

Amber, Hina; Chichaibelu, Bezawit Beyene

**Article — Published Version**

## Patterns and Causes of Female Labor Force Participation: An Age–Period–Cohort Analysis for Pakistan

Population Research and Policy Review

**Provided in Cooperation with:**

Springer Nature

*Suggested Citation:* Amber, Hina; Chichaibelu, Bezawit Beyene (2023) : Patterns and Causes of Female Labor Force Participation: An Age–Period–Cohort Analysis for Pakistan, Population Research and Policy Review, ISSN 1573-7829, Springer Netherlands, Dordrecht, Vol. 42, Iss. 2, <https://doi.org/10.1007/s11113-023-09751-9>

This Version is available at:

<https://hdl.handle.net/10419/312517>

### Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

### Terms of use:

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*



<https://creativecommons.org/licenses/by/4.0/>



# Patterns and Causes of Female Labor Force Participation: An Age–Period–Cohort Analysis for Pakistan

Hina Amber<sup>1</sup> · Bezawit Beyene Chichaibelu<sup>1</sup>

Received: 30 September 2021 / Accepted: 30 October 2022 / Published online: 2 March 2023  
© The Author(s) 2023

## Abstract

Female participation rates in Pakistan's labor force are well below regional averages despite approximately 9 percent growth in the past three decades. To probe the underlying causes of the dynamics of female labor force participation in Pakistan, we use a synthetic panel constructed from nationally representative labor force surveys (1990–2017). The results indicate that the rising population share of working-age women does not account for changes in aggregate labor force participation rates. The age–period–cohort analysis demonstrates that for cohorts born since the 1900s, urban females' age effects follow a slight M-shaped curve, representing the child-raising phase during which females reduce labor force participation. The cohort effects signal an increase in the labor force participation of cohorts born after the 1950s. This is particularly the case for married females and females with less education that traditionally have weaker attachments to the labor market due to social norms. Therefore, understanding and identifying the factors that can have an effect on the inhibiting role of social norms are central to devising policies to foster female labor force participation.

**Keywords** Demographic · Female labor force participation · Synthetic panel · Age–period–cohort · Pakistan

**JEL Classification** J16 · J21 · J22

---

✉ Hina Amber  
s7hiambe@uni-bonn.de; hina.700@gmail.com

Bezawit Beyene Chichaibelu  
bchichai@uni-bonn.de

<sup>1</sup> Center for Development Research (ZEF), University of Bonn, Genscherallee 3, 53113 Bonn, Germany

## Introduction

Women constitute almost 50 percent of the world population, yet overall female contributions to economic activity are far below their potential. Despite remarkable growth over recent decades, females remain underrepresented in the labor force. The percentage of women participating in the labor force declined from 50.9 percent in 1990 to 47.7 percent in 2019.<sup>1</sup> However, substantial differences exist concerning female participation in the labor force across regions. Mincer (1985) finds considerable differences in female labor force participation across 12 industrialized countries over 20 years. Nevertheless, these countries have experienced a common trend of rising female labor force participation over the past few decades. For developing countries, Klasen (2019) finds heterogeneous trends in female labor force participation rates, moderate upturns in the Middle East, and an increase in Latin America, whereas female labor force participation has declined in South Asia.

South Asia presents a gloomy picture of the second lowest women's employment participation rates after the Middle East and North Africa (Kapsos et al., 2014). Moreover, the participation of women in economic activity is the lowest for females in the age group between 15 and 29. Between 1990 and 2020, Pakistan, Bangladesh, and Afghanistan each witnessed increasing female labor force participation. However, for India and Sri Lanka, female labor force participation has declined since 1990. Among South Asian countries, female labor force participation in Pakistan is well below the regional average, despite growing by approximately 9 percent over the past three decades (Fig. 1). According to ILO estimates of labor force participation in Pakistan, the percentage of females in the labor force went from 13.95 in 1990 to 21.67 in 2019.<sup>2</sup> Although the change has been steady, female labor force participation reached a minimum of 12.51 percent in 1995 and a maximum of 23.86 percent in 2015.

Females' participation in the labor force constitutes a decision that is dynamic in nature because women enter into and exit from the labor force at different points in their lives (Sarkar et al., 2019). For instance, Gutierrez-Domenech (2005) examines the employment transition of women following the advent of motherhood in five European countries, observing a high transition from employment to unemployment for both Germany and Spain. The author also identifies changes in working hours after motherhood, which demonstrate the transition from full-time to part-time employment.

Age-period-cohort analysis presents a needed analytical tool for the analysis of female labor force participation by considering changing labor market behavior over time and across generations (Paweenawat & McNown, 2018). Previous research on labor force participation using cohort-based models offers comprehensive explanations of these changes across cohorts (Balleer et al., 2014; Beaudry & Lemieux, 1994; Fitzenberger et al., 2004; Fukuda, 2006; Grigoli et al., 2018; JmohsinJoshi

<sup>1</sup> Catalyst (2021) *Women in the Workforce – Global: Quick Take*. <https://www.catalyst.org/research/women-in-the-workforce-global/>.

<sup>2</sup> <https://data.worldbank.org/indicator/SL.TLF.CACT.FE.ZS?locations=PK>.

et al., 1996; Lassassi & Tansel, 2020; Lee, 2014; Nientker & Alessie, 2019; Paweenawat & McNown, 2018; Tunali et al., 2021). For instance, younger cohorts enter the labor market with lower fertility rates and higher educational attainment than older cohorts do, and hence, they are more likely to participate. Tunali et al. (2021) examine labor force participation of Turkish women with a synthetic cohort analysis, noting that later cohorts participate more in the labor force. Similarly, in terms of advanced economies, the entry of new cohorts has improved aggregate participation rates, indicating the progression of social norms and preferences (Grigoli et al., 2018).

Thus far, there is a dearth of literature examining the dynamics of female labor force participation in Pakistan by applying cohort analysis. Research on employment has largely been performed using cross-sectional data sets from labor force and Pakistan Social and Living Standards Measurement surveys (Arif et al., 2002; Azid et al., 2010; Ejaz, 2011; Fafchamps & Quisumbing, 1999; Ferdoos, 2005; Khaliq et al., 2017). Arif et al. (2002) are the only ones to investigate labor market dynamics using panel data from the Pakistan Socio-Economic Survey (PSES), demonstrating that women's transitions from unemployment to employment are slow in Pakistan. Age and marital status of females are also found to have a negative influence on the transition from employment to unemployment. Moreover, females with below-college-level education are more likely to lose their jobs than those with college educations are. Another panel study conducted by Fafchamps and Quisumbing (1999) presented an analysis of human capital, labor productivity, and labor allocation in rural Pakistan. One of the main findings is the absence of evidence supporting the effect of education and nutrition on female labor productivity and labor market allocation.

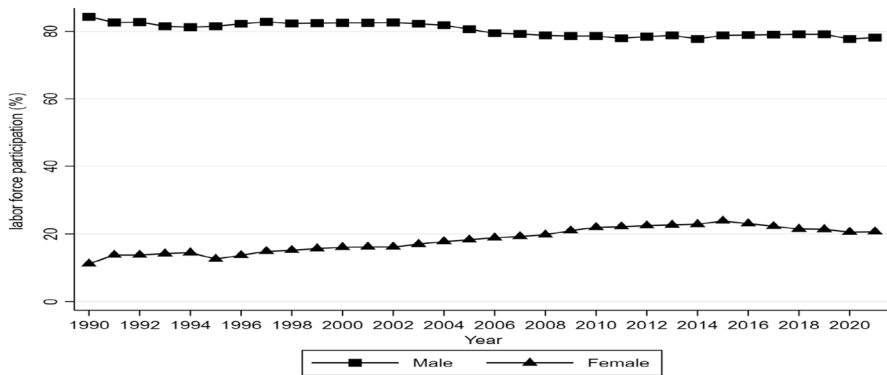
An important contributing factor that accounts for the changes in labor force participation in the end is the change in demographic distribution. It has been observed that changes in the female populations' demographic structure account for changes in overall participation rates (Lichter & Costanzo, 1987). Pakistan's population statistics indicate a gradual increase of females in the total population, from 46.4 percent in 1960 to 48.5 percent in 2019.<sup>3</sup> However, the contribution of this growth in female population to economic participation is under-researched. This study fills this gap by examining the patterns of female labor force participation in Pakistan over the past three decades,<sup>4</sup> applying an age-period-cohort (APC<sup>5</sup>) analysis. It also contributes toward understanding the long-recognized puzzle of the potential contributions to slow growth in female labor force participation.

The present study aims to achieve two objectives, (1) to investigate the contribution of demographic changes to changes in aggregate female labor force participation

<sup>3</sup> World Bank (2019) Population, female (% of total population)—Pakistan. <https://data.worldbank.org/indicator/SP.POP.TOTL.FE.ZS?locations=PK..>

<sup>4</sup> There has not been much variation in the labor force participation of men over the past three decades. It hovers around 80 percent. This is the reason for which the study primarily focuses on female labor force participation.

<sup>5</sup> This abbreviation refers to the age-period-cohort term.



**Fig. 1** Labor force participation rates of males and females (1990–2020). *Source:* Authors' own calculations from labor force surveys

and (2) to analyze the determinants of the dynamics of female labor force participation by dividing total change into age, period, and cohort components for separate examination. To this end, the study uses annual labor force surveys (1990–2017) to construct a synthetic panel data set to support the analysis of the dynamics of female participation in Pakistan's labor force. The use of a synthetic panel allows the study of the dynamic behavior of a population group that would not be possible with a single cross-sectional data set (Duval Hernández & Orraca Romano, 2009). The study separates changes in aggregate female labor force participation into changes attributable to population share and those attributable to labor force participation within each age group category in order to identify the influence of demographic fluctuations. The age–period–cohort model aims to explain the following: (1) differences in labor force participation over the lifetime; (2) variations in labor force participation due to differences over the years, when women are exposed to different events simultaneously; and (3) differences in labor force participation due to differences in the year of birth. The analysis also separately examines location and education level. Additionally, we perform analysis for marital status and results are presented in the appendix. Location is divided into rural and urban domains. Marital status is divided into two categories of ever-married (including married, divorced, and widowed females) and never married. Furthermore, the subdivisions of education include no formal education, primary education, secondary education, and tertiary education.

The results demonstrate that the rising population share of working-age females does not account for changes in aggregate labor force participation rates between 1990 and 2017. It reveals that Pakistan has not taken advantage of its demographic dividend.<sup>6</sup> For the cohorts born since the 1900s, the age effects follow an inverted U-shaped curve. However, urban females' age effects reveal a slight M-shaped curve, representing a child-raising phase during which labor force participation is

<sup>6</sup> The term *demographic dividend* refers to a stage in demographic transition wherein an increased working-age population has the potential to serve as an economic benefit (Durr-e-Nayab 2006).

reduced. The cohort effects of labor force participation plateaued around the 1990s and began to decline more recently. Therefore, the declining labor force participation of recent cohorts is limiting the gains Pakistan could reap from its demographic dividend.

