Literature Review
Open Access

# Index of female labour force participation and its association with demographic dividends of India

## Abstract

India has entered into *Amrit Kaal* (an auspicious period most conducive to achieving the country's potential). Share of working-age population (WAP) has exceeded the combined share of children and elderly population since 2018 and is likely to continue till 2055 with peak expected around 2041. To take maximum advantage of demographic dividends, India needs to increase female labour participation rate (FLFPR) and bring the unemployed labour into the labour market by implementing policies aiming at gender equality, improved health, education, expansion of opportunities of employment, etc. The paper describes multidimensional index of FLFPR of a country at *t*-th year $I_{FLFPR_t}$ by aggregating correlates of FLFPR and also describes measures of both first and second demographic dividends ( $FDD_t$ and $SDD_t$ ). $I_{FLFPR_t}$ avoids problems of logarithmic transformations, scaling/normalization, finding weights and issues related to multiple regressions and involves no bias for developed, developing or under-developed countries. Since base period figures are different for different countries, comparison of countries may be meaningful in terms of progress made from base period or on Year-to-Year basis. Since higher considering theoretical advantages, $I_{FLFPR_t}$ is recommended for finding relationship of the form *Demographic dividend* = $\alpha + \beta(FLFPR)$ further relationship of $GDP_t$ or Per Capita $GDP_t$ of a country with ( $FDD_t$ and $SDD_t$ ) by regression analysis to see effect of FLFPR on economic growth.

**Keywords:** female labor force participation; demographic dividend; regression, geometric mean; support ratio.

**JEL Codes:** B41, C4, J1

Volume 8 Issue 4 - 2024

Satyendra Nath Chakrabartty
Indian Statistical Institute, India

**Correspondence:** Satyendra Nath Chakrabartty, Professor at Indian Statistical Institute, Flat 4B, Cleopatra, DC 258, Street No. 350, Action Area 1, New Town, Kolkata 700156, India, Tel 91-7838333652, Email chakrabarttysatyendra3139@gmail.com

**Received:** July 30, 2024 | **Published:** August 22, 2024

## Introduction

India's favourable demographic dividends, growth of the economy and the emerging opportunities have helped the country to enter into *Amrit Kaal* (an auspicious period most conducive to achieving the country's potential) which is the era of Elixir. With well-planned roadmap, India aims at becoming a developed nation by 2047 and to fulfill the nation's aspirations, by nurturing new possibilities, realizing new resolutions, and moving ahead with confidence to achieve rapid profitable growth, better living conditions for all, infrastructural and technological advancements, and re-awakening the world's trust in India.

Demographic window or window of opportunity is defined by United Nations,[1] in terms of dependency ratios ($DR$) = $\frac{Child\ population + OldAge\ population}{WorkingAge\ population}$ * 100. It may be noted that, a portion of working age population (WAP) may actually be unemployed or do not belong to the labor force and a small portion of the "old age population" may be employed and not economically dependent. Clearly, increase in percentage of WAP indicates lower economic dependence of children and elderly people of the country. People in WAP and participating in labour force can support their own consumptions, produce for the economically dependent sector and can open windows of economic opportunities and accelerate per capita income growth.[2] Relationship between percentage share of WAP and economic growth rate was found to be positive.[3]

India's median age was 27.3 years in 2023 against estimated median age of 49.5 in Japan, 46.7 9 in Germany and 39.8 in China. Percentage of WAP in India is continually increasing across time and thus, resulting in decreasing trend of dependency ratios, as shown in Table 1.

**Table 1** Age-structure of India's population

| | 2012 | 2017 | 2022 | 2023 | $2030 (Projection) |
|---|---|---|---|---|---|
| Children population (Up to 14 years) | 30.08% | 27.60% | 25.31% | 25% | 22.30% |
| Working age population(15 – 64 years) | 64.76% | 64.76% | 67.80% | 68% | 68.90% |
| Elderly population (Above 65 years) | 5.22% | 6.04% | 6.90% | 18% | 12.90% |
| Dependency ratio(Percentage) | 54.42% | 54.42% | 47.49% | 47.06% | 45.14% (31.2% EY estimate) |

**Source** Statista, 2023 $: Projection by ESCAP 2022. https://www.population-trends-asiapacific.org/data

Mid-bulging shape of age-structure implying increasing size of WAP and decreasing trend of dependency ratio in India is likely to peak around 2041 and continue till 2055,[4] giving the country advantages of higher opportunities and growth of per capita income, known as first

demographic dividend (FDD),[2] and second demographic dividend (SDD) emerging from higher degree of motivation to save and accumulate asset in the working years to support old-age consumptions and security, which accelerate real output, employment and help to generate higher economic growth.[5] While FDD is a transitory bonus, the SDD transforms the bonus into greater consumption and higher saving and investment leading to formation of assets and sustainable development. Both FDD and SDD are contributed primarily by the WAP.

