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Does increased access to an in-home water supply increase female labor force participation rate?

I. Introduction

Women and girls worldwide spend on average 200 million hours each day collecting water.¹ This presents countries that lack widespread, in home access of water with many challenges. One of which is a large population of women who are essentially excluded from the labor force due to the burden of retrieving water daily. This consequence may have an effect on the labor force participation rate of females. Although it has been noted that female labor force participation rate is U-shaped (Goldin 1994)², if more households in a certain country have greater proximity to water, females should be more willing and able to participate in the labor force regardless of their respective countries GDP. By taking such a wide sample and comparing it over time, the effects of this hypothesis should be more clear and independent.

II. Sample

The sample will consist of all countries not included in the IMF's list of "High Income Countries". These countries will have few issues with water collection and therefore do

¹ Collecting water is often a colossal waste of time for women and girls. 29 August 2016.
https://www.unicef.org/media/media_92690.html

² Goldin, C. 1994 The U-Shaped Female Labor Force Function in Economic Development and Economic History. *National Bureau of Economic Research*. doi 10.3386/w4707.

not belong in the data set. The sample ended up being 76 countries because some were eliminated for lack of data.

III. Dependent Variable

Female Labor Force Participation Rate

The dependent variable will be female labor force participation rate. Female labor force participation rate is the calculation of the number of females over the age of 15 who participate in the labor force divided by the total number of females above the age of 15. This data will be taken from the International Labor Organization (ILO) for the years 1990 and 2015. For some of the countries that do not have a complete dataset, it will be estimated by the ILO's model. If the data is unavailable for the years 1990 and 2015, this will be estimated by using the years 1991 or 2014. The estimates are based mainly on nationally representative labor force surveys, with other sources (population censuses and nationally reported estimates) used only when no survey data are available.

Some issues in data collection may arise from the fact that the definition of labor force participation varies from country to country. In some countries, the agricultural sector makes up a large section of the economy, a lot of which takes place on family farms. It is common for women to work on these farms as well as other jobs around the house, which may be unpaid. Whether this counts towards participating in the labor force varies from country to country.

IV. Independent Variables

Percentage of households with water "piped on premises" (Piped)

Percentage of households with water piped on premises refers to the UNICEF metric, which means that a user has a "piped water connection located inside their dwelling, plot

or yard". For many underdeveloped countries water collection is a main daily task that takes on average 30 minutes a day but can be as many as several hours.³ Usually this burden falls on adult women as well as female children. This potentially limits female children's ability to go to school and reduces the probability of adult women having a job outside of their household. Therefore, access to water in home can have far reaching effects regarding women in the labor force. The data will be pulled from 1990 and 2015 and used to see if the change between these two years has a marginal effect on female labor force participation rate. Regardless of a countries' GDP, the hypothesis to be tested is that access to water in home should free women to participate in the labor force.

As noted in previous research, another aspect of this variable which pertains to its importance is that it had been noted that advances in technology in household chores has led to a long term increase in female labor force participation rate (Greenwood, Seshardi and Yorukoglu, 2005).⁴ Access to water within the house can be thought of as a technological advancement, thus freeing up women to participate in other jobs outside of the household.

Real GDP Per Capita (GDP)

GDP per capita will be used to measure how developed a country is. Although I have effectively eliminated the top 78 most developed countries, within the remaining countries there is still some stratification. As explained earlier, the labor force

³ How Long Does It Take to Get Water? For Aysha, Eight Hours a Day 1 November, 2016. <https://www.unicefusa.org/stories/how-long-does-it-take-get-water-aysha-eight-hours-day/30776>

⁴ Greenwood, J., Seshardi, A., & Yorukoglu, M., 2005. Engines of Liberation. *Review of Economic Studies*. 72, 109–133.

participation rate is u-shaped and detailed effectively in the research of Goldin for why this u-shape exists. Initially, when incomes are low, women work around the house or on family farms. Then when incomes rise more high wage jobs become available but an income effect outweighs the substitution effect so women exit the job market. However, if incomes rise to a certain level, women will be inclined to take a higher wage job as the substitution effect begins to outweigh the income effect. This is further explained by Goldin (1990)⁵ and Smith and Ward (1985)⁶, who attribute approximately half of the rise in labor force participation of married women to increases in women's market wage. However, this is in contrast with the research of (Pencavel 1998)⁷, who finds that very little of lifetime participation differences across cohorts can be explained by observed wage differences. Despite the differing underlying reasons, the u-shape presents a challenge for measuring an effect on labor force participation rate. Although the income effect may outweigh the substitution effect in the observed under-developed nations, the hypothesis should be independent of this metric.

Female Education Level (Education)

The education level of females will be determined by the Primary Completion Rate as % of Total in Age Group within each country. This data will be taken from the World Bank from the years 1990 and 2015 for comparison. If the data is unavailable for some countries in these years, the nearest available year, no more than five years away, will be used. UNESCO defines this metric as "Total number of new entrants in the last grade of

⁵ Goldin, C. (1990) *Understanding the Gender Gap*.

⁶ Smith, J. & Ward, M., 1985. Times Series Growth in the Female Labor Force. *Journal of Labor economics*, Vol 3. No 1 59-90.

⁷ Pencavel, J. 1998 The Market Work Behavior and Wages of Women: 1975-94. *Journal of Human Resources*, 33 4 771-804.

primary education, regardless of age, expressed as a percentage of the population of the theoretical entrance age to the last grade."

Education level is an important factor in the rate of labor force participation because of the nature of the u-shaped curve. Until the curve reaches the minimum, females in general are not well educated, and therefore the income effect dominates. However, when females begin to get more educated and attain higher overall levels of education, the substitution effect dominates and females tend to start participating in the labor force again. Therefore, the level of education of the population is shown to be associated with labor force participation rate.

