

Lechman, Ewa

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GDAŃSK UNIVERSITY OF TECHNOLOGY  
FACULTY OF MANAGEMENT AND ECONOMICS

# FEMALE LABOR FORCE PARTICIPATION AND ECONOMIC GROWTH – RE-EXAMINATION OF U-SHAPED CURVE

**Ewa Lechman\***

**GUT Faculty of Management and Economics**

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\* Gdansk University of Technology, Faculty of Management and Economics,  
[eda@zie.pg.gda.pl](mailto:eda@zie.pg.gda.pl) (corresponding author)



# Female labor force participation and economic growth

## – re-examination of U-shaped curve

Ewa Lechman<sup>1</sup>

### Abstract

The paper contributes by providing new insights into the relationship between female labor force and economic growth in 162 countries over the period 1990-2012. We anticipate uncovering U-shaped impact of economic growth on female labor force. To examine the previous we deploy longitudinal data analysis assuming non-linearity between variables. Our main findings support the hypothesis on U-shaped relationship between female labor force participation and economic growth, however high cross-country variability on the field is evident.

**Keywords:** *female labor force, women, economic growth, U-shaped curve, panel data.*

**JEL classification:** *J21, O10, O50.*

### Highlights:

- U-hypothesis on female labor force and economic growth relationship is re-examined.
- A panel of 162 countries over the period 1990-2012 is deployed.
- High female labor force participation goes along with low and high GDPpc levels.
- Panel variability is attributed to countries` specific features.

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<sup>1</sup> Assistant Professor at Faculty of Management and Economics, Gdansk University of Technology (eda@zie.pg.gda.pl)

## 1. Introduction

Sizeable evidence suggests U-shaped relationship between female labor force (FLF) participation and economic growth (Tam, 2011; Lechman&Okonowicz, 2013; Olivetti, 2013; Tsani *et al.*, 2013). The U-hypothesis claims that economic development (approximated by GDP *per capita*) and FLF are mutually conditioned (Boserup *et al.*, 2013) and such regularity is probably attributed to countries' structural transformations. Declining part of U-shaped curve explains shifts from subsistence agriculture economy to industrialize and labor intensive where more male compared to female input is demanded. It suggests existence of *trade-off* between economic growth and women's equal access to labor market in early stages of development. However, such *trade-off* partly disappears particularly as development proceeds and next transition – from industrial sector to services – reveals. The post-industrial phase on economic growth is “*unambiguously associated with increasing female labor (...)*” (Olivetti, 2013). Economic growth, accompanied by declines in fertility rates, expansion of women's access to education and their growing agency, allow rising female economic activity (Bayanpourtehrani, G. *et al.*, 2013; Gaddis&Klassen, 2013). The process of growing women's involvement in labor market participation is demonstrated by increasing portion of the U-shaped curve, and is characteristic as national economy becomes more service-based (Gaddis&Klassen, 2013; Olivetti 2013), thus the ‘de-feminization’ of labor force occurs.

The main goal of the paper is to provide new evidence on U-shaped association between female labor force participation and economic growth in 162 countries over the period 1990-2012. The introductory part is followed by section explaining data and methodology. Section 3 contains empirical results, and the last part – concludes.

## 2. Data and empirical strategy

To complete the analysis we deploy two distinct variables. We account for Female Labor Force [ $FLF_{it}$ ] participation, which explains women's [15 years old and above] share in country's total labor force. Secondly, to approximate level of economic development, we consider gross domestic product *per capita* [ $GDPpc_{it}$ ], and take natural logarithms of purchasing-power-parity adjusted national GDP *per capita* in constant 2005 US\$. All data are exclusively derived from World Development Indicators 2013. Finally we define cross-country panel including 162 economies over the period 1990-2012.