To increases the economy's overall productivity and to take maximum advantage of demographic dividends, India needs to ensure very high participation of WAP in labour market by increasing female labour participation rate (FLFPR) and by bringing the untapped or unemployed labour into the labour market, along with implementing policies aiming at gender equality, improved health, education, and expansion of opportunities of employment, etc. to increase economic activities. This is in line with the focus of the government towards women led development.[6]

In India, unemployment rate in 2022 was 9.3%, against the global average of 6.8% (World Bank estimate). Large proportion of marginal workers in India's pool of untapped labor could be attracted into the jobs market, easing any potential recruitment pressures. This slack contrasts with concerns about labor shortages in other countries, so it could offer manufacturers some risk mitigation against escalating employment costs.

The global FLFPR is little over 50% compared to 80% for men. Women work less in formal employment and have fewer opportunities for business expansion or career progression. FLFPR is an important dimension of Gender Inequality Index (GII),[7] Gender Gap Index (GGI).[8] The Goal-5 of Sustainable Development Goals (SDG-5) to be achieved by 2030 includes among others recognition of contributions of unpaid and domestic work, equal opportunities, participation in education and employment.[9] As per the Periodic Labour Force Survey Report 2022-23 (www.mspi.gov.in) of the Ministry of Statistics and Programme Implementation, Govt. of India, the FLFPR in India has improved to 37.0% in 2023 from 32.5% in 2020-21 and 23.5% in 2019. The improved FLFPR using the usual definition of labour force (employed for at least 30 days in a year) signifies a considerable improvement towards women's empowerment and their active involvement in India's socio-economic development. However, it implies:

(i) 63% of women in WAP are yet to join the country's labour force. Non-utilisation of women to reach their full potential implies loss of human capital and slowing down economic advancement.[10]

(ii) Need to look into measurement issues of FLFPR and FDD and SDD

(iii) The paper describes multidimensional index of FLFPR of a country at *t*-th year $I_{FLFPR_t}$ by aggregating chosen correlates of FLFPR leading to better comparisons, plotting of fluctuations of $I_{FLFPR_t}$ across time and undertaking statistical test of significance. $I_{FLFPR_t}$ Satisfying desired properties can be used to find empirical relationship with demographic dividend.

## Measurement issues

### Female labour participation

Empirical investigations on U-shaped FLFPR curve proposed by Goldin,[11] have given contrasting results in the Indian context. Inverted U-shaped curve was observed between FLFPR and income with inflexion point at extremely high-income levels,[12] between literacy rate and FLFPR at Uttarakhand state of India,[13] and the Goldin hypothesis did not hold true for rural areas. Dispute exists regarding verification of the U-shaped feminizing theory.[14] In India, FLFPR declined from 34.1% in 1999-00 to 27.2 % in 2011-12, despite strong economic growth associated with rising wages and incomes, unlike urban women for whom FLFPR increased from 14.6% to 15.5%. Decreasing trend of FLFPR was also observed for rural women. For example, FLFPR in Bihar declined between 2004–05 and 2018–19, with a modest increase after 2018–19, despite continuous economic growth rates.[15] However, women working in home were counted as unpaid workers and not counted in in FLFPR in 2011-12.

Estimation of FLFPR depends heavily on the data, methods of estimation and may not support the U-shaped hypothesis for non-OECD countries.[16] Thus, consideration of issues and methods to find empirical relationship between estimated FLFPR and its correlates are felt needed. Methodological issues in empirical relationships of FLFPR with its correlates by multiple linear regressions involving number of countries, transformations of the chosen variables, etc. might have resulted in divergent results.

Empirical estimation of direct relationship between FLFPR and demographic dividend is rare. Using multiple linear regression analysis, Bloom et al.,[17] found significant positive effect of fertility reduction due to FLFPR and increased income levels, especially for the fertile years (20–39 years of age) and concluded that increased female labor supply may increase economic returns to women's schooling, providing positive incentives for women to invest in education. Rusatira et al.,[18] came out with demographic dividend effort index *(DDEI)* using questionnaire containing of 10-point items covering six key sectors: family planning, maternal and child health, education, women's empowerment, labour market, governance and economic institution, where sectoral and domain scores were calculated by arithmetic mean and country scores were obtained by weighted country mean scores, internal consistency of the questionnaire was evaluated by Cronbach's alpha. However, *DDEI* suffers from methodological limitations, in terms of non-admissibility of arithmetic mean of *K*-point items,[19] non-satisfaction of assumptions of Cronbach's alpha like one-dimensional and tau-equivalence (same true score for all test items i.e. equality of all factor loadings),[20] and weighting scheme may not be beyond controversy.[21]

Multiple linear regression equation of FLFPR on the chosen factors influencing FLFPR is most popular. However, measurements of correlates influencing FLFPR are not uniform across countries and time. Use of single self-reporting question in survey to measure labour force status of an individual, especially for rural population is prone to errors and is against ILO recommendations of additional 'recovery questions' in the questionnaire. Such regression equations often involve logarithmic transformations, scaling/normalization, finding weights and issues related to inter-correlations, score-ranges and distributions of the independent variables. For example, Tam,[22] considered equation of the form

$$FLFPR_{it} = \alpha + \beta_1 \log\left(GDP_{it}\right) + \beta_2 \log\left(GDP_{it}\right)^2 + error_{it} \qquad (1)$$

Where $\beta_1 > 0$ and $\beta_2 > 0$ indicate positive transitions; $\beta_1 < 0$ and $\beta_2 < 0$ give negative transitions and $\beta_1 > 0$ and $\beta_2 < 0$ give rise to inverted U-shaped curve.

