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# Gender and GDP Contributions: The Effects of Culture

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Elizabeth Graham graduated from UW Oshkosh in December 2007, with a B.B.A. degree in economics and a B.S. in political science. Her research paper began as a project for econometrics her junior year. Based on this preliminary work, Elizabeth received a Student/Faculty Collaborative Research Program grant to expand her project with the assistance of Dr. Marianne Johnson and Dr. M. Kevin McGee. Elizabeth plans to attend graduate school in economics.

Dr. Marianne Johnson is an associate professor of economics. She received her Ph.D. from Michigan State University, and taught for two years in Boston before coming to UW Oshkosh. Dr. M. Kevin McGee is a professor of economics. He received his Ph.D. from Ohio State University, and has taught at UW Oshkosh ever since. Both Drs. Johnson and McGee teach econometrics and regularly supervise student research projects.

## ***Abstract***

This paper uses Ordinary Least Squares regressions to examine the cultural, demographic, and geographical sources of differences in the Gross Domestic Product (GDP) contributions of women. These cultural variables include religion, level of female education, fertility, political representation, and the mean age of marriage. The results show that culture has considerable explanatory power for female labor force participation rates, the gender wage gap, and women's contributions to GDP. Surprisingly, fertility rates were not found to have any impact on women's contributions to GDP.

## ***Introduction***

In the United States today, women on average earn 78% of men's earnings. This disparity is present and consistently documented in almost every society in the world. There are many possible explanations for why women get paid less than men for essentially the same work. Through the use of several estimation models, this paper aims to discover what factors significantly contribute to this phenomenon around the world.

My theory is that culture has a large impact on women's pay as well as their decision whether or not to participate in the labor force. While demographic variables may have some impact on these issues of gender inequality, it is more likely that differences in traditional gender roles cause the majority of the variation in the dependent variables, *female labor force participation rates (FLFPR)*, women's wages relative to men's, and *women's labor share (WLS)*—a combination of the two. I used macro data to analyze international differences in women's contributions to the GDP from a sample of 137 countries from every region of the world.

## ***Literature Review***

Several studies highlight the relationship between cultural factors and women's market earnings. Blau and Kahn (1992) studied the characteristics of the labor market to establish their importance in determining gender wage gaps in eight countries. Their conclusion was that an industrialized country's wage structure is important in explaining international differences in the gender pay gap. This means that countries with centralized wage-determination systems, such as high minimum wage requirements, are likely to have smaller gender pay gaps, and therefore higher *WLS* (pp. 533, 538).

Differences in occupational choices may be related to the lower GDP contributions of women. To study this, Nabil and Gerhart (1991) examined the importance of the percentage of female employees in an industry. They tested whether that percentage was important in explaining the earning gap between men and women. They found no significant differences between women working in predominately male occupations and women working in predominately female occupations, suggesting that factors other than job choices affect *WLS*.

Divorce rates also impact women's economic roles. Ressler and Waters (2000) used a model estimated by a Two-Stage Least Squares procedure to determine the relationship between divorce and female income. The authors wanted to test Gary Becker's hypothesis, which states that rising female income over time may be partly responsible for increases in the divorce rate (p. 1889). Ultimately, Ressler and Waters' results do not support the existence of a single equation model but support two-way causality between female income and divorce. Two-way causality may also be present between *FLFPR* and female earnings as a percentage of men's.

Religious traditions almost certainly affect *WLS*. Lehrer's research (2004) titled "Religion as a Determinant of Economics and Demographic Behavior" studied the impact of religion on people's life choices, particularly marriage and gender roles, in the United States. Lehrer focused on mainline American religions, not including the Muslim community. She wrote that the religious affiliation of both spouses appeared to have an impact on their expected roles, and behavior. She found that some religions, namely the Mormon and Protestant faiths, have strict guidelines determining the social and economic roles of males and females (p. 713). Major religions have been included in this study to measure these effects in my study.

## ***Model***

Based on the studies reviewed in the previous section, I constructed the following model. This model, unlike the study done by Blau and Kahn (1992), which focused on the female to male earnings ratio, studied the combined effects of differences in earnings on the basis of gender and *FLFPR*. I combined these variables to arrive at a model that allowed me to measure female GDP contributions, a dependent variable I labeled *Women's Labor Share (WLS)*.