In empirical part, applying longitudinal analysis, we examine U-shaped relationship, defining  $FLF_{it}$  as response variable, and  $LnGDPpc_{it}$  - as explanatory one, where  $i$  stands for country and  $t$ -year. Firstly we adopt pooled OLS, to examine whether 2-degree polynomial, expressed as:

$$FLF_{it} = \alpha_0 + \delta_1 LnGDPpc_{it} + \delta_2 LnGDPpc_{it}^2 + \epsilon_{it} \quad [1],$$

is appropriate to approximate relationship between assumed variables.

If convex relationship is confirmed, hence we deploy quadratic panel regressions to explore cross-country relationship between  $FLF_{it}$  and  $LnGDPpc_{it}$  and its square term. To capture time-invariant countries' specific effects, we specify fixed effects model:

$$FLF_{it} = \alpha_i + \delta_1 LnGDPpc_{it} + \delta_2 (LnGDPpc_{it})^2 + \varepsilon_{it} \quad [2],$$

or alternatively, if adopting binary variables:

$$FLF_{it} = \delta_0 + \delta_1 LnGDPpc_{it} + \delta_2 (LnGDPpc_{it})^2 + \gamma_2 C_2 + \dots + \gamma_n C_n + \varepsilon_{it} \quad [3]$$

where  $i$  – stands for country,  $t$  – period (year),  $\alpha_i$  – unknown intercept for each country,  $\gamma_2$  - coefficient for binary-country regressors,  $C$  – is country-dummy, and  $n$  – is the number of countries in the sample.

Additionally, we test time-fixed effects regressions, which can be formalized as:

$$FLF_{it} = \delta_0 + \delta_1 LnGDPpc_{it} + \delta_2 (LnGDPpc_{it})^2 + \gamma_2 C_2 + \dots + \gamma_n C_n + \lambda_2 Y_2 + \dots + \lambda_t Y_t + \varepsilon_{it} \quad [4],$$

where  $Y$  is year-dummy and  $\lambda$  stands for its coefficient. Hence equations [3]-[4] are estimated for  $n-1$  countries and  $t-1$  years. As estimates generated from [3] and [4] might be not consistent due to endogeneity of explanatory variables, to confirm the results we also introduce instrumental variables [IV] estimator. Hence we use the IV-regression to re-estimate model [2], using lagged  $LnGDPpc_{it}$  and  $LnGDPpc_{it}^2$  as instruments. Finally, to account for dynamic effects, we include lagged depended variable, and consider:

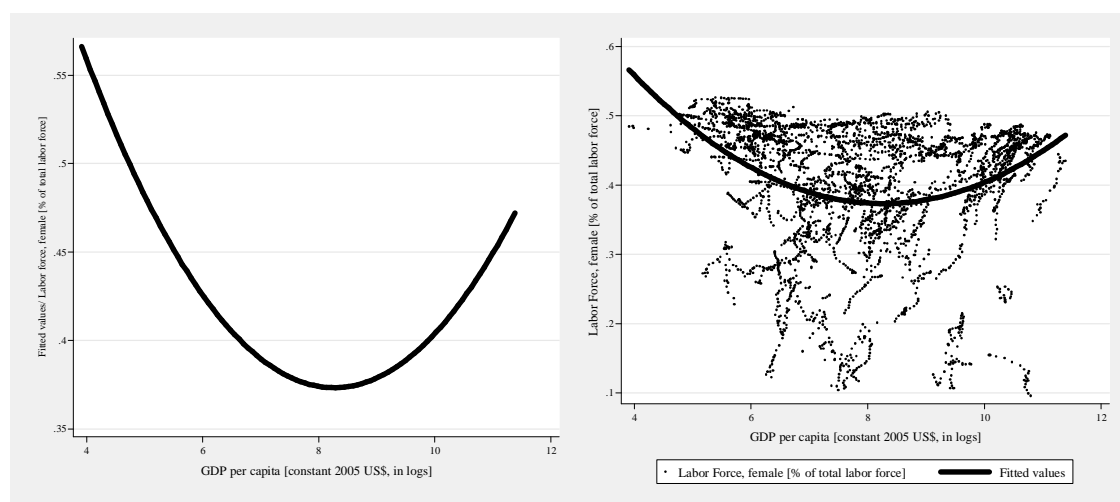
$$FLF_{it} = \alpha_i + \delta_1 LnGDPpc_{it} + \delta_2 (LnGDPpc_{it})^2 + \delta_3 (FLF_{i(t-1)}) + \varepsilon_{it} \quad [5]$$

applying GMM and GMM-system estimators.

