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Women in Labor Market: The Effect of Years of Schooling on Labor Force Participation in the Service, Industrial, and Agricultural Sectors across Countries

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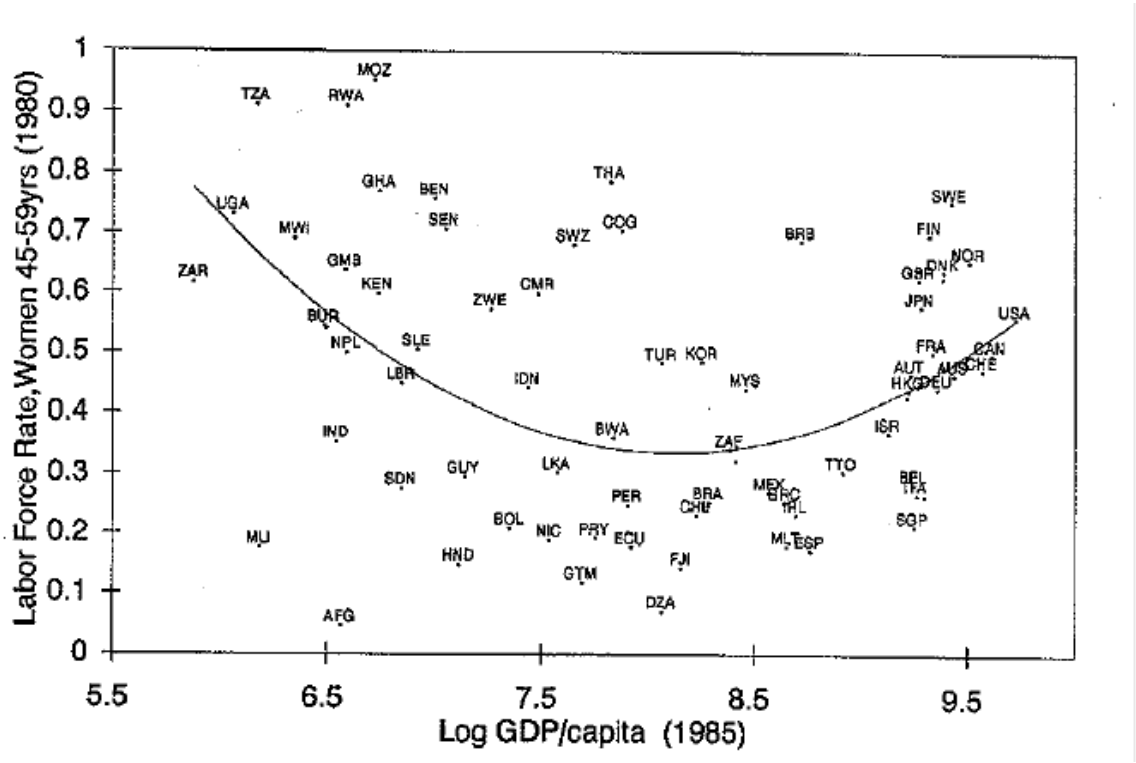
I. Introduction

It is widely accepted that women's education is a key factor in increasing a country's involvement in the global economy and thus, stimulating economic growth. Women account for 49.6% of the world's population. In developing societies, wherein social stigma and prejudice often strictly dictate the actions of women, we see very low labor force participation rates. In these cases, in which women do not work, men are left with the financial burden and responsibility for women, children and the elderly. Claudia Goldin showed us that as countries develop economically, there is a U-Shaped curve along which women's labor force participation rate follows. As a country develops and industry increases rapidly, women work less. They move from agricultural and familial work in rural areas to urban areas in which they have no useful skill or knowledge. Thus, they are mostly removed from the economy in any way that can be measured monetarily. However, after a certain point of development, education among men increases followed slowly by the education of women. As this occurs, women become more better educated and gain skills that can be applied in the workplace. Typically, when women's education approaches that of men in society, women are allowed access to service jobs. The relationship between economic growth and labor force participation rate of women is displayed below.



Source: Goldin, Claudia. 1995. "The U-Shaped Female Labor Force Function in Economic Development and Economic History." *Investment in Women's Human Capital*, pp. 61-90. Chicago: University of Chicago Press.

When women are educated and valued in an economy with proper wages and workers' rights, capital and production increase, resulting in greater GDP per capita and better standards of living. Despite the immense empirical evidence defending women's importance to the economy, many developing nations deliberately keep women uneducated and out of the workforce. Some of the countries that do offer women's education only allow the wealthiest women to be educated and continue to limit their involvement in the labor market, prioritizing their role in the household. This paper seeks to evaluate how these changes in a nations social structures might be affecting the U-Shaped curve predicted by Claudia Goldin in her 1995 paper *The U-Shaped Female Labor Force Function in Economic Development and Economic History.* This paper establishes that a U-Shaped curve still exists, creating a polynomial relationship between women's labor force participation and development, however, more countries are clustered at the middle of the curve which suggests that countries are becoming more developed, but women's participation in the labor force is decreasing consistently among countries that have fewer women's rights. The curve has thus become steeper than earlier predicted.

This study only evaluated these variables across 20 countries, representing little more than 10% of the world. For this reason, it cannot be concluded that the trend found among these countries is consistent with the world trend, however, the implications of this trend are varied.

II. Literature Review

The research described below forms the theoretical basis on which my research is based. Claudia Goldin's work is one of the most prominent and widely cited study in gender labor economics because she was the first to establish the relationship between economic development and women's labor force participation over time, owing the trend between these variables to the improvement of education over time as a country develops economically. I expand upon Goldin's claims, replacing GDP per capita with CO2 emissions in metric tons per capita as an indicator of economic growth. This substitution is supported by the research by Simon Kuznets and his Environmental Kuznets Curve. The curve indicates that as per capita income increases, so does environmental damage and pollutants. In my research, I am combining both Goldin and Kuznets's theories by using CO2 as an indicator of economic growth. My hypothesis is that when analyzing the statistical relationships between women's labor force participation, education, and carbon dioxide emissions, I will find a similar U-Shaped curve to that of Claudia Goldin.

a. Theoretical Framework

"The Role of Women's Education in the Modern Nation-State" by Michael Hirsch, Castillo, and Price (2018) is a qualitative analysis of the theoretical basis on which my paper and many others are founded. This article discusses the impact of women's education on a nation's ability to compete in the global market. This article primarily provides evidence of the theoretical framework underpinning my research; women's education impact on women's work force participation.