Assume a Cobb Douglas production function for a domestic economy. The parameters on the Cobb Douglas function are the relative weights assigned to labor or capital in the production process.

$$Q = AK^m L_1^{\alpha_1} L_2^{\alpha_2} \dots L_n^{\alpha_n}, \quad m + \sum \alpha_i = 1,$$

where  $L_i$  is the  $i$ th worker's labor,  $P$  is price,  $Q$  is quantity, and  $K$  is capital. Then if worker  $i$  is paid his or her marginal product,  $W_i = P \frac{\partial Q}{\partial L_i} = \alpha_i \frac{PQ}{L_i}$ , from this, I can calculate

total women's income,  $Y_F$ , as  $Y_F = \sum^F L_i W_i = PQ \sum^F \alpha_i$ . Therefore, women's labor

share of total production  $\left( \frac{\sum^F \alpha_i}{\sum^{F+M} \alpha_i} \right)$  equals their share of total income,  $Y_F/PQ = Y_F/GDP$ .

Similarly, men's labor share is calculated as  $Y_M/GDP$ .

For the purposes of this research, I wanted to measure women's labor share as a fraction of the total labor share of production,  $WLS$ :  $WLS = \frac{\sum^F \alpha_i}{\sum^{F+M} \alpha_i}$ .

By the above analysis, this will equal  $Y_F/(Y_F + Y_M)$ . I used a measurement of mean labor income for women and men, which can be calculated as

$$WLS = \left[ \frac{y_F n_F}{\bar{y}_F n_F + \bar{y}_M n_M} \right].$$

From this, I developed an econometric model that looks at several important variables associated with  $WLS$ ,  $WLS = \alpha + \beta_0 x_0 + \beta_1 x_1 + \beta_2 x_2$ , where  $x_1$  is a vector of demographic/geographic variables and  $X_2$  is a vector of cultural variables.

### **Data and Variables**

The purpose of this study is to uncover what contributes to the varying levels of women's share of GDP around the globe. To examine this, I included several explanatory variables in the study. The data collected are from 137 countries, the largest sample possible considering the availability of data from the OECD and World Bank. Most of the data are from 2004. Again, for instances where data are not available for 2004, the most recent entry is used.

The percentage of the population living in urban areas, or *urban*, may help to explain the structure of the economy. A country with low percentages of people in urban areas is likely to be highly agricultural and thus have a lower overall GDP. Also, more rural countries may have different views about appropriate roles for women than their more urban counterparts.

The percentage of the population that is female, or *female population*, may contribute to the study. If there is a significantly high female population in a country, women's roles may be forced to change. For example, if a war reduced the number of young men in a country, there may be an increase in the number of women without providers or an increase in unmarried women. In either case, women would be forced to enter the workplace to provide for themselves and their families when otherwise they would have chosen not to participate in the labor force.

*Per-capita GDP* is measured in U.S. dollars and adjusted for purchasing power parity. It estimates the level of poverty in a country by measuring economic development. I was interested to learn whether there was any relationship between it and gender equality.

Beyond geographic and demographic factors, there are significant differences in the opportunities of women around the world. I expected varying cultural attitudes to have an impact on women's opportunities because these attitudes reduce women's

desires and opportunities to work outside the home and, therefore, contribute to GDP. To this end, I included a number of variables designed to capture aspects of culture. *Mean age of marriage* measures the average age at which women marry in a country. This variable is intended to measure the impact of different cultural attitudes toward marriage and women's ability to earn income. I hypothesized that in countries where the mean marriage age is higher, women will have more educational and vocational opportunities than their counterparts in countries where women marry comparatively younger. *Fertility rates* are the average number of children born to a woman in a particular country. It seems intuitive that as this number gets higher, the increased domestic burden will make it more difficult for women to work outside the home.

Also included in the study is a ratio measuring women's educational opportunities compared to men's. This ratio, simply called *education*, measures the combined gross enrollment of primary, secondary, and tertiary schools of women as a percentage of men. Due to the differences in levels of education received by citizens around the world and the fact that, in many countries, women are given fewer educational opportunities than men, a ratio is the best way to characterize these data. Also, a higher ratio indicates a country's willingness to invest in women and, therefore, their value in society.

