universität wien

DISSERTATION | DOCTORAL THESIS

Titel | Title

Female Labour Force Participation in the Context of the Demographic Dividend: Evidence from South Asia

verfasst von | submitted by

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angestrebter akademischer Grad | in partial fulfilment of the requirements for the degree of

Doktorin der Philosophie (Dr.phil.)

Wien | Vienna, 2025

Studienkennzahl lt. Studienblatt | Degree programme code as it appears on the student record sheet:	UA 796 310 120
Dissertationsgebiet lt. Studienblatt | Field of study as it appears on the student record sheet:	DissG: Demografie
Betreut von | Supervisor:	Mag. Dr. Wolfgang Lutz

Abstract

Over recent decades, female labour force participation has risen across most developing countries. Yet, South Asia stands out as the region that has experienced the least progress in advancing female employment. At the same time, the region has undergone significant shifts in its age structure, whereby the working-age population has grown larger than the non-working-age share. This transformation has created an unprecedented window of opportunity–the demographic dividend window–referring to the economic growth potential that emerges from shifts in a population's age structure. However, the capacity of the region to realise its dividend is under scrutiny. This thesis investigates the underlying reasons behind the region's difficulty in capturing its dividend despite conducive demographic and economic contexts. It has three major aims: (i) to examine how India's labour force will evolve by 2060 under different scenarios; (ii) to analyse the drivers and consequences of gendered labour market imbalances in India; and (iii) to assess the likelihood of women entering the labour market in South Asia.

Presented as a thesis by publication, this work draws on multiple quantitative approaches and analyses of large-scale national and international datasets. The findings show that the demographic dividend in South Asia is now largely contingent on gender, i.e., the female dividend, and that the role of the female component is instrumental in successfully reaping the benefits of the demographic dividend. However, persistently low levels of female employment pose a substantial challenge to harnessing the demographic dividend.

This thesis, which aims to provide a fuller understanding of the reasons why women are not yet able to fully contribute to the labour market, makes important contributions to the topics of gender imbalance, human capital investment, and population economics; it thus has pivotal implications not only for scholars but also for policymakers concerned with development goals and policy evaluation.

Kurzfassung

In den vergangenen Jahrzehnten ist die Erwerbsbeteiligung von Frauen in den meisten Entwicklungsländern gestiegen. Dennoch fällt Südasien als jene Region auf, die beim Ausbau weiblicher Beschäftigung die geringsten Fortschritte verzeichnet hat. Gleichzeitig hat die Region bedeutende Veränderungen in ihrer Altersstruktur erfahren, wobei die erwerbsfähige Bevölkerung größer geworden ist als der Anteil der nicht erwerbsfähigen Bevölkerung. Diese Transformation hat ein beispielloses Zeitfenster eröffnet–das Fenster der demografischen Dividende–, das sich auf das wirtschaftliche Wachstumspotenzial bezieht, das aus Veränderungen in der Altersstruktur einer Bevölkerung hervorgeht. Allerdings steht die Fähigkeit der Region, diese Dividende zu realisieren, zunehmend unter Beobachtung. Diese Dissertation untersucht die zugrunde liegenden Gründe für die Schwierigkeiten der Region, ihre Dividende trotz günstiger demografischer und wirtschaftlicher Rahmenbedingungen zu nutzen. Sie verfolgt drei zentrale Ziele: (i) die Entwicklung der indischen Erwerbsbevölkerung bis 2060 unter verschiedenen Szenarien zu analysieren; (ii) die treibenden Faktoren und Konsequenzen geschlechtsspezifischer Ungleichgewichte auf dem Arbeitsmarkt in Indien zu untersuchen; und (iii) die Wahrscheinlichkeit zu bewerten, dass Frauen in Südasien in den Arbeitsmarkt eintreten.

Als kumulative Dissertation konzipiert, stützt sich diese Arbeit auf verschiedene quantitative Methoden sowie auf die Analyse umfangreicher nationaler und internationaler Datensätze. Die Ergebnisse zeigen, dass die demografische Dividende in Südasien heute in hohem Maße vom Geschlecht abhängt, also von der sogenannten „weiblichen Dividende“, und dass die Rolle der weiblichen Bevölkerungsgruppe entscheidend dafür ist, die Vorteile der demografischen Dividende erfolgreich zu nutzen. Allerdings stellen die anhaltend niedrigen Beschäftigungsquoten von Frauen eine erhebliche Herausforderung für die Ausschöpfung dieses demografischen Potenzials dar.

Diese Dissertation, die darauf abzielt, ein umfassenderes Verständnis der Gründe zu vermitteln, weshalb Frauen noch nicht in vollem Umfang zum Arbeitsmarkt beitragen können, leistet einen wichtigen Beitrag zu den Themen Geschlechterungleichgewicht, Humankapitalinvestitionen und Bevölkerungsökonomie und hat damit wesentliche Implikationen sowohl für die wissenschaftliche Forschung als auch für politische Entscheidungsträgerinnen und Entscheidungsträger, die sich mit Entwicklungszielen und Politikbewertungen befassen.