Globally, women make up 40% of the workforce while only representing 1% of ownership of wealth. Social scientists agree that education is a driving force of economic development, because knowledge improves skill and one's ability to contribute to the labor force. It has also

been determined that a lack of women's rights typically correlates to low GDP per capita. Despite the empirical evidence supporting the value of women in the workforce, many countries seeking to industrialize have stagnantly low or even declining rates of women in the workforce. This could be due to many factors including social progress, political ideology, and the expectation of short-term return to investment. Elaborating on the latter, improving women's education and encouraging those educated women to join the labor force can be difficult due to the amount of time and investment required to close the existing gender gaps. Nevertheless, the advantages far outweigh the short-term cost, if only authorities within those countries are willing to properly address existing disparities and social conflicts.

This paper articulates many of the reasons I believe education is a useful endogenous variable in my analysis; the positive impacts of education, in my opinion, are essential to changing a society's outlook and value of women. When women are better educated and literate, they are likely to have children later in life and have fewer children, which makes both women and children healthier. As women become educated and decrease fertility rates, infant mortality decreases, maternal mortality increases, life expectancy increases, democracy or public choices increase, crimes rates and violence decrease, and ultimately barriers to education begin to disappear. All of these factors are important and must be considered when determining which control variables are most important to determining a causal relationship between gender ideology and women's labor force participation.

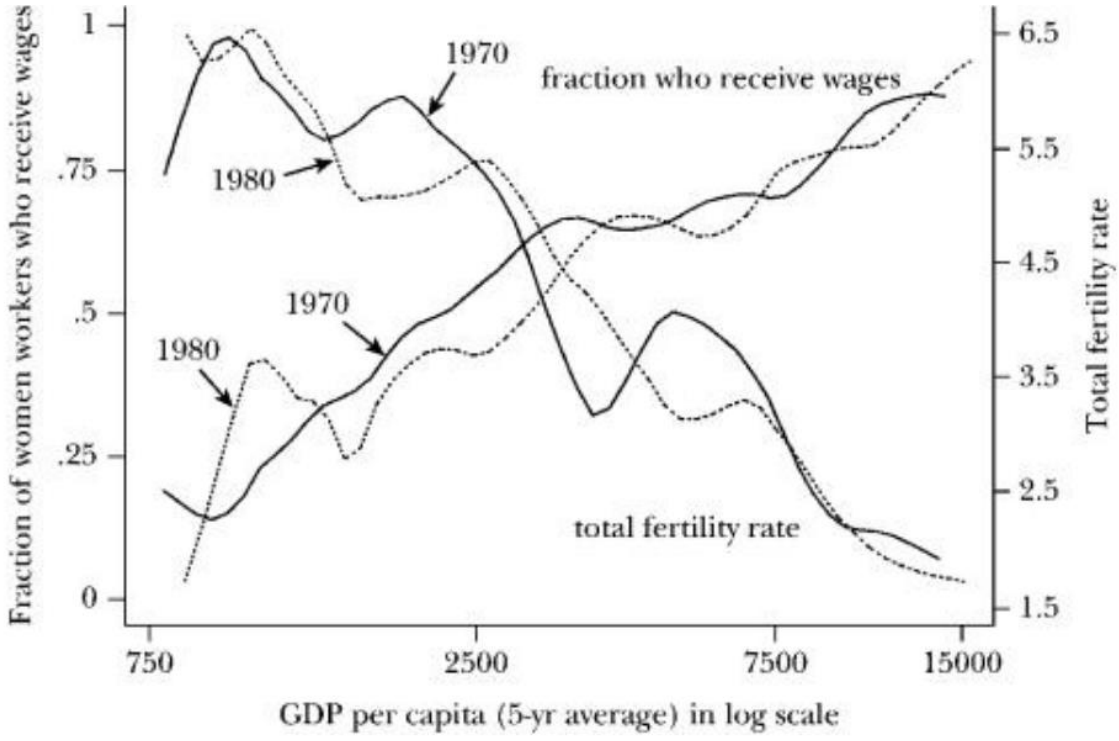
One of the most widely referenced studies that address not only the effects of women's increased labor force participation, but also address the process through which women must endure to be allowed entry to the work force in a developing country includes Claudia Goldin's study on "The U-Shaped Female Labor Force Function in Economic Development and Economic History." Goldin's 1994 study established a pattern for women's labor force participation across developing countries; she found that women's labor follows a U-shaped function as a country goes from completely undeveloped to completely industrialized. She established that when a country is primarily agricultural, women's labor force participation is significant, though often unpaid. At this point women perform agricultural labor, family work, and produce home-made goods for family enterprises. While they are typically unpaid, their work is valued and an integral part of the family work dynamic, as most people don't work to make a profit in an underdeveloped economy. As a country becomes more industrialized, women's labor force participation initially falls, somewhat drastically, as families move to cities. This is due to the nature of the work in newly industrialized nations. Labor in factories, or blue-collar work, becomes the most readily available job in the market. Men occupy the majority of these jobs. They typically do not pay well and thus the cost of a woman leaving her home and children during the day to earn minimal wages outweighs the benefit of those wages. Furthermore, home produced goods lose value in comparison to rapidly, mass produced products that are subsequently cheaper and readily available. Thus, women remain in the home, either by choice or by force through social norms and stigmas.

However, as industrialization continues, education becomes more widespread and easier to access and revenue and resources are generated; education becomes less of a luxury and thus more readily accessible to women. Women's average level of education is typically slow to increase, however, with each generation, the average level of education will rise (Schultz, 1988). As this happens, women gain skills that are applicable to jobs in an office and are able to

participate in the workforce more often, as white-collar workers such as secretaries and clerical workers, so long as the stigma to women working reduces accordingly. This work is widely cited and serves as a basis for further research in the field of women's labor force participation and their impact on GDP. It is significant because prior to this, it was unclear the exact trajectory of women's labor force participation, why this happens, and how their participation in the work force contributed to the per capita GDP and industrialization efforts of a nation.

b. Cross-country trends that account for varying levels of economic development

A study by Kristin Mammen and Christina Paxson from Princeton University called, "Women's Work and Economic Development," (2000) expands upon Goldin's work and looks at gender gaps in wage, controlling for education and labor market experience as well as how the rights of women in these countries effect access to credit and ownership. Mammen and Paxson are attempting to determine a causal relationship between factors effecting women's labor force participation and whether participation in the labor market is a cause or an effect of societal changes like wage, opportunity, education, and experience. This paper specifically evaluates women's ability to work outside of the home or family enterprise, their ability to receive wages or paid employment, and the legal restrictions to which opportunities they have available (Mammen and Paxson, 141).



Source: Kristin Mammen and Christina Paxson. "Women's Work and Economic Development." *Journal of Economic Perspectives*, The American Economic Association, 2000, pp. 141-164. https://www.aeaweb.org/articles?id=10.1257/jep.14.4.141.

