Economic Growth-Female Labour Force Participation Nexus: An Empirical Evidence for Pakistan

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Abstract
Economic literature shows significant attention towards the role played by Female labor force in the economic development of nations. The structural changes of economies from agriculture to industrial and services sector reduce the female labor force participation in case of developing nations like Pakistan. This study investigates the nexus between economic growth and female labour force participation for Pakistan's economy over the period of 1980-2010. In this respect, an attempt is made to find out the U-shaped curve between Female labor force and economic development by employing ARDL technique. The results show long run and U-shaped association between economic development and female labor force participation in case of Pakistan. Our study shows that an increase in education and dynamics of economic activity increases the female labour force participation in later stage of development.

1. Introduction:

Economic literature shows significant attention towards the role played by Female labor force in the economic development of nations. The structural changes of economies from agriculture to industrial and services sector reduce the female labor force participation in case of developing nations. The activities of Female labor force increases in the later stage of economic development due to increase in education and dynamics of economic activity. As the size of the economy expands females have easier and better access of jobs thus are encouraged to become economically active, it leads to increase female participation in the productive activities. The participation of female labour force is desirable for both equity and efficiency reasons. The equity aspect shows that the women's participation in the labor market ultimately improves their relative economic position, increase the overall economic efficiency by enhancing the development

potential of the country. Moreover, the increasing integration of women in the economy helps in reducing gender disparities in education, improving maternal health, increasing sectoral share of female employment in different sectors of the economy, demonstrating the hidden contribution of women as unpaid family worker especially in agriculture sector. According to the modernization theorists, economic development is positively associated with female labor force participation through change in the occupational structure and increase in educational opportunities along with the household responsibilities. The modernization process is linked with increased demand for labor, a general social acceptance of women's education and employment as well as lower fertility [Heckman (1980); Standing (1981); Bauer and Shin (1987)]. A body of theoretical and empirical literature provides evidence that female labor force participation has a positive and strong relationship with economic growth (Tansel (2002) and Fatima and Sultana (2009).

Pakistan is going through a demographic transition where the proportion of productive young persons is increasing. It is in fact the demographic dividend for future development of Pakistan. The economic development of the country reveals the fact that both male and female are contributing in the market activities. It is evident from various studies, as in the early phases of economic development the female participation increases specially as unpaid family worker in the agriculture sector. Later, their employment increases in the manufacturing and services sector. As female's education improves so do their opportunities in the services sector. Education not only guarantees higher income but also provide opportunities in the labour market. Therefore, there exist a strong causality between female labour force participation and the level of economic development.

The objective of the study is to investigate the relationship between female labour force participation and the level of economic development of Pakistan for the period of 1980-2010. ARDL technique will be applied to study the short run and long run relationship between female labour force and economic development.

Rest of study is organized as follows: section 2 describes theoretical and empirical review of literature. Section 3 explains analytical frame work, modeling and data sources. Section 4 discusses the Methodology and empirical results and section 5 presents the conclusion and policy implication.

2. Theoretical and Empirical Review of Literature

The relationship between female labour force and economic development is an empirical issue discussed both in time series and cross country literature.

Mincer (1962), Killings worth and Heckman (1986) and Goldin (1994;1995) deliver a theoretical exposition of the stages of economic development.

The U- shaped, also known as U curve hypothesis[1] establishes a long-term relationship between female labour force participation and economic development has been alluded in voluminous studies. Boserup (1970), Durand (1975), Pampel and Tanaka (1986), Psacharopoulos and Tzannatos (1989), Schultz (1990; 1991), Kottis (1990), Goldin (1995), Mammen & Paxson (2000) and Bloomet.al.(2009) are among such authors.

Hills (1983) posits that the countries on the left side of the U curve represents the share of labour force associated in the agriculture sector and the gross domestic product generated from the agrarian economy while the countries on the right side portion shows that industrial activities are dominant and the share of GDP is high as compare to the GDP from the agriculture sector. Psacharopoulos and Tzannatos (1989) stressed the definitions and theories of labour supply of females and examine them with respect to the data of 136 countries including developed and developing nations for the period 1960 and 1980. The findings of the paper confirmed the U-shaped pattern of female labour supply in the process of economic development. It is evident that during the transition from agrarian subsistence economy to industrial economy, the female employment represents a U-pattern curve. The author found that during the last twenty years, the female labour supply increased by 10% in the industrialized countries while it decreased by 7% in the developing countries. Pampel and Tanaka (1986) postulates that high-income and low-income countries have the highest female participation rate, however their participation is lowest in the middle-income countries. The authors employed the cross- national data on 70 nations for the periods

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[1] In the early stages and process of economic development, there is a rapid increase in the blue collar jobs which raises the employment due to industrialization and urbanization which is reflected in the growth of the manufacturing sector. Because of the opportunities in the blue collar jobs, male labour force participation increases so do their earnings and wages. On the other hand, female labour force participation declines because of the income effect (as male's employment raises family income) and due to the demarcation between female household chores and male productive work. As the development takes place in the economy, introduction of technology and household appliances minimize the opportunity cost of time of female in the household leads to increase in education which in turn leads to the increase in the demand for women in the white collar jobs. The higher demand for females increases female's earnings. Therefore, during rapid industrialization the substitution effect of the wage rate increases and dominates the income effect which resultantly increase the female labour supply.

1965 and 1970. The used the consumption of energy per capita as a measure of development and concludes that it has a curvilinear impact on female labour supply.

Goldin (1994) revealed that the labor supply of married women is U-shaped as the countries move on the path of development. Initially the female labour supply decreases as then later on it increases. This U-shaped relationship between female labor force participation and economic development is also evident through the histories of recently advanced countries. The author employed the data of more than 100 countries and the history of United States is used to expose the U- shaped female labor supply curve. In the initial stages of development less educated women are only and mostly work in the house hold, agriculture sector and in the family farm with which a strong social stigma exists. With the over all development, women becomes more educated and there exist more job opportunities for white- collar jobs for females specially of secondary education level, for which no social stigma exists. With the introduction of new technologies and the expansion of the markets family income rises so the rate of female participation in the labor market declines while their domestic activities increase. The reduction in the female labor supply owes to an income effect but ultimately the substitution effect dominates the income effect at some point in time. Goldin (1995) explores the U-pattern hypothesis by employing data for 180 countries for the period 1985 and taken real GDP per capita as a measure of development. The falling portion of the U-shaped curve shows the existence of the poorest countries of the world while the wealthier nations are on the rising portion and the middle income countries are at the bottom. Mammen and Paxson (2000) explores evidence of the U-shaped curve using the cross country data for 90 countries for the years 1970,1975,1980 and 1985.The authors finds a U-pattern, the richest and the poorest countries represents more than 50% participation rates and 35% for the middle income countries which is in line with the findings of Goldin (1995). Tansel (2002) affirms the U-shaped hypothesis between economic development and female labour supply for Turkey. The author used the time series data and considers its cross-provincial factors to determine the female participation rate. Using data for 67 provinces for three different points in time i.e. 1980,1985 and 1990. The findings are