The remainder of this paper is organized into five sections. “[Theoretical Background and Related Literature](#)” provides an overview of related theories and literature. In “[Data and Descriptive Statistics](#)”, we describe the construction of the synthetic panel and map out the general trends using the constructed data set to provide clarity regarding the rationale behind this research. “[Empirical Methodology](#)” presents a description of the techniques used to analyze the data into distinct subdivisions of analyses. The first part explains the methodology applied to disentangle aggregate labor force participation into compositional and participation components. The second part explains the APC methodology and the two methods that were used to subdivide APC effects. “[Estimation Results](#)” discusses the results and interpretations. This section is divided into two subsections. The first subsection provides the results of the decomposition analysis of the overall change in female labor force participation. Furthermore, the second subsection presents the results of age effects, cohort effects, and period effects respectively. “[Conclusion and Policy Recommendations](#)” section concludes the paper with pertinent policy recommendations.

## Theoretical Background and Related Literature

The topic of labor supply dynamics is one of the most researched domains in the economics and social science literature. Below, we will explore two specific strands of the literature to describe the objectives of this study.

First, the theory of demographic transition refers to variations in population structure, from high birth and death rates indicating low technological advancement, education levels, and development, to low birth and death rates accompanying improved technology, education levels, and economic development. Demography is correlated with female labor force participation through its link to fertility rates (Abraham et al., 2017). The contribution of demographic shifts to aggregate labor force participation has been examined by many researchers (Aaronson et al., 2006; Fuchs et al., 2008; Guettabi, 2019; Hotchkiss, 2009). Changes in the demographic structure of female populations account for substantial differences in overall participation rates (Lichter & Costanzo, 1987). For example, Smith (1977) reports that, for the U.S. economy, changes in the demographic structure of females in the labor force between 1971 and 1975 accounted for 28 percent of the increase in participation. The decline in fertility during demographic transition also serves to increase female labor force as women with fewer children are more likely to participate in the labor force (Sullivan, 2019). Such demographic shifts facilitate improvement in labor force participation through two effects. First, the composition effect refers to the changes in overall participation attributable to the change in each age category’s population share. Lee (2014) finds that composition effects from education, marriage, and child rearing account for 7, 11, and –2 percent changes in female labor force participation in the U.S., respectively. Second, the behavioral effect relates to

a population's characteristics or behaviors that translate into the labor market inclusion of women. For example, characteristics that inhibited female labor force participation, including the number of children, marriage, and low levels of education, have declined over the years. However, changing behaviors (e.g., social norms) are recognized as more influential in pulling women into the labor force (Hotchkiss 2006). In general, demographic transition changes aggregate labor force participation through changing each age category's population share, which might translate into increased participation. Thus, the following hypothesis is proposed:

**H<sub>1</sub>** Changes in population share account for substantial changes in aggregate female labor force participation.

Testing this hypothesis by tracing change in population composition is relevant, as changes due to demographic structure might misleadingly be interpreted as part of behavioral change. Observed variations in female labor force participation may result from a change in population behavior over the years; for instance, changing social norms with regard to girls' education might translate into higher female labor force participation.

The second strand of the literature follows an analysis of three sources of change in labor force participation rates, i.e., age, cohort, and period,<sup>7</sup> and requires labor supply models that reflect different periods over which these considerations can be observed. The first source relates to life cycle models that differ from static labor supply models,<sup>8</sup> considering the allocation of time between work and leisure over individual lifetimes (Owen, 1989). Labor force participation over a lifetime has been shown to follow an inverted U-shaped curve, wherein younger cohorts are more likely to participate in the labor force than earlier ones are (Abrahamsen 2015; Duval Hernández & Orraca Romano, 2009; Goldin & Mitchell, 2017; Lee, 2014). Tunalı et al. (2021) reveal an M-shaped curve in rural areas and for low-educated females in urban areas. Evidence from Turkey also demonstrates that participation rates of rural women are higher than those of urban women and that rural women remain in the labor force longer than their urban counterparts. However, a study of five selected Middle Eastern and Northern African (MENA) countries describes the same participation rates for rural and urban females (Lassassi & Tansel, 2020). Thus, we can propose the following hypothesis:

**H<sub>2</sub>** Female labor force participation over the life cycle depends on the timing of education, children, and retirement.

<sup>7</sup> Participation at a given age; participation in the given birth cohort; and participation due to the influence of institutional changes.

<sup>8</sup> The neo-classical model of labor-leisure choice is typically used to analyze individuals' life supply behavior (Borjas, 2010). According to this model, individuals decide how much time they will spend working by mapping out competing utility gains from work and leisure. The simple model of labor supply has been elaborated in many different ways. For example, work and leisure decisions made over the life cycle result in a predictable path, and labor supply decisions are often made within households, rather than by individuals alone (Johnston 2005).

Cohort-based models capture unobserved sources of shifts in labor force participation between various generations (Balleer et al., 2014). Cohort effects can explain differences in labor force participation over the life cycle that can be attributed to the choices made earlier in life, e.g., education, marriage, and fertility. For example, women from later cohorts are more likely to participate in the labor force and exit from the labor market less often when they have their first child than women from older cohorts are (Nientker & Alessie, 2019). Further, participation rates of ever-married females in Egypt are increasing across the cohort, whereas they are decreasing for never-married females (Lassassi & Tansel, 2020). In general, changes in social norms and policy interventions affect individuals' choices of participation in the labor market. Hence, we formulate our third hypothesis as follows:

**H<sub>3</sub>** Higher educational attainment, decreased fertility rates, and changed social norms allow younger cohorts to participate more in the labor force.

The third source describes the behavior of workers who adjust their labor participation to take advantage of economic opportunities brought about by business cycles (Borjas, 2010). The relationship between business cycles and labor force participation can be explained with the help of two effects. The discouraged worker effect occurs when during an economic downturn, many workers find it difficult to find work; hence, they give up. In contrast, the added worker effect arises during a recession, when secondary workers join the labor force when the main breadwinner becomes unemployed; hence, the labor force participation of secondary workers exhibits a counter-cyclical trend. Women's participation in the labor force is considered a coping strategy during recessions. Başlevant and Onaran (2003) find that women's labor force participation follows a counter-cyclical trend; hence, the added worker effect dominates the discouraged worker effect. However, Benati (2001) and Gregg (1994) identify the discouraged worker effects for the U.S. and the U.K., respectively. Thus, we propose our fourth hypothesis as follows:

**H<sub>4</sub>** Female labor force participation follows a pro-cyclical behavior.

All hypotheses presented are tested for aggregate female labor force participation over the past three decades as well as labor force participation disaggregated by education level, location, and marital status.

## Data and Descriptive Statistics

The study uses annual rounds of labor force surveys (LFSs) taken over 27 years (1990–2017) obtained from the Pakistan Bureau of Statistics.<sup>9</sup> We do not have all the datasets from 1990 to 2017. Labor force survey was not conducted for the years

<sup>9</sup> The questionnaires and methodology of the LFSs can be accessed at <http://www.pbs.gov.pk/content/labour-force-statistics>.



2011, 2015, and 2016. Additionally, data sets were not available for the years 1995, 1998, 2000, 2002, and 2004. The Pakistan Bureau of Statistics launched a LFS for the first time in 1963, and LFSs have since undergone suitable improvements in questionnaire design and methodology. The questionnaire was improved in 1990 to include additional economic activities. LFSs provide data on the sociodemographic attributes of the total population, including age, gender, marital status, level of education, and current employment. The LFS also collects data on different elements of the labor force, such as the number of persons employed, unemployed, underemployed, or out of the labor force. LFSs are the primary source of labor force statistics of the population of Pakistan. Because of the dearth of longitudinal data sets for Pakistan that track individuals' labor force participation over their life course, cross-sectional data provide a good source to trace people who share some common features, e.g., a birth year. LFSs are the only independent cross-sectional surveys to have been conducted in Pakistan on a regular basis since 1963 and are most suitable for conducting our APC analysis.<sup>10</sup> We use labor force surveys until 2017. According to the annual report of LFS (2017–2018), the enumeration of the sampled households took place between July 2017 and June 2018.

This study constructs a synthetic panel from repeated cross sections of LFSs to identify cohorts and follow them over time, wherein cohorts are defined by date of birth. The birth year is computed as a survey year subtracting age. A synthetic panel constructed from repeated cross-sectional data sets has an advantage over panel data in that it does not incur the problem of attrition and that it is less susceptible to measurement error (Deaton, 1997). Although the synthetic panel has the shortcoming of the inability to follow the same individuals over time, it is more useful than short-lived panel data as it covers a sufficiently lengthy time (Duval Hernández & Orraca Romano, 2009).

In this study, labor force participation for each cohort is calculated as the sum of employed and unemployed individuals divided by active and inactive individuals in each age category and each year.<sup>11</sup> Employed females include the females 15 years and above who (1) work(ed) for pay, profit, or family gain, during the reference period, for at least 1 h any day, and (2) had a job or enterprise, even if, for some reason, they did not work in the reference period. The reference period for the above-mentioned questions is one week. Unemployed females comprise females 15 years and above who are (1) not working; (2) looking for work during the reference period; and (3) available for work during the reference period. The study calculated labor force participation rates for all females aged 15 and above as well as by education level, marital status, and location. To structure a measure of education level that is same over all the surveys, the study divides education levels into four categories: (1) no formal education; (2) primary education: grades 1–8; (3)

<sup>10</sup> Other cross-sectional surveys, the PSLM (2004–2015) and the Demographic Household Survey (1990–2017) are not conducted annually.

<sup>11</sup> The labor force participation rates are calculated for females aged 15 years and above, while labor force participation rates reported by the Pakistan Bureau of Statistics are calculated for females aged 10 years and above.

secondary education: grades 9–12; and (4) tertiary education: above 12 grades or years. The study divides marital status into two categories: (1) ever married (which includes married, widowed, and divorced) and (2) never married. To account for the effects of fertility changes over the years, married females' labor force participation effects are observed. Location classification delineates between urban and rural.

For the sake of amenability, the study tracks female labor force participation rates for various age groups: 15–19, 25–29, 30–34, 35–39, 40–44, 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79, 80–84, and 85 and above. Summary statistics for each age group are presented in Table 1,<sup>12</sup> reporting the participation rate and sample size. Labor force participation rates follow an inverted U pattern, wherein women participate less at an early age but increase their participation with age and begin to decline after retirement age. In addition, participation rates for different categories of marital status, location, and education are also presented.

Figure 2 presents the labor force participation rates for various cohorts over their life cycle. The pattern suggests that labor force participation in later cohorts is higher than that in earlier cohorts for the same age group. For example, for the age group 45–49, the highest participation is from the 1970 cohort, followed by 1965, 1960, and older cohorts. Figure 2 clearly shows that females participate more in the labor force in their late 30 s and early 40 s, confirming the existence of a U-shaped path in the supply of labor over their life cycle.

Changes in the population's age structure are considered a vital source of change in labor force participation.<sup>13</sup> Pakistan is undergoing the most important demographic development in recent decades as its working-age population is increasing alongside a decline in the dependency ratio (Durr-e-Nayab, 2006). As shown in the left-hand-side panel in Fig. 3, the female population share between the ages of 20 and 60 increased sharply between 1990 and 2017, whereas the share of the female population between 0 and 15 years of age has decreased. Moreover, the Population Council projects that the working-age population's share will continue to rise until 2050.<sup>14</sup> This might influence females' aggregate participation rate as they constitute 48.54 percent of the total population.<sup>15</sup> As a typical life cycle pattern of labor force participation in the right-hand-side panel shows an increase in labor force participation from the working-age population.