The percentage of parliamentary seats held by women, or *female parliament*, may reflect women in positions of power in a country. In countries where few women are given the opportunity to participate in politics, it seems likely that few women will be company managers, academics, or company owners; thus, women's employment opportunities will be limited. Finally, the year in which women received the right to vote, called *vote*, measures how recently the women's rights movement occurred in a country. The longer women have had the right to vote, the less resistant the public will be to many aspects of gender equality. It follows that these counties will have higher levels of female labor force participation and more equal wage distribution than in countries where women received the right to vote only recently.

**Table 1**  
**Summary Statistics\***

VARIABLE	OBS.	MEAN	STD. DEV.	MIN	MAX
Mean Age of Marriage	137	23.56	3.17	18.00	33.0
Fertility Rates	137	3.09	1.72	1.10	7.8
Education	137	0.97	0.13	0.57	1.3
Female Parliament (%)	137	16.49	10.11	0.00	48.8
Vote	137	1949	21.87	1893	None
Female Population (%)	137	50.29	1.84	39.6	54.3
Urban (%)	137	55.44	23.24	10.0	98.3
Per-Capita GDP (US \$)	137	\$10,580.00	\$11,663.00	\$561.0	\$69,961.0
WLS	137	27.51	9.77	3.42	45.4
FLFPR	137	58.21	14.88	18.47	92.8
RATIO FEMALE TO MALE MEAN INCOME	137	0.53	0.14	0.15	0.8

\*N=137

Table 1 summarizes the independent variables used to examine GDP contributions and gender. *Fertility rates* vary considerably from country to country, with a range of 1.1 to 7.8 children per woman. It is interesting to note that *female population*, which would be expected to remain steady at about 50%, actually ranges from 39.6% in Kuwait to 54.3% in Estonia. Also, it is surprising that the mean year in which women received the *vote* was as recent as 1949, with one country, Saudi Arabia, still not allowing women to vote. A dependent variable in this study, *WLS*, is explained in the previous section. The other dependent variables, *FLFPR* and the *ratio of female to male mean income*, are summarized in Table 1. Interestingly, women get no closer to equal pay than 83 cents for every dollar men earn for comparable work. Also, I was surprised to see the wide range in *FLFPR*; they range from approximately 18.5% in Saudi Arabia to nearly 93% in Burundi.

To control for the impact of region on *WLS*, I used dummy variables that divided the world by continent and identified countries by religion. Religion, intuitively, plays a large role in determining women's roles and responsibilities. As Lehrer (2004) found in her study of religion and demographic behavior, in countries where strict adherence to religious teachings is widespread, families are more likely to be structured traditionally, with men working to support the family while women work in the home and raise the family (pp. 712-714). To measure any possible impact religion may have, dummy variables were created to separate countries based on their religious majority and largest religious minority. In this way, any differences in the roles and expectations of women based on different religious teachings can be appropriately measured. Also, the interaction term *Muslim vote*, the year in which Muslim countries gave women the right to vote, was included in the analysis.

## **Results**

### **Women's Labor Share OLS**

The results of the OLS model are illustrated in the following table. The explanatory variables *urban*, *female population*, *education*, *mean age of marriage*, and *female parliament* were all statistically significant. In addition to these, the dummy variables for Latin America, Muslim, Hindu, Protestant minority, Evangelical minority, and Orthodox minority were also statistically significant. The interaction term *Muslim vote*, the year in which Muslim countries gave women the right to vote, was statistically significant. The variable *vote* on its own, however, was less significant. This OLS model has an adjusted R-squared of 0.6091. In other words, this model explains approximately 61% of the variation in *WLS*.

**Table 2**  
**OLS Regression Result: Dependent Variable WLS\***

WOMEN'S LABOR SHARE (WLS)	COEFFICIENT	STD. ERROR	t	P>  t
Urban	-0.4240	0.1230	-3.44	0.001
Urban squared	0.0036	0.0010	3.24	0.002
Female Population	-13.2580	6.9350	-1.91	0.058
Female Population squared	0.1506	0.0717	2.10	0.038
Fertility Rate	0.6657	0.6173	1.08	0.283
Per-Capita GDP	0.0001	0.0001	1.24	0.218
Mean Age Marriage	-11.1511	2.3607	-4.72	0.000
Mean Age Marriage squared	0.2091	0.0464	4.50	0.000
Education	21.0067	7.1807	2.93	0.004
Female Parliament	0.2302	0.0641	3.59	0.000
Muslim	-13.9298	3.6055	-3.86	0.000
Hindu	-11.5862	2.7506	-3.09	0.002
Minority Orthodox	5.4708	2.9225	1.87	0.064
Minority Evangelical	-7.0620	3.4014	-2.08	0.040
Minority Protestant	6.5141	2.1836	2.98	0.003
Latin America	-7.8499	2.0362	-3.86	0.000
Muslim Vote	-0.1377	0.0605	-2.28	0.024
Constant	443.5923	171.6501	2.58	0.011