### Major areas of concern are:

Interpretation of negative value of $\alpha$ is difficult

Increase in log (GDP) will have "stronger" impact in FLFPR for more extreme values.

**Citation:** Chakrabartty SN. Index of female labour force participation and its association with demographic dividends of India. *Sociol Int J.* 2024;8(4):174–181. DOI: 10.15406/sij.2024.08.00392

High correlation between log (GDP) and log $(GDP)^2$ gives rise to multicolinarity.

Equation (1) pre-specifies that at the point of inflection, log (GDP) $\beta_1/2\beta_2$ which has no theoretical justification.

It would have been better to estimate GDP = f (FLFPR) to see effect of FLFPR on GDP than FLFPR= f (GDP)

Within-group estimation could be biased if FLFPR is persistent (because of correlation of residuals with the lagged dependent variable in the differenced data) and endogenous regressors.

Different trends of FLFPR for different countries at different time periods gave rise to a number of puzzles,[23] who found weak correlation of FLFPR with log( $GDP_{Per\ capita}$ ), insignificant correlation with female gross enrolment ratio in secondary school; and positive correlation with proportion of women in parliament

## Selection of independent variables

Researchers differed in selection of independent variables. Altuzarra et al.,[14] considered *log GDP* based on purchasing power of parity ( $lnGDP_{pc_{it}}$ ) and a set of control variables like fertility rate, life expectancy, unemployment rate, secondary and tertiary education and found that U-shaped hypothesis holds if the coefficient of $lnGDP_{pc_{it}} < 0$ and the coefficient of $ln(GDP_{pc_{it}})^2 > 0$. However, shape of *FLFPR – lnGDP*$_{PC}$ relationship for a selected time-period may be different for different countries (or groups of countries) since such countries could be transiting on different phases of the U-curve.

Major factors other than GDP influencing FLFPR are: level of education of women,[24] unemployment rate, urbanization offering more employment opportunities and more liberal socio-cultural attitudes,[25] sectoral structure,[28] wages, social and cultural norms,[26,27] etc. However, fertility rate and unemployment rate are ambiguous since they could also be taken as outputs of higher FLFPR.[29] Women education and fertility rates having high negative correlation may result in a collinearity problem.[14] Literacy rates may not adequately represent education levels to be employed in secondary or tertiary sectors.

## Other factors influencing FLFPR include

Immigration increasing supply of labor with possible decline in wages. Theoretical framework by Borjas,[30] showed impact of immigration in redistribution of wealth in an economy where the natives compete with immigrant workers in the labor market with reduced availability of job opportunities.

Various welfare schemes like monthly payment to adult women may act as disincentives to FLFPR.

Religion and religious orthodoxy discouraging women to participate in labour force

Environmental factors, macroeconomic policies specific to a country

Socio-geo-economic pattern of living including legal and tax regulations, *openness* of the country, etc.

## Correlations

The assumption of linear relationship of each independent variable with FLFPR (as the dependent variable) may not be satisfied by high value of $r_{FLFPR,X_i}$ since $|r_{X,Y}| \geq 0.9$ may not always confirm linearity between X and Y,[31] who also gave example of change in value of $r_{XY}$ (and direction) with change in score range for *X* following *N (0, 1)* and $Y = \frac{1}{\sqrt{2\pi}} e^{\frac{-1}{2}X^2}$ where $r_{XY}$ = - 0.93 for $0 \leq X \leq 3.9$ and $r_{XY}$ = 0.00036 for $-3.9 \leq X \leq 3.9$ . In other words, data homogeneity may distort correlation coefficient. Non-verification of linearity between FLFPR (as *Y*) and *i*-th independent variable ( $X_i$ )by constant value of $\frac{Y_i - Y_{i+1}}{X_i - X_{i+1}}$ for all values of $X_i$ or by checking distribution of residual as normal with zero mean and constant variance and transferring each $X_i$ to a common score range may raise question regarding validity of the multiple regression equation. Thus, relevance of independent variables goes beyond the observed correlations.

## Transformations

Logarithmic transformation of a variable (*X*) may change value and even direction of correlation between *X* another variable (*Y*). For example, Kovacevic,[32] found $r_{Life\ expetancy,HDI} > r_{Life\ expetancy,GDP}$ but $r_{\ln(Life\ expetancy),HDI} < r_{\ln(Life\ expetancy),GDP}$ . Logarithmic transformation fails to satisfy desired properties like Translation Invariance and consistency in aggregation.[33]

Relative importances of the independent variables are given by β-coefficients in (1) when the variables are standardized. However, such standardization may not be possible if the purpose is to find FLFPR for a single country for a given year.