positive and strong effect on female labour supply while negative effect on unemployment. Onzur Cakir (2008)focuses the effects of economic development on female labour supply using time series data from 1980-2000 in Turkey. The study incorporates 5 different models to measure different determinants of female labour supply. The study concludes that Turkey is experiencing the declining portion of U shaped curve but it is expected that the country will move to the rising portion of U-shaped curve in the future. Fatima and Sultana(2009) finds the U pattern relationship between female labour force participation and economic development using cross-sectional data for 4 provinces with respect to regions (urban/rural) are pooled for three periods 1992-93, 1996-97 and 2001-2002 using a fixed effect test and affirms the U shaped existence in Pakistan. The authors used household expenditure on fuel consumption to measure the level of economic development as the data on GDP are not available at the provincial level. Sanjukta (2010) revisits the U- shaped hypothesis for 172 countries from 1990 through 2007, with the total observations 3060 for the South Asia and South East Asia. The study concludes that both the regions are on the falling portion of the U- curve. Roughly, the South Asian countries are below the U curve while the South East Asian countries are slightly above the curve with Pakistan having the lowest female labour supply and countries like Cambodia and Vietnam having the highest female participation rates.

The pattern and amplitude of the U- shaped trend varied between countries and periods of time. The U-shaped curve for the female labour force participation specially during the process of economic development is not agreed by all the researchers. Standing (1978) stressed that the factors of female labour supply is too complicated and complex to be explained by the U-shaped hypothesis. Such as Durand (1975:150)[2] finds that in the case of developing countries, the U-shaped phenomena is not a general trend of female labour supply. Economic development can have positive and negative effect on female labour supply depending on the share of female participation rate employed in the growing and

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[2] Durand, J.D.(1975)"The Labour Force in Economic Development", Princeton: Princeton University Press(seen in "Economic Development and Female Labour Force Participation in Turkey: Time-series Evidence and Cross-Province Estimates", Aysit Tansel (2005).

expanding sector. Steel(1981:163)[3] argues that in the 1960s, as Ghana modernized its economy in terms of rapid manufacturing employment but does not experience the U-shaped curve for female participation rate infact the female labour supply rose because of industrialization.

3. Analytical Framework, Model and Data Sources

This study explores the relationship between economic growth and female labour force participation. So, this study expects that better economic conditions encourage women to enter the labour market for earnings. According to Kuznets, (1955) economic progress measured by income per capita, first increases inequality but as the benefits from development is accrued and spread in the society the disparities starts declining. Goldin (1994) and Mammen and Paxson (2000) reveal that there is a U-shape relationship between female labor force and economic growth with the view that developing countries are mostly agrarian in nature where the contribution of females in the fields are dominant. The females in these poor countries are burden laden as they contribute not only in the fields but are also involved in rearing and bearing of children and in domestic chores. Due to industrialization, there is an expansion in the manufacturing sector with the introduction of the technologies, the family income rises so that female labour force participation squeezes. This is said to be an unearned income effect that reduces the female labour supply.

3.2 The model:

On the basis of theoretical literature and empirical studies we use the GDP and its square for the estimation of U- shaped relationship between female labour supply and economic development. Based on the general form of U-shaped relationship between female labor force participation and economic growth is modeled as follows:

$$FP_t = f(Y_t, Y_t^2) \qquad (1)$$

Where, FP is female labor force participation and Y is level of economic development. We have converted the both series into per capita before taking natural log of female labor force participation and economic development. It is pointed by Ehrlich, (1975, 1996) and Cameron, (1994) that adoption log-linear specification is better option for empirical analysis. The log-linear

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[3] Steel,W.F(1981)"Female ans small scale employment under Modernization in Ghana".Economic Development and Cultural change,30:153-167(seen in Tansel, Aysit(2005).

specification provides reliable, efficient and unbiased results. So, the log-linear specification is as following:

$$\ln FP_t = \alpha_1 + \alpha_Y \ln Y_t + \alpha_{Y_t^2} \ln Y_t^2 + \varepsilon_i \qquad (2)$$

where $\ln FP_t$, $\ln Y_t$, $\ln Y_t^2$ and ε is natural log of female labor force participation per capita, natural log of real GDP per capita, squared of natural log of real GDP per capita and is residual term supposed to be independently, identically and normally distributed.

3.3 Data Sources:

The study coves the period of 1980-2010 due to availability of data on female labor force participation from 1980. The data on female labor force participation is collected from webpage of International Labour Organization (ILO). The world development indicators (CD-ROM, 2011) have sourced to collect data on real GDP per capita.

4. Methodological Framework and Empirical Results

This study use time series data, which always show some trends that's why the properties of stationarity are necessary. Stationarity properties of the macroeconomic variables can be investigated by applying a variety of unit root tests which are available in applied economics. We use following unit root tests; ADF by Dickey and Fuller (1979), P-P by Philips and Perron (1988) and Ng-Perron by Ng-Perron (2001). The explanation of all tests is given below:

4.1 ADF Unit Root Test

Extensive empirical research is available, where researchers have used ordinary least squared (OLS) method to investigate the relationship between macroeconomic series. The problem with OLS procedure is that it is supposed that residual term is normally distributed and has zero mean and finite constant. This implies that without examining unit root properties of the variables, OLS provides misleading empirical evidence which may be useless for policy analysis. It is necessary to test the integrating order of the series while investigating cointegration relationship between the variables. We start from widely used unit root test i.e. Augmented Dickey-Fuller developed by [Dickey and Fuller, (1981)] which can be applied if residual term seems to be time variant. The knowledge about unit root properties is necessary to make times series reliable and efficient. The estimable equation is modelled as following:

$$\Delta Y_t = \beta_1 + \beta_2 T + \delta Y_{t-1} + \alpha_j \sum_{i=1}^{m} \Delta Y_{t-i} + \varepsilon_i \qquad (3)$$

Where Δ is difference operator and ε is residual term following the assumption of normality.

$$\Delta Y_t = (Y_t - Y_{t-1}), \Delta Y_{t-1} = (Y_{t-1} - Y_{t-2}), \ \Delta Y_{t-2} = (Y_{t-2} - Y_{t-3}) \text{ etc.}$$

The main objective here is to test whether δ is equal to zero or not. The critical T-statistics are generated by Dickey and Fuller, (1979) to examine unit root problem. The series Y is said to be stationary, if the estimate of δ is less than tabulated T-statistics.

