two statistically significant variables to predict Fertility Rate: Female labor participation, Male labor participation, Female unemployment, Male Unemployment, Female advanced Unemployment Male\_advanced\_Unemployment GDP. When all other factors remain constant for a particular country, as female labor participation fluctuates by one percent over time, the fertility rate reduces by 0.03028 units. Then, GDP fluctuates by one unit over time, but fertility grows by 0.029 unit. However, because the tstatistics is -5.74, we have a possibility of seeing a coefficient of GDP per fertility rate of 0.0297 by chance when GDP and fertility rate have zero correlation and everything else is constant.

The fertility rate fluctuates by less than one unit as for a particular nation, female labor participation, GDP, male labor participation, male and female unemployment, and male and female advanced unemployment fluctuate by one percent over time. While female labor participation, female unemployment, and GDP have a negative effect on fertility, the remaining factors have a positive effect. Female unemployment fluctuates by 1% over time for a specific nation, and fertility drops by.0328453 units ceteris paribus. Furthermore, for a particular nation, male and female advanced unemployment differs by 1% over time. Fertility rates rise by.0178059 and.022884 units, respectively. Male labor participation is the only variable with a t statics that demonstrates insignificance.

I ran several tests to review the specification of the equation. I performed the Hausman test (Appendix Figure A.5) to determine whether a fixed-effects are better than a random-effects model. As the chi-squared statistics is 44.21 and the corresponding p-value is approximately 0, I have strong evidence that there is a systemic difference between random and fixed effects. Therefore, I kept the fixed-effects model. Then, the time series test (Appendix Figure A.4) shows that the model has a chi-squared statistics 13.36 and a p-value of 0.000. Thus, I have strong evidence to suggest that time effects are necessary to explain the variability of Fertility Rate. The last equation also undergoes a review of heteroskedasticity (Appendix Figure A.2) and multicollinearity (Appendix Figure A.3). Modified Wald test (Appendix Figure A.2) indicates that the chi-squared test statistics is 160.55, and the p-value is approximately 0. Therefore, I have strong evidence that the final fixed effect regression model has a groupwise heteroskedasticity. Female unemployment has multicollinearity with Male unemployment, Female advanced unemployment, and Male advanced unemployment. With the correlations exceeding 0.7 the model displays multicollinearity.

**Discussion**

This paper has been concerned with the relationship between Female Labor Participation and Fertility Rate. The regression estimates show that trade has a negative yet small impact on Fertility Rate, assuming all the other variables are held constant in a model. This finding is consistent with Mishra, Vinod, and Russell Smyth. (2010) research on 28 OECD countries using panel unit root, panel cointegration, Granger causality and long-run structural estimation. This result suggests that in an economically prospers country fertility rate is in a decline and negatively related to the countries Female Labor Participation.

This paper has limitations. First, I have assumed that a real functional form is linear, but I've never investigated if a non-linear form fits a model better than a linear equation. Second, omitted variable bias is very concerning. This model fails to include Countries policy around female employees, Country government structure, cultural views, prominent Belief, and countries main Revenue. All these components are correlated with Female and Labor Participation. Thus, the presence of a bias indicates that the estimated coefficients of Female Labor Participation and Male Labor Participation are located at the upper or Lower bounds of the true parameters in population. Therefore, coefficients of this model are likely to be biased. Multicollinearity is also a problem in this dataset with my variables having a correlation of over 0.7 the final model is insufficient to predict Fertility Rate with Female Labor Participation.

This paper is largely limited and leaves lot of room for future research. Future research should focus on not only the numbers regarding labor force but also female graduate rates, female job retention, and female specific policy that revolved around having a baby. Also, an in-depth analysis on the country’s history around women in the labor force. Overall, this paper shows there is a negative relationship between Female Labor Participation and Fertility Rate in developed countries.

**Appendix**

Definitions of Variables

**GDP**

Output-side real GDP (Current US$)

**Female labor participation rate**

Female Labor Participation rate from ages 15+ (%) (National estimate)

**Male labor participation rate**

Male Labor Participation rate from ages 15+ (%) (National estimate)

**Female\_Unemployent**

Female Unemployment rate from ages 15+ (%) (National estimate**)**

**Male\_Unemployment**

Male Unemployment rate from ages 15+ (%) (National estimate)

**Female\_advanced\_Unemployent**

Female Unemployment rate with Advanced education from ages 15+ (%) (National estimate)

**Male\_advanced\_Unemployment**

Female Unemployment rate with Advanced education from ages 15+ (%) (National estimate)