## Sample size

Consideration of few countries (<30) and observations on few time-periods may not satisfy the minimum sample size required to obtain reliable estimates of population parameters, for which usual power analysis is insufficient,[34] since power analysis depends on the sample size and on the expected effect size too.[35] Estimating FLFPR of a country avoiding complex calculation and decomposition of correlation ratio by product of ratios of current and base period values of chosen independent variables may be desirable.[36]

Interpretations of results of the relationship between FLFPR through regression need caution due to the associated problem areas, consideration of small time periods in analysis and non-exhaustive or strongly correlated selection of independent variables.

## Demographic dividend

Different approaches are there to estimate FDD and SDD. Avoiding FDD and SDD, Navaneetham,[37] used regression analysis of GDP growth rate on changing share of different age cohorts, controlling selected macroeconomic indicators and found no statistically significant regression coefficient. Similar regression analysis by Lal,[38] found inadequacy of theoretical framework to reveal FDD and SDD. Desai,[39] considered FLFPR by years of schooling and household income and concluded that India may fail to realize its demographic dividends to the fullest extent unless significant changes are made to improve participation of women in labour force. However, panel data regression can lead to biased estimators in traditional linear regression models.

The SDD has typically been larger than the FDD and the combined effects of the two are taken as sum of percentage contribution of each of FDD and SDD to GDP per effective consumer.[2] Estimates of FDD and SDD were obtained by Mason,[40] for a number of countries and found that duration and magnitude of the estimates varied. Ladusingh and Narayana,[41] used National Transfer Accounts (NTA) framework to estimate demographic dividends for India. The NTA framework helps

to introduce age into national income and product accounts (NIPA). Here, growth rate of per capita income is taken as product of labor productivity and the support ratio $\frac{Effective\,number\,of\;producers(L)}{Effective\,number\,of\;consumers(N)}$ is computed from the age profiles of aggregate labor income and consumption. Here, FDD is expressed as the economic support ratio (ESR) i.e.

$$\frac{L}{N}=\frac{\sum_{a=0}^{w}\gamma(a)P(a,t)}{\sum_{a=0}^{w}\phi(a)P(a,t)} \quad (2)$$

Where, $P(a, t)$ is the population aged $a$ at time $t$, $\gamma(a)$ and $\phi(a)$ are the age patterns of labour income and consumption respectively.

Income per capita can be decomposed as

$$\frac{Y}{N}=\frac{L}{N}\times\frac{Y}{L} \quad (3)$$

Where $Y$ denotes the income, $N$ is the total population and $L$ is the total number of workers.

Equation (3) implies growth rate of $\frac{Y}{N}$ = growth rate of $\frac{Y}{N}$ x growth rate of $\frac{Y}{N}$ . In other words, per capita output would grow if growth rate of workers exceeded the growth rate of total population even if the output per worker did not change.[42] For a given productivity the period of the positive growth rate of the ESR in the demographic transition is the FDD.

By differentiating (3) one can get growth rates as

$$(g_y=g_z+(g_l-g_n)) \quad (4)$$

Where $g_y$:growth rate of per capita income; $g_z$: growth rate of income per worker; $g_l$: growth rate of labour force and $g_n$: growth rate of total population.

In equation (4), the per capita income is categorized into two components: support ratio and productivity. Increase in support ratio, keeping the productivity constant is called the accounting effect of the FDD.

SDD depends on two major factors. First, some of the economic benefits of the FDD are likely to be invested in human capital through intergenerational transfers and capital. This will lead to an increase in output per worker. Second, the prospects of a longer life and an extended period of retirement will motivate individuals to save and accumulate more wealth. Savings and wealth accumulation for consumption in retirement intensifies with fewer children to support due to fertility declines. SDD can be estimated in terms of income index (income per equivalent consumer relative to income) and consumption index (consumption per equivalent consumer relative to income per equivalent consumer) where equivalent consumer is the adult equivalent number of consumers in the population. Capital accumulation of working-age population can be taken as the wealth held to the population aged >50 years may be used to estimate the life cycle wealth and SDD.[40] Thus, wealth accumulation is the function of the ratio of effective consumption with effective production and the difference between the number of years of effective consumption and production, which can be formulated as

$$(w(\le b,t)=(\frac{C(t)}{Y^l t}(\frac{PVN(\le b,t)}{N(t)})-\frac{PVL(\le b,t)}{L(t)}) \quad (5)$$

Where, $w\ (\le b,\ t)$ denotes the wealth in $t$-th year of people born on or before the $b$-th year. $\frac{C(t)}{Y^l t}$ Denotes ratio between consumption per effective consumer and income/production per effective labour in $t$-th year.

$\frac{PVN(\le b,t)}{N(t)}$ is the present number of future lifetime effective years of consumption for all persons born on the $b$-th year per effective producer in $t$-th year.