Some of the biggest factors for women deciding to work outside of the home or not include social norms and tastes among women against working blue-collar jobs, stigmas against the husbands of women who work blue-collar jobs, and the opportunity cost of earning a wage while

working outside of the home. The graph displayed above shows the theoretical relationship between a woman's fertility rate and increased wages. Mammen and Paxson theorize that women's ability to produce children is a normal good, thus as wages increase the demand for children increases as well according the income effect while simultaneously decreasing demand to an increased opportunity cost of a woman's time. They claim that if demand primarily decreases due to opportunity cost, then increased wages contributes to fertility decline, however causality could not be determined.

While the hypotheses and theories vary between countries and economist, ultimately, we know that women are less likely to work blue-collar industrial jobs, especially when years of schooling and quality education are below that of men, making wages low (Goldin, 70). When wages are low, women have to compare the "unearned" wages they gain from their working husbands to the cost of travel and paying for childcare to work outside the home, potentially making no profit at all due to low wages (Mammen, Paxson, 143). As such, decreasing fertility rates often signal an increase in labor force participation among women, though no causal relationship has been determined. It remains clear, however, that fewer children in the home would reduce the cost of working outside the home. This paper articulates a good deal of factors and theoretical basis that will be discussed later in this paper, regarding the results of the data. Much of this paper, like many of the literature in this field, is based on and frequently references the work of Claudia Goldin (1995).

While the study was unable to determine a causal relationship, the analysis of data from 90 countries resulted in a strong correlation between rising GDP and Average years of schooling among women. Mammen and Paxson explained that this is due to the fact that education is a "((normal) consumer good, more of which is demanded at higher income levels, and a productive asset which results in higher income" (Mammen &Paxson, 146). Besamusca, Tijdens, Keune, and Steinmetz in the Netherlands sought to evaluate similar factors of women's labor force participation rates in "Working Women Worldwide. Age Effects in Female Labor Force Participation in 117 Countries," (2015).

This more recent article seeks to understand the disparities between women's workforce participation in the World Bank Commission on Growth and Development 2008 report by evaluating survey data regarding religious ideology and the effects of discriminatory legislation on workforce participation. In an attempt to understand the differences in industrialized v. developing nations within the report, they evaluate common characteristics within 117 countries at different levels of development to understand to determine a correlation between these factors and aggregate female labor force participation. The authors of this study ran a runmlwin package in Stata to first determine a model of female labor force participation rate by age across 117 countries. Then, they used the runmlwin package to predict the relationship between age and other economic conditions such as per capita GDP, type of labor, family factors, and gender ideologies like religion and non-discrimination policies (2015).

They concluded that anti-discrimination legislation is associated with lower labor force participation, however the biggest negative correlation between age of women in the labor force was religion generally and Islam specifically. The effects of religious ideology were focused on women of childbearing age and was associated with a decrease in labor force participation. As a result, they concluded that addressing social conservatism and religion in a country can impact

women's participation in the labor force with the greatest potential improvement among women. The most interesting conclusion found regards the effect of education on female participation in the workforce, and whether the education is stratifying the existing ideologies within that country or aligning with global views which tend to be more progressive.

c. Case studies regarding relationships between internal ideologies and female labor force participation rates

A perfect example of how these socio-cultural ideologies can subsequently and causally affect their economy is seen in Yasemin Dildar's study (2015) on female labor force participation in Turkey, a country with abnormally low and decreasing labor participation rates among OECD countries. It is explained, however, that Turkey's ideology fits more closely with that of highly conservative patriarchal societies that exist nearby in the "patriarchy belt" of Northern Africa and the Middle East.

In the context of the social and structural change occurring in Turkey, this paper analyzes the effect of social conservatism on women's labor force participation. They used a labor supply model, controlling for endogeneity, and a probit regression analysis based on data from Turkey Demographic and Health Surveys (TDHS) to find that patriarchal norms and religiosity relate negatively to women's labor force participation. The author was unable to determine causality due to endogeneity factors; it is unclear if an increase in women's labor force participation is a result of progressive attitudes and social liberalism or if social liberalism is a result of an increase in women's labor force participation.

Shown below, it is clear that Dildar's variables rely heavily upon survey data that is typically self-reported. Most of her variables, even schooling, showed a negative relationship with women's labor force participation, which is contrary to current theory

Table 5. *Probit regression results: urban versus rural*

	Labor force participation			
	(1) URBAN	(2) URBAN	(1) RURAL	(2) RURAL
Patriarchy	−0.155***	−0.162***	−0.0394	−0.0603
	(0.033)	(0.033)	(0.055)	(0.054)
Religiosity	−0.0821**	−0.0796**	0.0389	0.0324
	(0.039)	(0.039)	(0.078)	(0.077)
Age	0.0441***	0.0447***	0.0513***	0.0514***
	(0.006)	(0.006)	(0.010)	(0.010)
Age squared	−0.000613***	−0.000622***	−0.000638***	−0.000645***
	(0.000)	(0.000)	(0.000)	(0.000)
Schooling	0.0365***	0.0348***	0.0672***	0.0586***
	(0.009)	(0.009)	(0.020)	(0.020)
Schooling squared	−0.00787***	−0.00771***	−0.0180***	−0.0170***
	(0.002)	(0.002)	(0.005)	(0.005)
Schooling cubed	0.000522***	0.000516***	0.00110***	0.00106***
	(0.000)	(0.000)	(0.000)	(0.000)
Number of children under 5	−0.0736***	−0.0730***	−0.0316**	−0.0289**
	(0.010)	(0.010)	(0.013)	(0.013)
Household size	0.000145	0.000167	0.00891**	0.0121***
	(0.004)	(0.004)	(0.004)	(0.004)
Wealth Quintile 2	−0.0341	−0.0285	−0.0713***	−0.0693***
	(0.024)	(0.024)	(0.026)	(0.026)
Wealth Quintile 3	−0.0855***	−0.0788***	−0.130***	−0.124***
	(0.023)	(0.024)	(0.033)	(0.033)
Wealth Quintile 4	−0.111***	−0.104***	−0.170***	−0.171***
	(0.023)	(0.023)	(0.043)	(0.043)
Wealth Quintile 5	−0.146***	−0.141***	−0.222***	−0.231***
	(0.022)	(0.023)	(0.068)	(0.066)
Husband's schooling	−0.00497**	−0.00461**	−0.00408	−0.0035
	(0.002)	(0.002)	(0.004)	(0.004)
Mother's education	0.0114***	0.0113***	0.00940*	0.00839*
	(0.002)	(0.002)	(0.005)	(0.005)
Migration	−0.00352	−0.00404	−0.0459	−0.0437
	(0.013)	(0.013)	(0.032)	(0.032)
West Marmara	0.0272	0.00176	0.0518	0.0135
	(0.031)	(0.034)	(0.096)	(0.100)
Aegean	0.0831***	0.0657**	0.212**	0.194**
	(0.030)	(0.031)	(0.089)	(0.093)
East Marmara	0.0841***	0.127***	0.200**	0.296***
	(0.028)	(0.038)	(0.091)	(0.085)
West Anatolia	−0.0875***	−0.0675**	−0.125	−0.0179
	(0.024)	(0.029)	(0.089)	(0.099)
Mediterranean	−0.0314	−0.0201	−0.00887	0.141
	(0.024)	(0.036)	(0.089)	(0.095)
Central Anatolia	−0.0812***	−0.0727**	−0.0199	0.0316
	(0.025)	(0.031)	(0.093)	(0.095)
West Black Sea	0.0931***	0.132***	0.0662	0.163

