



ECONOMIC DEVELOPMENT, WOMEN EMPOWERMENT AND U SHAPED LABOUR FORCE FUNCTION : TIME SERIES EVIDENCE FOR BANGLADESH



Humaira Husain¹

¹Senior Lecturer Dept of Economics, North South University, Bangladesh

ABSTRACT

This paper supports the validity of nonlinear quadratic U shaped function between female labor force participation rate and Economic Growth for Bangladesh over the period 1991 -2012. The result is robust when growth of per capita energy consumption is considered as a proxy indicator of economic development. In Bangladesh the rising portion of U curve is explained by women's active participation in manufacturing and service sector. Women are still economically active in the Agricultural sector of the economy. Added worker effect dominates discouraged worker effect. Women join the labor force regardless their marital status. Female labor force participation has positive impact on economic growth.

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Contribution/ Originality

The contribution of this paper is to find the Quadratic U shaped labor supply function for women of Bangladesh Economy over the period 1991-2012. Women are mostly economically active in the manufacturing sector, along with service and agricultural sectors. This paper estimates the level of per capita GDP beyond which the U Curve bends upward. Time series evidence adheres to the notion that female labor force participation expedites Economic growth of Bangladesh.

1. INTRODUCTION

U hypothesis suggests that there is a trade-off between macroeconomic gain in terms of growth and Women's participation in labor force for the developing countries. Exploring the nature of this trade-off is crucial for policy makers to suggest appropriate macroeconomic policies. This paper makes an attempt to explain the rationale of U shaped labor supply function in the context of Bangladesh which has experienced considerable rise in female labor force participation compared to its other neighboring countries in South Asia in recent years. Section 2 illustrates review of literature, and provides the trend and descriptive statistics on selected macroeconomic indicators section 3 discusses the econometric estimations of the baseline model. Section 4 provides Robustness tests of the original

specification. Section 5 introduces the model of the determinants of Female labor force participation. Section 6 discusses about the turning point of U function. Section 7 discusses concluding remarks.

2. REVIEW OF LITERATURE

2.1. U in Theory

The theory behind U hypothesis was discussed in detail by Goldin (1995). She argued that at lower level of GDP per capita, women are primarily engaged in family owned firms so they serve as unpaid workers. Over time with economic development, as agricultural and manufacturing sectors start to grow options are available for women to work as paid workers in these sectors but they face impediment to join because of the social barrier. In the process of economic development more opportunities are opened up for women for higher education, and eventually they start securing positions in white collar jobs in service sectors. This expedites female labor force participation.

According to Goldin (1995) and Tam (2011) the declining portion of U is explained by Income effect, where household produced goods are not profitable to sell relative to factory produced goods. At the same time the advancement of technology in Agriculture sector may reduce their demand as wage laborers. Social, cultural and religious barriers may create impediment in this regard. The rising portion of U is explained by substitution effect. Given Income remains constant women get broader access to higher education and new technologies and they are offered better positions in service sector as white collar jobs as highly paid workers. This substitution effect is stronger than Income effect that induces women to join labor force. Income effect dominates substitution effect at the initial phase of economic development.

According to Goldin (1995) U is actually hypothesized as a relationship between women's educational attainment and advances of economic development. At earlier stage of Economic development because of advances in male education compare to women Income effect dominates substitution effect. But eventually with greater access to higher education for women ultimately makes the substitution effect stronger than Income effect, and the labor supply function bends upward. This argument of U is applicable for developed countries.

According to Tinsel (2001) along with Economic growth, female labor force participation is also affected by Unemployment and urbanization. The impact of Unemployment could be positive on FLPR if added worker effect dominates discouraged worker effect, the added worker effect is if male unemployment is high, women take the responsibility to earn Income for family. The effect of education on FLPR could be negative if discouraged worker effect dominates added worker effect. The discouraged worker effect is economic and psychological costs for searching job is high which may impede women to join labor market.