\*N=137

When I examined some of the estimated coefficients more carefully, I found that the percentage of the population living in urban areas is statistically significant when describing changes in *WLS*. I found a nonlinear relationship between *WLS* and the percentage of the population living in urban areas. *WLS* decreases 0.42% for each 1% increase in the urban population until the urban population reaches 59.3%. As the percentage of the population living in urban areas moves from 59.3% to 100%, *WLS* increases 0.004% for each 1% increase in urban population.

I found a similar relationship for the percentage of the population that is female. As the female population approaches 44.2%, *WLS* decreases 13.26% for each 1% increase in female population. As the statistically significant variable female population increases by 1% after the minimum, *WLS* increases 0.15% for each 1% increase in female population.

Also, significant and nonlinear is the mean age of women at the time they are married. As the age of marriage reaches 26.6 years, *WLS* decreases 11% for every one-year increase in the *mean age of marriage*. After the age 26.6, *WLS* increases by about 0.21% for each year increase in age. *Education* also has a significant impact on *WLS*. For every 1% increase in the number of women enrolled in primary, secondary, or tertiary schools compared to men, *WLS* goes up 2.1%. As the percentage of parliamentary seats held by women increases by one, *WLS* goes up 0.23%, which is also statistically significant.

Several religious dummy variables were statistically significant, holding all other factors constant. Women in Islamic and Hindu countries have a *WLS* that is almost 14% and 11.6% lower than their non-Muslim, non-Hindu counterparts respectively. Also, countries with large Orthodox Christian and Protestant minorities had *WLS* that were about 5.5% and 6.5% higher, respectively, than other countries. A strong minority Evangelical population was significantly tied to a *WLS* that was 7% lower than average.

Latin America, which consists of Central and South America, is the only geographical region with statistically significant differences in *WLS*. Latin American women experience *WLS* rates that are 7.84% lower than average; all else held constant. Finally, in Muslim countries, the longer women have had the right to vote, the higher the *WLS*. For each additional year with the right to vote, the *WLS* increased 0.14%.

Surprisingly, *fertility rates* and *per-capita GDP* were not statistically significant in any specifications of the model. While many of these results are consistent with our expectations, I more carefully examined the relationship between the cultural variables and women's contributions to GDP. In particular, I wanted to examine separately which variables are important in determining women's choices to participate in the labor force, and which variables are important for explaining *WLS*.

### **Female Labor Force Participation Rate (FLFPR) OLS**

I was interested to see if regressions of the variables used to calculate *WLS*, *FLFPR*, and the ratio of *female/male mean income* would yield similar results. The variables included in the following regression of *FLFPR* were the same as those for the *WLS* OLS model.

This model has an adjusted R-squared of approximately 55%. In other words, this model explains about 55% of the variation in *FLFPR*. The results appear in Table 3.



**Table 3**  
**OLS Regression Results: Dependent Variable FLFPR\***

FEMALE LABOR FORCE PARTICIPATION RATE	COEFFICIENT	STD. ERROR	t	P>  t
Urban	-0.5647	0.201	-2.80	0.006
Urban <sup>2</sup>	0.0043	0.001	2.41	0.017
Female Population	-22.9227	11.337	-2.02	0.045
Female Population <sup>2</sup>	0.2526	0.117	2.16	0.033
Fertility Rate	2.5855	1.009	2.56	0.012
Per-Capita GDP	0.0003	0.000	2.03	0.044
Mean Age Marriage	-15.8729	3.839	-4.11	0.000
Mean Age Marriage <sup>2</sup>	0.2975	0.076	3.92	0.000
Education	28.1978	11.738	2.40	0.018
Female Parliament	0.4065	0.105	3.88	0.000
Muslim	-17.8418	5.894	-3.03	0.003
Hindu	-15.5734	6.131	-2.54	0.012
Minority Orthodox	9.6939	4.777	2.03	0.045
Minority Evangelical	-12.9641	5.560	-2.33	0.021
Minority Protestant	10.0249	3.569	2.81	0.006
Latin America	-6.1815	3.328	-1.86	0.066
Muslim Vote	-.1618	.099	-1.64	0.104
Constant	751.172	280.595	2.68	0.008

\*N=137

The results of this OLS model are very similar to the previous results. All the variables that were significant in the model examining the dependent variable *WLS* are significant here. The only exception is that the dummy variable for Latin America is no longer significant at a 95% confidence level, but at a 90% level. *Muslim vote* also significantly decreased.