The increased female labor force participation observed over the past three decades could be attributed to the rise in female education levels. As reported by many researchers, an increase in female education level is accompanied by an increase in female labor force participation (Dao et al. 2021; Duval Hernández & Orraca Romano, 2009; Goldin & Mitchell, 2017; Klasen & Pieters, 2012; Lee, 2014). The left-hand-side panel in Fig. 4 demonstrates this positive relationship between education and labor force participation. Moreover, the percentage of women in primary,

<sup>12</sup> See Appendix.

<sup>13</sup> See Aaronson et al. (2006), Grigoli et al. (2018), and Hotchkiss (2009).

<sup>14</sup> See Figure A13 in the Appendix.

<sup>15</sup> World Bank (2019) Population, female (% of total population)—Pakistan.  
<https://data.worldbank.org/indicator/SP.POP.TOTL.FE.ZS?locations=PK>

secondary, and tertiary education has risen across birth cohorts. In comparison, the percentage of women with no formal education has steadily decreased across birth cohorts. Females with no education are participating more in the labor force than are females with primary and secondary education across all birth cohorts, although their share in the population is steadily decreasing. Women with primary and secondary education reside more in the urban areas which comes with certain constraints that hinder their labor force participation. For instance, restriction on the physical mobility outside the home is an important determinant of low female labor force participation in urban Pakistan (Field & Vyborny, 2016). Klasen and Pieters (2012) have shown, in the case of India, that labor force participation of less educated women is determined by economic push factors, whereas the participation of females with high levels of education is determined by economic pull factors.

## Empirical Methodology

### Decomposition of Change in Total Labor Force Participation

To probe how demographic changes have contributed to the changes in labor force participation since 1990, the study performs a decomposition analysis of the overall change in female labor supply. The method decomposes observed changes in aggregate labor force participation into different components,<sup>16</sup> which should not be considered causal components because other factors could also be attributed to these changes (Fuchs et al., 2008). An analysis of causal influence is beyond the scope of this study.

Formally, aggregate female labor force participation can be written as the sum of labor force participation for each age group and its respective population share in the year  $t$ :

$$Lfpr_t = \sum_i (P_t^i * lfpr_t^i) \quad (1)$$

where  $i$  denotes age group and  $t$  is the year.  $P_t^i$  is the share of the population of age group  $i$  in the year  $t$ , and  $lfpr_t^i$  is labor force participation rate of age group  $i$  in the year  $t$ . A decomposition analysis can be performed by disaggregating total female labor force participation between a year ( $t$ ) and a base year ( $t=0$ ) into three components:

$$Lfpr_t - Lfpr_0 = \sum_i \{ [lfpr_0^i (P_t^i - P_0^i)] + [P_0^i (lfpr_t^i - lfpr_0^i)] + [(lfpr_t^i - lfpr_0^i) * (P_t^i - P_0^i)] \} \quad (2)$$

Equation (2) decomposes changes in labor force participation between two periods into changes due to population share and changes attributable to labor force

<sup>16</sup> See Aaronson et al. (2006), Grigoli et al. (2018), and Hotchkiss (2009).

**Table 1** Summary statistics (1990–2017)

Age group	Labor force participation rate	Observations (#)
15–19	0.104 (0.0029)	189,542
20–24	0.147 (0.0040)	159,658
25–29	0.146 (0.0038)	134,485
30–34	0.155 (0.0046)	117,719
35–39	0.167 (0.0047)	105,017
40–44	0.179 (0.0052)	84,829
45–49	0.175 (0.0049)	73,099
50–54	0.162 (0.0046)	54,679
55–59	0.140 (0.0048)	40,676
60–64	0.103 (0.0042)	32,349
64–69	0.075 (0.0039)	21,007
70–74	0.042 (0.0036)	13,051
75–79	0.024 (0.0032)	5,887
80–84	0.017 (0.0038)	4,237
85 and above	0.014 (0.0051)	2,767
15–85 and above	0.102(0.00196)	1,039,002
Marital status		
Never married	0.200 (0.0061)	259,644
Married	0.099 (0.0019)	779,358
Location		
Urban	0.063 (0.0014)	437,337
Rural	0.133 (0.0025)	601,665
Education		
No formal education	0.106 (0.0021)	657,423
Primary	0.078 (0.0024)	204,542
Secondary	0.103 (0.0028)	136,542
Tertiary	0.279 (0.0064)	40,391

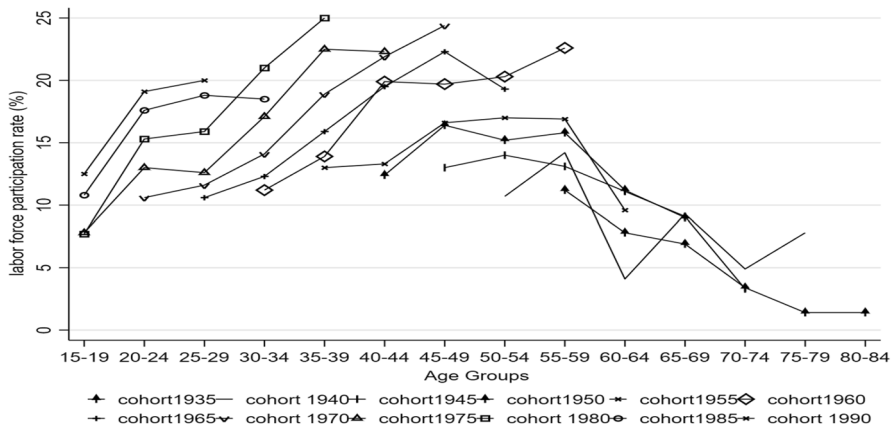
Standard errors are given in parentheses

*Source:* Author's own calculations from labor force surveys

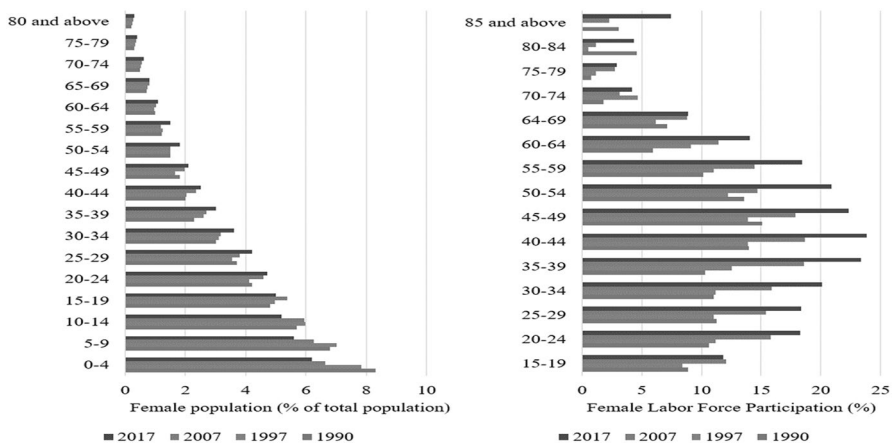
participation within each age group category. The third part is the interaction effect that shows simultaneous changes attributable to the first two components.

### Decomposition of Age, Period, and Cohort Effects

APC models are widely used to analyze the behavior of individuals or populations over time. The APC model divides age, period, and cohort effects for a particular outcome of interest. The age effect corresponds to the influence of aging, whereas period and cohort effects correspond to the influence of the survey year and the subject's date of birth. Frost (1939) employed this approach to perform a descriptive analysis in his classic study of tuberculosis. Ever since, it has become a popular

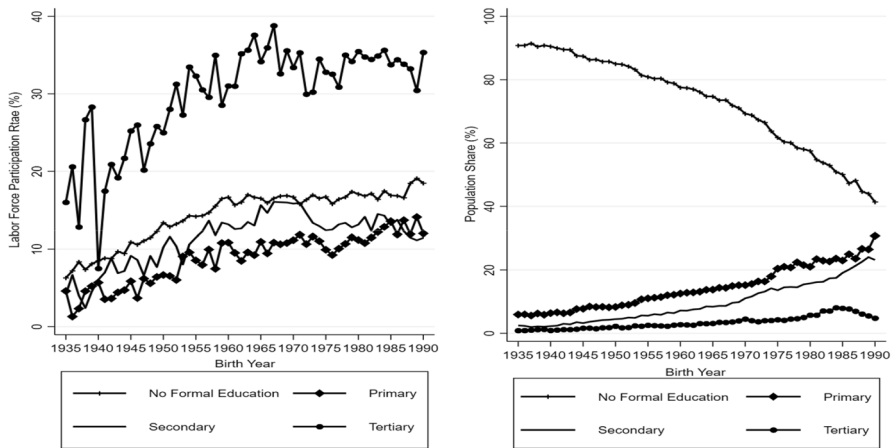


**Fig. 2** Female labor force participation by cohort. *Source:* Authors' own calculations from labor force surveys



**Fig. 3** Labor force participation rates and population shares of females for different age groups and years. *Source:* World Bank data and authors' own calculations from labor force surveys

tool in data analysis and is commonly used in various fields, including sociology, epidemiology, demography, economics, and business. In economics, APC models are used to examine labor market behavior, saving, and consumption patterns over time. Age effects explain the differences associated with different subjects within a population at different life stages related to schooling, work, marriage, fertility, etc. Period effects relate to changes in certain years wherein all subjects within a population are exposed to specific events simultaneously, e.g., recessions, pandemics, epidemics, wars, environmental changes, and policy interventions. In contrast, cohort effects refer to variations across subjects with shared life experiences, such as birth year and graduation.



**Fig. 4** Female labor force participation rates and percentage of women by education level and birth year. *Source:* Authors' own calculations from labor force surveys

The APC model for labor force participation can be expressed as follows:

$$lfp_{iapc} = \alpha + \beta_a A_{ap} + \gamma_p P_p + \delta_c C_c + \varepsilon_{iapc} \quad (3)$$

The above equation<sup>17</sup> shows labor force participation by individual  $i$ , at age  $a$ , belonging to cohort  $c$  in period  $p$ .  $A$ ,  $P$ , and  $C$  represent dummies for age, period, and cohort, respectively. Moreover,  $a = 1 \dots n$ ;  $p = 1 \dots n$ ; and  $c = 1 \dots (p - a)$ . Hence,  $c = p - a$ .  $A_{ap}$  is equal to 1 if individual  $i$  is aged  $a$  at the end of year  $p$ .  $C_c$  is equal to 1 if individual  $i$  was born in year  $c$ , and  $P_p$  is equal to 1 if labor force participation is recorded in year  $p$ .  $Lfp$  is a dummy variable that equals 1 if individual  $i$  at age  $a$  born in year  $c$  participates in labor force in year  $p$ .

### Identification Problem

APC models suffer from a well-known conundrum of identification with reference to the perfect collinearity among age, period, and cohort effects: survey year (period) = year of birth (cohort) + age. The identification problem makes it impossible to observe independent variations among these variables, consequently making it difficult for standard regression models to separate them (Browning et al., 2012). The literature on the APC methodology offers many possible solutions and identification strategies (Browning et al., 2012; Deaton & Paxson, 1994; Hanoch & Honig, 1985; Yang and Land, 2008).

One of the simplest ways to manage the identification problem is to set age, period, or cohort effects equal to 0. This can be applied to each variable in three different equations, and the models can be estimated by using ordinary least squares

<sup>17</sup> We estimate the model for averaged version, i.e.,  $lfp_{apc} = \sum_{i=1}^n lfp_{iapc}$ .