FEMALE LABOUR FORCE PARTICIPATION IN THE CONTEXT OF THE DEMOGRAPHIC DIVIDEND: EVIDENCE FROM SOUTH ASIA

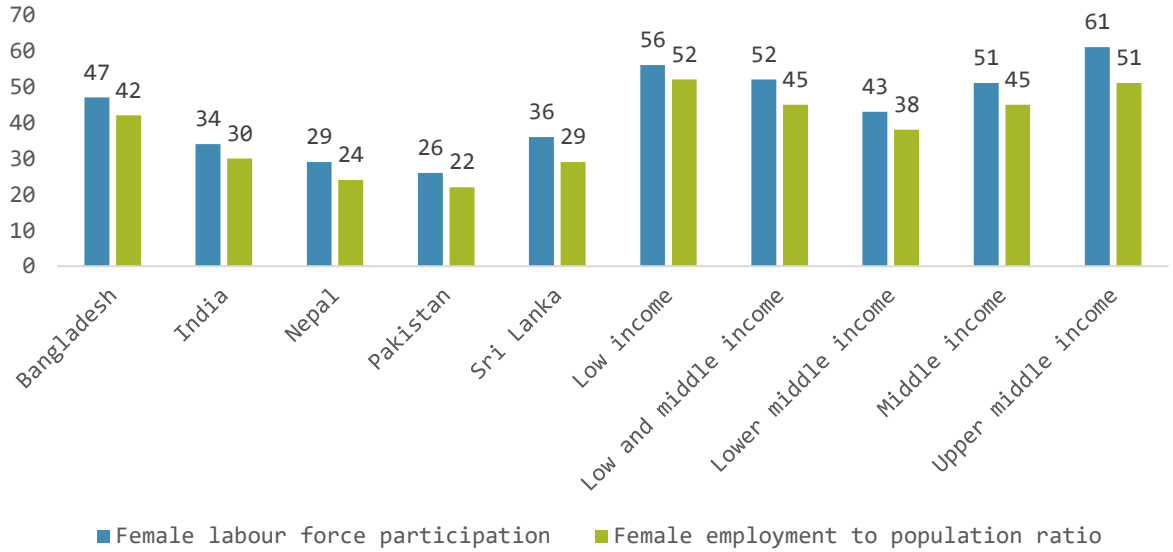
Contents

1. Introduction

1.1. Research motivation

Over the last decades, female labour force participation has been on the rise across almost all developing countries. Though the trends in female employment in developing countries have played out in a relatively similar and positive fashion, some striking outliers have been identified in the regions of South Asia as well as the Middle East and North Africa (MENA). The Global Gender Gap Report (Mukhopadhyay 2023) emphasises that, in these regions, female labour is at the biggest disadvantage and the gender gap is the largest of all developing countries in South Asia (i.e., 33.8%) and the MENA region (i.e., 40.9%). However, at the same time, it is South Asia that has experienced a much higher economic ascent and a marked increase in women's educational attainment. The participation of women in South Asia's labour market has lingered at a persistently low level: as of 2023, the aggregate labour force in South Asia totalled 776,968,229 people, of which women formed a modest 28.4% (World Bank 2024). In reality, the figures mentioned amount to approximately half the average figure for developing countries and emerging markets (Raiser 2023). The data from ILOSTAT further offers a good overview indicating the female employment gaps between South Asian countries and all the income brackets in which other developing countries fall.

Table 1. Comparisons of female employment estimates, 2023, in percent



Source: Author's calculation based on ILOSTAT data https://ilostat.ilo.org/data Accessed January 07, 2025.

Whether in terms of greater equality or amplified economic output – the inclusion of women in the labour market has historically led to exclusively positive outcomes as concerns the furtherance of both those objectives. Also today, the importance of female labour force cannot be overstated – South Asia has the fastest-growing population in the world, and this opens up an opportunity without precedent for its countries' advancement (Olivetti 2014; Ortiz-Ospina et al. 2023; Standing 1976). Conversely, failure to seize that opportunity would amount to the underutilisation of the region's human capital potential, generating adverse consequences such as forced migration or swelling crime rates (Buterin et al. 2023; Carranza et al. 2018). Another dimension inherent in the issue of women staying out of the labour market has to do with the trump card newly dealt to South Asian countries and which is a cornerstone of its importance today – the demographic dividend window, which has been entered by all the South Asian states. The United Nations Population Fund (2020) defines the demographic dividend as "the economic growth potential that can result from shifts in a population's age structure, mainly when the share of the working-age population (15 to 64) is larger than the non-working-age share of the population (14 and younger, and 65 and older)", and those "shifts" have been recorded in South Asian countries. State leaders as well as national and international organisations have all acknowledged the cruciality of the demographic dividend and the necessity of its correct utilisation. The International Monetary Fund (Gu et al. 2024) notes that despite the fact that declining fertility and lower dependency ratios are non-negligible factors for economic growth and societal advancement growth, they are, on their own, far from being sufficient to drive such development, which again throws the spotlight on the need to harness the demographic dividend. Moreover, since gender-responsive investment takes time to translate into future labour force capacity, the matter is time-sensitive, and any delay might increase the odds of suboptimal outcomes. The United Nations (2023) further confirms that the latest demographic and productivity-related trends warrant the urgency of actively pursuing the extraction of maximum benefit from the demographic dividend window. Individually, state leaders have also been vocal about their national demographic dividend pathways. In December 2024, the Prime Minister of India chaired the fourth National Conference of Chief Secretaries in Delhi entitled 'Promoting Entrepreneurship, Employment & Skilling – Leveraging the Demographic Dividend'. The conference highlighted that leveraging the demographic dividend amid geopolitical tensions remains a significant challenge for policymakers. Achieving the targeted per capita income is, in fact, not enough, and efforts must also focus on fostering a "more inclusive

and innovative" economy with women playing a central role in the development journey (The Indian Express 2024). As a result, the demographic dividend continues to attract increasing attention, with no signs of its relevance diminishing.

Since the shifts in South Asian countries' age structure are ongoing and the changes in fertility rates have taken place, their cohorts central to the demographic dividend have therefore already been born. And although those changes have taken place to varying extents depending on the particular South Asian country in question, the overarching process by which they are heading towards their new demographic scenario is a shared reality. Nonetheless, demographic dividend windows do not last *in perpetuum* and do not usually repeat. Only one opening of such a window occurs, and that same window shuts within the span of a generation (Mitra & Nagarajan 2005). In the case of India, the largest demographic contributor in the region, the demographic dividend window is only expected to last for another 30 years, and the time-sensitive imperative to seize it calls for expeditious action (Jain & Goli 2022).