2.2. Empirical Findings in Literature

Extensive volume of empirical research is found to test U function. (See for instance Boserup (1970); Durand (1975); Psacharopoulos and Tzannatos (1989); Kottis (1990); Goldin (1995); Tam (2011)). Evidence of U shaped relationship is traced out on historical experience of developed economies. Few papers are available focusing in the context of developing countries. Gaddis and Klasen (2013) found U relationship for non OECD countries using panel data, but the estimation results are not robust across alternative data sources. Tsani *et al.* (2013) found U shaped relationship between Economic growth and Female labor force participation rate for Southern Mediterranean countries and they indicate region specific barriers hinder women's entry into the labor force. Chapman (2015), examined the hypothesis for Middle East and North Africa from a pooled panel data of 20 countries for 1990 - 2012. The estimation results suggest the U relationship for this region. Verme (2015) tested U on a large sample for 172 countries for 1991-2012 and could not trace the U pattern for MENA region.

Study by [Lahoti and Swaminathan \(2012\)](#) on data from 1983 - 2010 demonstrates that it was difficult to explore U shaped relationship between female labor force participation rate and Economic growth in India. Authors argued that the Agriculture and Manufacturing sectors are labor intensive, but the service sector which has been considered the driving force of economic growth in India, requires skill predominantly possessed by male labor force. The process of Economic development in India has been such that it does not attract or enhance economic activity of women. [Rahman and Islam \(2013\)](#) were unable to come to a definite conclusion of U shaped pattern between economic growth and women's employment, based on Data collected from Bangladesh bureau of statistics.

2.3. The Dynamics of Female Labor Force in Bangladesh

According to [Chaudhary and Verick \(2014\)](#) the rate of Female labor force participation was 31.1% in South Asia in 2012 while the global average was 51.1%. In comparison to India which experienced declining involvement of women in the Indian Labor force, Bangladesh experienced considerably high female labor force participation in rural and urban area and it has the highest rate in the region of South Asia, because of increased female labor force participation in labor intensive export oriented industries (especially in RMG sector) and micro credit program in non-crop agricultural sector.

2.4. Summary Statistics

Variable	Year 1991 -2012	
	Mean	Median
Female Labor force Participation rate (%)	56.86	56.5
Log of per capita real GDP (in constant 2005 US \$)	6.09	6.06
Agriculture Value added (% of GDP)	22.30	22.35
Industry Value added(% of GDP)	24.36	24
Service value added (% OF GDP)	53.27	53.75

3. BASELINE SPECIFICATION AND ESTIMATION METHODOLOGY

The conventional model to examine the U hypothesis between female labor force participation rate and Economic Growth is the following, ([Gaddis and Klasen, 2014](#))

$$FLFPR_{it} = \alpha + \beta_1 \ln y_{it} + \delta (\ln y_{it})^2 + e_{it} \dots \dots \dots (1)$$

$FLFPR_{it}$ is female labor force participation rate (in %), i = country and t indicates time. y is per capita real GDP in constant 2005 US dollar. The regressors are natural log of per capita real GDP and the square of natural log of per capita real GDP. e_{it} is random error term. Per capita real GDP is widely accepted in large volume of literature as a proxy of economic Growth. According to The U, at the initial stage of development a country would experience a decline in Female labor force participation with Economic growth, so $\beta_1 < 0$, at the later stage of economic development women get access to education beyond secondary level and because of the change of social outlook and religious norm more white collar jobs are becoming available for women due to expansion of the service sector as well as in manufacturing sector. So we would expect the sign of δ to be >0 .

We present regression results applying Ordinary Least square (OLS) and instrumental variable (2SLS) approach to estimate equation (1) for Bangladesh Economy from the period 1991 – 2012. Data has been collected from World Development Indicators, World Bank. Following table presents the estimation results.²

²We had to drop observations for 2013 and 2014, because the data on per capita energy consumption for these two years were not available in World development indicator . To have same number of observations in all estimations we considered the study period 1991- 2012.