(OLS). This solution seems impractical because if removing one variable causes two effects to change dramatically, then the removed variable might be important for the total effect (Abrahamsen 2015).

Another way to address the APC identification problem is using proxy variables to capture the effect of explanatory variables. For instance, a proxy variable can be used for the period that is not correlated with age and cohort. Euwals et al. (2011) use unemployment rate as a proxy variable for period effects. However, the reliability of results depends on the choice of proxy variable and not all the potential variations in explanatory variables are explained by the proxy (Abrahamsen 2015).

The Deaton–Paxson normalization approach to address the identification problem was first popularized by Hanoch and Honig (1985) and further elaborated by Deaton and Paxson (1994). It requires applying an extra parametric restriction so that the APC model is just identified. This involves detrending so that period effect dummies are orthogonal to a trend and sum to 0. This method is more plausible when there are sufficient years for trend and cycle to be separated (Browning et al., 2012). Despite applying an arbitrary restriction, this method is most widely used by researchers to employ APC models (Abrahamsen 2015; Browning et al., 2012; Epstein, 2018; Nientker & Alessie, 2019; Tunali et al., 2021).

The maximum entropy approach of Browning et al. (2012) is the most recent method of addressing the identification problem introduced in the APC literature. It offers an approach that can formalize uncertainty in the model. Instead of providing one unique solution, this method estimates the *most likely* solution. The main idea is to reparametrize the APC model's coefficient vector in terms of a probability distribution over the set of possible solutions, from which to choose the probability distribution that has the maximum entropy allowed by the data.<sup>18</sup> Browning et al. (2012) note that this approach is best employed in cases wherein the set of possible solutions is enclosed. In economics literature, wherein the application of the APC model is imperative, the outcome variable is naturally bounded, making it plausible to use the maximum entropy approach.

This study applies both the Deaton–Paxson normalization and maximum entropy approaches<sup>19</sup> to test the robustness of our results.<sup>20</sup> These two methods were chosen over others for the following reasons: (1) sufficient years of LFSs almost cover three decades; and (2) the predicted variable, labor force participation rate, is enclosed.

<sup>18</sup> For a more detailed description of the maximum entropy method, see Browning et al. (2012).

<sup>19</sup> Yang et al. (2004) propose an intrinsic estimator approach to manage the APC identification problem. This approach elicits primarily the same results as the other approaches and is not discussed in detail.

<sup>20</sup> The results of APC model estimates are close to OLS estimates as we categorize age in fourteen categories which somehow solve this identification problem.

## Estimation Results

### Decomposition of Change in Total Labor Force Participation

Table 2 presents the contributions of the demographic and participation components in total labor force participation. We perform a decomposition analysis over various periods, and selection of time is arbitrary. As shown in the last row of Table 2, the overall change in age structure only accounted for 0.048 percent of the 7.465 percent increase in aggregate participation rate between 1990 and 2017. The results clearly demonstrate that demographic changes do not explain the increase in participation rates between different periods. Therefore, we cannot accept the first hypothesis and infer that changes in aggregate labor force participation are driven by changes in labor supply behavior within different demographic categories. The second row of the table indicates that an increase in participation rate mainly occurred during 1997–2007. This period was marked by high economic growth under the authoritarian rule of General Musharraf.<sup>21</sup> However, the rapid growth in this period is attributed to the aid provided by the United States' government and Washington's financial institutions (Zaidi, 2008). The important steps that might have helped increase women's economic participation include the foundation of the Higher Education Commission in 2002, the establishment of the Ministry of Women's Development as an independent ministry in 2004, and the approval of the Women's Protection Bill<sup>22</sup> in 2006.

### Decomposition by Age, Period, and Cohort

This section explains the results of the decomposition of female labor force participation rate (LFPR) by age, period, and cohort, following the Deaton–Paxson normalization and maximum entropy approaches (Browning et al., 2012; Deaton & Paxson, 1994). The purpose of applying two approaches is to address the identification problem and ensure the robustness of our results. The analysis is also performed separately for location, marital status, and education level. The analysis is conducted for females aged 15 and above and by subdividing age into the 15 previously introduced categories. The oldest birth cohort that can be tracked are the females born in 1891, and the youngest are those born in 2002. All figures in this section provide age, period, and cohort effects of predicted participation rates along with 95 percent confidence intervals.

### Age Effects in Female Labor Force Participation Rates

Figure 5 below presents the age effects of the LFPR of females aged 15 and above. Labor market activity depends on several demand and supply factors, along with

<sup>21</sup> After a successful military takeover in 1999, General Musharraf became the 10th president of Pakistan (2001–2008).

<sup>22</sup> The bill initiated the legal punishment of rape and adultery in Pakistan.



**Table 2** Components of labor force participation rate (LFPR) (LFPR refers to labor force participation rate) change as percentage of total change

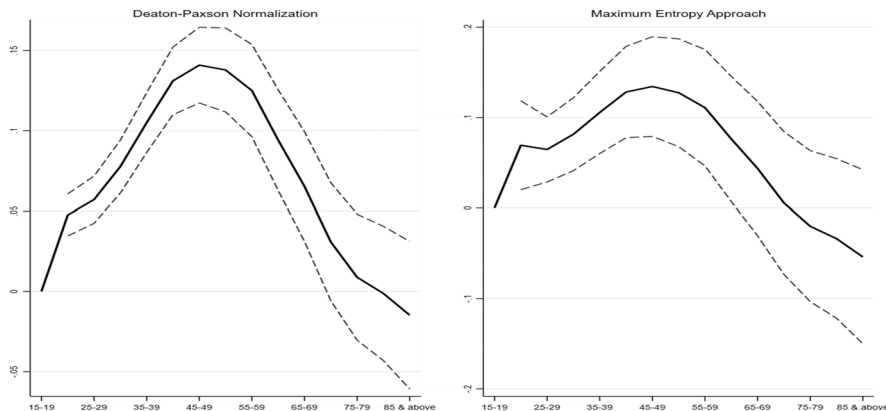
	Demographic (%)	Participation (%)	Interaction (%)	Total change in aggregate LFPR (%)
1990–1997	0.016	0.169	0.004	0.190
1997–2007	0.025	4.144	0.013	4.188
2007–2017	0.008	3.009	0.068	3.086
1990–2017	0.048	7.343	0.072	7.465

*Source:* Authors' own calculations from labor force surveys

different institutional settings that may result in very distinct age effects (Fitzenberger et al., 2004). Both panels reveal an inverted U-shaped curve for female labor force participation in Pakistan, supporting our second hypothesis. Participation rates increase in early adulthood, remain constant, and begin to decline after the 50 s. This might be a result of the joint family system institution of multigenerational cohabitation in Pakistan, wherein child raising and employment are compatible. The results are consistent with other studies' labor force participation age effects (Abrahamsen 2015; Browning et al., 2012; Lassassi & Tansel, 2020).

When we decompose participation rates separately for urban and rural areas,<sup>23</sup> we observe that urban females' age effects display a slight M-shaped curve. This dip represents the child-raising age of females, during which labor force participation is reduced. Grigoli et al. (2018) also find an M-shaped curve without a rural–urban divide for advanced economies. They observe that females from the United States join the labor force earlier than in Europe. However, they drop out at a higher rate in the late 20 s and early 30 s. Furthermore, a slight M-shaped curve for Egyptian urban women shows the existence of a temporary exit faced by women for child-bearing purposes (Lassassi & Tansel, 2020). In some developed countries, married women with children are more likely to work part-time, rather than quitting completely for home responsibilities (Ferriman et al., 2009). For rural females, there is an inverted U-shaped curve. A closer look at the age effects of rural and urban females reveals, for almost all the age groups, that LFPRs are higher in rural areas. The same difference of a rural–urban divide has been observed in Turkey (Tunali et al., 2021). The reason might be rural females' increased involvement in unpaid work (Amir et al., 2018). In addition, the possibility of combining home production and employment is greater in rural areas because workplace and home are in close proximity (Bloom & Freeman, 1986). We also notice that the age effects in rural areas peak late. Considering the median age at marriage for rural females is lower than urban females' median age at marriage and larger household size, young rural

<sup>23</sup> The age effects of female labor force participation with subcategories of location, marital status, and education level are provided in the Appendix. Ever-married females' age profiles follow the inverted U-shaped curve. In comparison labor force participation age profiles of never-married females show more fluctuations.



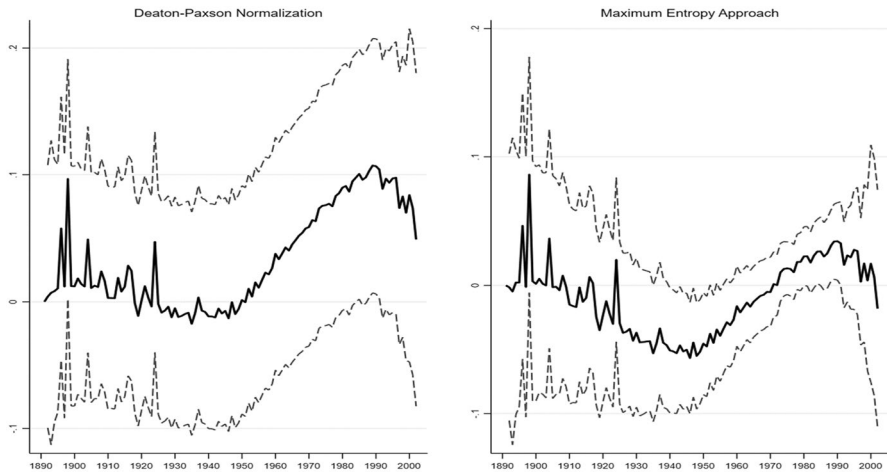
**Fig. 5** Age effects of female labor force participation rates. *Source-* Author's own calculations. The connected line represents predicted participation rates and dashed lines are 95 percent confidence intervals

women participate in the labor force with the double burden of home production (with infants) and labor market work. The later peak reflects that when kids reach a certain age, managing home production and labor work is easier because they can help perform different tasks at home and on the farms.

On different subdivisions of education level, the study reports age effects of females with no formal education, primary education, secondary education, and tertiary education. LFPR age effects for females with no formal education follow a standard U-shaped curve, and their participation begins to decrease after age 50. In comparison, the age profile of females with tertiary education is not exactly U-shaped. The distinct feature is that their exit from the labor market is not very steep after age 50 as they appear to choose to participate even after retirement age. The age profile of females with primary and secondary education level follows the same pattern, but participation rates are lower than those of females with no formal education. Females from rural areas have been observed to participate more in the labor force. Many females in rural areas have no formal education, which might be relevant to their higher participation than that of females with primary and secondary education. We can also infer that educated females (with primary, secondary, and tertiary levels) remain in the labor force longer than females with no formal education do. The two methods' results are quite consistent, other than those for education level estimates, which indicate the robustness of our estimates.