This doctoral work aims to investigate the extents to which South Asian countries utilise or compromise their demographic dividend opportunities through female (un)employment as well as to assess the likelihood of those countries actually attaining favourable levels of female employment. This thesis adopts a more comprehensive approach by analysing major drivers behind the enhancement of female employment, such as female education, and scrutinises the role it plays in the sluggish dynamic of women's involvement in the labour market across South Asia. This work attempts to shed light on the unresponsiveness of the labour market to improved female educational attainment as well as to address the unmet expectations of women's inclusivity in the labour market. Many existing studies illuminate the importance of female labour force participation in developing countries (Lechman & Okonowicz 2013) and in South Asia in particular (Chaudhuri 2010; Najeeb et al. 2020), and the role of education in facilitating the integration of more women into the labour market (Aslam & Kingdon 2012). The current discourse on the demographic dividend also suggests the subsidiarity of the education dividend in the demographic dividend, which encompasses it (Crespo Cuaresma et al. 2014; Kotschy et al. 2020). Nevertheless, gaps in the understanding of the current trajectories of sluggish female labour force participation across the South Asian region invite to create robust quantitative base for other researchers in the future to make use of. Therefore, this research aspires to stretch beyond just

contributing to the existing body of literature and provide up-to-date insight that may lend itself to the furtherance of development goals by forming a quantitative picture of the regional employment landscape. Finally, the idea behind this project draws its inspiration from the pivotal yet at times overlooked and understated role that women play today in the strengthening of developing economies, and it hopes to further encourage scientific inquiry into women's presence in the workforce.

1.2. Research context and gaps

The publication of Thomas Malthus's 1798 seminal work "An Essay on the Principle of Population" is considered a watershed moment for the entry into the public discourse of population changes as conceived of through the prism of its economic implications. In spite of this, however, scholarship on the particular question of the demographic dividend is still relatively fresh and predominantly theoretical. The discourse on the returns on human capital surplus began to gain traction in the early 2000s, when several prominent economists and demographers started to evaluate the results from shifts in populations' age and educational attainment structures, thus crystalising the idea of the demographic dividend (Bloom et al. 2003; Bloom et al. 2007; Bloom et al. 2017; Drumond et al. 2014; Gribble & Bremner 2012). Initially, the notion emerged from the earlier work by Bloom and Williamson (1998) who devised the concept of a "demographic gift", which soon was dubbed more suitably as a "demographic dividend" as, contrary to a gift which is gratuitous, a dividend must be earned.

The "earning" of the dividend is therefore a matter that takes centre stage, and the complexities of that process as well as the assessment of the results constitute a subject of major interest for contemporary research. As argued by policy specialists (Harasty & Ostermeier 2020; Ross 2004), the improvement in the ratio of productive workers to dependents in the population mitigates the burden on families and generates faster economic growth. Nevertheless, the dividend is not acquired automatically, and failing to accommodate the large contingent of arrivals into the working-age population as well as ignoring the obstacles that prevent the absorption of extra labour in a productive way can portend a nation's failure to capture that demographic dividend. And because the dividend originates from the surplus of working-age persons, it is the accommodation of that group that is essential to securing the benefits in question.

There is consensus as to the proposition that education exerts a positive impact on labour force participation rates (Bowen & Finegan 1966; Ince 2010; Woessmann 2015). Research on the demographic dividend also highlights the role of education in harnessing in the dividend. Lutz et al. (2019) argue that true demographic dividend is in fact a human capital dividend and indicate that it is education rather than age structure that generates the demographic dividend. Based on the findings obtained from panel data for 105 countries over the period 1980–2005, Crespo Cuaresma et al. (2014) argue that improvements in educational attainment are key to interpreting income growth and productivity and point to the virtual equivalence of the demographic dividend and educational dividend. Scholarship on female educational attainment further underscores the positive influence education exerts on employment (Baerlocher et al. 2021; Bloom et al. 2009; Desai 2010; Choudhry & Elhorst 2018). Black & Juhn (2000) point at the increases in demand for more jobs among more educated women. Some data on developing countries show that educating more women boosts employment rates in those countries (Gad 2020; Herz & Sperling 2004). In South Asian countries in particular, however, scholars point towards a divergence in trends as compared with other developing countries. The absence of significant progress as far as women's labour force participation is concerned in spite of lower fertility and a swiftly changing economic landscape has stoked concern from scholarship, the media as well as policymakers. Many scholars, most notably Desai & Joshi (2019), Chowdhury (2013), Heath & Jayachandran (2016), Kapsos et al. (2014), Klasen & Pieters (2012), Lahoti & Swaminathan (2016) and Verick (2014), have accounted for the distinctive paradox consisting in the stagnant or even shrinking female labour force participation in South Asia, and especially in India. These works have been successful at exposing this issue and theorising the dynamics behind South Asia's decrease in women's labour force participation despite its concurrent increase in women's education. The principal explanation for this has always revolved around sociocultural attitudes as the cultural stigma of women's salaried employment in patriarchal societies (Chatterjee & Vanneman 2022) shapes how acceptable it is for a woman to maintain a professional career in the eyes of a given society. A gender bias unfavourable to female employment remains prevalent as the dominant model features the man as breadwinner and the woman as homemaker, thus deterring women from seeking greater participation in the labour market. Moreover, in view of growing incomes, families are now less reliant on additional income contributions by women (Gunatilaka 2013). This income effect is also tied to a sense of prestige claimed by the families who can afford to not send their female family

members into professional work, which additionally discourages women from seeking paid employment.

Despite these findings, the topic of contemporary female labour force participation in South Asia lacks sufficient quantitative underpinnings which could help map out the mechanisms behind sluggish female labour force participation and allow for a better understanding of those trends' trajectories. The inadequacy of existing assessments is problematic for two main reasons:

i. Focusing predominantly on the assessment of sociocultural frameworks offers a limited perspective on the de facto situation in the labour market and on the assessment of the full extent of the impediments to realising women's labour force potential.
ii. The dearth of systematic examination of the underlying drivers and consequences of the persistent gender imbalance in the labour market continues to result in a skewed foundation for subsequent analyses and assessments.