4.2 Philips and Perron Unit Root Test

ADF unit root test is applicable when there is serial correlation and heteroskedasticity is found between error terms. ADF unit root test is parametric test and different in nature from Philips and Perron unit root test. Philips and Perron (1988) unit root test is non-parametric test. PP does not consider if there is any serial correlation in test regression while ADF test follows serial correlation. The empirical equation is modelled as following:

$$\Delta Y_t = \beta' D_t + \theta Y_{t-1} + \varepsilon_i \qquad (4)$$

Where ε is assumed to be stationary at level with heteroskedasticity. Phillips and Perron (1988) unit root test solves the problem of serial correlation and heteroskedasticity by revising the T-statistics $t_{\pi=0}$ and $T\hat{\pi}$. These revised statistics, are renamed as Z_t and Z_π, given by:

$$Z_t = \left(\frac{\hat{\sigma}^2}{\hat{\lambda}^2}\right)^{1/2} . t_{\pi=0} - 1/2 \left(\frac{\hat{\lambda}^2 - \hat{\sigma}^2}{\hat{\lambda}^2}\right) \left(\frac{T.SE(\hat{\pi})}{\hat{\sigma}^2}\right)$$

$$Z_\pi = T\hat{\pi} - 0.5 \times \left(\frac{T^2.SE(\hat{\pi})}{\hat{\sigma}^2}\right) \times (\hat{\lambda}^2 - \hat{\sigma}^2)$$

These terms such as $\hat{\sigma}^2$ and $\hat{\lambda}^2$ are variance parameters.

$$\sigma^2 = \lim_{T \to \infty} T^{-1} \sum_{t=1}^{T} E[u_t^2]$$

$$\lambda^2 = \lim_{T \to \infty} \sum_{t=1}^{T} E[T^{-1} S_T^2]$$

Where, $ST = \sum_{t=1}^{T} u_t$. The least square residual u_t seems to be consistent with σ^2 and estimates u_t

and $\hat{u}_t$ of Newey-West long run variances are consistent with λ^2 . Following the null hypothesis of

$\pi = 0$, Z_t and Z_π in PP unit root test do have normal distribution as the ADF unit root test has. The

PP unit root test selects appropriate lag (bandwidth) by itself endogenously. The PP unit root test

considers heteroskedasticity of residual terms while doing analysis. It is pointed out by Dejong et al.

(1992) and Harris (2003) that these unit root tests have poor size and power properties. So results

provided by these tests are not reliable and efficient for small samples. ADF and PP unit root tests

seem to over-reject the null hypotheses when it is true and accept it when it is false. Ng-Perron

(2001) developed a test statistics wherein GLS is applied to de-trend the series D_t^d . The critical

values of the tests are based on those of Philip-Perron (1988) Z_α and Z_t statistics, Bhargava (1986)

R_1 statistics, and Elliot, Rotherberg and Stock (1996). The following annotations are used:

$$k = \sum_{t=2}^{T} (D_{t-1}^d)^2 / T^2 \qquad (5)$$

The de-trended GLS tailored statistics is given by:

$MZ_a^d = (T^{-1}(D_T^d)^2 - f_\circ)/(2k)$

$MZ_t^d = MZ_a \times MSB$

$MSB^d = (k/f_\circ)^{1/2}$

$$MP_T^d = \left\{ (\bar{c}^2 k - \bar{c} T^{-1}(D_T^d)^2 / f_\circ, and, (\bar{c}^2 k + (1 - \bar{c}) T^{-1}(D_T^d)^2 / f_\circ \right. \qquad (6)$$

All these econometric tests don't contain any information about the structural break points

of the time series. Therefore, these tests yield biased and spurious results due to the absence of

information about structural break points occurred in the time series.

4.3   Zivot-Andrews Unit Root Test

The drawback about the absence of structural break points has been removed by Zivot-

Andrews (1992) by developing three new econometric models. These econometric models are very

useful in investigating the stationarity properties of the macroeconomic variables in the presence of

structural break points in the series. These models allow (i) a one-time change in variables at

level form, (ii) a one-time change in the slope of the trend component i.e. function and (iii) a model

has one-time change both in intercept and trend function of the variables to be used for empirical

propose. Zivot-Andrews (1992) adopted three models to check the hypothesis of one-time structural break in the series as follows:

$$\Delta x_t = a + ax_{t-1} + bt + cDU_t + \sum_{j=1}^{k} d_j \Delta x_{t-j} + \mu_t \quad (7)$$

$$\Delta x_t = b + bx_{t-1} + ct + bDT_t + \sum_{j=1}^{k} d_j \Delta x_{t-j} + \mu_t \quad (8)$$

$$\Delta x_t = c + cx_{t-1} + ct + dDU_t + dDT_t + \sum_{j=1}^{k} d_j \Delta x_{t-j} + \mu_t \quad (9)$$

In the above equation dummy variable is represented by DU_t showing mean shift occurred at each point with time break, while trend shift variables is shown by DT_t [4]. So,

$$DU_t = \begin{cases} 1...if\ t > TB \\ 0...if\ t < TB \end{cases} \text{and} DU_t = \begin{cases} t - TB...if\ t > TB \\ 0...if\ t < TB \end{cases}$$

The null hypothesis of unit root break date is $c = 0$ which indicates that series is not stationary with a drift not having information about structural break point while $c < 0$ hypothesis implies that the variable is found to be trend-stationary with one unknown time break. Zivot-Andrews unit root test fixes all points as potential for possible time break and does estimate through regression for all possible break points successively. Then, this unit root test selects that time break, which decreases one-sided t-statistic to test $\hat{c}(= c - 1) = 1$. Zivot-Andrews intimate that in the presence of end points, asymptotic distribution of the statistics is diverged to infinity point. It is necessary to choose a region where end points of sample period are excluded. Further, Zivot-Andrews suggested the trimming regions i.e. (0.15T, 0.85T) are followed.