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Dildar explains that religiosity and patriarchy create a sort of income effect among women, especially those that belong to the wealthier class of Turkish society. Women have access to education and wealthy women tend to pursue high levels of education but lack the financial incentive to join the labor force. In the chart below, it is evident that Turkish women with a university degree or higher make up the greater portion of women's labor force participation rate annually, while men who are completely illiterate retain high levels of employment. This indicates that women are either not valued in the workplace or see little incentive to participate.

Table 2. *Labor force participation rates by year and education level Source: TURKSTAT, Household Labor Force Statistics*

	1988		1995		2002		2013	
	M	F	M	F	M	F	M	F
Illiterate	70.5	32.3	62.5	28.4	48.1	24.4	33.8	17.4
Literate but no school completed	76.3	31.7	67.6	25	48.5	22.4	58.2	20.8
Primary school	88.9	34.3	86	31.8	78.8	26.7	73.3	29.5
Junior high school or vocational school	61.4	19.5	59	15.9	68.4	18.4	79.8	27.5
High school	75.5	45.7	73.4	34.9	64.6	28.5	70.1	32.1
Vocational school at high school level	82.8	52.5	80.9	46.4	77.7	39	81.3	39.3
University and other higher education	89.5	82.5	88	73.8	84.5	71.5	86.1	72.2

One of the biggest flaws of this paper, which is addressed briefly, is that while Turkey does have one of the lowest female workforce participation rates amongst OECD countries, they also have one of the lowest GDP per capita among OECD countries (Dildar, 42). The paper also discusses the relationship between gender, education, and work force participation in Table 2, where it is shown clearly that return for education varies greatly between women and men. Men's labor force participation does not appear to depend upon education level, while there is a more linear relationship between education and work force participation for women. While Dildar was able to determine a causal relationship between the internalization of conservative patriarchal norms and the decrease female labor force participation rate in Turkey, we must admit that this relationship is not evident amongst other countries and cannot even loosely be applied in the context of development; Turkey's low GDP per capita indicates low development, in which extremely low labor force participation rates were predicted by Goldin (1995) and reaffirmed by many other scholars in the field.

III. Methodology

a. Data Collection

I collected my data primarily from the World Bank Gender Database and my data on mean years of schooling for women from The United Nations Development Program: Human Development Reports. I collected data on 20 countries representing varying levels of economic development, which can be found in Appendix B. I chose some countries that were outliers in their world regions, having at times lower female labor force participation rates than the average in their regions. I chose to include countries that were represented in Claudia Goldin's curve because I wanted to see if using carbon dioxide emissions as an indicator of growth would change their position along that curve (Goldin, 74). My data encompasses 20 countries from 1998 to 2018. See Table 1 for all of the Variables used in the proceeding research.

Figure 1: Variable Summary

Variable	Observations	Mean	Std. Dev.	Min	Max
Year	441	2008	6.062178	1998	2018
MeanSchooling	441	7.971634	3.157601	1.4	13.75368
CO2_Emissions	441	3.604149	4.09602	.0490696	20.17875
ServiceEmp	441	63.77026	24.62782	13.552	91.801
IndustryEmp	441	15.76898	10.86278	6.833	60.457
AgricultureEmp	441	20.46095	23.4739	.497	74.796
FertilityRate	440	2.719233	1.241168	1.21	6.769
GDP_PerCapita	441	11775.36	16066.68	-2.232639	71311.79
LFPR	441	50.31347	18.13172	12.567	86.169
LifeExpectancy	441	75.88472	6.736342	52.311	86
InfantMortality	441	24.83741	26.87668	2	153.6
EduExpend	441	4.997104	2.087399	1.24599	14.05908
MilExpend	399	4.18e+10	1.24e+11	0	7.11e+11
FDI	399	2.53e+10	7.35e+10	-7.85e+10	5.24e+11
CountryId	441	10.19048	5.801646	1	20
FDI_bn	399	25.33398	73.51561	-78.456	523.89
Milexpend_bn	399	41.81536	123.6172	0	711.338

These variables were chosen primarily based on common variables observed in prior research. When analyzing the relationship between labor force participation and education there are many variables that are consistently observed: women's and men's labor force participation are used together or separately in some studies to establish a comparison or control of sorts. Mean years of schooling is also commonly used and is sometimes observed as primary, secondary, and tertiary education. Fertility rates serves as an indicator of women's health and access to birth control. Many other studies like that of Besamusca et al. and Dildar were able to observe some macroeconomic effects (labor force participation, participation across sectors, GDP per capita, education, and fertility rates) coupled with survey data or micro data in order to determine causality and explain why some countries see greater rates of women's labor force participation. Without the resources to obtain survey data, I chose to instead observe other macroeconomic indicators that might clarify a country's level of development and openness to the global market. I chose Foreign Direct Investment (FDI_bn) because many of the countries I observed had very different levels of development and production levels, which can be explaining by the amount of aid being provided from abroad. I chose to observe military expenditure (Milexpend_bn) to better understand the socioeconomic position of the country in the absence of survey data. A country with large military expenditure could be more volatile, and evidence shows that lower-

income countries with high military spending are less likely to have equal rights to education. To better observe this, I would have liked to obtain data regarding education policies and information regarding women's civil rights in a country. I would have also liked to include a variable such as patriarchal norms, religiosity, or family values to see how the trend might change with respect to women's labor force participation and economic growth.

Due to the number of variables, I categorized them by the type of economic indicator they were and summarized them below. "Labor Variables" consists of Labor Force Participation Rate of Women, Ages 15 to 64 (LFPR), Agricultural Employment, Industry Employment, and Service Employment. "Macroeconomic Variables" refers to macroeconomic data such as Carbon Dioxide Emissions in metric tons per capita (CO2_Emissions), GDP per capita, Military Expenditure in billions of US$ (Milexpend_bn), and Foreign Direct Investment in billions of US$ (FDI_bn). "Health Variables" is the category consisting of health indicators of a country such as fertility rate, life expectancy, and infant mortality rate in 1000 births. The last group, "human capital" only consists of mean years of schooling of women in each country. This is one of the biggest limitations of the paper; I would have liked to use other indicators of human capital like trade schooling in years or experience, but I was unable to collect consistent data across different countries. I would have liked to include institutional data regarding religious beliefs and ideologies such as patriarchal internalization or laws regarding gender equality however, this data also proved difficult to obtain and when it was available, it was not longitudinal or consistent for every country. Nevertheless, using the variables listed above, I was able to determine a correlation between mean years of schooling and labor force participation overall and within different sectors of employment, using carbon dioxide emissions as an indicator for growth.