Table-1. Regression Results of Model (1)

Regressors	OLS	IV
Log of per capita GDP	- 452.75 *** (75.16)	-452.75 *** (63.5)
Square of Log of per capita GDP	36.52 *** (6.13)	36.52 *** (5.17)
R squared	0.77	0.77
Adjusted R ²		0.74
F ratio	32.45	32.37
Number of observations	22	22

*** significant at 1% level , OLS Standard errors are robust standard errors.

The above table depicts the predicted sign of the coefficients and all coefficients are precisely determined and the estimated coefficients are jointly statistically significant. Since estimated β_1 is negative, coefficient of log of per capita GDP and estimated δ , coefficient with quadratic term is positive, U relationship is traced out between Economic growth and womens' labor supply over the period for Economy of Bangladesh.

4. ROBUSTNESS CHECK

Pampel and Tanaka (1986) used Per capita energy consumption as a proxy Indicator of Economic development. In the following model log of Per capita energy consumption and its square are used as regressors.

$$FLFPR_{it} = \alpha + \beta_2 \ln Pce_{it} + \delta_1 (\ln Pce_{it})^2 + e_{it} \dots \dots \dots (2)$$

$\ln Pce_{it}$ = Log of Per capita Energy Consumption of country i in year t

$(\ln Pce_{it})^2$ = Square of log of Per capita Energy Consumption of country i in year t

Estimation results

Table-2. Regression results of Model (2)

Regressors	OLS	IV
Log of per capita GDP	-69.12 *** (7.25)	-69.12 *** (6.42)
Square of Log of per capita GDP	6.98 *** (0.75)	6.98 *** (.67)
R squared	0.89	.89
Adjusted R ²	68.71	.88
F ratio		78.11
Number of observations	22	22

*** significant at 1% level , OLS Standard errors are robust standard errors.

In Table 2. The estimated coefficients have predicted signs and they are all precisely determined.(statistically significant at 1 % level) and high F ratio indicates that the model is valid. This test strengthens our claim that U shaped relationship exists between Economic development and Female labor force participation³.

In both specifications, the magnitude of the estimated coefficient with log per capita GDP is quite larger, while the coefficient with the quadratic term is smaller. In country specific study of U relationship Tinsel (2001) got similar type of estimates, for Turkey. Empirically U holds in cross section.

³To address typical serial correlation problem which is associated with High R square we performed Residual based Engel Granger test for co-integration on our baseline models (equation 1 and 2), since data is available only for two decades long run relationship could not be traced out.

To examine whether the rise in female labor force is the result of structural change in the economy, we proceed with the next section that makes attempt to identify the determinants of Female labor force participation in Bangladesh.

5. DETERMINANTS OF FEMALE LABOUR FORCE PARTICIPATION

Our proposed model differs from Chapman (2015) as we have included the value added of the major three sectors of GDP composition; agriculture, manufacturing and service sector as our explanatory variables.

$$FLFPR_{it} = \alpha + \beta_2 \ln y_{it} + \delta_1 (\ln y_{it})^2 + \beta_3 agrival_{it} + \beta_4 indusval_{it} + \alpha_1 serviceval_{it} + e_{it} \dots (3)$$

indusval= Industry Sector Value added (% of GDP)

agrival= Agriculture Sector Value added (% of GDP)

serviceval= Service Sector Value added (% of GDP)

If the industry sector expands substantially and absorbs female as work force the sign of β_4 should be positive and precisely determined, concurrently the sign of β_3 should be negative, because country with initially large share of value added from agriculture sector will experience decline in the value added over time in the process of structural change and we expect sign of α_1 to be greater than zero, if the service sector starts to expand and engage women in white collar jobs.

For Robustness check we replace Log of per capita GDP by log of per capita energy consumption in model (3) and we get the following model (4)

$$FLFPR_{it} = \alpha + \beta_2 \ln Pce_{it} + \delta_1 (\ln Pce_{it})^2 + \beta_3 agrival_{it} + \beta_4 indusval_{it} + \alpha_1 serviceval_{it} + e_{it}$$

.....(4)

Estimation result of model (3)

Table-3. Regression results of Model (3)