In this model, unlike the *WLS* model, *fertility rates* and *per-capita GDP* rates are both statistically significant. While *fertility rate* does not directly impact *WLS*, it does affect it indirectly by influencing women's choices to enter the labor market, though I am surprised to find that a higher *fertility rate* increases the likelihood of female participation in the labor market. As a country's *fertility rate* increases by one (one additional child is born to each woman), the *FLFPR* increases by 2.59%. Also, as per-capita GDP increases by 1%, *FLFPR* increase by .0003%. Thus, in higher income countries, women are more likely to participate in the labor force.

## Mean Earned Income Ratio OLS

The final OLS model examines the ratio of female/male mean income. I wanted to determine if there are any significant differences in the variables explaining relationships of *FLFPR*, the *mean earned income ratio*, and *WLS*. This model initially included the same explanatory variables as the previous two models, but, due to statistical insignificance, some variables had to be removed from this OLS model.

This model has an adjusted R-squared of approximately 59%; it explains nearly 59% of the variation in the differences between female and male mean earned incomes.

**Table 4**  
***OLS Regression Results, Dependent Variable Female/Male Mean Income\****

RATIO FEMALE/MALE MEAN EARNED INCOME	COEFFICIENT	STD. ERROR	t	P>  t
Urban	-0.0078	0.002	-4.33	0.000
Urban <sup>2</sup>	0.0001	0.000	4.30	0.000
Female Population	0.0149	0.007	2.28	0.024
Mean Age Marriage	-0.1784	0.034	-5.21	0.000
Mean Age Marriage <sup>2</sup>	0.0034	0.001	5.00	0.000
Education	0.2941	0.091	3.23	0.002
Female Parliament	0.0032	0.001	3.46	0.001
Muslim	-0.2018	0.052	-3.88	0.000
Hindu	-0.1788	0.056	-3.21	0.002
Minority Orthodox	0.0700	0.044	1.62	0.108
Minority Evangelical	-0.0762	0.051	-1.50	0.136
Minority Protestant	0.0970	0.033	2.96	0.004
Latin America	-0.1420	0.029	-4.90	0.000
Muslim Vote	-0.0020	0.001	-2.19	0.030
Constant	1.9710	0.517	3.81	0.000

\*N=137

Several statistically significant differences exist in this model compared to the previous two models. *Per-capita GDP* and *fertility rate* are not significant in the mean earned income ratio model, which is consistent with the *WLS* model but unlike the *FLFPR* model. These variables operate directly on participation rates but not on income earned or overall *WLS*.

Also no longer statistically significant were the religious dummy variables measuring minority Christian Orthodox and minority Evangelical populations. Finally, the female percentage of the population was linearly related to the female/male earnings ratio, instead of non linear as in the case for *FLFPR* and *WLS*.

## ***Discussion of Findings and Conclusion***

It is particularly interesting to speculate about why *fertility rate* is not statistically significant in two of the three models used in this study. This may be because some of the explanatory variables, such as mean age of marriage and

education, are also, in part, measuring the same thing; women are less likely to enter the workforce if they marry young and/or have little education. Although these variables were significant, collinearity between these variables may contribute to a lower significance level than expected. *Fertility rate* appears to be positively related to *WLS* and, therefore, female GDP contributions. This seems counterintuitive but may be because, as women have more children, the family needs more income.

After careful analysis, I found that explanatory variables measuring cultural differences were the most significant independent variables included in the study. Demographic/geographic indicators are still important, but according to this research, culture plays a larger part in determining the social and economic opportunities for women.

While the gender wage gap and *FLFPR* tell important stories on their own, I was particularly interested in seeing the combined effects of the variations in these variables. It turns out that there is little difference in the significance of explanatory variables when *FLFPR* and female/male income are studied apart or when combined to form *WLS*. This is good news for countries interested in creating more equitable employment opportunities. Any efforts they make may have an impact on both wage discrimination and levels of female labor force participation.

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