Figure 2: Grouped variable summarization

Variable	Observations	Mean	Std. Dev.	Min	Max
Labor Variables	441	221	127.45	1	441
Human Capital	441	67.22902	44.15597	1	160
Macroeconomics	357	177.1821	102.9154	1	355
Health Variables	440	205.5659	118.5871	1	417

b. Regression Models

I used a standard panel data regression (xtreg) to evaluate the relationship between these variables.

The data was performed in four steps. The bulk of the statistical models shown below were used to determine the validity of using carbon dioxide emissions per capita as a substitute for GDP per

capita. It is important to note that the carbon dioxide emissions data is a consumer-based account collected from the World Bank. World bank data on per capita CO2 emissions includes the burning of fossil fuels and the manufacture of cements, which is critical to infrastructure development. It also includes emissions produced during consumption of solid, liquid, and gas fuels and gas flaring. In addition to the emissions from consumption of goods and services produced locally, consumption-based accounting also includes the emissions from the consumption of goods produced abroad. In other words, it includes the consumption of imports, but does not include production of goods that are exported; thus, the account is trade adjusted. After determining that CO2 emissions are a statistically sound substitute for GDP, I went forward with my regression evaluation the effect of years of schooling on labor force participation.

First, I tested whether it is statistically relevant to substitute CO2 Emission per capita (metric tons) for GDP per capita (current US$). To see if this course of action was justified, I used an OLS regression the following model:

(1) $\textbf{GDP\_PerCapita} = \beta_0 + \beta_1 CO2\_Emissions + \beta_2 EduExpend + \beta_3 FDI\_bn + \beta_4 MilExpend\_bn + \beta_5 FertilityRate + \beta_6 LifeExpectancy + \beta_7 InfantMortalityRate + \beta_8 MeanSchooling + e_i$

Figure 3: Linear regression results testing relationship between GDP_perCapita and CO2_Emissions

VARIABLES	GDP_PerCapita
CO2_Emissions	1,787***
	(313.3)
MeanSchooling	1,930***
	(187.6)
LifeExpectancy	1,961***
	(182.7)
InfantMortalityRate	516.5***
	(41.98)
EduExpend	1,732***
	(386.2)
FDI_bn	7.510
	(16.80)
Milexpend_bn	-1.967
	(12.03)
Constant	-179,803***
	(15,303)
Observations	357
R-squared	0.750

Robust standard errors in parentheses

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

Figure 3 shows that carbon dioxide emissions are a highly significant figure, establishing a significant relationship between carbon dioxide emissions and GDP per capita. The next step was to test if carbon dioxide emissions was exogenous with regards to labor force participation rate in women aged 15 to 64. I used an Instrumental Variable Test (ivreg) using the following model:

(2) $$Labor\ Force\ Participation\ Rate = \beta_0 + \beta_1(GDP\_PerCapita = CO2\_Emissions) + \beta_2 EduExpend + \beta_3 FDI\_bn + \beta_4 MilExpend\_bn + \beta_5 FertilityRate + \beta_6 LifeExpectancy + \beta_7 InfantMortalityRate + \beta_8 MeanSchooling + e_i$$

Figure 4: Instrumental variable regression

VARIABLES	LFPR
GDP_PerCapGrowth	0.000514***
	(0.000185)
MeanSchooling	1.627**
	(0.647)
FertilityRate	-7.833***
	(1.170)
LifeExpectancy	0.772
	(0.476)
InfantMortalityRate	0.294**
	(0.133)
EduExpend	-1.439**
	(0.731)
FDI_bn	-0.0111
	(0.0167)
Milexpend_bn	-0.0129
	(0.0123)
Constant	-8.473
	(44.50)
Observations	357
R-squared	0.534

Robust standard errors in parentheses

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

Then, I used a linear prediction of the residuals (e2) and did an OLS regression of the model below to reaffirm that CO2_Emissions is not a significant contributor to residuals or error value.

(3) $\mathbf{e2} = \beta_0 + \beta_1 CO2\_Emissions + \beta_2 EduExpend + \beta_3 FDI\_bn + \beta_4 MilExpend\_bn + \beta_5 FertilityRate + \beta_6 LifeExpectancy + \beta_7 InfantMortalityRate + \beta_8 MeanSchooling + e_i$

Figure 5: Tested relationship between predicted residual (e2) and carbon dioxide emissions

	(1)
	residual
VARIABLES	e2
CO2_Emissions	-8.98e-09
	(0.325)
MeanSchooling	-4.26e-09
	(0.421)
FertilityRate	2.77e-08
	(1.125)
LifeExpectancy	3.18e-09
	(0.195)
InfantMortalityRate	-1.54e-09
	(0.0873)
EduExpend	-4.26e-09
	(0.601)
FDI_bn	-6.56e-10
	(0.0167)
Milexpend_bn	5.72e-10
	(0.0124)
Constant	-1.90e-07
	(18.13)
Observations	357
R-squared	0.000

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

To summarize, these three tests statistically verified that carbon dioxide emissions per capita was significantly related to GDP per capita, exogenous from LFPR, and was not a significant contributor to the error constant present in the regressions; this confirmed that carbon dioxide emissions per capita could replace GDP per capita as an indicator for economic development.

Next, I regressed each of the models below using fixed and random effects.

(4) Labor Force Participation Rate = $\beta_0 + \beta_1 MeanSchooling + \beta_2 EduExpend + \beta_3 FDI\_bn + \beta_4 MilExpend\_bn + \beta_5 FertilityRate + \beta_6 LifeExpectancy + \beta_7 InfantMortalityRate + \beta_8 (i.Year) + \beta_9 CO2\_Emissions + e_i$

(5) Service Employment = $\beta_0 + \beta_1 MeanSchooling + \beta_2 EduExpend + \beta_3 FDI\_bn + \beta_4 MilExpend\_bn + \beta_5 FertilityRate + \beta_6 LifeExpectancy + \beta_7 InfantMortalityRate + \beta_8 (i.Year) + \beta_9 CO2\_Emissions + e_i$

(6) Industrial Employment = $\beta_0 + \beta_1 MeanSchooling + \beta_2 EduExpend + \beta_3 FDI\_bn + \beta_4 MilExpend\_bn + \beta_5 FertilityRate + \beta_6 LifeExpectancy + \beta_7 InfantMortalityRate + \beta_8 (i.Year) + \beta_9 CO2\_Emissions + e_i$

(7) Agricultural Employment = $\beta_0 + \beta_1 MeanSchooling + \beta_2 EduExpend + \beta_3 FDI\_bn + \beta_4 MilExpend\_bn + \beta_5 FertilityRate + \beta_6 LifeExpectancy + \beta_7 InfantMortalityRate + \beta_8 (i.Year) + \beta_9 CO2\_Emissions + e_i$

Then I used a Hausman Test for each model and determined that each model was a random effect model, meaning that the variables are not endogenous, or each has individual effects independent of the other.