Regressors	OLS	IV
Log of per capita GDP	-548.445*** (180.66)	-548.445*** (158.81)
Square of Log of per capita GDP	44.23*** (14.44)	44.23*** (12.99)
Agrival	2.67*** (1.24)	2.67*** (1.29)
Indusval	2.91*** (1.28)	2.91*** (1.33)
serviceval	2.73**	2.73**
R ²	0.82	0.82
Adjusted R squared		0.77
F ratio	17.3	15.46
Number of observations	22	22

*** significant at 1% level , ** significant at 5% level OLS Standard errors are robust standard errors presented in parenthesis

Estimation results of model (4)

Table-4. Regression results of Model (4)

Regressors	OLS	IV
Log of per capita GDP	-76 ^{***} (11.77)	-76 ^{***} (11.22)
Square of Log of per capita GDP	7.52 ^{***} (.105)	7.52 ^{***} (.104)
Agrival	1.34 ^{***} (.43)	1.34 ^{***} (.76)
Indusval	1.85 ^{***} (.47)	1.85 ^{***} (.79)
serviceval	1.48 ^{***} (.46)	1.48 ^{***} (.78)
R ²	.92	0.92
Adjusted R squared		0.90
F ratio	33.86	39.06
Number of observations	22	22

*** significant at 1% level, ** significant at 5% level OLS Standard errors are robust standard errors presented in parenthesis

Estimation results suggest that all the estimated coefficients are precisely determined (at 1% level and 5% level) and high F ratio indicates that the model (3) is valid. Coefficient of industry value added is positive as theory predicts and the largest in magnitude among all other value added coefficients. This manifests that women are becoming more economically active in manufacturing sector as wage laborers along with male labor force. Labor oriented industries that export their produced goods are absorbing women as their paid laborers. Along with this the estimated coefficient with service sector value added is also found to be positive and statistically significant. This result indicates that women are getting absorbed in white collar jobs in private and public sector. They are working as sales workers, getting salaried jobs in administrative positions, as well as independent small entrepreneurs. This might be the result of advancement in education beyond secondary level and the overall change in the social norm or attitude.

The coefficient of Agriculture value added β_3 is positive, female labor force is still actively participating in rural agriculture, possibly because of their active involvement in non-crop agricultural sector as a result of Microfinance by Non-government organizations such as BRAC and Grameen Bank. The precisely determined coefficients of industry and service sector's value added could explain the rising portion of the U shaped labor supply function of women in Bangladesh though our estimation results have not got any substantial evidence of structural transformation. Because the estimated parameter of agriculture value added is positive, which is supposed to be negative in case of structural shift.

We extend model 4 by including additional regressor unemployment and get the following one.

$$FLFPR_{it} = \alpha + \beta_2 \ln y_{it} + \delta_1 (\ln y_{it})^2 + \beta_3 agrival_{it} + \beta_4 indusval_{it} + \alpha_1 serviceval_{it} + \alpha_2 unemployment_{it} + e_{it} \dots \dots \dots (4a)$$

Estimation results

Table-5. Regression results of Model (4a)

Regressors	OLS	IV
Log of per capita GDP	-595.31 ^{***} (127.26)	-595.31 ^{***} (110.95)
Square of Log of per capita GDP	47.38 ^{***} (10.13)	47.38 ^{***} (8.78)
Agrival	1.94 ^{***} (.85)	1.94 ^{***} (.91)
Indusval	2.5 ^{***} (.88)	2.5 ^{***} (.93)
serviceval	2.18 ^{***} (.97)	2.18 ^{***} (.99)
Unemployment	1.53 ^{***} (.34)	1.53 ^{***} (.36)
R ²	.92	0.92
Adjusted R squared		0.89
F ratio	39.46	29.68
Number of observations	22	22

*** significant at 1% level, ** significant at 5% level OLS Standard errors are robust standard errors presented in parenthesis

Estimated coefficients of value added are precisely determined. Estimated $\alpha_2 > 0$. Female labor force participation rises with increase in unemployment rate. Added worker effect is stronger than discouraged worker effect. Women take the responsibility of earning to support family in case of male unemployment⁴. This also implies that married women are also joining the labor force to support their family.