There exists an imbalance in the contemporary approaches to examining the sluggish participation of women in the labour market in that the research appears to rely more pronouncedly on qualitative rather than quantitative assessment. In addition, emerging scholarship calls for a closer examination of a gender dividend as being part of the demographic dividend, especially in the South Asian context. Since male employment has traditionally been high and steady in the region, it is female employment whose productive contribution to the economy has a decisive role to play in realising the demographic dividend.

Lastly, this thesis aims to set itself apart from the research that this area of scholarship has thus far produced by proposing novel labour force projections and assessment of the probability for women to join the labour market – information that is instrumental for evaluating how women's contribution to the demographic dividend prospers.

1.3. Objectives and research questions

Understanding the patterns behind the low and stagnating female employment is particularly pertinent today in South Asia where the largest cohorts have already been born and where the demographic dividend windows have been flung open. Demographic shifts have created an unprecedented opportunity for accelerated economic growth. The low and stagnant participation of women in the labour force is increasingly characterised as problematic, especially in view of an

unprecedented acceleration of female education which should normally have an invigorating effect on labour.

Therefore, this thesis has the two following principal objectives, both of which are closely interlinked:

(i) to create a clear, quantitative picture of the present and the future of the female labour force landscape in one of the most demographically promising regions for labour force worldwide;

(ii) to analyse the changes (or the absence of change) in female employment.

Based on the research problem and the objectives outlined above, this thesis addresses the following research questions and sub-questions:

RQ 1: How will India's labour force evolve by 2060 under different demographic and labour force participation scenarios?

- What is the impact of female labour force participation and what are its implications on the demographic dividend?

RQ 2: What are the drivers and consequences of gendered labour market imbalances in India?

- How have educational expansion and economic growth shaped the gendered occupational barriers from 1983 to 2021?

RQ 3: What are the odds of women joining the labour market in South Asia?

- How does a woman's education, a woman's partner's education or household wealth impact the probability of her employment in three of the most populous South Asian countries?

Two of the three research questions focus on India owing to the fact that India's population has already surpassed that of China, becoming the most populous country in the world and thus an immensely potent demographic player. Furthermore, the working-age population in India is predicted to make up 18.6% of the entire global labour force by 2027 (Giudice & Lu 2017). With the current population trends, India is poised to also surpass China as the largest contributor to the global labour force within the next decade.

The wider goal of this research is to expand the existing body of scholarship on the interplay between human capital, demography and the labour force. Though this information is relevant in itself, the findings can be used to support gender equality initiatives and global development goals.

The questions that this thesis engages with are all the more pertinent and time-sensitive given the short-lived nature of the demographic dividend window. If realising the demographic dividend is on the cards, seizing it becomes a matter of urgency, and the greater the awareness about its dynamics, the better informed the corrective action that can be taken in order to derive maximum benefit from the demographic surplus.

And as any government can be expected to desire to maximise the potential of its human capital for the bettering of its economy, the optimal path for reining in the forces of the demographic dividend will be of interest to all the stakeholder countries facing a demographic dividend window.

1.4. Research approach

This thesis adopts several quantitative approaches in the attempt to answer the research questions previously listed. It makes use of official and internationally recognised data from three of the most comprehensive and representative data sources that deal with the collection of data on key population indicators that include employment – the Periodic Labour Force Survey, the National Sample Survey Office's Employment-Unemployment Survey and the Demographic and Health Surveys Program.

The Periodic Labour Force Survey (PLFS) is a survey conducted by the Indian National Statistical Office (NSO). It provides crucial data on employment, unemployment, and labour force participation, including gender-specific participation. The survey offers annual estimates for rural and urban areas of India and quarterly reports for regions, ensuring timely labour market insights. It is also the best available platform for acquiring data related to employment in the country that is used by the government, making it a crucial tool for evidence-based decision-making and development planning.

The Employment-Unemployment Survey (EUS) is a large-scale, periodic survey conducted by the National Sample Survey Office's (NSSO) under the Ministry of Statistics and Programme Implementation (MoSPI). The survey offers quinquennial estimates for rural and urban areas of India and since 2017 it has been succeeded by the PLFS.

The Demographic and Health Surveys (DHS) Program is a global initiative that collects and analyses data that is primarily related to developing countries and pertains to various population indicators, including data on employment. It has been internationally recognised as valuable in helping to assess employment trends, barriers to employment and gender disparities, as it includes crucial data on education and economic participation. Its standardised methodology ensures high-quality, comparable data for all the developing countries surveyed, which makes the DHS useful by grouping together harmonised data, which facilitates the comparison between the South Asian nations that is undertaken in the present research.

The different parts of this thesis rely on the use of a variety of methods. The solution addressing the first research question (RQ 1) involves the building of labour force projections up to the year 2060 and forecasting the changes in population size and composition resulting from interactions between demographic characteristics, educational attainment, and secular trends. Therefore, the most suitable projection model that would account for all of these parameters would be one that employs a microsimulation approach. A microsimulation model begins with a baseline population consisting of individual units, each representing different demographic characteristics across selected dimensions. These individuals face various life events that influence their status, such as mortality, childbirth (i.e., introducing new individuals into the model), migration within or beyond national borders, educational advancement, and transitions in labour market participation. The likelihood of these events occurring is determined through stochastic processes using the Monte Carlo method. Compared to traditional multistate population projection models, microsimulation offers a more comprehensive framework by incorporating a wider range of demographic and socioeconomic factors.

The integration of state- and education-based projections from a multistate cohort-component model (KC et al. 2018) into a microsimulation framework permits the utilisation of pre-validated long-term assumptions for demographic and educational components, removing the necessity to develop them *ab initio*. These assumptions are derived from historical trends, expert evaluations, and statistical modelling. The detailed overview is provided in Paper 1 (*see* Table 1).