$\frac{PVL(\le b,t)}{L(t)}$ denotes the present number of future lifetime years of production of total person born in the $b$-th year or earlier per effective producer in $t$-th year.

Evaluation of equation (5) is complex under the dynamic conditions, where the ratio of wealth to income varies with time. Moreover, life cycle wealth may not continue to increase as the share of the retired population increases.

As per estimates, India's income per effective consumer could increase by 24.9% from 2005 to 2035, of which 9.1% is from the first demographic dividend, and 15.8% is from the second demographic dividend. FDD in India may increase by around 25% in 2035 from 9.1% in 2005 and 15.8% from the SDD —and will be stable up to 2070, provided raising productivity is continued by appropriate institutional reforms, failing which it will be difficult for India to meet the fiscal challenges posed by aging population.

## Proposed method of index of FLFPR

### Set up

Let $X_{1t},X_{2t},\ldots\ldots,X_{nt}$ are the raw scores at $t$-th year of $n$-chosen indicators consisting of FLFPR and factors influencing FLFPR of a country (excluding factors like fertility rate, unemployment rate etc. which are outputs of FLFPR). Let values of the corresponding indicators at the base period are $X_{10},X_{20},\ldots\ldots,X_{n0}$. As a part of pre-processing of data, (i) ensure that higher value of each indicator increases FLFPR. For the indicators where lower value tends to increase FLFPR, reciprocal of such indicators may br considered, (ii) For indicators in ordinal scale, like attitudes, awareness, social rigidity discouraging women to work outside home, etc. obtained from survey using $K$-point scales ($K$= 2,3, ……, ), convert each discrete raw scores to monotonically increasing, equidistant scores following normal distribution say $N(35,10^2$ to attain comparable results by the method suggested by Chakrabartty.[43]

Avoiding logarithmic transformations, scaling or normalization, weights and considering all relevant chosen indicators, irrespective of their inter-correlations, score-ranges Index of FLFPR of a country at $t$-th year $I_{FLFPR_t}$ are proposed as:

Geometric Mean (GM) of ratios of $X_{it}$ and $X_{i0}$ i.e.

$$I_{FLFPR_t}=\sqrt[n]{\frac{X_{1t}.X_{2t}\ldots\ldots\ldots X_{nt}}{X_{10}.X_{20}\ldots\ldots X_{n0}}}$$

Or equivalently by $I_{FLFPR_t}=\prod_{i=1}^{n}\frac{X_{it}}{X_{i0}}$ (7)

The equation (7) indicates overall socio-economic achievement of the country at the $t$-th year over the base period, in terms of FLFPR and factors influencing FLFPR.

**Citation:** Chakrabartty SN. Index of female labour force participation and its association with demographic dividends of India. *Sociol Int J.* 2024;8(4):174–181. DOI: 10.15406/sij.2024.08.00392

## Assessment of improvement/decline

Equation (7) helps to find improvement of FLFPR by a country in two successive years by $I_{FLFPR_t} - I_{FLFPR_{(t-1)}} > 0$ or by $\frac{I_{FLFPR_t}}{I_{FLFPR_{(t-1)}}}$ >1. Improvement of the *i*-th indicator at *t*-th year over the base period is reflected by $\frac{X_{it}}{X_{i0}}$>1. The *i*-th indicator is critical if $\frac{X_{it}}{X_{i(t-1)}}<1$ and merits managerial attention for initiation of necessary corrective action.

Here, $I_{FLFPR_{t0}} * I_{FLFPR_{0t}} = 1$. Thus, time-reversal test is satisfied. The index also satisfies $I_{FLFPR_{20}} = I_{FLFPR_{21}} * I_{FLFPR_{10}}$ enabling formation of chain indices and plotting $I_{FLFPR_t}$ graph of a country in successive years depicting improvement/decline since the base period. Two different countries may also be compared in terms of such graphs registered by the countries in longitudinal studies. If the base period data is replaced by the data of the previous year, $I_{FLFPR_t}$will indicate growth on Y-Y basis.

## Mean and variance of $I_{FLFPR_t}$

Mean and variance of $I_{FLFPR_t}$for a group of countries may be found by considering logarithmic transformations since $\log(GM)$ approaches lognormal distribution.[44] Thus, mean and variance of $\ln I_{FLFPR_t}$ are $e^{\mu_X + \frac{\sigma_X^2}{2}}$ and $e^{2\mu_X + \sigma_X{}^2}\left(e^{\sigma_X{}^2} - 1\right)$ respectively.

## Properties

Following desired properties of the proposed $I_{FLFPR_t}$ are satisfied by (7):

- Measures overall socio-economic improvement or decline of a country in the *t*-th year in comparison to the base year by a continuous variable and is independent of change of scale - $I_{FLFPR_t}$ is monotonically increasing since increase in value of an indicator $(X_i)$ ⇒ increase in value of $I_{FLFPR_t}$

$\frac{Corresponding\ increase\ in\ I_{FLFPR_t}}{Unit\ Increase\ in\ X_{it}}$ is constant, implying linearity between $I_{FLFPR_t}$ and $X_{it}$

- Significant reduction of trade-off among the indicators.