Finally, we add first lag of the dependent variable as one of the regressors in model (1) and in Model(2), to examine whether U holds using dynamic specification (Gaddis and Klasen, 2014) We get the following equations

$$FLFPR_{it} = \alpha + \beta FLFPR_{i,(t-1)} + \beta_1 \ln y_{it} + \delta (\ln y_{it})^2 + e_{it} \dots \dots (1a)$$

$$FLFPR_{it} = \alpha + \beta FLFPR_{i,(t-1)} + \beta_2 \ln Pce_{it} + \delta_1 (\ln Pce_{it})^2 + e_{it} \dots (2a)$$

Using OLS and 2SLS we find that $\beta > 0$ and precisely determined in both specifications, but β_1 , β_2 and δ , δ_1 do not have predicted signs and are poorly determined, that is statistically insignificant. U pattern is not supported by dynamic specification⁵.

6. TURNING POINT OF U FUNCTION

The sample regression function of Equation (1): $FLFPR = f(y)$.

Equation (1) has been differentiated with respect to y , and derivative set equal to zero, assuming the U function is differentiable at all points so the function is continuous and smooth throughout. Since at the turning point the tangent is horizontal and it is parallel to horizontal axis, at the Stationary point following condition is fulfilled:

$$\frac{d}{dy}(FLFPR_{it}) = 0$$

$$\Rightarrow \frac{d}{dy}(\alpha + \beta_1 (\ln y)_{it} + \delta (\ln y)_{it}^2) = 0$$

$$\Rightarrow \frac{d}{dy}(\alpha) + \frac{d}{dy}(\beta_1 (\ln y)_{it}) + \frac{d}{dy}(\delta (\ln y)_{it}^2) = 0$$

$$\Rightarrow \beta_1 \cdot \frac{1}{y} + \delta \cdot 2 \cdot \ln y \cdot \frac{d}{dy}(\ln y) + 0 = 0$$

⁴ We incorporated Urbanization rate and fertility rate in model (4) to examine their impact on FLPR and we found both variables are statistically insignificant.

⁵ OLS produces biased estimates in Dynamic specification. But our estimation result is not dissimilar using First difference GMM estimation technique using dynamic model on Panel data for Non OECD Countries. By Gaddis and Klasen (2013).

$$\Rightarrow \beta_1 \cdot \frac{1}{y} + \delta \cdot 2 \cdot \ln y \cdot \frac{1}{y} = 0$$

$$\Rightarrow \beta_1 \cdot \frac{1}{y} + \delta \cdot 2 \cdot \ln y \cdot \frac{d}{dy}(\ln y) + 0 = 0$$

$$\Rightarrow \beta_1 \cdot \frac{1}{y} + \delta \cdot 2 \cdot \ln y \cdot \frac{1}{y} = 0$$

Rearranging the above equation we get the following:

$$\Rightarrow \beta_1 \cdot \frac{1}{y} = -\delta \cdot 2 \cdot \ln y \cdot \frac{1}{y}$$

$$\Rightarrow \beta_1 = -\delta \cdot 2 \cdot \ln y$$

$$\Rightarrow -\beta_1 = \delta \cdot 2 \cdot \ln y$$

$$\Rightarrow \ln y = \frac{-\beta_1}{2 \cdot \delta} = \frac{-\hat{\beta}_1}{2 \cdot \hat{\delta}} = \frac{-(-452.75)}{2.36.52} = 6.19$$