A better measure would be one of tertiary education as that indicates a high education level and would show if a higher educated population has an effect. However most of these under developed countries have minimal participation in tertiary education so the data would not be significant.

Birth Rate Per Woman

The birth rate per woman will be used as a proxy for women's liberation in a country. The more children on average women in a country have, the more limited their ability is to participate in the labor force. Some countries, which have high birth rates, have effectively relegated a woman to be the care taker and little else. While a low birth rate on average symbolizes the ability for women to make their own decisions regarding reproductive rights. It also shows that a woman can have a work life outside of child

rearing. I hypothesize that an increase in birth rate will result in a decrease in the female labor force participation rate.

Muslim Majority

Each country will be evaluated if it is a country with a majority Muslim population. A list from the Pew Research Forum⁸ was used to identify the 49 Muslim-majority nations. A nation with a majority Muslim population could have a more traditional view of gender roles, in effect lowering the female labor force participation rate.

V. Summary Statistics

Correlation Matrix

	Piped	GDP Per Capita	Primary rate	Birth Rate	Muslim Majority
Piped	1.0000000				
GDP Per Capita	0.6933946	1.0000000			
Primary Rate	0.5961277	0.6016845	1.0000000		
Birth Rate	-0.7690567	-0.6653360	-0.7638930	1.0000000	
Muslim Majority	-.12201	-.1774325	.02851605	.1575782	1.0000000

Regression Results

$$\text{Formula} = \beta_0 + \beta_1 \text{Percentage of Households with piped water (Piped)} + \beta_2 \text{GDP} + \beta_3 \text{Education} + \beta_4 \text{Birth} + \beta_5 \text{Muslim Majority} + \varepsilon$$

⁸ The Future of The Global Muslim January 2011. <http://assets.pewresearch.org/wp-content/uploads/sites/11/2011/01/FutureGlobalMuslimPopulation-WebPDF-Feb10.pdf>

Variable	Coefficient	St. Error	P value	95% Confidence Interval	95% Confidence Interval
Piped	-0.3516	.101	.0009	-.5546	-.1486
GDP	.00112	.000	.023	.00016	.00209
Education	-.0398	.111	.720	-.2612	.1815
Birth	-5.056	2.64	.060	-10.338	.2246
Muslim Majority	-15.063	5.178	.005	-25.419	-4.707

Summary Statistics

R-Squared: .2933

Variable	Mean	Std Deviation	Max	Min
FLFPR	52.16	16.54	91.9	15.5
PIPED	64.714	30.91	100	3
GDP Per Capita	5991.76	5887.94	36350	98
Education	71.213	26.621	136.2	1.7
Birth	2.96	1.354	7.5	1.23
Muslim Majority	.19	.400	1	0

Percentage of households with water “piped on premises” (Piped)

This metric “Piped” was found to be statistically significant at the 99% level and implied that on average a 1 point increase in the percentage of people with water piped on premises would result in a .35 point decrease in the female labor force participation rate. This result is opposite of what was hypothesized. An explanation for this is that the multicollinearity among the independent variables giving large confidence intervals. While this variable does not have a negative to positive interval, it does have a wide interval making the value harder to pin down. Another alternate reason for this result could be a result of elite capture. This could explain why access to water would increase but not be related to the female labor force participation rate except in possibly an indirect way.

GDP Per Capita (GDP)

The GDP Per Capita was a statistically significant result which implied that a 1 dollar increase in GDP Per Capita on average resulted in a .00112 increase in the female labor force participation rate. It was significant at the 95% level and I fail to reject the null hypothesis. This result was also interesting because I hypothesized that it would decrease the participation rate.

Female Education Level (Education)

The regression showed this variable to be not statistically significant and therefore I fail to reject the null hypothesis. This is not as surprising and a regression was run without this variable. However it did not offer any other insights, mainly because the other results were statistically significant. The p-value is so high that the sign of the coefficient is of no significance to comment on.

Birth Rate Per Female

The Birth variable showed the most direct significance to the female labor force participation rate. The regression showed on average for an increase in 1 birth per female resulted in a 5 percent drop in the female labor force participation rate. The results were statistically significant at the 94% confidence level, narrowly missing the 95% level. This makes sense as women have more and more children to take care of they have fewer opportunities to get a job and participate in the labor force.

Muslim Majority

The Muslim majority variable was significant at the 99% confidence interval showing that a country with a Muslim majority population on average had a 15% lower female labor force participation rate than ones that did not. Caution should be exercised with interpreting this result as the standard error was quite large and the sample size of Muslim majority countries was limited to only 12. While this could truly have a large impact on female labor force participation rate, a larger sample size overall is needed.

VI Notes

There are some issues that should be addressed in trying to further identify why the hypothesis failed. Firstly, there are collinearity issues between all of the variables. Because the variables all correlate to increase in economic prosperity, this makes sense but results in large confidence intervals for all of the variables. The second issue is with data collection. The data comes from several sources and as a result of collecting data

from low-income countries many elements in the data set are left empty, leaving many countries out of the analysis. Out of 164 countries, the final data set was 62 observations. Finally, an alternate regression was run trying to account for elite capture. I used data from the Fund for Peace and their variable for “Factionalized Elite”. This variable accounts for resource distribution and separatist sentiment among the populace and government. However, a regression was run adding this variable into account but it yielded no significant results. Furthermore, there was no data from 1990 so only 30 observations were available which could explain the lack of significance.



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I, Michelle A. Phillips, the undergraduate honors thesis coordinator for the Economics Department (CLAS), certify that the thesis:

Title of thesis: Does increased access to an in-home water supply increase female labor force participation rate?

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Was approved by the Economics Undergraduate Thesis Committee on:

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Regards,

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