- Relative importance of *j*-th indicator may be assessed by $\frac{\nabla\left(I_{FLFPR_t}\right)}{\nabla X_j}$

- Ranking and classification of countries with respect to $I_{FLFPR_t}$

- Not affected much by outliers. Linearly related $I_{FLFPR_t}$ produces no bias for economically developed or under-developed countries or regions.

## Empirical illustration

Computation of $I_{FLFPR_t}$ with 2017-18 as the base year for *t* = 2019-20 to 2022-23 in India is illustrated considering FLFPR and four positively related correlates (Table 2, Table 3).

**Table 2** Illustrative Data considered

| Year | FLFPR (in %) | Female literacy rate (in %) | Percentage of female enrolment to total enrolment | Degree of urbanization (In %) | Number employed |
|---|---|---|---|---|---|
| 2017-18 (Base year) | 23.3 | 64.6 | 47.5 | 34.03 | 455 |
| 2018-19 | 24.5 | 65 | 48.2 | 34.47 | 467.5 |
| 2019-20 | 30 | 66.2 | 48.6 | 34.93 | 511 |
| 2020-21 | 32.5 | 67.8 | 49 | 35.39 | 516.5 |
| 2021-22 | 32.8 | 69.1 | 53.58 | 35.87 | 522.2 |
| 2022-23 | 37 | 70.3 | 67.69 | 36 | 527.9 |

**Source** National Statistical Office (NSO)

**Table 3** Ratios of $X_{it}$ and $X_{i0}$ and computation of $I_{FLFPR_t}$

| Year | FLFPR | Female literacy rate | % of female enrolment to total enrolment | Degree of urbanization | Number employed | $I_{FLFPR_t}$ (Product of ratios) | Improvement of FLFPR in successive years $\frac{I_{FLFPR_t}}{I_{FLFPR_{(t-1)}}}$ |
|---|---|---|---|---|---|---|---|
| 2017-18 (Base year) | 1 | 1 | 1 | 1 | 1 | | |
| 2018-19 | 1.051502 | 1.006192 | 1.014737 | 1.01293 | 1.027473 | 1.117362 | |

**Citation:** Chakrabartty SN. Index of female labour force participation and its association with demographic dividends of India. *Sociol Int J.* 2024;8(4):174–181. DOI: 10.15406/sij.2024.08.00392

| Year | FLFPR | Female literacy rate | % of female enrolment to total enrolment | Degree of urbanization | Number employed | $I_{FLFPR_t}$ (Product of ratios) | Improvement of FLFPR in successive years $\frac{I_{FLFPR_t}}{I_{FLFPR_{(t-1)}}}$ |
|---|---|---|---|---|---|---|---|
| 2019-20 | 1.287554 | 1.024768 | 1.023158 | 1.026447 | 1.123077 | 1.556251 | 1.39279% |
| 2020-21 | 1.39485 | 1.049536 | 1.031579 | 1.039965 | 1.135165 | 1.782808 | 1.145579% |
| 2021-22 | 1.407725 | 1.069659 | 1.128 | 1.05407 | 1.147692 | 2.05479 | 1.152558% |
| 2022-23 | 1.587983 | 1.088235 | 1.425053 | 1.05789 | 1.16022 | 3.022598 | 1.471001% |

**Source** Compiled by author.

## Observations

$I_{FLFPR_t}$ of each year from 2018-19 exceeded unity

Improvement of FLFPR by a country in two successive years by $\frac{I_{FLFPR_t}}{I_{FLFPR_{(t-1)}}} > 1$

Continuous increase in value of $\frac{I_{FLFPR_t}}{I_{FLFPR_{(t-1)}}}$ indicates that the $I_{FLFPR_t}$ – time graph increased continuously

## Applications

$I_{FLFPR_t}$ can be applied for data in percentages or skewed. Each method facilitates computation of the index for properly different sub-groups say rural or urban groups, soci-economically backward groups, educated or uneducated groups, etc. The index $I_{FLFPR}$ may be correlated with actual FLFPR to reflect association between them and regression equation can be fitted of FLFPR on $I_{FLFPR}$ along with reporting of distribution of the residual.

## Limitations

The index $I_{FLFPR}$ considers each $X_{it} > 0$ for all values of $t$ = 0, 1, 2 ……and so on. If needed, zero target of an indicator like Gender inequality = 0 need to be modified as $\frac{Male}{Female} = 1$, failing which, a small value say 0.00001 may replace the zero target. In case a new indicator is introduced, one needs to estimate its values in each year starting from the base year. $I_{FLFPR}$ Assumes no missing data.