Figure 6: The results of the Hausman test to determine endogeneity

VARIABLES	(1) HausmanTest2 LFPR	(2) HausmanTest3 ServiceEmp	(3) HausmanTest4 IndustryEmp	(4) HausmanTest5 AgricultureEmp
MeanSchooling	0.446	0.493*	-0.0559	-0.644**
	(0.466)	(0.270)	(0.155)	(0.283)
CO2_Emissions	0.367	1.017***	0.402***	-1.453***
	(0.322)	(0.191)	(0.113)	(0.201)
EduExpend	-0.569*	1.083***	-0.157	-0.998***
	(0.343)	(0.209)	(0.130)	(0.219)
FDI_bn	0.00296	0.00103	-6.92e-05	-0.00108
	(0.00657)	(0.00406)	(0.00256)	(0.00425)
Milexpend_bn	-0.0210***	0.00801*	0.00259	-0.0113***
	(0.00687)	(0.00409)	(0.00247)	(0.00428)
FertilityRate	-1.558	2.908***	1.163***	-4.375***
	(1.193)	(0.709)	(0.421)	(0.743)
LifeExpectancy	-0.369	0.657**	-1.171***	0.746**
	(0.543)	(0.298)	(0.159)	(0.312)
InfantMortalityRate	0.327***	-0.0309	-0.285***	0.351***
	(0.0861)	(0.0489)	(0.0275)	(0.0513)
1999.Year	0.846	0.0876	-0.527	0.415
	(1.344)	(0.831)	(0.526)	(0.871)
2000.Year	1.473	0.414	-0.980*	0.515
	(1.351)	(0.835)	(0.527)	(0.874)
2001.Year	2.281*	0.398	-0.925*	0.449
	(1.372)	(0.845)	(0.532)	(0.885)
2002.Year	2.729*	0.727	-1.461***	0.661
	(1.388)	(0.852)	(0.535)	(0.893)
2003.Year	3.448**	1.230	-1.596***	0.285
	(1.403)	(0.860)	(0.539)	(0.901)
2004.Year	3.970***	1.474*	-1.793***	0.176
	(1.457)	(0.885)	(0.550)	(0.927)
2005.Year	4.600***	1.621*	-2.040***	0.297
	(1.506)	(0.908)	(0.560)	(0.952)
2006.Year	4.770***	2.165**	-2.069***	-0.183
	(1.585)	(0.946)	(0.576)	(0.991)
2007.Year	5.250***	2.281**	-1.966***	-0.408
	(1.666)	(0.985)	(0.594)	(1.032)
2008.Year	5.682***	2.522**	-1.760***	-0.857
	(1.746)	(1.024)	(0.610)	(1.073)
2009.Year	6.342***	2.986***	-1.759***	-1.338
	(1.859)	(1.080)	(0.637)	(1.133)
2010.Year	6.472***	3.249***	-1.933***	-1.457
	(1.949)	(1.123)	(0.655)	(1.178)

2011.Year	6.619***	3.926***	-2.071***	-2.050*
	(2.006)	(1.151)	(0.668)	(1.207)
2012.Year	7.803***	5.131***	-2.503***	-2.832**
	(2.073)	(1.184)	(0.683)	(1.242)
2013.Year	7.606***	5.725***	-2.718***	-3.237**
	(2.137)	(1.217)	(0.699)	(1.277)
2014.Year	7.904***	5.105***	-2.244***	-3.101**
	(2.252)	(1.275)	(0.726)	(1.338)
2015.Year	7.997***	5.437***	-2.448***	-3.230**
	(2.255)	(1.277)	(0.727)	(1.340)
2016.Year	7.819***	5.654***	-2.458***	-3.485**
	(2.315)	(1.307)	(0.741)	(1.372)
2017.Year	8.275***	5.653***	-2.309***	-3.639***
	(2.379)	(1.339)	(0.756)	(1.405)
2018.Year	8.649***	5.858***	-2.580***	-3.551**
	(2.386)	(1.343)	(0.759)	(1.410)
Constant	68.80	-8.307	108.3***	-15.53
	(42.45)	(23.22)	(12.23)	(24.39)
Observations	357	357	357	357
R-squared	0.307			
Number of CountryId	16	16	16	16

Standard errors in parentheses

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

After determining that a random effect model should be used, I compared the results therein and compared the effects of Labor Force Participation Rate among women 15 to 64 and the results of Female Labor in each sector: Service, Industrial, and Agricultural employment.

IV. Results and Discussion

The regressions shown in the table below (figure 7) is panel data, using a random effect xtregression. There were four notable results in the data below: the lack of significance of mean years of schooling on labor force participation, the significance of carbon dioxide emissions on the different sectors of employment, military expenditure on labor force participation among women ages 15 to 64 generally, and the relationship of health indicators life expectancy and infant mortality on female employment generally and across sectors of employment.

Figure 7: Results of random effect regressions for all forms of employment divided by sector

	(1)	(2)	(3)	(4)
VARIABLES	LFPR	Service Employment	Industry Employment	Agriculture Employment
MeanSchooling	0.953*	0.493	-0.0559	-0.644
	(0.520)	*(0.744)*	*(0.490)*	*(0.714)*
CO2_Emissions	0.553	1.017**	0.402*	-1.453***
	(0.511)	*(0.421)*	*(0.231)*	*(0.372)*
EduExpend	-0.426	1.083	-0.157	-0.998
	(0.629)	*(0.997)*	*(0.319)*	*(1.188)*
FDI_bn	0.00195	0.00103	-6.92e-05	-0.00108
	(0.00182)	*(0.00231)*	*(0.00146)*	*(0.00228)*
Milexpend_bn	-0.0153***	0.00801	0.00259	-0.0113*
	(0.00463)	*(0.00501)*	*(0.00370)*	*(0.00621)*
FertilityRate	-2.505	2.908	1.163	-4.375**
	(1.644)	*(2.246)*	*(1.471)*	*(2.039)*
LifeExpectancy	0.429	0.657	-1.171**	0.746
	(0.719)	*(0.513)*	*(0.506)*	*(0.767)*
InfantMortalityRate	0.430***	-0.0309	-0.285***	0.351***
	(0.129)	*(0.0893)*	*(0.0849)*	*(0.103)*
1999.Year	0.768***	0.0876	-0.527**	0.415
	(0.229)	*(0.467)*	*(0.265)*	*(0.342)*
2000.Year	1.282**	0.414	-0.980**	0.515
	(0.518)	*(0.585)*	*(0.434)*	*(0.401)*
2001.Year	1.825***	0.398	-0.925**	0.449
	(0.543)	*(0.679)*	*(0.367)*	*(0.646)*
2002.Year	2.156***	0.727	-1.461***	0.661
	(0.640)	*(0.770)*	*(0.509)*	*(0.784)*
2003.Year	2.783***	1.230	-1.596**	0.285
	(0.759)	*(0.772)*	*(0.633)*	*(0.759)*
2004.Year	3.022***	1.474	-1.793**	0.176
	(1.072)	*(0.932)*	*(0.820)*	*(0.842)*
2005.Year	3.407***	1.621	-2.040**	0.297
	(1.142)	*(1.076)*	*(0.851)*	*(1.008)*
2006.Year	3.261***	2.165	-2.069**	-0.183
	(1.134)	*(1.348)*	*(0.887)*	*(1.184)*
2007.Year	3.488***	2.281	-1.966**	-0.408