### Cohort Effects in Female Labor Force Participation Rates

Figure 6 presents the differences between participation rates among females from different cohorts. The figure reveals that cohort effects increase for women born after 1950, plateau around 1990, and have started to decline more recently, thus partially supporting our third hypothesis. Evidence from some advanced economies reflects the same cohort profile patterns (Grigoli et al., 2018). The effects are estimated to be larger with Deaton–Paxson normalization than those with the maximum



**Fig. 6** Cohort effects of female labor force participation. *Source-* Author's own calculations. The connected line represents predicted participation rates and dashed lines are 95 percent confidence intervals

entropy approach. These differences might reflect changing social norms, education levels, and individual preferences across generations. The decline after 1990 implies that new cohorts are limiting the gain that the economy can achieve from increasing female labor force participation. However, we report these results cautiously as we observe later cohorts for a short period of time. To understand the cohort effects across generations, we further decompose cohort effects in labor force participation conditional on location, marital status, and educational attainment. We observe a dip in the cohort effects for the females born in the 1940s and 1950s. The reason relates to the central historical event in the twentieth century South Asia i.e., British India gained independence from Britain. Therefore, the eras of 1940s and 1950s are viewed as years of economic instability for Pakistan due to the absence of economic infrastructure, financial resources, and industrial base (Anjum & Sgro, 2017). The dip for these cohorts is justified in the sense that they were born during the unfortunate times of economic turmoil.

Cohort effects with a rural–urban divide follow almost the same pattern for rural areas. In the rural areas, the participation rates hover around 0 until the 1950s and then follow the same pattern under the Deaton–Paxson approach, whereas with the maximum entropy approach, after remaining stable for over two decades, the participation rates take negative values and start to increase after the 1950s.

Considering educational attainment reveals a rise in labor force participation from cohorts with no formal education and born after the 1950s. We observe this increase in both urban and rural areas. In urban areas, it might be because of the growth of the services sector, which provide employment opportunities to uneducated females, especially in the textile sector, where approximately 30 percent of

the workers are women.<sup>24</sup> However, the rise in the labor force participation of rural females with no formal education is closely linked with poverty in Pakistan. Pakistan faced high poverty in the late 1980s due to the adherence to structural adjustment programs to deal with the current account deficit. It has been observed that Pakistani women from poor urban households disproportionately bear the burden of poverty because of lesser ownership of land and productive assets, lower educational attainment, social norms favoring men, and primarily unpaid farm jobs (Akram, 2016). There is a small increase in labor force participation among females with primary education, although their share in population increases over time. Labor force participation for females with secondary education shows different results with different methods. With Deaton–Paxson normalization, the cohort profile begins decreasing after the 1930s; however, with the maximum entropy approach, it remains constant and hovers around 0. It is not possible to reach a precise conclusion about cohort effects, given the different results with the two methods. Nevertheless, Fig. 4, along with cohort effects of females with secondary education, demonstrates that participation rates are declining for the cohorts born after the 1970s. For females with tertiary education, the results of estimated cohort effects are inconsistent under different methods, making it difficult to draw conclusions. Women with high educational attainment have been observed to participate more in the labor force (Amir et al., 2018). However, the Asian Development Bank (ADB) reports that only 25 percent of Pakistani women with a university degree participate in the labor force (Tanaka & Muzones, 2016).

### Period Effects in Female Labor Force Participation Rates

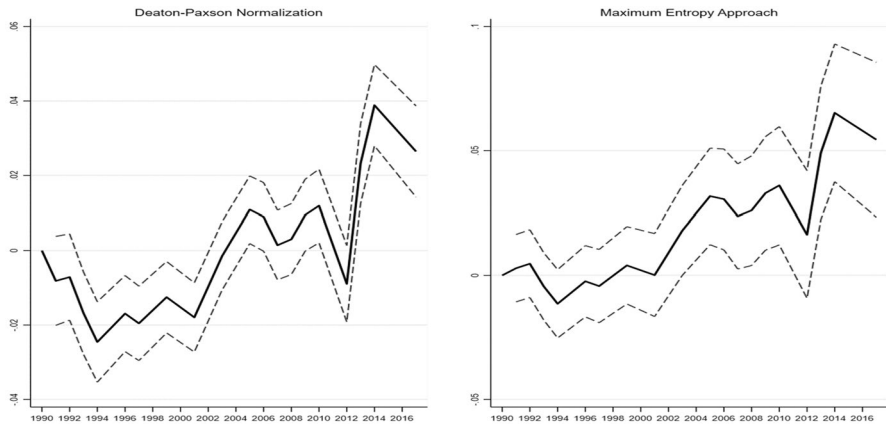
In this section, we present period<sup>25</sup> effects in the participation rates covering almost three decades. Figure 7 shows the year effects of aggregate female labor force participation from 1990 to 2017. The year effects reveal how participation rates behave over almost three decades. Female LFPRs are pro-cyclic, displaying a positive relationship between female labor force participation and the annual GDP growth rate, confirming our fourth hypotheses. This is higher for the years in which GDP growth rate is high and lower for the years in which it is low.<sup>26</sup> For instance, annual GDP growth rate is less than 5 percent between 1993 and 2002, which translates into lower female labor force participation. A sharp dip in participation is observed for 2012, which might be the repercussion of low annual growth rate in preceding years (less than 3 percent from 2008 to 2011). Concerning the global financial crisis, Haq et al. (2014) find that GDP growth declined by 8.8 percent, whereas there was an increase in unemployment by 6 percent during 2007–2011.

Considering the rural–urban divide, the year effects of labor force participation rates for rural females follow the similar pattern, i.e., pro-cyclicality. The main difference is that the estimated participation rates are higher for rural females than they

<sup>24</sup> <https://gender-works.giz.de/competitions2020/pakistan-inspiring-change-women-in-action-in-the-textile-garment-industry-of-punjab/>.

<sup>25</sup> *Period* and *year* are used interchangeably.

<sup>26</sup> See Figure A14 in Appendix.



**Fig. 7** Year effects of female labor force participation. *Source-* Author's own calculations. The connected line represents predicted participation rates and dashed lines are 95 percent confidence intervals

are for urban females under both approaches. Turning to the year effects of ever-married females, one can observe the pro-cyclical behavior in year effects.

The period effects with no formal education follow a similar trend as aggregate labor force participation. However, females' labor force participation with a primary level of education presents an increasing trend over the years, with no sharp decline around 2012. The estimates of labor force participation with secondary and tertiary education show different results under different approaches. Deaton–Paxson normalization shows a slightly increasing trend in labor force participation for females with secondary and tertiary education. However, the estimates under the maximum entropy approach are negative, with no clear trend.

## Conclusion and Policy Recommendations

In this study, we analyze the patterns and causes of female labor force participation in Pakistan over three decades. To probe how demographic changes have contributed to the changes in labor force participation since 1990, the study employed a decomposition analysis of overall change in female labor supply. This study has also performed APC analysis to decompose the total change in female labor force participation into three components using two different methods to solve the identification problem.<sup>27</sup> In general, female labor market behavior in Pakistan shows that women's participation in the labor force is driven by necessity rather than intent. High participation of females observed for rural areas with no formal education confirms this notion. Saqib and Arif (2012) identify monetary poverty an important factor compelling females to work for long hours and at the lowest wage-rate to make both ends meet. In view of our first hypothesis that demographic changes explain a substantial increase in female labor force participation, the results demonstrate that changing demographic composition accounts for a slight change in female labor

<sup>27</sup> Deaton–Paxson normalization and maximum entropy approach.

force participation since the 1990s. If this trend continues, it is highly unlikely for Pakistan to reap the benefits of demographic dividend.

Second, the results of our APC decomposition uncover some interesting insights. The results support our second hypothesis regarding age effects which relates labor force participation of females to the timing of education, children, and retirement. We have observed the following patterns. First, female labor force participation follows an inverted U-shaped curve. Participation rates increase in early adulthood, remain constant, and start declining at around age 50. Participation rates remain constant between the ages of early 30 s to late 40 s, which is a period marked by increasing household responsibilities because of marriage and child rearing. Second, urban females' age effects show a slight M-shaped curve demonstrating a withdrawal from the labor market to take care of children. Age effects of rural females show that they remain in the labor force longer than urban females do. Third, the analysis of age effects with different education levels reveals that females with no formal education participate more in the labor force than females with primary and secondary education do; however, females with a high level of education remain in the labor force longer.

Regarding the cohort effects, we observe a continuous increase in labor force participation rates of cohorts born after the 1950s. The evidence supports our third hypothesis which establishes a link between labor force participation with changing social norms, increasing education levels, and decreasing fertility rates. Considering marital status and educational attainment, younger cohorts of married females and females with less education are participating more in the labor force. This suggests that females with traditionally weaker attachments to the labor market are participating more in the labor force. Finally, the period effects of female labor force participation behave pro-cyclically, they are higher for the years when the GDP growth rate is higher and lower for the years when it is lower.

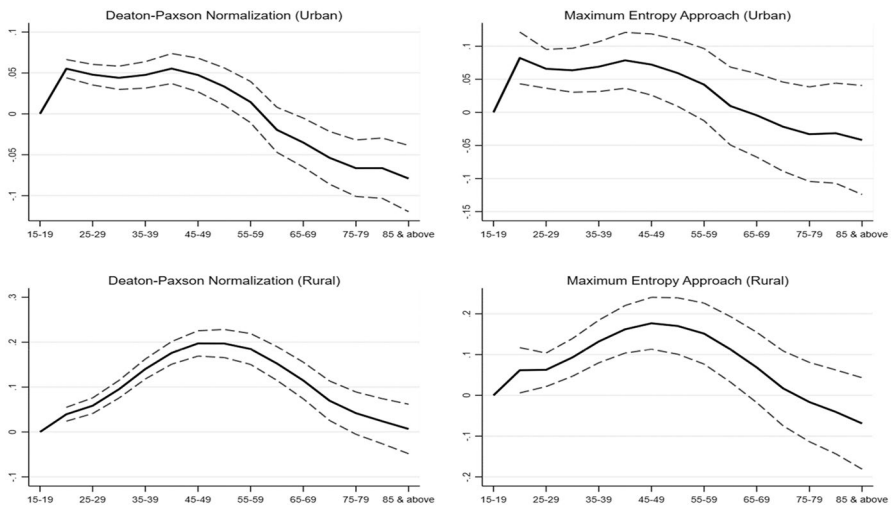
The findings of this study have several policy implications. First, given that changing demographic composition explains a very small change in female labor force participation in Pakistan since the 1990s, it is clear that ingenious planning is required to maximize the gains from an ongoing demographic dividend. The key areas of focus include investment in female education and family planning, provision of affordable childcare facilities, generation of employment opportunities in the manufacturing and services sector (Durr-e-Nayab, 2006; Navaneetham & Dharmalingam, 2012), and creating a family-friendly work environment for females to maintain work–life balance.<sup>28</sup>

Second, the APC analysis results indicate that what is required to improve female labor force participation in Pakistan is the provision of childcare services, especially for urban women, as well as the improvement of access to tertiary education, particularly in rural areas where education levels are low. Increased participation of married females from younger cohorts implies the designing of policies that can persuade more progressive gender attitudes toward the inclusion of females in the labor force. Additionally, identifying causal links between social norms and female labor force participation requires further examination.