To examine long run relationship between the variables of interest, there are numerous cointegration approaches available in existing literature. For example, Engle and Granger (1987) based on two-step procedure, Johansen (1988), Johansen and Juselius (1990) based on full information maximum likelihood and, Stock and Watson (1993) based on dynamic ordinary least square require that all the series should be integrated at same order of integration. These cointegration approaches do not have good power properties for small sample and require large sample data for efficient and reliable empirical evidence (Gonzalo and Lee, 1998). These tests seem produce misleading results regarding cointegration if series are integrated at I (1) or I (0) in the

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[4] We used model-4 for empirical estimations following Sen (2003)

system (Cheung and Lai, 1993). Moreover, critical values developed by Johansen co-integration approach are not suitable (Turner, 2009).

4.4 The ARDL Bounds Testing Approach to Cointegration

The autoregressive distributed lag modeling or the ARDL bounds testing approach developed by Pesaran et al. (2001) is superior to traditional cointegration approaches due to numerous aspects. For example, the ARDL bounds testing approach is suitable to apply for long run relationship between the variables if the variables are found to be stationary at level or 1st difference. The bounds testing approach to cointegration is suitable for small sample. In the presence of some endogenous variables, the ARDL bounds testing provide efficient long run estimates with valid t-statistics. The bounds approach to cointegration also seems to combine short run dynamics with long run equilibrium path having long run information following unrestricted error correction model (UECM). The UECM is modeled as following:

$$
\Delta \ln FP_t = \vartheta_1 + \vartheta_T T + \vartheta_Y \ln Y_{t-1} + \vartheta_{Y^2} \ln Y_{t-1}^2 + \vartheta_{FP} \ln FP_{t-1} + \sum_{j=1}^{q} \vartheta_j \Delta \ln FP_{t-j}
$$

$$
+ \sum_{k=0}^{r} \vartheta_k \Delta \ln Y_{t-k} + \sum_{l=0}^{r} \vartheta_l \Delta \ln Y_{t-l}^2 + \varepsilon_i
$$

(10)

Where difference operator is indicated by Δ, T is trend variable and ε is residual term assumed to have normal distribution with finite variance and zero mean. Next step is to compute the ARDL F-statistic to examine whether cointegration between the variables exists or not. Appropriate lag order of is necessary to choose because value of F-statistic varies with lag order. We use Akaike Information Criteria (AIC) to choose suitable lag length. We apply F-test developed by Pesaran et al. (2001) to examine the joint significance of estimates of lagged level of the series. The null hypothesis of no co-integration is $H_0 : \vartheta_Y = \vartheta_{Y^2} = \vartheta_{FP} = 0$ and hypothesis of co-integration is $H_0 : \vartheta_Y \neq \vartheta_{Y^2} \neq \vartheta_{FP} \neq 0$. Two asymptotic such as upper critical bound (UCB) and lower critical bound (LCB) have been generated by Pesaran et al. (2001). We accept the hypothesis of cointegration if computed F-statistic is more than upper critical bound. The hypothesis of cointegration is rejected once lower critical bound is more than our computed F-statistic. We cannot make decision about cointegration if computed F-statistic is between upper and lower critical bounds. We utilize critical bounds developed by Narayan (2005) because these are suitable for small sample i.e. T = 30 to T = 80.It is pointed by Narayan (2005) that critical -bounds provided by Pesaran et al. (2001) are downwards and may produce misleading results. The diagnostic tests have also been conducted to test the problem of normality, serial correlation, autoregressive conditional heteroskedasticity,

white heteroskedasticity and specification of the ARDL bound testing model. Once long run relationship between economic development and female labor force participation is established then it is necessary to find short run impact of economic development on female labor force participation in case of Pakistan. In doing so, we apply error correction method (ECM). The empirical equation of ECM is modeled as follows:

$$\Delta \ln FP_t = \delta_{\circ 1} + \sum_{i=1}^{l} \delta_{FP} \Delta \ln FP_{t-i} + \sum_{j=0}^{m} \delta_Y \Delta \ln Y_{t-j} + \sum_{k=0}^{n} \delta_{Y^2} \Delta \ln Y_{t-k}^2 + \vartheta ECM_{t-1} + \varepsilon_i \quad (11)$$

Where, ECM_{t-1} is lagged error term. ϑ is estimate of lagged error term captures the speed of adjustment from short run towards long run equilibrium path. Here, we say that differenced of female labor force participation is explained by differenced of linear (non-linear) term of real GDP per capita plus lagged error term and stochastic term.

We have conducted diagnostic tests to test the CLRM assumptions such as normality of error term, serial correlation, autoregressive conditional heteroskedasticity, white heteroskedasticity and specification of short model. The reliability of short run estimates is investigated by applying the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMsq) suggested by Pesaran and Shin, (1999).

4.5 Empirical Results

Our empirical discussion starts from descriptive statistics and correlation matrix. The results are reported in Table-1. The results specify that all the series have been normally distributed. The mean is and variance is constant of the residual terms of the series. The correlation matrix reveals that there is a positive and strong correlation exists between economic development and female labor force participation in case of Pakistan.

Table-1: Descriptive Statistics and Correlation Matrix

Variables	$\ln FP_t$	$\ln Y_t$	$\ln Y_t^2$
Mean	1.4293	10.1256	102.5631
Median	1.3353	10.1501	103.0261
Maximum	1.9675	10.4512	109.2295
Minimum	1.1656	9.7734	95.5200
Std. Dev.	0.2309	0.1872	3.7915
Skewness	1.1060	-0.0125	0.0217

Kurtosis	3.1213	2.2586	2.2571
Jarque-Bera	6.3398	0.7107	0.7152
Probability	0.0420	0.7009	0.6993
Observations	31	31	31
$\ln FP_t$	1.0000		
$\ln Y_t$	0.8689	1.000000	
$\ln Y_t^2$	0.8732	0.9999	1.0000

Source: Author's Estimation

The next step is to test the unit root properties of female labor force participation and economic development, in doing we have applied ADF (Dickey and Fuller, 1979), PP (Philips and Perron, 1988) and Ng-Perron (Ng-Perron, 2001) unit root tests. Although, the ARDL bounds testing approach to cointegration is flexible whether variables are integrated at I (0) or I (1) or I (0)/ I (1). But it is important to have information about the unit root properties of the variables. The assumption of the ARDL bound testing approach is that the series under investigation should be integrated at I (0) or I (1). If any variable is found to be stationary beyond that order of integration, then process of computing the ARDL F-statistic becomes unusable. Just to ensure that none of the variables is stationary at 2nd difference. The results of ADF, PP and Ng-Perron unit root tests are detailed in Table-2.