The base population has been adjusted and calibrated using the latest estimates from the United Nations World Population Prospects for 2010–2020. The original population data from KC et al. (2018) was derived from the 2011 census but did not include adjustments for potential under- or

over-reporting. Given that more than a decade has passed since the census was carried out, the projection ought to be updated with demographic estimates and calibration steps should be taken to align the base population with the most faithful estimates.

Finally, a labour force participation module is incorporated, following a state-of-the-art approach where the likelihood of an individual being in the labour force at any given time is estimated based on sociodemographic characteristics. This module is inserted at the end of each period, following the occurrence of the relevant demographic events. As for the labour force participation, it is calculated based on logit regression parameters using the available data of the PLFS 2017/2018 (individuals aged 15-74; n=323,092).

At the conclusion of each given period, the module performs a stochastic determination of the status of labour force participation, conducting a Monte Carlo experiment relying on individual characteristics as determinants. Such determinants can be age, education, sex, and a binary variable denoting whether the person is a female that had a child in the last five years. Such an experiment can thus allow for assumptions regarding fertility's impact on the labour force result.

In this study, three scenarios are developed in order to project future labour force. The Constant Rates Scenario is a scenario which does not assume any change in labour force parameters and is considered a 'business-as-usual' state where no significant changes occur in labour force trends even though, at the aggregate level, the changes in population composition such as higher educational attainment may affect the rates for labour force participation. The second scenario – the Best Region Scenario, assumes that by 2060 the labour force participation rate of women in India will achieve a level that is at least commensurate with the one observed in Goa in the PLFS 2017/2018. The state of Goa has been selected as the 'model' region as it is one of the most advanced, with a relatively stable and high female labour force participation, a considerable population in rural and in urban areas alike, and an elevated human development index. In this way, the Best Region Scenario constitutes a middle-of-the-road, practical trajectory of development that can serve as a litmus test for other regions trying to catch up.

The third scenario – the Equality Scenario – assumes that female labour force participation rates will undergo a gradual increase to eventually reach, by 2060, the same levels as those observed in men. In this scenario, parameters are interpolated between 2020 and 2060 using parameters identical to those applied in the case of men. While achieving such an outcome may appear

improbable at first glance, it is not entirely unrealistic, as some nations in Europe have already attained gender parity in labour force participation. The model for labour force participation is

$$logit(P) = \beta_{s,0} + \beta_{s,1}AGEGR + \beta_{s,2}AGEGR^2 + \beta_{s,3}EDU + \beta_{s,4}REGION + \beta_{s=F,5}YOUNG\_KID + \beta_{s=F,6}POSTSEC * YOUNG\_KID + \beta_{s,7}EDU * AGEGR + \beta_{s,8}EDU * AGEGR^2 \quad (1)$$

P is labour force participation, β are the corresponding coefficients for each sex s, $AGEGR$ is the age group, EDU is the educational level. The variable REGION in the model combines the state and the type of residence (rural/urban). The parameter for the binary variable YOUNG_KID represents the lower propensity to work among women who gave birth within the last 5 years and is interacted with the education, as this impact is much more significant for women (S=F), with postsecondary education ($POSTSEC$) than for women belonging to the other categories. The microsimulation is performed with the help of the Statistical Analysis System (SAS).

The solution addressing the second research question (RQ 2) involves the construction of a novel pooled dataset of over 2.7 million individuals which helps to outline the drivers and consequences of gendered labour market imbalances in India between 1983 and 2021. The paper employs the data from the NSS's EUS and PLFS national surveys and the study sample includes all individuals reported as 'working'. Since trend analysis of occupation requires consistency and surveys have transitioned through three major revisions, occupational codes are harmonised to the NCO-2004 standard (consistent with the International Standard Classification of Occupations ISCO-88) to ensure comparability.

The primary outcome variable in the study is the Gender Occupational Segregation Index (GSI). GSI is estimated by Duncan Dissimilarity Index using unit level data from successive rounds of EUS and PLFS during 1983 to 2021. The key socio-economic and structural drivers include the literacy rate, Life Expectancy at Birth (LEB), per capita Net State Domestic Product (NSDP), poverty ratio, urbanisation, Total Fertility Rate (TFR), Gini coefficient, the agricultural to non-agricultural working population ratio, the workforce participation rate, and a governance index. Rainfall and the export openness index are used as instrumental variables to control for endogeneity. The negative consequences of occupational segregation are evaluated using the male-female wage gap and the Gender Empowerment Measure (GEM).

The research follows a four-step econometric strategy. First, it estimates the GSI to evaluate trends over time across rural and urban areas, regions, and states. Second, it decomposes the GSI to observe the within- and between-group contributions of gender. Third, it constructs a state-year panel dataset of the GSI and its correlates, assembled from several data sources. Based on this dataset, panel data regressions are performed to identify the determinants of the GSI, and to tackle potential endogeneity challenges, it uses instrumental variable regression models. Finally, the study assesses the impact of the GSI on male–female wage gaps and the levels of gender empowerment. The employed fixed-effects regression model helps to assess the socio-economic and structural drivers of gendered occupational segregation in India. The study converts all variables into the following logarithmic form:

Fixed Effects Model (FE):

$$Y_{(GSI)it} = \beta_0 + \beta_{i\,(drivers)} X_{it} + \alpha_i + e_{it} \qquad (1)$$
$$i=1\ldots.n;\ t=1\ldots T$$

Where, Y_{it} is the GSI; β_0 is unknown intercept for each entity; $\beta_{i\,(drivers)}$ are coefficients of the X_{it} explanatory variable (Literacy rate, LEB, TFR, Level of urbanisation, per capita NSDP, Poverty ratio, Gini coefficient, WPR, Agriculture to Non-Agriculture workers ratio, Governance quality), α_i= entity specific fixed effect, e_{it}= overall error term, i=unit of observation, t=period of time.