## Discussion

The paper develops multidimensional index of FLFPR of a country at $t$-th year $I_{FLFPR_t}$ based on all relevant chosen indicators, irrespective of their inter-correlations, score-ranges and distributions and also describes measures of demographic dividends. The index $I_{FLFPR_t}$ avoids problems of logarithmic transformations, scaling/ normalization, finding weights and issues related to multiple regressions and involves no bias for developed, developing or under-developed countries. $I_{FLFPR_t}$ Satisfies desirable properties like monotonically increasing continuous scores, facilitate identification of critical indicators, measurement of progress of a country across time, time-reversal test and enables formation of chain indices. $I_{FLFPR_t}$ Facilitates ranking, comparison of countries for a given year or with respect to progress-paths registered by the countries since the base year. For a group of countries, it is possible to compute mean and SD of $I_{FLFPR_t}$. Since base period figures are different for different countries, comparison of countries may be meaningful in terms of progress made from base period or on Year-to-Year basis.

It enables undertaking of statistical testing of (i) equality of mean of log ($I_{FLFPR_t}$) of a pair of countries at a given year (ii) equality of mean of log ($I_{FLFPR_t}$) of a country at two time periods.

Since higher FLFPR $\Longrightarrow$ increased size of WAP $\Longrightarrow$ higher FDD and SDD, it is possible to find empirical relationship of demographic dividends enjoyed by a country at $t$-th time period separately for $FDD_t$ and $SDD_t$ or ( $FDD_t$ + $SDD_t$ )on the multidimensional index $I_{FLFPR_t}$ for better understanding of demographic dividend as function of opportunities posed by population structure with emphasis on FLFPR.

For improving Female Labor Force Participation Rate (FLFPR), and to maximize advantages of demographic dividends, India may provide new skills and opportunities for women, befitting their participation in an envisaged $3 trillion economy along with bringing back the unemployed youth to labour market by up skilling and job creations.

**Citation:** Chakrabartty SN. Index of female labour force participation and its association with demographic dividends of India. *Sociol Int J.* 2024;8(4):174–181. DOI: 10.15406/sij.2024.08.00392

## Conclusion

Based on the theoretical advantages, $I_{FLFPR_t}$ as multiplicative aggregation is recommended. Empirical relationship may be found between $I_{FLFPR_t}$ and $(FDD_t + SDD_t)$ and separate equation of $GDP_t$ or per capita $GDP_t$ on $(FDD_t + SDD_t)$ of a country by regression analysis to see effect of FLFPR on economic growth. Relationship of the form *Demographic dividend (sum of FDD and SDD)* $= \alpha + \beta(FLFPR)$ can be fitted to see how FLFPR is related to demographic dividend of a country. Future studies may be undertaken to investigate relationships with actual FLFPR data along with distribution of residuals for fitting regression equation of FLFPR on $I_{FLFPR_t}$ along with comparison of approaches to measure country specific demographic dividend (year-wise) to conclude.

## Funding

No funds, grants, or other support was received.

## Ethical statement

This is a methodological paper and no ethical approval is required.

## Availability of data and material

Nil (The paper used hypothetical data).

## Code availability

No application of software package or custom code.

## Credit statement

Conceptualization; methodology; data analysis; writing and editing the paper by the **sole author.**

## Acknowledgements

None.

## Conflicts of interest

The author has no conflicts of interest to declare that are relevant to the content of this article.