Table-2: Unit Root Analysis

Variables	ADF Unit Root Test		PP Unit Root Test		Ng-Perron Unit Root Test			
	T-statistic	Prob. value	T-statistic	Prob. value	MZa	MZt	MSB	MPT
$\ln FP_t$	-1.3747 (1)	0.8463	-0.8427 (3)	0.9459	-4.2816 (1)	-1.2598	0.29425	19.4041
$\ln Y_t$	-1.9645 (1)	0.5946	-1.8076 (3)	0.6749	-8.3933 (1)	-2.0322	0.2421	10.9069
$\ln Y_t^2$	-1.9268 (1)	0.6140	-1.7576 (3)	0.6988	-8.5504 (1)	-2.0455	0.2392	10.7288
$\Delta \ln FP_t$	-4.8335 (1)*	0.0032	-5.7271 (3)*	0.0004	-34.7297 (2)*	-4.1629	0.1198	2.6465
$\Delta \ln Y_t$	-3.5666 (0)***	0.0514	-3.5324 (3)***	0.0551	-84.1507 (5)*	-6.486	0.07708	1.0838
$\Delta \ln Y_t^2$	-3.5464 (0)***	0.0536	-3.5111(3)***	0.0575	-82.9746 (5)*	-6.4408	0.07762	1.09913
Note: *, ** and *** indicate significant at 1%, 5% and 10% levels respectively. Optimal lag order for ADF and bandwidth for PP unit root tests is determined by Schwert (1989) formula. Optimal lag order of the variables is given in small parentheses.								

Source: Author's Estimation

The results indicate that female labor participation per capita and real GDP per capita have unit root problem at level with constant and trend. Both series are stationary at 1st difference indicated by statistics of ADF, PP and Ng-Perron unit root tests. This shows that series have same order of integrated i.e. (1). The problem with these unit root tests is that they do not have information about structural break stemming in the series. In such an environment, application of these tests provides unreliable and biased results. Baum (2004) forced to apply structural break unit root test to examine unit root properties of the variables. The reason is that misleading results about order of integration of the variables would be helpful for policy makers in articulating comprehensive economic policy. To overcome this objection, we choose to apply Zivot-Andrews (Zivot and Andrews, 1992) structural break unit root test which allows having information about the unknown structural break point stemming in the time series.

The results are reported in Table-3. The results indicate that variables do have unit root problem at level with a structural break both in intercept and trend. The both variables are found to be stationary at 1st difference. This implies that the variables are integrated at I (1). The unique integrating properties of the both series leads us to implement the ARDL bounds testing approach to cointegration examining the long run relationship between female labor force participation per capita and real GDP per capita over the study period in case of Pakistan. An appropriate lag order of the variables is needed to apply the ARDL bounds testing. Various lag length criterion are available indicated in Table-3.

Table-3: Zivot-Andrews Structural Break Unit Root Test

Variables	At Level		At 1st Difference	
	T-statistic	Time Break	T-statistic	Time Break
$\ln FP_t$	-3.963 (0)	1996	-5.678 (0)*	1997
$\ln Y_t$	-3.629(1)	1997	-5.632(0)*	2004
$\ln Y_t^2$	-3.667(1)	1997	-5.623(0)*	2004
Note: * represents significant at 1% level. Critical T-values are -5.57 and -5.08 at 1% and 5% levels respectively. Optimal lag order of the variables is given in small parentheses.				

Source: Author's Estimation

We followed Akaike information criteria to select appropriate lag length. It is pointed by Lütkepohl, (2006) that AIC has superior power properties for small sample data compared to any

lag length criterion. Our decision about leg length is based on the minimum value of AIC. The results are reported in Table-4. It is found that we cannot take lag more than 1 in such small sample data.

Table-4: Lag Length Selection

VAR Lag Order Selection Criteria						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	113.3788	NA	9.92e-08	-7.612329	-7.470884	-7.568030
1	245.0620	227.0401*	2.11e-11*	-16.07324*	-15.50747*	-15.89605*
2	252.8795	11.86094	2.34e-11	-15.99169	-15.00158	-15.68160

* indicates lag order selected by the criterion   LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error   AIC: Akaike information criterion
SC: Schwarz information criterion   HQ: Hannan-Quinn information criterion

Source: Author's Estimation

The next step is to estimate the ARDL F-statistic to examine the existence of cointegration between female labor force participation and real GDP per capita over the study period of 1980-2010 in case of Pakistan. The results of the ARDL F-statistic are reported in Table-5.

Table-5: The ARDL Co-integration Analysis

Estimated Model	$FP_t = f(Y_t, Y_t^2)$	
Optimal lag structure	(1, 1, 1)	
F-statistics	11.017*	
Significant level	Critical values (T = 31)#	
	Lower bounds, $I(0)$	Upper bounds, $I(1)$
1 per cent	7.763	8.922
5 per cent	5.264	6.198
10 per cent	4.214	5.039
R^2 0.5582 F-statistics 2.1481***	$Adj - R^2$ 0.2983 DW Test 1.9727	
$\chi^2 NORMAL$ 3.0576 (0.2167) $\chi^2 ARCH$ 0.0372 (0.8478) $\chi^2 RAMSEY$ 0.4396 (0.5166)	$\chi^2 SERIAL$ 1.2057 (0.3268) $\chi^2 WHITE$ 0.9252 (0.5782)	

Note: * and *** show significant at 1 per cent and 5 per cent levels respectively. We have used critical bounds developed by Narayan (2005). $\chi^2 NORM$ is for normality test, $\chi^2 SERIAL$ for LM serial correlation test, $\chi^2 ARCH$ for autoregressive conditional heteroskedasticity, $\chi^2 WHITE$ for white heteroskedasticity and $\chi^2 RAMSEY$ for Resay Reset test. In parenthesis p-values is given.

The results indicate that our computed F-statistic i.e. 11.017 is greater than upper critical bounds at 1 per cent level of significance once we used real GDP per capita (squared of real GDP per capita) is used as forcing variable. This confirms the existence of cointegration between the variables. This shows that there is a long run relationship between female labor force participation and economic development over the period of 1980-2010 in case of Pakistan. Furthermore, the model of ARDL bounds testing has passed the assumptions of CLRM such as error term is normally distributed. There is no existence of serial correlation between the variables and residual term. No evidence is found for autoregressive conditional heteroskedasticity and same inference can be drawn for white heteroskedasticity. The statistic of Ramsey reset test shows that model is well articulated.