However, the regressors, socio-economic and structural drivers are influenced by multiple factors (endogeneity problem). Sometimes gendered segregation in employment itself may affect some of these socio-economic factors (creating the chance of reverse causality), producing the risk of endogeneity bias. To avoid this, the study employs instrumental variable (IV) regression. The IV estimation splits the regressor into two parts: one part that is correlated with the error term (endogeneity), and the other that is uncorrelated with the error term (exogeneity). The dependent variable is then regressed on the predicted values of the socio-economic variable obtained from an equation uncorrelated with the error term, using ordinary least squares (OLS). The two-stage least-squares (2SLS) estimation technique is subsequently employed. Since it is evident that the model suffers from an endogeneity and reverse causality problem, a dynamic panel data regression model is fit to estimate the impact of the GSI on gender differences in wages, and the Arellano–Bond Generalized Method of Moments (GMM) is selected. The analysis is performed in STATA, while the graphs are produced using Python.

The solution addressing the third research question (RQ 3) involves the building of a logistic regression model, which illustrates the odds of women joining the labour market in the three most populated countries in South Asia. With the use of the DHS data for Bangladesh, India and Pakistan, the study focuses on all adult women aged 30 to 49 who were interviewed within the survey. Since, in most DHS surveys, the sample is selected with an unequal probability, the data was weighted for better accuracy and representativeness, to account for the non-response rate, and for the acquisition of a better set of statistical findings that is generalisable to the wider population. The study investigates the impact on female employment with the explanatory variables including women's age groups, women's educational levels, those women's partners' educational levels and wealth.

In the survey, women's age groups are divided into 5-year intervals and range from 15 to 49. For the purposes of this project, the age groups *30-34*, *35-39*, *40-44* and *45-49* are considered. Selecting these age groups ensures a better representation of the core workforce and therefore also more representative results. The data on women's educational levels that is sourced from the survey is represented in the categories – *no education*, *primary education*, *secondary education*, *higher-than-secondary education* (in the paper, the latter is referred to as *higher education*). The paper excludes samples where women's responses to education were *do not know*. By analogy, the woman's partner's education is represented in the same categories. The *do not know* responses for women's partners were also excluded to ensure accuracy in the determination of effect of the education. Finally, the paper includes the Wealth Index (WI) which, in the absence of direct income/salary data, serves as the best measure of economic status. The WI is a composite measure of a household's cumulative living standard. It is represented in the following five categories (wealth quintiles) – lowest, second, middle, fourth, and highest. In the paper, those are referred to as *wealth index poorest* (first), *wealth index poorer* (second), *wealth index middle* (middle), *wealth index richer* (fourth) and *wealth index richest* (highest). The outcome variable in this project is female employment, which is registered by inquiring into women's working activity, but excluding household work. This comprises women who have worked in the previous 7 days as well as those who, although in regular employment have not worked in the previous 7 days for reasons such as illness, holidays or other temporary circumstance. For this measure, the categories are *yes* or *no*.

For more precise and direct insight into actual employment, the study utilises the employment variable and not female labour force participation, as it includes unemployed individuals.

This paper employs a logistic regression model as this technique is suitable for an examination of the independent effect of a variable on a binomial outcome. This relationship is incorporated into a predictive model estimating the likelihood of an event occurring and measures the impact of each input variable along with the level of uncertainty associated with these effects. The model calculates the odds ratio in relation to a woman's education, her partner's educational background, and the economic status of her household, and forest plots are created for visualising the calculations. The model is applied independently for Bangladesh, India and Pakistan. The logistic model is defined as:

$$\log\left(\frac{p}{1-p}\right) = \beta_{0(a:d)} + \beta_{1i(a:d)} \cdot EDU_{wi(a:d)} + \beta_{2j(a:d)} \cdot EDU_{pj(a:d)} + \beta_{3k(a:d)} \cdot WI_{k(a:d)},$$

with p being the probability of the event occurring. The relevant event is whether the sampled woman was in employment in the last 7 days at the time of the survey and $a:d$ are the women's age groups, where a is age group 30-34, b is 35-39, c is 40-44 and d is 45-49.

For the purpose of data sensitivity, two additional models are run. These checks are conducted in order to explore the sensitivity of the findings to alternative specifications. First, the model using variables for the woman's education and the partner's education is run afresh. Second, the model using the variables for the woman's education and the wealth index is run afresh. The regression is performed in RStudio.

1.5.Thesis structure

This thesis is organised into three sections, each corresponding to a separate research question. Of the three research questions, each is engaged with and answered in an independent and standalone publication that forms a pillar of the overarching composite argument that the thesis advances. Accordingly, each of the three segments addresses – on a separate basis – the data and methods employed, the limitations of the research as well as possible future developments.

Paper 1. Labour Force Projections in India Until 2060 and Implications for the Demographic Dividend.

This paper presents the first-ever demographic forecasts of the future of the labour force across all the regions of India up to 2060, factoring in the expansion of educational attainment, urbanisation, and declining fertility. The research sets out labour force projections and assesses the consequences of policy-oriented scenarios by testing the impact of higher female labour force participation and its implications on potential demographic dividend. Using the Periodic Labour Force Survey 2017-18, the projections are formulated using a discrete-time microsimulation model in which changes in population size and composition stem from the interaction between demographic characteristics, educational attainment, and secular tendencies. The findings reveal that under constant labour force participation rates, the labour force dependency ratio (non-workers/workers) is very unlikely to attain favourable levels, which compromises the potential demographic dividend that the country could gain from its favourable age structure. At the subnational level, the forecast yields the most favourable dependency ratio in 2060 in the regions that combine both a low-age dependency ratio and a higher participation of women. Moreover, the results highlight that female labour force participation is a better driver of the labour force dependency ratio than age composition. Remarkably, the difference in the labour force dependency ratio in 2060 between the scenarios is much broader than the difference in the age dependency ratio between the high- and low-variant scenarios in the United Nations World Population Prospects.