Figure A.1

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Table A.1

|  |
| --- |
| Variable | Obs Mean Median Std. dev. Min Max |
| -------------+--------------------------------------------------------- |
| Fertility\_~e | 160 1.791313 1.81 .1719152 1.33 2.12 |
| Female\_lab~n | 160 57.20725 57.305 6.131474 41.87 70.6 |
| Male\_labor~n | 160 69.52544 70.14 4.267165 58.72 78.17 |
| Female\_Une~t | 160 6.128188 5.725 2.085271 2.36 12.75 |
| Male\_Unemp~t | 160 6.434313 5.795 2.693439 1.81 17.7 |
| -------------+--------------------------------------------------------- |
| Female\_adv~t | 160 3.5705 3.415 1.308886 1.35 8.06 |
| Male\_advan~t | 160 3.56275 3.455 1.287355 1.28 8.42 |
| GDP | 160 2.39e+12 5.29e+11 4.28e+12 1.09e+11 1.87e+13 |

Table A.2: Regression estimation of The Relationship between Fertility Rate and Female Labor participation

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| DEPENDENT VARIABLE: FERTILITY RATE | (1) | (2) | (3) | (4) | (5) |
| VARIABLES | (Model) | (Model) | (Model) | (Model) | Random Effect (Model) |
|  |  |  |  |  |  |
| lFemale\_labor\_participation |  | -0.00458 |  | -0.00130 |  |
|  |  | (0.00373) |  | (0.0136) |  |
| l2Female\_labor\_participation |  | 0.00469 |  | 0.00431 |  |
|  |  | (0.00346) |  | (0.00834) |  |
| l3Female\_labor\_participation |  | 0.000209 |  | 0.00865 |  |
|  |  | (0.00313) |  | (0.0139) |  |
| l4Female\_labor\_participation |  | 0.000257 |  | -0.0108 |  |
|  |  | (0.00328) |  | (0.0130) |  |
| Female Unemployment rate from ages 15+ (%) (National estimate) | -0.0328 | -0.0387 | -0.0426 | -0.0417 | -0.0314 |
|  | (0.0218) | (0.0320) | (0.0334) | (0.0333) | (0.0219) |
| Male Unemployment rate from ages 15+ (%) (National estimate) | 0.00331 | 0.0121 | 0.0154 | 0.0112 | 0.00387 |
|  | (0.0179) | (0.0241) | (0.0248) | (0.0241) | (0.0181) |
| Female Unemployment rate with Advanced education from ages 15+ (%) (National estimate) | 0.0229 | 0.0334 | 0.0397 | 0.0375 | 0.0197 |
|  | (0.0207) | (0.0229) | (0.0262) | (0.0246) | (0.0207) |
| Male Unemployment rate with Advanced education from ages 15+ (%) (National estimate) | 0.0178 | -0.00785 | -0.0113 | -0.00559 | 0.0180 |
|  | (0.0297) | (0.0403) | (0.0413) | (0.0424) | (0.0317) |
| GDP in Current USD | -0\*\*\* | -0\*\*\* | -0\*\*\* | -0\*\*\* | -0\*\*\* |
|  | (0) | (0) | (0) | (0) | (0) |
| Female Labor Participation rate from ages 15+ (%) (National estimate) | -0.0143 |  |  |  | -0.0114 |
|  | (0.00869) |  |  |  | (0.00795) |
| Male Labor Participation rate from ages 15+ (%) (National estimate) | 0.0290\*\*\* |  |  | 0.00399 | 0.0269\*\*\* |
|  | (0.00818) |  |  | (0.0117) | (0.00726) |
| lMale\_labor\_participation |  |  | -0.00373 | -0.00354 |  |
|  |  |  | (0.00490) | (0.0164) |  |
| l2Male\_labor\_participation |  |  | 0.00465 | 0.000849 |  |
|  |  |  | (0.00319) | (0.00768) |  |
| l3Male\_labor\_participation |  |  | -0.00284 | -0.0115 |  |
|  |  |  | (0.00540) | (0.0175) |  |
| l4Male\_labor\_participation |  |  | 0.00459 | 0.0141 |  |
|  |  |  | (0.00821) | (0.0186) |  |
| Constant | 0.561\*\* | 1.131\*\*\* | 0.890 | 1.056\* | 0.530\*\*\* |
|  | (0.183) | (0.305) | (0.505) | (0.487) | (0.194) |
|  |  |  |  |  |  |
| Observations | 160 | 120 | 120 | 120 | 160 |
| R-squared | 0.697 | 0.674 | 0.672 | 0.678 |  |
| Number of country code | 10 | 10 | 10 | 10 | 10 |

Robust standard errors in parentheses

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

Measured with year effect

Figure A.2

Graphical user interface, text

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Figure A.3

Table

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Figure A.4

Table

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Figure A.5

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