The existence of long run relationship between the variables leads us to examine long run impact of independent variables on dependent variable. The empirical evidence of marginal impact of economic development on female labor force participation is reported in Table-7. Our results show that both linear and non-linear terms of real GDP per capita are statistically significant at 1 per cent level of significance. This finding validates the existence of U-shaped relationship between female labor force participation and economic development. It is noted that a 1 per cent rise in economic growth is linked with -60.1726 per cent decline in female labor force participation shown by estimate of linear term while positive sign of non-linear (squared) term of real GDP per capita indicates the joining point of female labor force participation and real GDP per capita with a rise economic growth to higher levels. The estimate of non-linear term of real GDP per capita is 3.0191.

This shows that initial level of economic growth lowers the demand for female labor force and demand for female labor force increases at higher level of economic development after the threshold point. The threshold point Rs. 21597 real per capita GDP and Pakistan achieved this point in 1987[5].These findings are consistent with Pampel and Tanaka, (1986);Tansel, (2002) and Fatima and Sultana, (2009). All these studies support that the coefficient of the level of income per worker was negative and significant but that of its square is positive and significant.

The results show that female labor force participation is 95.36 per cent explained by real GDP per capita and squared of real GDP per capita and rest is by other factors included in residual term. Overall model is significant shown by F-statistic. There is no evidence of autocorrelation as indicated by Durban Watson test. The diagnostic tests show that there is no evidence of serial correlation between the variables used in the model. The evidence of autoregressive conditional

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[5]The long span of data may change that threshold point.

heteroskedasticity is not found and same view is about the white heteroskedasticity. The model is well specified reported by estimate of Ramsey reset test.

Table-7: Long Run OLS Analysis

Dependent Variable = $\ln FP_t$ [6]				
Variable	**Coefficient**	**Std. Error**	**T-Statistic**	**Prob. value**
Constant	301.0709*	47.3969	6.3521	0.0000
$\ln Y_t$	-60.1726*	9.3234	-6.4539	0.0000
$\ln Y_t^2$	3.0191*	0.4584	6.5862	0.0000
R-squared 0.9536 Adj. R-squared 0.9483				
Durbin-Watson 1.5883 F-statistic 178.4347*				
$\chi^2 SERIAL$ 1.7708 (0.1676) $\chi^2 ARCH$ 0.0010 (0.9739)				
$\chi^2 WHITE$ 0.2348 (0.7922) $\chi^2 RAMSEY$ 0.5310 (0.4724)				
Note: * shows significance at 1% level. $\chi^2 NORM$ is for normality test, $\chi^2 SERIAL$ for LM serial correlation test, $\chi^2 ARCH$ for autoregressive conditional heteroskedasticity, $\chi^2 WHITE$ for white heteroskedasticity and $\chi^2 REMSAY$ for Resay Reset test. In parenthesis p-values is given.				

Source: Authors' estimation.

The next step is to examine the short run impact of economic development on female labor force participation in case of Pakistan. For this purpose we have used error correction method (ECM). The results are reported in Table-8. It is found from our analysis that U-shaped relationship between economic development and female labor force participation also exists in Pakistan. The linear and non-linear (squared) of real GDP per capita have negative and positive according to expectations and it is statistically significant at 10 per cent level of significance. The short run coefficients are smaller than log run estimates. This confirms that our results are reliable and efficient.

The estimate of error correction term i.e. ECM_{t-1} has negative sign and it is statistically significant at 1 per cent level of significance. The coefficient of ECM_{t-1} shows the speeds of adjustment from short run towards long run equilibrium path. If speed of adjustment is higher then greater would be correction in deviations from short run towards long run (Banerjee, et al. 1993). It is also pointed by Bannerjee et al (1998) that we can validate our established long run relationship between the variables through the statistical significance of error correction term. The coefficient of

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[6] We have used AR (1) process to remove autocorrelation in the model. The estimate of AR (1) is 0.3573 and it is statistically significant at 5% level.

ECM_{t-1} is -0.5980 and it is statistically significant at 1 per cent level of significance. This confirms our long run established relationship between economic development and female labor force participation in case of Pakistan.

Table-8: Short Run OLS Analysis

Dependent Variable = $\Delta \ln FP_t$				
Variable	Coefficient	Std. Error	T-Statistic	Prob. value
Constant	0.0122	0.0127	0.9635	0.3441
$\Delta \ln Y_t$	-25.6126***	13.5074	-1.8961	0.0691
$\Delta \ln Y_t^2$	1.2978***	0.6614	1.9620	0.0605
ECM_{t-1}	-0.5980*	0.1368	-4.3698	0.0002
R-squared 0.3771		Adj. R-squared		0.3052
Durbin-Watson 1.5507		F-statistic		5.2480*

Diagnostic Tests
$\chi^2 SERIAL$ 1.9049 (0.1706) $\chi^2 ARCH$ 0.1142 (0.7380)
$\chi^2 WHITE$ 0.2509 (0.9539) $\chi^2 RAMSEY$ 0.1620 (0.6906)

 CUSUM   Unstable (5%)   CUSUMsq   Stable (5%)

Note: * and *** represent significant at 1% and 10% levels respectively. $\chi^2 NORM$ is for normality test, $\chi^2 SERIAL$ for LM serial correlation test, $\chi^2 ARCH$ for autoregressive conditional heteroskedasticity, $\chi^2 WHITE$ for white heteroskedasticity and $\chi^2 REMSAY$ for Resay Reset test. In parenthesis p-values is given.

Source: Author's Estimation

Moreover, our results show that deviation is female labor force participation from short span of time to long run is précised by 59.80 per cent every year. This speed of adjust is fast and indicates that adjustment process would take 1 year and 7 months in case of Pakistan for female labor force participation model. The empirical evidence of diagnostic checks shows no indication of serial correlation, autoregressive conditional heteroskedasticity, white heteroskedasticity and functional form of short run model is well specified.

The stability of long run and short run estimates has been tested by applying the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMsq) are applied. It is suggested by Pesaran and Shin, (1999) to apply these tests. The null hypothesis of both CUSUM and CUSUMsq may be accepted that if plots of both tests are moving between critical limits. The null hypothesis is "regressions equation is correctly specified" (Bahmani-Oskooee and Nasir, 2004).