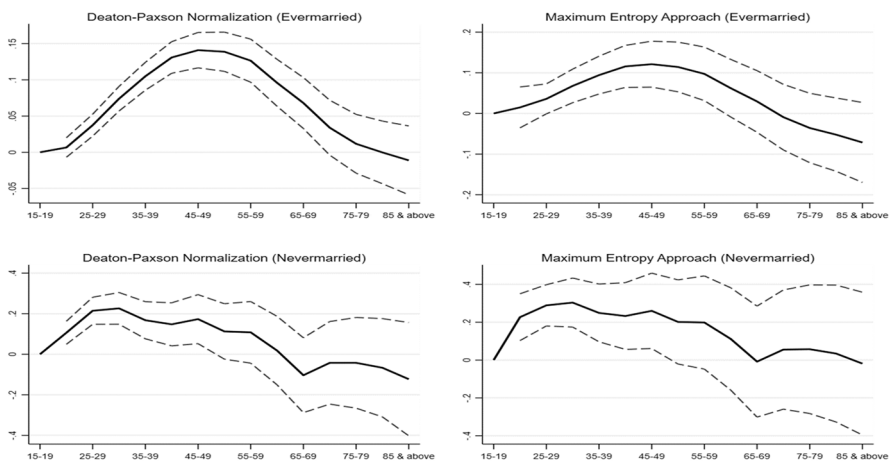
<sup>28</sup> More than 50 percent of women in each LFS (1990–2017) are inactive because of housekeeping.

## Appendix

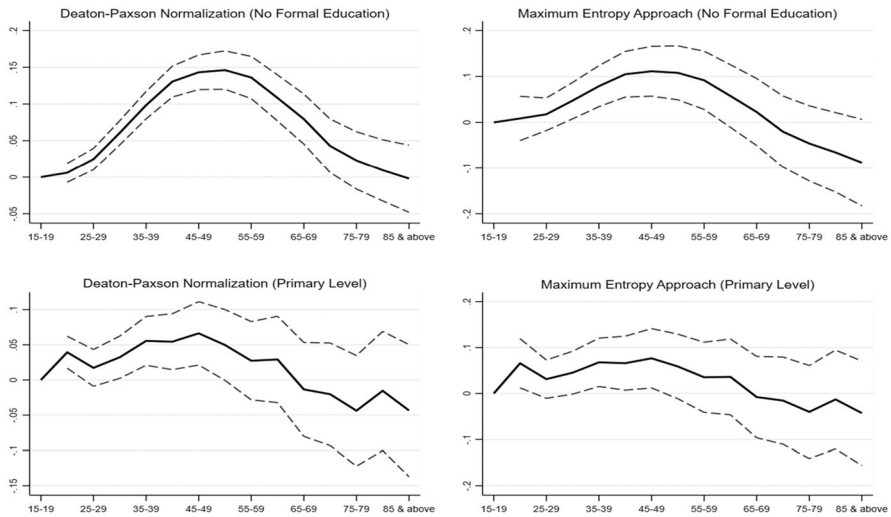
See Figs. 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21.



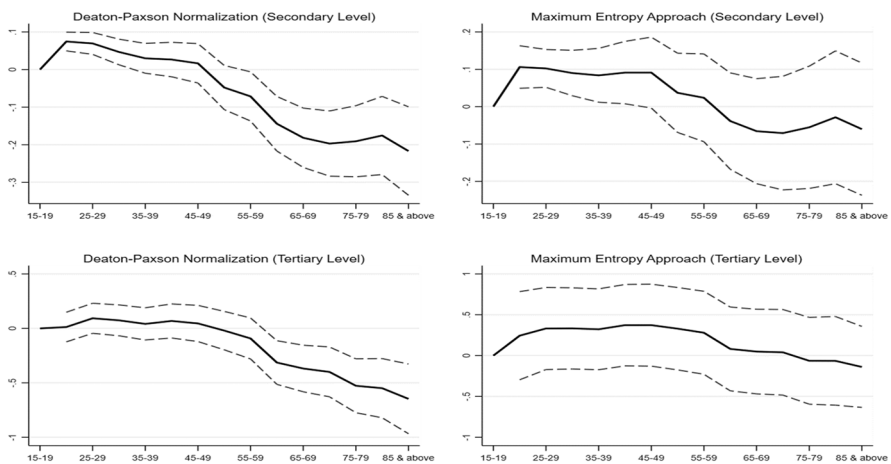
**Fig. 8** Age effects of urban and rural females. *Source-* Author's own calculations. The connected line represents predicted participation rates and dashed lines are 95 percent confidence intervals



**Fig. 9** Age effects of ever-married and never-married females. *Source-* Author's own calculations. The connected line represents predicted participation rates and dashed lines are 95 percent confidence intervals

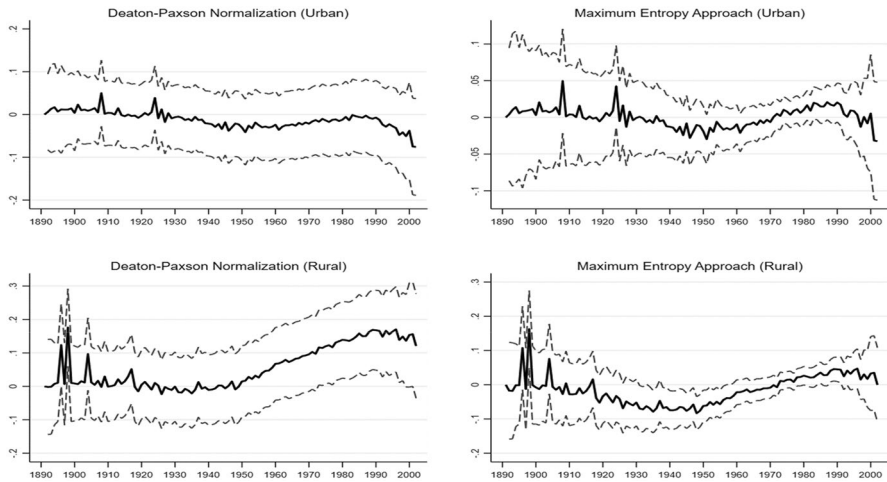


**Fig. 10** Age effects of females with no formal education and primary level of education. *Source-* Author's own calculations. The connected line represents predicted participation rates and the dashed lines are 95 percent confidence intervals

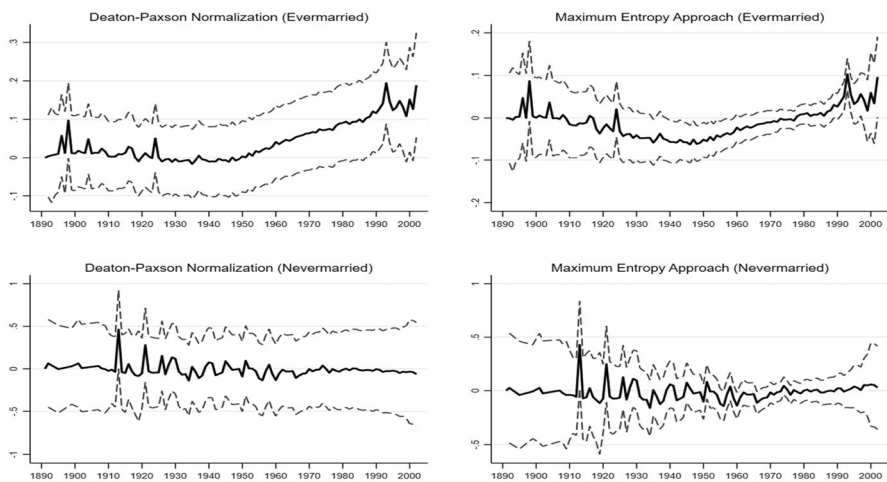


**Fig. 11** Age effects of females with secondary and tertiary levels of education. *Source-* Author's own calculations. The connected line represents predicted participation rates and dashed lines are 95 percent confidence intervals

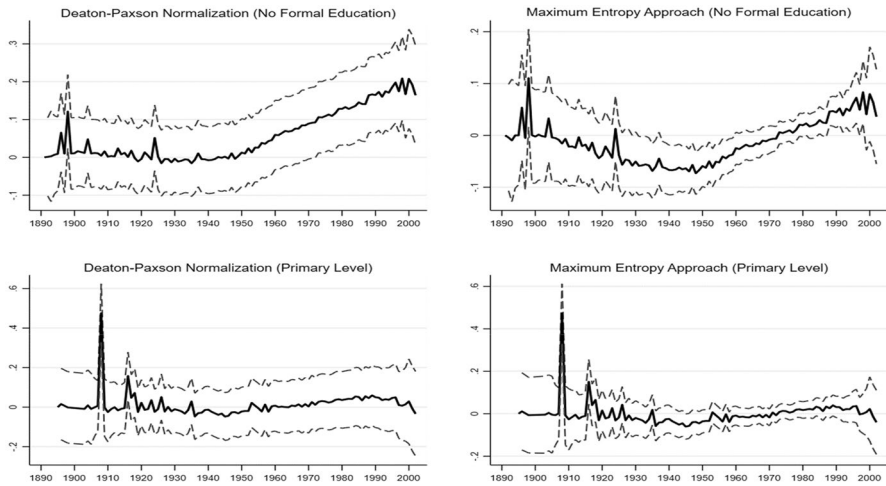




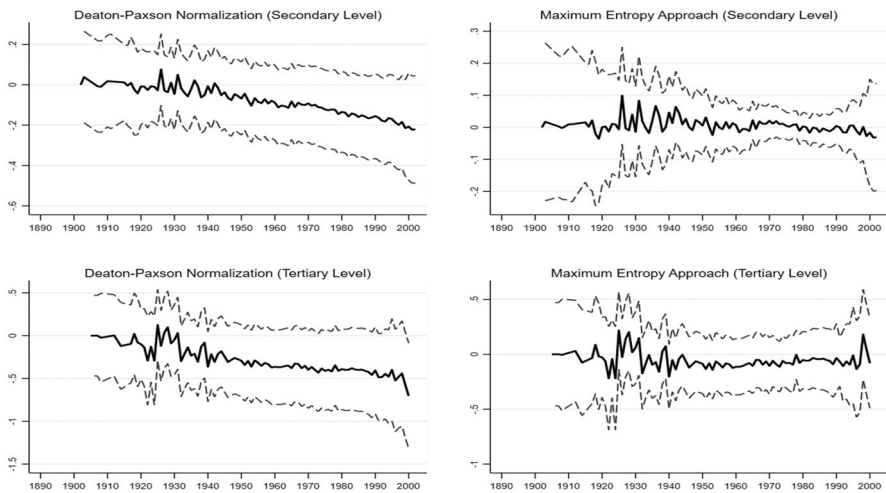
**Fig. 12** Cohort effects of urban and rural females. *Source:* Author's own calculations. The connected line represents predicted participation rates and dashed lines are 95 percent confidence intervals



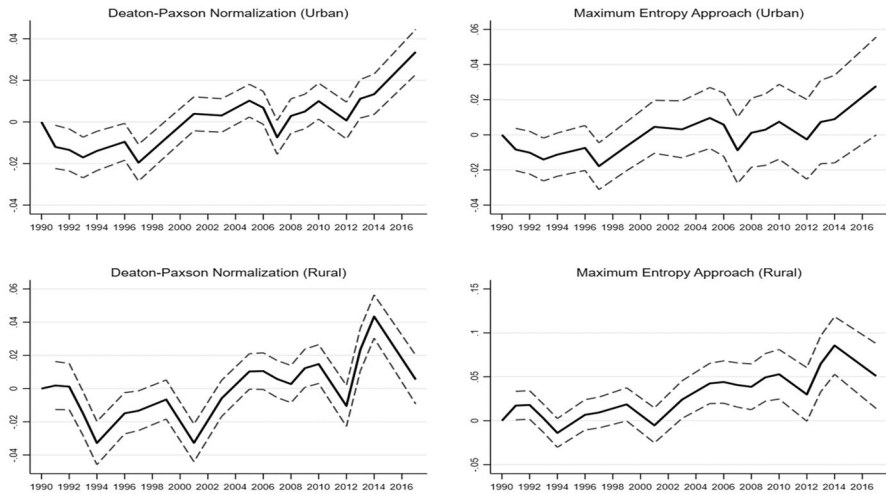
**Fig. 13** Cohort effects of ever-married and never-married females. *Source:* Author's own calculations. The connected line represents predicted participation rates and dashed lines are 95 percent confidence intervals