Paper 2. Drivers and Penalties of Gendered Occupational Segregation: A Long-Run Analysis of the Indian Labour Market, 1983-2021.

The paper presents an enhanced and more accurate picture of women's position in the workforce by documenting long-run trends in gender occupational segregation among wage workers in India. Using the Employment-Unemployment Survey and Periodic Labour Force Survey data for 1983-2021, a comprehensive pooled dataset of more than 2.7 million individuals is constructed. The study links the occupation segregation to a comprehensive set of predictors such as including state-level per capita income, poverty, inequality, structural transformation, economic opportunity, governance indices, and environmental factors through fixed-effects and instrumental-variable regression models. The findings show persistent, and in many states rising, gendered occupational segregation trend and help uncover a significant heterogeneity that is concealed by national averages, showing that present all-India segregation portrait masks considerable state-level divergence. Rising literacy proves to reinforce gender-typed occupational sorting, higher fertility increases segregation, and economic inequality is a robust positive correlate. However, improved governance and life expectancy only marginally reduce segregation. There is also a persistent urban-rural contrast: urban labour markets are thicker and more diverse, they remain consistently more segmented than rural ones, whilst segregation widens significantly rural gender wage gaps, with a statistically weaker urban effect. The paper suggests that educational expansion and economic growth, without complementary demand-side interventions, are insufficient to bring down gendered occupational barriers and policy must also pair human capital investments with targeted measures such as equal-opportunity enforcement, childcare, and place-based skilling in order to foster occupational integration and mitigate its associated wage penalties.

Paper 3. What Are the Odds? Understanding the Probability of Women Joining the Labour Market in South Asia.

The paper is designed to help understand the mechanisms behind the unique female employment patterns in South Asia, where women's improved education has not been reflected in their employment. It assesses the probability of women's joining of the labour market in the three most populous South Asian countries – Bangladesh, India and Pakistan. With the help of data from the most recent available rounds from the Demographic and Health Surveys, logistic regression is applied to examine the effects brought about by the strongest drivers of female employment such as women's education, their partners' education and household wealth. Separate models have been run to calculate the odds ratio for various female age groups. The results indicate a J-shaped pattern of female employment by level of education. Neither a woman's partner's education nor household wealth has been found to exert a positive effect on that woman's employment. It is highlighted that the only parameter that improves the odds of a woman working is her education, yet – crucially – exclusively higher education, as even the fact of having completed secondary education has no effect on a woman's employment odds. The higher the education of a woman's partner and the larger the household wealth, the lower the odds of that woman being in employment. The research thus concludes that higher education among women is the only driver that realistically improves the odds of female employment.

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2. Thesis publications

2.1. Labour Force Projections in India Until 2060 and Implications for the Demographic Dividend

The first paper was published on 29.06.2022 as

Marois, G., Zhelenkova, E. & Ali, B. (2022). Labour Force Projections in India Until 2060 and Implications for the Demographic Dividend. *Social Indicators Research* **164**, 477–497. https://doi.org/10.1007/s11205-022-02968-9

Abstract: While India is entering the period of demographic dividend, female labour participation rates remain very low. This paper aims to provide the very first labour force projections for India and its regions up to the year 2060. Projections are achieved using a discrete-time microsimulation model in which changes in population size and composition come from the interaction between demographic characteristics, educational attainment, and secular tendencies. Labour force participation rates are estimated at the individual level using personal characteristics as predictors. Results show that under constant labour force participation rates, the labour force dependency ratio (non-workers/workers) is very unlikely to attain favourable levels, which compromises the potential demographic dividend that the country could gain from its favourable age-structure. At the subnational level, the forecast yields the most favourable dependency ratio in 2060 in the regions that combine both a low-age dependency ratio and a higher participation of women. Results moreover suggest that female labour force participation is a better driver of the labour force dependency ratio than the age composition.

Social Indicators Research (2022) 164:477–497
https://doi.org/10.1007/s11205-022-02968-9

ORIGINAL RESEARCH

Labour Force Projections in India Until 2060 and Implications for the Demographic Dividend

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Accepted: 14 June 2022 / Published online: 29 June 2022

Abstract

While India is entering the period of demographic dividend, female labour participation rates remain very low. This paper aims to provide the very first labour force projections for India and its regions up to the year 2060. Projections are achieved using a discrete-time microsimulation model in which changes in population size and composition come from the interaction between demographic characteristics, educational attainment, and secular tendencies. Labour force participation rates are estimated at the individual level using personal characteristics as predictors. Results show that under constant labour force participation rates, the labour force dependency ratio (non-workers/workers) is very unlikely to attain favourable levels, which compromises the potential demographic dividend that the country could gain from its favourable age-structure. At the subnational level, the forecast yields the most favourable dependency ratio in 2060 in the regions that combine both a low-age dependency ratio and a higher participation of women. Results moreover suggest that female labour force participation is a better driver of the labour force dependency ratio than the age composition.

Keywords Demographic dividend · Labour force · Gender inequality · Projection · India

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1 Introduction

India is about to enter the final stage of its demographic transition. In the past few decades, its fertility level has declined sharply and continuously from more than 5 children per woman in the 1970's to 2.2 nowadays, and is expected to fall below the replacement level of 2.1 within the next decade (United Nations, 2019b). Consequently, the share of the working-age population, which has typically produced more than it has consumed is growing. At the same time, the share of children is declining and the share comprising the elderly remains low. The relationship of these economic life cycles with this shift in the age structure is likely to provide more labour supply and more saving and investment in education, which should give India a demographic dividend characterised by quick economic development (Ladusingh & Narayana, 2012; Mason, 2005). From a demographic point of view, this mechanism is captured by the demographic dependency ratio (or age dependency ratio, ADR), which includes the non-working age groups (children and the elderly population) in the numerator and the working-age population in the denominator (typically the 15–64 year-olds), or alternatively, by its inverse equivalent, the support ratio, dividing the working-age group by the non-working-age group (Bloom & Williamson, 1998; Bloom et al., 2007).