	(1.156)	*(1.507)*	*(0.952)*	*(1.342)*
2008.Year	3.671***	2.522	-1.760*	-0.857
	(1.332)	*(1.750)*	*(1.049)*	*(1.555)*
2009.Year	4.056***	2.986	-1.759	-1.338
	(1.410)	*(1.866)*	*(1.148)*	*(1.648)*
2010.Year	3.924***	3.249	-1.933	-1.457
	(1.521)	*(2.000)*	*(1.296)*	*(1.667)*
2011.Year	3.935**	3.926*	-2.071	-2.050
	(1.653)	*(2.071)*	*(1.335)*	*(1.762)*
2012.Year	4.953**	5.131***	-2.503*	-2.832
	(1.964)	*(1.950)*	*(1.353)*	*(1.802)*
2013.Year	4.618**	5.725***	-2.718*	-3.237*
	(1.903)	*(1.971)*	*(1.486)*	*(1.869)*
2014.Year	4.653**	5.105**	-2.244	-3.101
	(2.005)	*(2.230)*	*(1.425)*	*(2.047)*
2015.Year	4.740**	5.437**	-2.448*	-3.230
	(2.021)	*(2.252)*	*(1.438)*	*(2.053)*
2016.Year	4.430**	5.654**	-2.458	-3.485
	(2.115)	*(2.353)*	*(1.519)*	*(2.163)*
2017.Year	4.739**	5.653**	-2.309	-3.639
	(2.256)	*(2.480)*	*(1.464)*	*(2.316)*
2018.Year	5.099**	5.858**	-2.580*	-3.551
	(2.283)	*(2.500)*	*(1.452)*	*(2.368)*
Constant	2.869	-8.307	108.3***	-15.53
	(58.05)	*(37.06)*	*(40.07)*	*(58.53)*
Observations	357	357	357	357
Number of	16	16	16	16

Robust standard errors in parentheses

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

Notable results from this data, shown below in figure 7, was the lack of significance of mean years of schooling on labor force participation, the significance of carbon dioxide emissions on the different sectors of employment, military expenditure on labor force participation among women ages 15 to 64 generally, and the relationship of health indicators life expectancy and infant mortality on female employment generally and across sectors of employment.

I found it surprising that the statistical relationship between mean years of schooling and labor force participation of women overall was the only significant relationship, and it was not highly significant. As predicted, mean years of schooling had a positive impact on service employment among women and labor force participation of women which paralleled Goldin's research predictions. There was also a negative relationship between mean years of schooling and industry employment and agriculture employment, however, both of which were not significant. It is well established in the field of research, articulated by Goldin (1995) and Dildar (2015), that

education does impact employment however they each used average years of schooling rather than the mean. This might be contributing to the discrepancy in my data as well as the fact that it is my only indicator of human capital. However, it might also indicate that education is becoming a less impactful influencer of employment opportunities as more and more women around the world are using their education for higher level jobs than simple service jobs. That would also explain why there was a stronger relationship between schooling and the general labor force employment of all women of working age.

Carbon dioxide had the predicted results in this data set: there was a significant positive relationship between emissions per capita and service employment, as well as industry employments, and a significant negative relationship between emissions and agriculture employment. This parallels the research done by Goldin (1995) with GDP per capita in which it was determined that an increase in economic development resulted in the short-term effect of lower employment among women which primarily occurred in the agriculture sector. As development occurs and continues to grow, people move from rural to urban areas thus removing women from the workforce because they no longer have skills to apply in the new labor sector of industry. There is a small, positive significant relationship between emissions and industry employment as some women will being to work in industry as economic growth improves, however it is important to note that most women do not find work in this industry which explains the low value and low significance of the variable. Finally, there was a moderately strong significance between emissions and service employment which again was predictable. As economic development increases, women begin to enter the workforce in greater numbers and they primarily enter through job opportunities in the service sector, working as clerks or secretaries. While I cannot speak to the reasons for this with my data due to the lack of survey data, the reasons for this tends to be that service jobs are considered socially acceptable jobs for women, even if the additional income is not necessary.

One of the more interesting results was the relationship between military expenditure and employment; there was a highly significant negative relationship between military expenditure and women's labor force participation ages 15 to 64. It is important to remember that military expenditure here is valued in the billions of dollars, so the value for this variable means that an increase of 1billion$ spent on the military results in a decrease in labor force participation rate by -0.015% which is not a large number, however it is highly significant. I think this relationship might exists because military expenditure means an increase in jobs within the military which is typically restricted to men. Thus, the more a country spends on military, the more restrictive that job market is to women. I believe the number for this is so low, however, because the majority of women are not inclined to join the military as it has similar prejudice against it as industry jobs.

Another interesting result is displayed in the health indicators, specifically fertility rate and infant mortality rate relationships with employment. Fertility rate has a moderate significant and negative impact on employment on women's employment in the agriculture sector. As fertility rate (births per woman) increases by 1 unit, there is a 4.375% decrease of women in the agriculture sector. This is intuitive; as women have more children, they have less utility in agricultural work because their kids can do it for them. This is confirmed by the fact that the infant mortality rate has a highly significant relationship and positive relationship with agriculture employment; the higher ratio of infant deaths to births means that more women are

giving birth, but their kids don't live to help in agricultural work, pushing women into that workforce.