## References

1. United Nations. World urbanization prospects: The 2003 revision. United Nations publication. 2004.
2. Lee R, Mason A. What is the demographic dividend? *Finance Develop.* 2006;43(3):16–17.
3. Bloom DE, Canning D, Fink G, et al. Fertility, female labor force participation, and the demographic dividend. *National Bureau Econom Res*. Working paper. Cambridge. 2007.
4. United Nations. *World Population Prospects 2019*. 2019.
5. Ribaj A, Mexhuani F. The impact of savings on economic growth in a developing country (the case of Kosovo). *J Innov Entrep*. 2021;**10**:1.
6. Press Information Bureau. "Inception meeting of G20 empower group of ministry of WCD begins tomorrow in Agra". GoI, Ministry of women and child development. 2023.
7. UNDP. Gender inequality index (GII). 2022.
8. World Economic Forum. Global gender gap report 2020. *World Economic Forum*. Switzerland. 2020.
9. Dugarova E. Gender equality as an accelerator for achieving the sustainable development goals. Discussion paper. *United Nations Entity for Gender Equality and the Empowerment of Women*. New York, USA. 2018.
10. Sanghi S, Srija A, Vijay SS, et al. Decline in rural female labour force participation in India: a relook into the causes. *Vikalpa.* 2015;40(3):255–268.
11. Goldin C. The U -shaped female labour function in economic development and economic history. In T. P. Schultz, *Investment in Women's Human Capital and Economic Development.* Chicago, USA: University of Chicago Press. 1994.
12. Sai PD, Kameswari BL. The female labor force participation rate and India's economic development: tracing the U feminization hypothesis. *Int J Res Trend Innovat*. 2022;7(8):169–182
13. Agarwal A, Joshi D. Goldin's 'U'- shaped curve hypothesis on female labour participation rate: a case study of Uttarakhand. *Int J Develop Res*. 2015;5(3):3903–3907
14. Altuzarra A, Galvez CG, Flores AG, et al. Economic development and female labour force participation: the case of European union countries. *Sustainability***.** 2019;11(7).
15. Pandey Aviral. Explaining the U-curve trend of female labour force participation in Bihar. *EPW*. 2023;58(30).
16. Gaddis I, Klasen S. Economic development, structural change, and women's labor force participation. *J Popul Econ*. 2014;27:639–681.
17. Bloom DE, Canning D. Global demographic change: dimensions and economic significance. National Bureau of Economic Research. NBER Working Paper. Cambridge. 2004.
18. Rusatira JC, Cardona C, Martinez-Baack M, et al. Development of the demographic dividend effort index, a novel tool to measure existing efforts to create a favourable environment to harness a demographic dividend: results from an experts' survey from six sub-Saharan African countries. *BMJ Open*. 2023.
19. Bastien CH, Vallieres A, Morin CM, et al. Validation of the insomnia severity index as an outcome measure for insomnia research. *Sleep Medicine*. 2001;2(4):297–307.
20. Teo T, Fan X. Coefficient alpha and beyond: issues and alternatives for educational research. *Asia Pac. Educ. Res.* 2013;22:209–213.
21. Greco S, Ishizaka A, Tasiou M, et al. On the methodological framework of composite indices: a review of the issues of weighting, aggregation, and robustness. *Soc Indic Res.* 2019;141:61–94.
22. Tam H. U-shaped female labour participation with economic development: some panel data evidence. *Econom Lett*. 2011;110(2):140–142.
23. Chaudhary R, Verick S. Female labour force participation in India and beyond. New Delhi: ILO. 2014;1–32.
24. Vlasblom JD, Schippers JJ. Increases in female labour force participation in Europe: similarities and differences. *Eur J Popul.* 2004;20:375–392.
25. Tsani S, Paroussos L, Fragiadakis C, et al. Female labour force participation and economic growth in the South Mediterranean countries. *Econ. Lett*. 2013;120(2):323–328.
26. Mehrotra S, Parida JK. Why is the labour force participation of women declining in India? *World Dev*. 2017;98:360–380.
27. Dildar Y. Patriarchal norms, religion, and female labor supply: evidence from Turkey. *World Dev*. 2015;76:40–61.
28. Verme P. Economic development and female labor participation in the Middle East and North Africa: a test of the U-shape hypothesis. *IZA J Labor Develop.* 2015;4:3.

29. Fatima A, Sultana H. Tracing out the U-shape relationship between female labor force participation rate and economic development for Pakistan. *Int. J. Soc. Econ.* 2009;36:182–198.
30. Borjas GJ. The economic benefits from immigration. *J Econ Perspect*. 1995;9:3–22.
31. Chakrabartty SN. Improving linearity in health science investigations. *Health Sci J*. 2023;17(4).
32. Kovacevic M. Review of HDI critiques and potential improvements. The human development research paper (HDRP) series. Research paper. 2010;33:2011.
33. Chakravarty SR. A generalized Human development index. *Review Develop Econom*. 2003;7(1):99–114.
34. Trafimow D, Hyman MR, Kostyk A, et al. The (im) precision of scholarly consumer behavior research. *J Business Res.* 2020;114:93–101.
35. Tong T, Trafimow D, Wang T, et al. The a priori procedure (APP) for estimating regression coefficients in linear models. *Methodology*. 2022;18(3):203–220.
36. Becker SP, Burns GL, Garner AA, et al. Sluggish cognitive tempo in adults: psychometric validation of the adult concentration inventory. *Psychol. Assess.* 2018;30:296–310.
37. Navaneetham K. Age structural transition and economic growth: evidence from South and Southeast Asia. Centre for development studies, Working Paper No. 337. Thiruvananthapuram. 2002.
38. Lal D. India: population change and its consequences. *Populat Develop Rev.* 2006;32:145–182.
39. Desai S. The other half of the demographic dividend. *Economic and Political Weekly.* 2010;40:12–14.
40. Mason A. Demographic transition and demographic dividends in developed and developing countries. Paper prepared for the United Nations expert group meeting on social and economic implications of changing population age structures. Mexico City. 2005
41. Ladusingh, Laishram, Narayana MR, et al. Demographic dividends for India: evidence and implications based on national transfer accounts. In Aging, economic growth, and old-age security in Asia. Donghyun Park, Sang Hyop Lee, Andrew Mason., (Ed). Cheltenham, Edward Elgar Publishing, UK. 2012;203–230.
42. Bhat PNM. A demographic bonus for India? On the first consequence of population ageing. Occasion of the 10th anniversary celebration of the population research centre. University of Groningen. 2001.
43. Chakrabartty SN. Improved quality of pain measurement. *Health Science*. 2020;1:1–6.
44. Alf EF, Grossberg JM. The geometric mean: confidence limits and significance tests. *Percept Psychophysic*. 1979;26(5):419–421.


**Citation:** Chakrabartty SN. Index of female labour force participation and its association with demographic dividends of India. *Sociol Int J.* 2024;8(4):174–181. DOI: 10.15406/sij.2024.08.00392