Figure-1: Plot of Cumulative Sum of Recursive Residuals
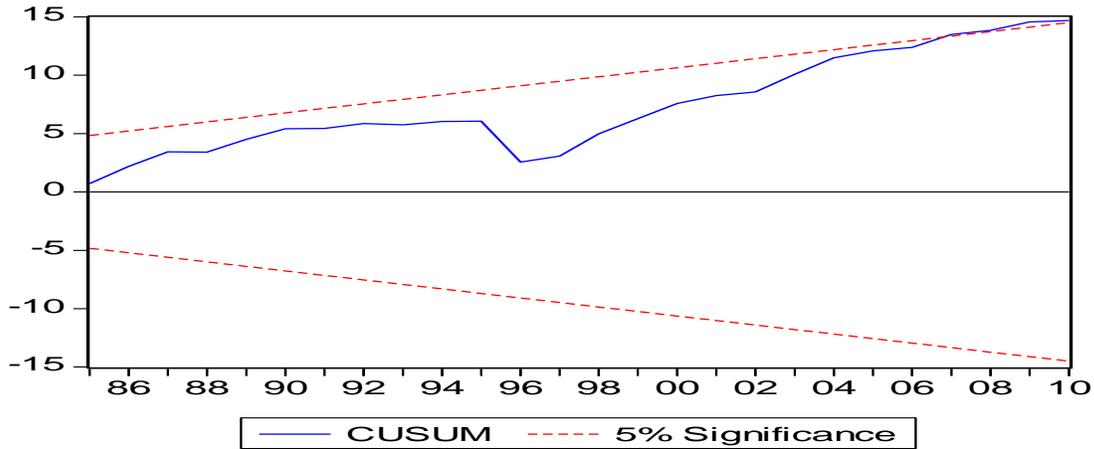
The straight lines represent critical bounds at 5% significance level

The results of both CUSUM and CUSUMsq tested are reported in Figures 1 and 2. The plot of CUSUM test crosses upper critical limit after 2008 may be showing the impact of regime shift from dictatorship to democracy (structural break).

Table-9: Chow Forecast Test

Chow Forecast Test: Forecast from 2008 to 2010			
F-statistic	0.1519	Probability	0.9273
Log likelihood ratio	0.5887	Probability	0.8990

Source: Author's Estimation

Leow, (2004) noted that we should not reply graphs. Graphs do not provide reliable results. That's we have applied Chow forecast test to observe the significance of structural break in case of Pakistan in 2008. The results of Chow Forecast Test do not seem to show any structural break in the country confirmed by F-statistic.

Figure-2: Plot of Cumulative Sum of Recursive Residuals
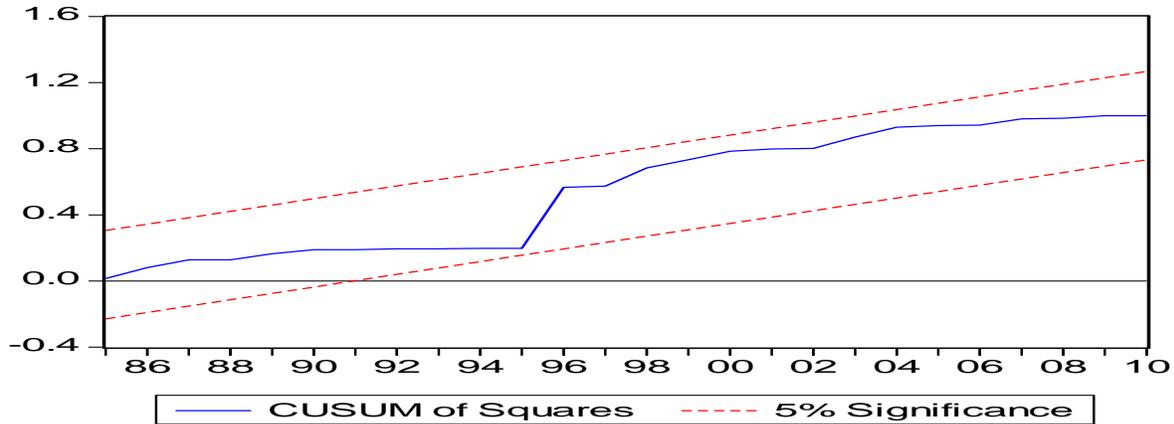
The straight lines represent critical bounds at 5% significance level

The CUSUMsq test shows that graph does not seem to cross lower and upper critical limits. So, we can conclude that long and short runs estimates are reliable and efficient.

5. Conclusion and Policy Implications

This study deals with the empirical investigation of relationship between economic development and female labor force participation in case of Pakistan over the period of 1980-2010. Unit root tests such as ADF, PP and Ng-Perron as well as Zivot-Andrews structural break unit root test have been applied to test the stationarity properties of the variables. The ARDL bounds testing approach to co-integration is implemented to examine cointegration for long run relationship between economic development and female labor force participation. Our results confirm long run and U shaped association between both variables long run as well as in short run in case of Pakistan. Pakistan is undergoing on the severe economic crisis that has produced a lot of social and economic problems within the country. Due to which the marginalized segment of the population which is in the form of women and children have become more actively associated in the marginalized activities. The participation of female is understated due to the exclusion of marginal activities and the invisible contribution of women in the economy. In case of Pakistan, it is desirable as well as the need of the day to narrow the gap between men and women through providing equal opportunities to females in terms of better market opportunities, better wages, more job opportunities etc. There is a strong link between economic growth and female labour supply so that the policy makers should concentrate on increasing and improving female's education and skills. The adoption of gender specific wage laws may be reduced the earning gap between both the genders. Moreover, measures to improve the employment opportunities along with the expansion of the manufacturing and industrial sector will contribute to increase the female labour supply. The

policy makers should focus on cottage industries where the role and participation of females can easily be increased due to our cultural and traditional skills. To encourage the female labour supply in the labour market the government must provide child care subsidies specially in the form of day care centers, pri-school education etc, which may ultimately supports the females and encourage them to participate in the economic activities.

References

- Pampel, F.C. and K. Tanaka (1986). Economic Development and Female Labor Force Participation: A Reconsideration. Social Forces, 64 (3): 599-619.

- Tansel, Aysit, (2002). Economic Development and Female Labor force Participation in Turkey: Time-Series Evidence and Cross-Province Estimates", Department of Economics, Middle East Technical University, Ankara, Turkey.

- Schultz, T. Paul (1990a). Women.s Changing Participation in the Labor Force: A World International Perspective., Economic Development and Cultural Change, Volume 38 (3): 456-488.

- Schultz, T. Paul (1990b). Testing the Neoclassical Model of Family Labor Supply and Fertility.,Journal of Human Resources, Volume 25 (4):599-634.

- Sinha, J. N. (1967). Dynamics of Female Participation in Economic Activity in a Developing Economy in proceedings of the World Population Conference.Belgrade, 1965, Vol. IV, Migration, Urbanization, Economic Development. New York: United Nations, pp

- Boserup, Ester. 1970. *Woman's role in Economic Development*. New York: St. Martin's Press.