### 3. Findings

Confronting  $FLF_{it}$  against  $GDPpc_{it}$  we have traced out the U-shaped association between the two. Chart 1 preliminarily confirms that selected countries follow the U pattern over the period 1990-2012. It is clearly displayed that both for relatively low and high levels of  $GDPpc_{it}$  the  $FLF_{it}$  is at approximately 40%, while for the “averages” *per capita* incomes –  $FLF_{it}$  reveals high variability in its absolute level. In countries where  $LnGDPpc_{it}$  ranges from approx. 6 to 9, women's participations in labor market activities is observed both at relatively high ( $\cong 50\%$ ), and – low ( $\cong 14-17\%$ ) level. However, the picture suggests that over analyzed decades, increases in female labor force participation in multiple countries were significant. But, despite positive changes there still remain economies lagging behind, not reaching at least the world's average  $FLF_{it}$  and are located far below the theoretical (fitted) line. Countries situated below the curve turning point are mostly Arab economies, where – due to cultural reasons, women's participation in labor market remains significantly low, regardless high GDP *per capita*. It leads to general conclusion that changes in female labor force participation are not exclusively attributed by economic growth, but depend on multitude of factors which are not captured in here.

Chart 1. Female Labor Force *versus* GDP *per capita* – quadratic fit. 162 countries. Period 1990-2012.



Source: own elaboration based on data derived from WDI 2013. Note: solid line presents quadratic prediction for  $FLF_{it}$  *versus*  $GDPpc_{it}$ .

Table 1 summarizes estimation results based on multiple periods. Outcomes displayed below suggest that  $FLF_{it}$  and  $GDPpc_{it}$  are specifically negatively correlated *ante* vertex of quadratic curve, while after passing the low point, examined relationship starts to be positive, thus the U-shaped patterns is generated. The low peak of the curve [OLS estimates] corresponds to  $LnGDPpc_{it}=8,31$  which is equivalent to approximately 4064 of GDP *per capita* (in 2005 constant US\$).

**Table 1. Female Labor Force *versus* GDP *per capita*. 162 countries. Period 1990-2012.**

	OLS	FE(1)	FE(2)	FE- IV $reg^{(a)(b)}$	GMM	GMM-SYS
$LnGDPpc_{it} \rightarrow (\delta_1)$	-16.8 (-18.1)*	-7.37 (-10.89)*	-5.92 (-10.17)*	-7.3 (-10.7)**	-0.942 (-1.9)**	-0.58 (-1.64)**
$LnGDPpc_{it}^2 \rightarrow (\delta_2)$	1.01 (17.8)*	.600 (13.6)*	.31 (8.12)*	.59 (13.5)**	.080 (2.6)**	.04 (1.96)**
$1\text{-year-lag}FLF_{it} \rightarrow (\delta_3)$					.87 (89.0)**	.931 (248.4)**
$_{-cons}$	106.8 (29.4)*	59.36 (23.0)*	64.88 (28.97)*	59.0 (22.7)**	7.50 (4.0)**	4.59 (3.32)**
Instruments	No	No	No	Yes	Yes	Yes
# of countries	162					

Source: own estimates based on data derived from World Development Indicators 2013. Note: \* - *t*-stats for  $p < 0.05$ ; \*\* -  $\chi^2$ -stats for  $p < 0.05$ . For *non-IVreg* estimates also robust and bootstrap (50 and 1000 replications) SE reported – all statistically significant. *IVreg* – instrumental variable regression; <sup>(a)</sup> – estimates using conventional SE; also tested for bootstrap SE (50 and 1000 replications) – in each case estimates are similar and statistically significant; <sup>(b)</sup> – within IV-regression with instruments → lagged (1-year) explanatory *vars*; (1) – estimates for country-fixed effects; (2) – estimates for year and country fixed effects.