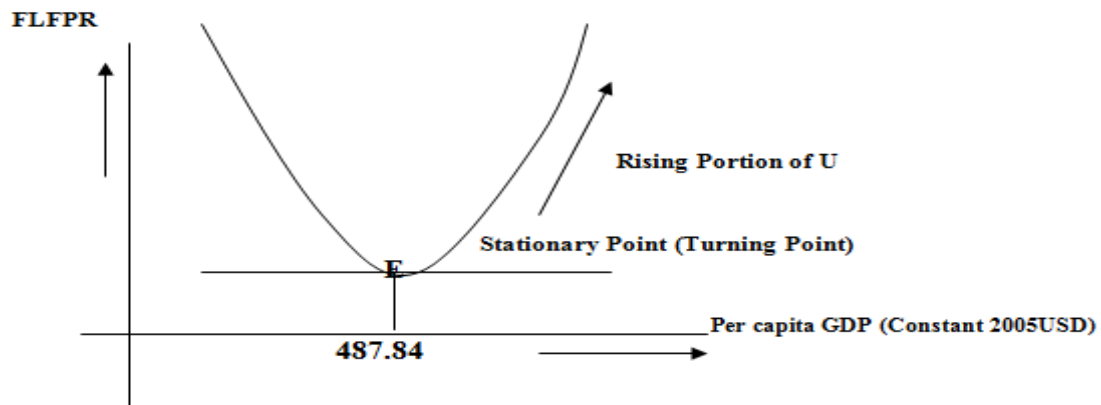
$$\Rightarrow y = e^{6.19} = 487.84$$

The threshold level of real GDP per capita y equals to 487.74 (2005 constant USD), after which the U function bends upward.

To proceed with the second derivative test we calculate the 2nd order derivative as following:

$$\begin{aligned} &= \frac{d}{dy} \left(\frac{d}{dy} FLFPR \right) = \frac{d}{dy} \left(\frac{\beta_1}{y} + 2\delta \ln y \cdot \frac{1}{y} \right) \\ &= \frac{d}{dy} (\beta_1 \cdot y^{-1}) + 2\delta \cdot \frac{d}{dy} [(\ln y)(y^{-1})] \\ &= \beta_1 \cdot \frac{d}{dy} (y^{-1}) + 2\delta \left[\ln y \cdot \frac{d}{dy} (y^{-1}) + y^{-1} \cdot \frac{d}{dy} (\ln y) \right] \\ &= \beta_1 (-1)y^{-2} + 2\delta \left[-\frac{\ln y}{y^2} + \frac{1}{y^2} \right] \end{aligned}$$

We substitute the values of estimated coefficients $\hat{\beta}_1$ and $\hat{\delta}$ and Stationary value of y in above expression we get the whole term to be greater than zero. So above stationary value of per capita GDP is the turning point of quadratic U Labor supply function after which the curve starts rising and the rate of change of slope is positive.



Graph of Non – Linear Quadratic U for Bangladesh

7. CONCLUSION

In our study, we have focused Bangladesh which has experienced considerable and substantial increase in women labor force compare to its neighboring countries. U holds for Bangladesh using the static model, where the log of per capita GDP is considered as an indicator of economic development. This result is robust to estimating the static model where log of per capita GDP is replaced by log of per capita energy consumption as a proxy indicator of Economic development. In our study U pattern is not supported using dynamic model, though the coefficient attached to the first lag was found to be positive and statistically significant.

From the Estimation results of model (3) and Model (4) the pattern of economic development gradually absorbs women in the labor force. Our study shows that women are mostly economically active in manufacturing sector.

In recent years they are employed in the service sector. The inference of this paper exerts importance to important policy implications. To enhance women empowerment and to have macroeconomic gain from gender equity, women should have better access to high quality education, appropriate training to improve their knowledge and skill. So the service sector could meaningfully absorb them. Estimation results suggest womens' participation in the labor force increases as the unemployment rate rises. Added worker effect is stronger than discouraged worker effect. Women are participating actively in labor force to supplement Income for the family.

In our study we have found that women are still economically active in Agriculture sector. Microfinance Institutes play an important role to attract and engage women in rural non crop small agribusiness. This result adheres to the notion that radical structural transformation is yet to take place in Bangladesh. But our study could conclude draw the inference that womens' economic activity expedites the Economic growth. The findings of the paper suggest that based on more recent data, the quadratic U shaped Labor supply function is obtained for the Economy of Bangladesh. This paper also estimates the threshold level of per capita real GDP beyond which the female labor participation expedites growth for Bangladesh Economy.

Future study could focus on more comprehensive analysis of the factors identified of female labor force participation in developing countries. Particularly the role of higher education for women. Marital status, religious values, social norm and cultural attitude, child care policies, congenial work environment might play important role in determining female labor force participation for developing economies. In addition to this, it should be checked whether the estimation results hold for alternative data sources.

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