Life expectancy has a negative and moderately significant relationship with industry work. This meant one of two things to me: people are retiring early from industry work due to the typically poor conditions, or as life expectancy increases, generationally people are leaving work in the industry sector and seeking work elsewhere. This relationship is unclear to me and requires more data to determine the exact causes therein. Infant mortality also has a negative and highly significant relationship with industry employment, showing that an increase in deaths per 1000 live births results in fewer women employed in the industrial sector. An increase of this indicator signals lower health standards in a country and thus might be caused by some sort of income or substitution effect. Due to the conflicting results concerning the industry sector employment, it is difficult to make coherent conclusions which I think may be due to the variability of employment rates in industry among different countries. In this sector, I believe more institutional and culture variables are needed to explain the relationships.

V. Conclusion

The results of this data are not sufficient in establishing a causal relationship between mean years of schooling and economic development as hypothesized, based on prior research. I do not believe this is due to my use of carbon dioxide as an indicator for economic development. In fact, I believe that carbon dioxide emissions per capita is a better indicator for economic development as it accounts for emissions per capita of any given person, whether they are producing a substantial product that can be sold or performing a service that is not accounted for by GDP and does not account for transactions but rather living costs and the utility of services therein. This is especially prudent when evaluating countries that do not have high levels of consumption in terms of luxury goods and services. Furthermore, the data shows a similar trend between labor force participation and economic growth that was established and reaffirmed in previous research. Figure 8, shown below, displays this relationship and can be compared to the graph displayed on page 2 sourced from Claudia Goldin's 1995 paper.

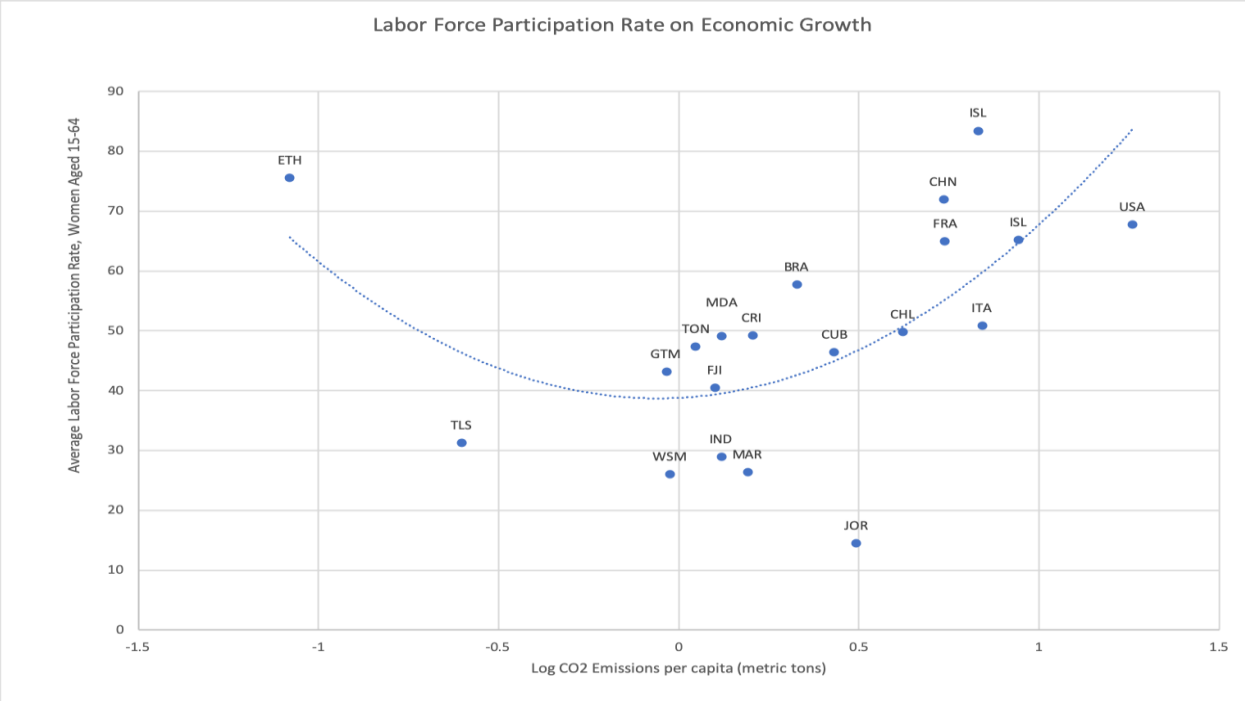

Figure 8: The effect of CO2 emissions on Women's Average LFPR among women aged 15 to 64, across 20 years

A causal relationship between mean years of schooling and labor force participation rates among women could not be established, thus reaffirming the hypothesis that such a relationship would not exist due to differing social factors across countries. This discrepancy between mean years of schooling and labor could be due to many factors. Schooling might not have as big an impact on the changes in labor as previously predicted by Goldin (1995). My data also lacks any institutional and cultural indicators which I think would change the results and offer more explanation to some of the more puzzling values. I believe survey data would sufficiently account for the lack of relationship between schooling and labor participation by clearly identifying the social effects causing the utility of a women's education in the labor force to change. I would expect to find a higher income effect in countries where women's education is only available to the higher classes, and where women's labor is not necessary for the well-being of the household.

Nevertheless, I think this research adds to the existing conversation by positing that other indicators of economic development besides GDP can yield similar results as prior research regarding patterns of labor force participation among working aged women. This might indicate that there is a larger underlying factor occurring that is not entirely economical and more to do with societal paradigms regarding women's role in the workforce over time.

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Appendix A: Correlational Data

LFPR	Mean Schooling	CO2 Emissions per capita	Fertility Rate	Life Expectancy	Infant Mortality Rate	Education Expenditure	FDI_bn	Military Expend_bn
LFPR	1.0000							
Mean Schooling	0.5763	1.0000						
CO2 Emissions per capita	0.5053	0.6643	1.0000					
Fertility Rate	-0.5261	-0.4637	-0.3017	1.0000				
Life Expectancy	0.6188	0.6687	0.5139	-0.5997	1.0000			
Infant Mortality Rate	-0.5477	-0.7828	-0.4896	0.7069	-0.8765	1.0000		
Education Expenditure	0.3216	0.5105	0.1957	-0.4698	0.4702	-0.5613	1.0000	
FDI_bn	0.2959	0.4076	0.7420	-0.1996	0.2401	-0.2310	0.0170	1.0000
Military Expend_bn	0.2797	0.3974	0.7887	-0.1860	0.1792	-0.1914	0.8843	1.0000

Appendix B: Countries

1. BRA- Brazil
2. CHL- Chile
3. CHN- China
4. CRI- Costa Rica
5. CUB- Cuba
6. ETH- Ethiopia
7. FJI- Fiji
8. FRA- France
9. GTM- Guatemala
10. ISL- Iceland
11. IND- India
12. ISR- Israel
13. ITA- Italy
14. JOR- Jordan
15. MDA- Moldova
16. MAR- Morocco
17. WSM- Samoa
18. TLS- Timor-Leste
19. TON- Tonga
20. USA- United States of America