Regardless model applied, the regressor ( $LnGDPpc_{it}$ ) always holds a negative sign, and ( $LnGDPpc_{it}^2$ ) – a positive one. The analysis is based on panel data, thus the evidence demonstrates evolution of changing participation of female labor supply (in total labor) which is attributed to economic growth. Downward

slope of the curve demonstrates de-feminization process of labor force which goes along with economic growth. Cited structural changes are characteristic for countries located in early stages of growth, and women (usually unskilled) quite low-paid jobs joining education system instead. Reversely, the upward slope – explains growth in women`s agency and empowerment across countries which is accompanied by economic growth. Observed positive changes in women`s labor market empowerment are probably becoming a permanent characteristic rather than mere cyclical change.

Using within estimator, the coefficients  $\delta_1$  and  $\delta_2$ , explaining mediated effects of  $LnGDPpc_{it}$  on  $FLF_{it}$  due to cross-country differences, are statistically significant however – in each case –  $\delta_1$  tends to be higher than  $\delta_2$ . It might suggest that the “negative” relationship between  $FLF_{it}$  and  $GDPpc_{it}$  is dominant. To test whether unexpected in-time variation affect the response variable ( $FLF_{it}$ ), we have additionally controlled for time-fixed effects. Coefficients resulted from considered FE(2) confirm the inter-temporal relationship between  $LnGDPpc_{it}$  on  $FLF_{it}$ . As coefficients produced under FE(1) are relatively “stronger” than those resulted from FE(2), we conclude that unobserved variability due to cross-country differences (but constants in time) has stronger impact on panel estimates rather unobserved effects varying in time. This again confirms the supposition that countries variability is hugely attributed to wide array of economic and non-economic features, which affects final results and conclusions.

To account for potential dynamic effects, we estimate equation [5], including first lag of response variable. This again confirmed previously obtained results on U-shaped relationship between  $FLF_{it}$  and  $GDPpc_{it}$ . Additionally, the  $\delta_3$  coefficients trace out that female labor force in ( $t$ )-year is strongly pre-determined by respective value in ( $t-1$ )-year, which demonstrates some kind of hysteresis in the case. The  $\delta_1$ ,  $\delta_2$  and  $\delta_3$  are statistically significant, except  $\delta_1$  resulted from GMM-system estimator.

#### 4. Conclusions

The paper was designed to re-examine the evidence on U-shaped curve combining female labor force participation and economic growth in 162 countries over the period 1990-2012. Estimates resulted from longitudinal analysis allow supporting the U-hypothesis, which implicates that in early stages of economic growth female labor force participation tends to fall, hence as country advances in economic development and its economy is more and more service-based, it grows systematically. Although we empirically confirmed the U-shaped relationship, high cross-country variability on the field remains. Still female labor force participation ranges significantly across economies regardless level of GDP *per capita* achieved, and is not solely attributed to economic growth, but preconditioned by wide array of legal, cultural, social or other unquantifiable factors. The complexity of structural changes which demonstrates differentiated patterns of adjustments, affects analyzed relationship between female labor force participation and economic growth. Finally the evidence is not highly convincing and might be sensitive to inclusion (exclusion) of different countries from the sample, which constitutes a promise for further research.

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Gdańsk University of Technology, Faculty of Management and Economics

Narutowicza 11/12, (premises at ul. Traugutta 79)

80-233 Gdańsk, phone: 58 347-18-99 Fax 58 347-18-61

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