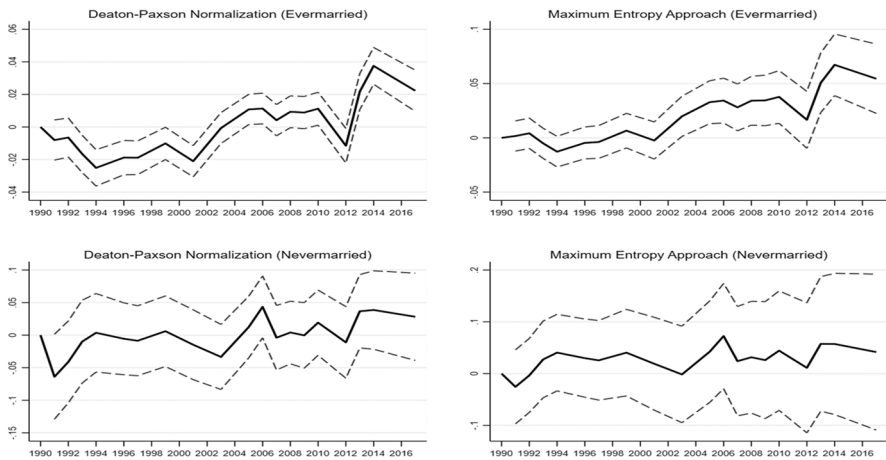
**Fig. 14** Cohort effects of females with no formal education and primary level of education. *Source:* Author's own calculations. The connected line represents predicted participation rates and the dashed lines are 95 percent confidence intervals



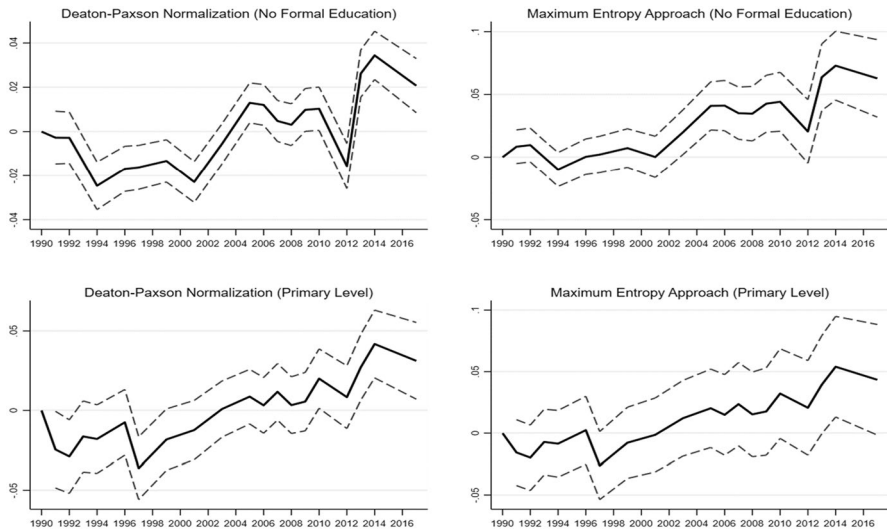
**Fig. 15** Cohort effects of females with secondary and tertiary levels of education. *Source:* Author's own calculations. The connected line represents predicted participation rates and dashed lines are 95 percent confidence intervals



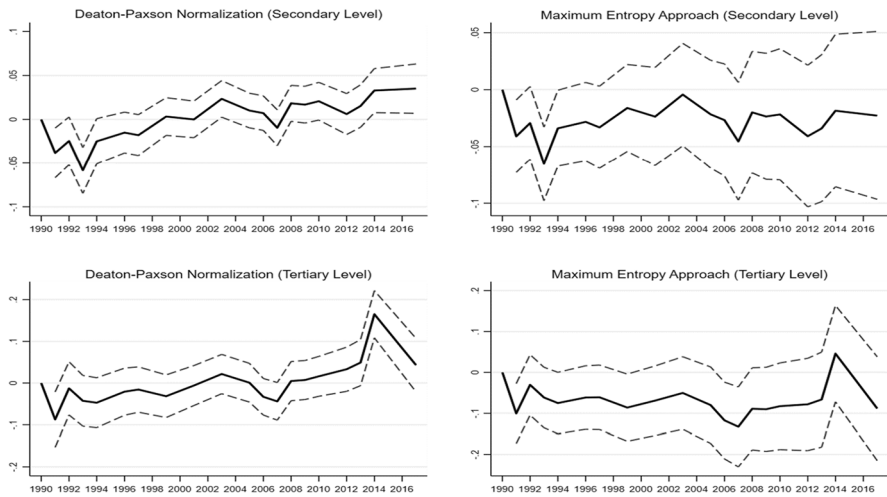
**Fig. 16** Year effects of urban and rural females. *Source:* Author's own calculations. The connected line represents predicted participation rates and dashed lines are 95 percent confidence intervals



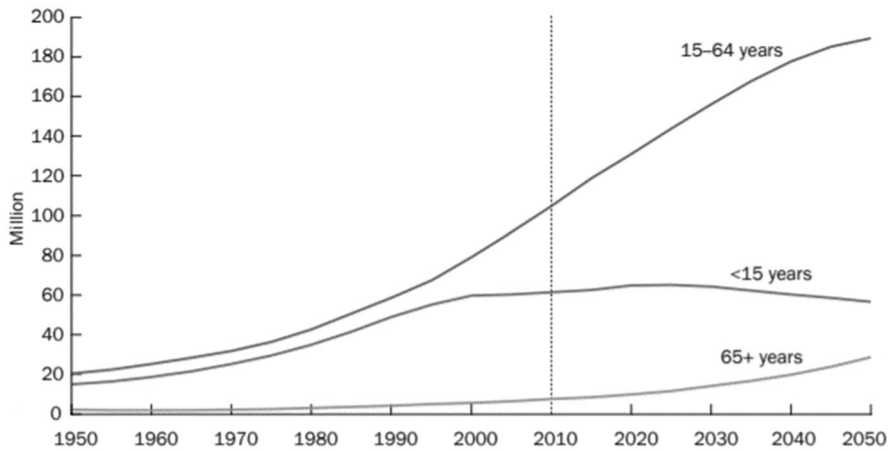
**Fig. 17** Year effects of ever-married and never-married females. *Source:* Author's own calculations. The connected line represents predicted participation rates and dashed lines are 95 percent confidence intervals



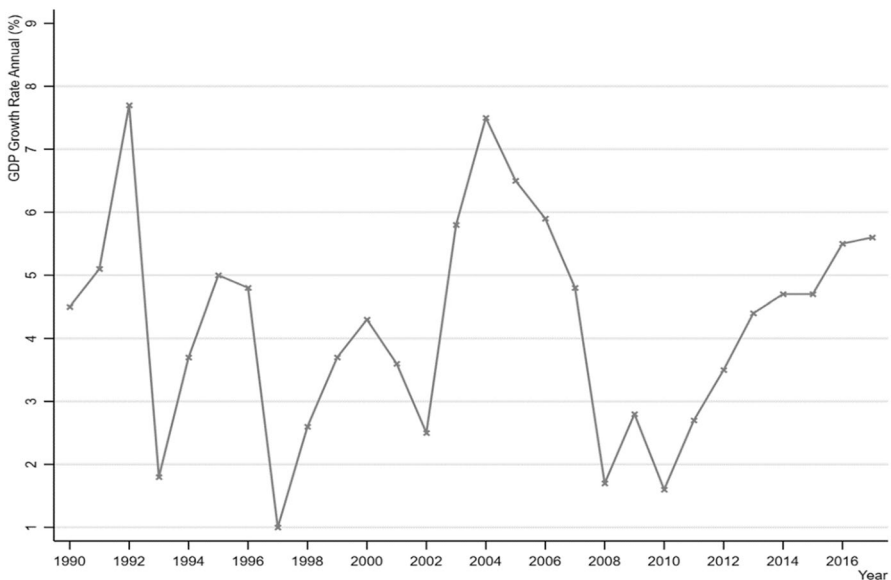
**Fig. 18** Year effects of females with no formal education and primary education level. *Source:* Author's own calculations. The connected line represents predicted participation rates and dashed lines are 95 percent confidence intervals



**Fig. 19** Year effects of females with secondary and tertiary levels of education. *Source:* Author's own calculations. The connected line represents predicted participation rates and dashed lines are 95 percent confidence intervals



**Fig. 20** Population share (1950–2010) and projections (2010–2050) for different age groups. *Source:* Population council 2011



**Fig. 21** Annual Growth rate of GDP (1990–2017). *Source:* World Bank data

**Acknowledgements** The authors thank Prof. Dr. Joachim von Braun for his valuable comments on the earlier and revised drafts of this manuscript. The authors would also like to acknowledge two anonymous reviewers for their valuable comments and suggestions which helped them to improve the quality of the manuscript.

**Author Contributions** HA and BBC contributed to the initial conceptualization of the manuscript. HA performed data analysis and wrote the manuscript. BBC contributed to the reviewing process.

**Funding** Open Access funding enabled and organized by Projekt DEAL. The authors greatly acknowledge the financial support received from the Development-Related Postgraduate Courses (EPOS) PhD scholarship granted by the German Academic Exchange Service (DAAD).

**Data Availability** The data and stata codes used for the analysis are available from the corresponding author on request.

## Declarations

**Competing Interests** We wish to confirm that there are no known conflicts of interest associated with this publication.

**Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

## References

- Aaronson, S., Fallick, B., Figura, A., Pingle, J., & Wascher, W. (2006). The recent decline in the labor force participation rate and its implications for potential labor supply. *Brookings Papers on Economic Activity*, 154(1), 69–134. <https://doi.org/10.1353/eca.2006.0012>
- Abrahamsen, C. K. (2015). Labor Supply over the Life Cycle-An Age-Period-Cohort analysis (Master's thesis).
- Abraham, A. Y., Ohemeng, F. N. A., & Ohemeng, W. (2017). Female labour force participation: Evidence from Ghana. *International Journal of Social Economics*, 44(11), 1489–1505. <https://doi.org/10.1108/IJSE-06-2015-0159>
- Akram, W. (2016). An Empirical analysis of household income in rural Pakistan: Evidences from Tehsil Samundri. *Pakistan Economic and Social Review*, 49(2), 231–249.
- Amir, S., Kotikula, A., Pande, R. P., Bossavie, L. L. Y., & Khadka, U. (2018). Female labor force participation in Pakistan. *Female Labor Force Participation in Pakistan*. <https://doi.org/10.1596/30197>
- Anjum, M. I., & Sgro, P. M. (2017). A brief history of Pakistan's economic development. *Real World Economics Review*, 80, 171–178.
- Arif, G. M., Kiani, M. F., & Sheikh, K. H. (2002). Labour market dynamics in Pakistan: Evidence from the longitudinal data. *Pakistan Development Review*. <https://doi.org/10.30541/v41i4iipp.701-720>
- Azid, T., Khan, R. E. A., & Alamasi, A. M. S. (2010). Labor force participation of married women in Punjab (Pakistan). *International Journal of Social Economics*, 37(8), 592–612. <https://doi.org/10.1108/03068291011060643>
- Balleer, A., Gomez-Salvador, R., & Turunen, J. (2014). Labour force participation across Europe: A cohort-based analysis. *Empirical Economics*, 46(4), 1385–1415. <https://doi.org/10.1007/s00181-013-0716-3>
- Başlevent, C., & Onaran, Ö. (2003). Are married women in Turkey more likely to become added or discouraged workers? *Labour*, 17(3), 439–458. <https://doi.org/10.1111/1467-9914.00248>
- Beaudry, P., & Lemieux, T. (1994). Evolution of the Female Labour Force Participation Rate in Canada, 1976–1994 : a Cohort Analysis. *Canadian Business Economics*, 1–14.
- Benati, L. (2001). Some empirical evidence on the “discouraged worker” effect. *Economics Letters*, 70(3), 387–395. [https://doi.org/10.1016/S0165-1765\(00\)00375-X](https://doi.org/10.1016/S0165-1765(00)00375-X)
- Bloom, D. E., & Freeman, R. B. (1986). The effects of rapid population growth on labor supply and employment in developing countries. *Population and Development Review*, 12(3), 381. <https://doi.org/10.2307/1973216>

- Borjas, G. (2010). Labor Supply - Harvard University. 21–83.
- Browning, M., Crawford, I., & Knoef, M. (2012). The age-period cohort problem: set identification and point identification. Cemmap Working Paper: Vol. CWP02/12 (Issue 1965). <https://doi.org/10.1920/wp.cem.2012.0212>
- Dao, N. T., Dávila, J., & Greulich, A. (2021). The education gender gap and the demographic transition in developing countries. *Journal of Population Economics*, 34, 431–474.
- Deaton, A. S. (1997). The Analysis of Household Surveys: Micro Econometric Analysis for Development Policy. The World Bank.
- Deaton, A. S., & Paxson, C. H. (1994). Saving, growth, and aging in Taiwan. *Studies in the Economics of Aging* (pp. 331–362). University of Chicago Press.
- Durr-e-Nayab (2006) Demographic dividend or demographic threat in Pakistan, PIDE Working Papers, Doi: <https://doi.org/10.2139/ssrn.963426>
- Duval Hernández, R., & Orraca Romano, P. (2009). A cohort analysis of labor participation in Mexico, 1987–2009. *IZA Discussion Paper*. <https://doi.org/10.2139/ssrn.1472563>
- Ejaz, M. (2011). The determinants of female labor force participation in Pakistan: An instrumental variable approach. *CREB Working Paper*, 1(11), 1–38.
- Epstein, B. (2018). Labor Force Participation Dynamics. MPRA Paper No. 88776.
- Euwals, R., Knoef, M., & van Vuuren, D. (2011). The trend in female labour force participation: What can be expected for the future? *Empirical Economics*, 40(3), 729–753. <https://doi.org/10.1007/s00181-010-0364-9>
- Fafchamps, M., & Quisumbing, A. R. (1999). Human capital, productivity, and labor allocation in rural Pakistan. *Journal of Human Resources*. <https://doi.org/10.2307/146350>
- Ferdoos, A. (2005). Social Status of Rural and Urban Working Women in Pakistan – a Comparative Study. Master Thesis, Osnabrück University.
- Ferriman, K., Lubinski, D., & Benbow, C. P. (2009). Work Preferences, life values, and personal views of top math/science graduate students and the profoundly gifted: developmental changes and gender differences during emerging adulthood and parenthood. *Journal of Personality and Social Psychology*, 97(3), 517–532. <https://doi.org/10.1037/a0016030>
- Field, E., & Vyborny, K. (2016). Female labor force participation in asia: Pakistan country study. Background report. Asian Development Bank, Manila
- Fitzenberger, B., Schnabel, R., & Wunderlich, G. (2004). The gender gap in labor market participation and employment: A cohort analysis for West Germany. *Journal of Population Economics*, 17(1), 83–116. <https://doi.org/10.1007/s00148-003-0141-6>
- Frost, W. H. (1939). The Age selection of mortality from tuberculosis in successive decades. *American Journal of Hygiene, Section A*, 30, 91–96.
- Fuchs, J., Söhnlein, D., & Weber, B. (2008). Demographic effects on the German labor supply. A decomposition analysis. IAB discussion paper. <http://www.econstor.eu/handle/10419/32706>.
- Fukuda, K. (2006). A cohort analysis of female labor participation rates in the US and Japan. *Review of Economics of the Household*, 4(4), 379–393. <https://doi.org/10.1007/s11150-006-0013-4>
- Goldin, C., & Mitchell, J. (2017). The new life cycle of women's employment: Disappearing humps, sagging middles, expanding tops. *Journal of Economic Perspectives*, 31(1), 161–182. <https://doi.org/10.1257/jep.31.1.161>
- Gregg, P. (1994). Out for the count : A social scientist's analysis of unemployment statistics in the UK. *Journal of the Royal Statistical Society: Series A (statistics in Society)*, 157(2), 253–270.
- Grigoli, F., Koczan, Z., & Topalova, P. (2018). A Cohort-Based Analysis of Labor Force Participation for Advanced Economies. IMF Working Papers, 18(120), 1. <https://doi.org/10.5089/9781484355251.001>
- Guettabi, M. (2019). A simple decomposition of Alaska ' s labor force participation rate.
- Gutierrez-Domenech, M. (2005). Employment after motherhood: A European comparison. *Labour Economics*, 12(1), 99–123.
- Hanoch, G., & Honig, M. (1985). True" age profiles of earnings: Adjusting for censoring and for period and cohort effects. *The Review of Economics and Statistics*. <https://doi.org/10.2307/1925966>
- Haq, M., Khan, K., & Parveen, A. (2014). The growth and employment impacts of the 2008 global financial crisis on Pakistan. *The Lahore Journal of Economics*, 19(2), 129–154. <https://doi.org/10.35536/lje.2014.v19.i2.a5>
- Hotchkiss, J. L. (2006). Changes in behavioral and characteristic determination of female labor force participation, 1975–2005. *Economic Review-Federal Reserve Bank of Atlanta*, 91(2), 1.

- Hotchkiss, J. L. (2009). Decomposing changes in the aggregate labor force participation rate. *Federal Reserve Bank of Atlanta Working Paper*. <https://doi.org/10.2139/ssrn.1433124>
- Johnston, G. (2005). Women's participation in the labour force (No. 05/06). New Zealand Treasury Working Paper.
- JmohsinJoshi, H., Macran, S., & Dex, S. (1996). Employment after childbearing and women's subsequent labour force participation: Evidence from the British 1958 birth cohort. *Journal of Population Economics*, 9(3), 325–348. <https://doi.org/10.1007/s001480050021>
- Kapsos, S., Silberman, A., & Bourmpoula, E. (2014). Why is female labour force participation declining so sharply in India? *ILO Research Paper No.*, 10, 1–51.
- Khalique, A., Khan, D., Akbar, S., Hamayun, M., & Ullah, B. (2017). Female labor market participation and economic growth: The case of Pakistan. *Journal of Social Science Studies*, 4(2), 217. <https://doi.org/10.5296/jsss.v4i2.11386>
- Klasen, S., & Pieters, J. (2012). Push or Pull? Drivers of Female Labor Force Participation during India's Economic Boom. IZA Discussion papers 6935.
- Klasen, S. (2019). What explains uneven female labor force participation levels and trends in developing countries? *World Bank Research Observer*, 34(2), 161–197. <https://doi.org/10.1093/wbro/ilkz005>
- Lassassi, M., & Tansel, A. (2020). Female labor force participation in five selected mena countries: an age-period-cohort analysis (Algeria, Egypt, Jordan, Palestine and Tunisia). *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3718780>
- Lee, J. Y. (2014). The plateau in US women's labor force participation: A cohort analysis. *Industrial Relations*, 53(1), 46–71. <https://doi.org/10.1111/irel.12046>
- Lichter, D., & Costanzo, J. (1987). How do demographic changes affect labor force participation of women? *Monthly Labor Review*, 110(11), 23–28.
- Mincer, J. (1985). Intercountry comparisons of labor force trends and related developments: an overview. *Journal of Labor Economics*. <https://doi.org/10.1086/298074>
- Navaneetham, K., & Dharmalingam, A. (2012). A review of age structural transition and demographic dividend in South Asia: Opportunities and challenges. *Journal of Population Ageing*, 5(4), 281–298.
- Nientker, W., & Alessie, R. (2019). Female labor market participation across cohorts: Evidence from the Netherlands. *De Economist*, 167(4), 407–433. <https://doi.org/10.1007/s10645-019-09352-y>
- Owen, J. D. (1989). Labor supply over the life cycle: The long-term forecasting problem. *International Journal of Forecasting*, 5(2), 249–257. [https://doi.org/10.1016/0169-2070\(89\)90092-7](https://doi.org/10.1016/0169-2070(89)90092-7)
- Paweewanawat, S. W., & McNown, R. (2018). A synthetic cohort analysis of female labour supply: The case of Thailand. *Applied Economics*, 50(5), 527–544. <https://doi.org/10.1080/00036846.2017.1324614>
- Saqib, N. U., & Arif, G. M. (2012). Time poverty, work status and gender: The case of Pakistan. *PIDE Working Papers*, 81, 1–23. <https://doi.org/10.30541/v5i1i1pp.23-46>
- Sarkar, S., Sahoo, S., & Klasen, S. (2019). Employment transitions of women in India: A panel analysis. *World Development*, 115, 291–309.
- Smith, R. E. (1977). Sources of growth of the female labor force 1971–1975. *Monthly Labor Review*, 100(8), 27–29.
- Sullivan, T. A. (2019). Demography of the Labor Force. 263–278. [https://doi.org/10.1007/978-3-030-10910-3\\_10](https://doi.org/10.1007/978-3-030-10910-3_10)
- Tanaka, S., & Muzones, M. (2016). Policy Brief on Female Labor Force Participation in Pakistan. ADB Briefs
- Tunali, İ., Kırdar, M. G., & Dayıoğlu, M. (2021). Down and up the “U”—A synthetic cohort (panel) analysis of female labor force participation in Turkey, 1988–2013. *World Development*, 146, 105609.
- Yang, Y., Fu, W. J., & Land, K. C. (2004). A methodological comparison of age-period-cohort 34 models: The intrinsic estimator and conventional generalized linear models. *Sociological Methodology*, 34(1), 75–110.
- Yang, Y., & Land, K. C. (2008). Age-period-cohort analysis of repeated cross-section surveys: Fixed or random effects? *Sociological Methods & Research*, 36(3), 297–326.
- Zaidi, S. A. (2008). The political economy of military rule in Pakistan: the Musharraf Regime. ISAS Working Paper, Institute of South Asian Studies, National University of Singapore