- Mincer, J. (1962). Labor Force Participation of Married Women: A Study of Labor Supply, in H. Gregg Lewis, (ed.), Aspects of Labor Economics", Princeton, N.J.: National Bureau of Economic Research, Princeton University Press.

- Psacharopoulos, G. and Z. Tzannatos (1989) Female Labor Force Participation: An
- International Perspective. **World Bank Research Observer**, 4(2): 187-201.

- Heckman, J. (1978) A Partial Survey of Recent Research on the Labor Supply of Women.
- **American Economic Review,** 68: 200-207.

- Durand, J.D. (1975) **The Labor Force in Economic Development**, Princeton: Princeton
- University Press.

- Mark R. Killingsworth. (1986). Female Labor Supply: A Survey, Handbook of Labor Economics, Vol. 1, Edited by O. Ashenfelter and R. Layard.

- Cameron, S.,1994, A review of the econometric evidence on the effects of capital punishment.Journal of Socio-economics23, 197-214.

- Dickey, D., Fuller, W.A., (1979). Distribution of the estimates for autoregressive time series with unit root. Journal of the American Statistical Association 74, 427-431.

- Zivot, E., Andrews, D., (1992). Further evidence of great crash, the oil price shock and unit root hypothesis. Journal of Business and Economic Statistics

- Gonzalo, J., Lee, T. H., (1998). Pitfalls in testing long run relationship. Journal of Econometrics 86, 129-154.

- Turner, P. (2009). Testing for Co-integration using the Johansen approach: are we using the correct critical values?, Journal of Applied Econometrics 24, 825-831.

- Cheung, Y., Lai, K. S., (1993). Finite-sample sizes of Johansen's likelihood ratio test for cointegration. Oxford Bulletin of Econometrics and Statistics 55, 313-328.

- Stock, J. H., Watson, M. W., (1993). A simple estimator of cointegrating vectors in higher order integrated systems. Econometrica 61, 783-820.

- Johansen, S., (1988). Statistical analysis of cointegration vectors. Journal of Economic Dynamics and Control 12, 231-254.

- Pesaran, M.H., Shin, Y., Smith, R., (2001). Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics 16, 289-326.

- Baum, C. F., (2004). A review of Stata 8.1 and its time series capabilities. International Journal of Forecasting 20, 151-161.

- Bahmani-Oskooee, M., Nasir, A. B. M., (2004). ARDL approach to test the productivity bias hypothesis. Review of Development Economics 8, 483-488.

- Kuznets, Simon Smith. (1966). *Economic Growth and Income Equality.*

- Pesaran, M. H., Shin, Y., (1999). An autoregressive distributed lag modeling approach to co-integration analysis. In S. Strom (ed.) Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium. Ch. 11. Cambridge: Cambridge University Press.

- Fatima, Ambreen, Humera Sultana,(2009). Tracing out the U-Shape Relationship Between Female Labor Force Participation Rate and Economic Development for Pakistan, Applied Economics Research Centre, University of Karachi.

- Goldin, C. (1995). The U-Shaped Female Labor Force Function in Economic Development and Economic History, National Bureau of Economic Research: Working Paper Series (Working paper No. 4707)

- Kristin Mammen. Christina, Paxson, (2000). "Women's Work and Economic Development", The Journal of Economic Perspectives, Vol. 14, No. 4. pp. 141-164.

- Schultz, T. Paul (1991). International Differences in Labor Force Participation in Families and Firms., Economic Growth Center Discussion Paper No 634, Yale University, August, pages 62.

- Dickey, D., Fuller, W.A., (1979). Distribution of the estimates for autoregressive time series with unit root, Journal of the American Statistical Association 74, 427-431.

- Phillips, P.C.B., Perron, P., (1988). Testing for a Unit Root in Time Series Regression.Biometrica 75, 335-446.

- Ng, S., Perron, P., (2001). Lag length selection and the construction of unit root test with good size and power. Econometrica 69, 1519-1554.

- Dejong, D.N., Nankervis, J.C., Savin, N.E. (1992). Integration versus Trend Stationarity in Time Series.Econometrica 60, 423-33.

- Harris, R., Sollis, R., (2003). Applied Time Series Modeling and Forecasting.Wiley, West Sussex.

- Engle, R., Granger, C., (1987). Cointegration and error correction: Representation, estimation and testing. Econometrica 55, 251-276.

- Narayan, P. K., (2005). The saving and investment nexus for China: evidence from co-integration tests. Applied Economics 37, 1979-1990.

- Baum, C. F., (2004). A review of Stata 8.1 and its time series capabilities, International Journal of Forecasting 20, 151-161.

- Lütkepohl, H., (2006). Structural vector autoregressive analysis for cointegrated variables, AStA Advances in Statistical Analysis 90, 75-88.

- Bannerjee, A., Dolado, J., Mestre, R., 1(998). Error-correction mechanism tests for co-integration in single equation Framework. Journal of Time Series Analysis 19, 267-283.

- Bloom, D. E. and J. G. Williamson,(1998). Demographic Transitions and Economic Miracles in Emerging Asia, World Bank Economic Review, 12(3), 419-455.

- Bloom, D. E., D. Canning, G. Fink, and J. E. Finlay. (2009a). Fertility, female labor force participation, and the demographic dividend, Journal of Economic Growth 14: 79– 101.

- Çakır,Onur , (2008),The Relationship between Economic Development and Female Labor Force Participation within the Framework of U-Shaped Hypothesis: Evidence from Turkey, Department of Economics, Master Thesis, Lund University.

- Sanjukta ,Chaudhuri,(2010) Women's Empowerment in South Asia and Southeast Asia: A Comparative Analysis,University of Wisconsin - Eau Claire

- Steel, W.F. (1981) Female and Small Scale Employment Under Modernization in Ghana.
- **Economic Development and Cultural Change**, 30: 153-167.

- Killingsworth, M. R., and J. J. Heckman. 1986. "Female Labor Supply: A Survey." Handbook of Labor Economics. Vol.1, edited by 0. Ashenfelter and R. Layard, eds., Amster-dam: Elsevier.

- Standing, G. (1978) **Labor Force Participation and Development**, Geneva: International
- Labor Office.

- Hill, M. A. (1983) Female Labor Force Participation in Developing and Developed
- Countries. **Review of Economics and Statistics,** 65: 459-467.

- Kottis, A.P. (1990) Shifts Over Time and Regional Variation in Women's Labor
- **Force Participation Rates in a Developing Economy. Journal of Development**
- **Economics, 33: 117-132.**