However, this purely demographic approach is incomplete (Mason et al., 2017). Indeed, the demographic dividend needs favourable institutions and labour market factors to translate the addition of working-age adults in the population into an effective economic asset (Golley & Tyers, 2012). An improvement in education could even come to take centre stage within the shift in age structure as has been seen in the patterns of economic growth in countries completing their fertility transition (Lutz et al., 2019; Crespo Cuaresma et al., 2014). This notwithstanding, an improvement in education alone can barely be sufficient when not accompanied by a favourable age structure (Kotschy et al., 2020). In any case, it becomes increasingly clearer that assessing the demographic dividend of a region should go beyond its age structure (Golley & Tyers, 2012). This is because, firstly, not all people making up the working-age population are involved in factual work. Secondly, not all workers are equally productive. Those who are educated are much more likely to have formal jobs with higher incomes that allow for more savings and investments (Mitra, 2016; Lutz & KC, 2011).

The main objective of the present paper is to provide the very first labour force projections for India and its regions up to the year 2060. Due to the stark gender inequality in the labour market in India and seeing as women's inclusion in the labour force is an important driver of development (Verick, 2018) as well as a critical factor in fulfilling the no. 5 UN Sustainable Development Goal for gender equality and empowering women(United Nations, 2016), the second objective of this paper is to assess the consequences of policy-oriented scenarios testing the impact of higher female labour force participation and its implications on the potential demographic dividend.

Hitherto, the only existing subnational human capital projection for India has relied on a multistate cohort-component approach (KC et al., 2018). We have built our projection model from the latter by transforming it into a microsimulation framework, which allows for higher flexibility in the inclusion of additional dimensions (such as labour force participation) and its interaction with characteristics of other individuals, such as education and fertility behaviour. While modern demographic challenges can best be explored through a multidimensional approach (Silverman et al., 2013), this paper

further provides a new methodological framework for the prospective analysis of the interaction of human capital, demography and labour force.

2 Female Labour Force Participation in a Transforming Society

India's unusual course of high growth and declining female labour force participation (FLFP) has been receiving heightened attention in academic circles and beyond. Numerous studies have pointed out that despite the drop in fertility rates, rising female education levels and higher incomes, there has been no substantial increase in women's employment rates, which further limits the much-anticipated benefits of India's demographic dividend (Desai, 2010; Mehrotra, 2015; Navaneetham & Dharmalingam, 2012). It has been determined that this complex phenomenon is caused by both demand- and supply-side factors.

As noted by Klasen and Pieters (2015), changes in the sectoral structure of employment are directly responsible for the decline in the volume of FLFP as the agricultural segment, which has traditionally employed more women, is on course for rapid optimisation. They further highlight that the sectors that attract female workers have also been seeing the least expansion (Klasen & Pieters, 2015), which means that the scope of opportunities for women is being de-escalated and structurally curbed. It is important to consider that India has experienced an atypical structural shift from agrarian to service economy, to a large extent 'leapfrogging the manufacturing sector' (Mitchell & Ashley, 2009). Lahoti and Swaminathan (2016) emphasised the impetus for growth is to be found in the service sector, which normally requires a set of high-level skills—a pre-requisite that disqualifies most women from applying for those jobs as they simply do not possess the necessary skillset. And even if more industrial agendas[1] for expanding the manufacturing segment were to enter the public debate, workers would still need to be more educated in order to be able to operate new equipment or to meet the specific job requirements. While this atypical structural change resulted in an absolute decrease in the agricultural employment, it was not accompanied by a substantial increase in the manufacturing employment.

Much of the research on female education in India (Chatterjee et al., 2018; Chaudhary & Verick, 2014) describes the relationship between FLFP and education as one that is U-shaped. Thus, participation rates are comparatively higher for illiterate or the least-educated women, who, by necessity, usually work in farms and fields, have limited employment options and are poorer (Verick, 2018). However, as women move up the educational ladder, they are likely to leave this type of employment. At the same time, the association with the increasing revenues, or the income-effect, must be considered. As the education of men also rises significantly, this allows for greater household income and benefits.

It has been extensively debated that FLFP also shows a U-shaped relationship with economic development (Goldin, 1994; Olivetti, 2013; Tam, 2011). Gunatilaka (2013) states that as incomes increase and the necessity for an additional salary reduces, households can

[1] The infirmness of the manufacturing segment and its impact on employment have been widely addressed in the literature (Colmer 2016; Iyer 2018; Kathuria and Natarajan 2013) and by policymakers. The leap towards service economy has left the manufacturing segment disproportionately unattended, which has prompted the government to propose such national initiatives as'Make in India'. Its goal is to accommodate India's demographic dividend by creating millions of new jobs in manufacturing as well as to smoothen the economic transition. This could potentially significantly stimulate FLFP as it did in India's neighbouring Bangladesh and Sri Lanka.

'afford' to withdraw women from the workforce. Mammen and Paxon (2000) assert that women will also try to avoid other than white-collar work since it cannot compensate for the fixed costs of their time away from home. Their research further suggests that once women acquire higher education and achieve necessary qualifications to compete in the white-collar sector, they are less likely to refrain from joining the workforce (Mammen & Paxson, 2000). Although it has been argued that the phenomenon is a standard trend of economic development (Boserup, 1970) and that with the progress of development women's employment can catch up (Tam, 2011), the extent of such prospects for the particular case of India has been called into question. Gender disparity, which still prevails in the form of socially-constructed and predefined gender roles, is more than likely to significantly affect India's labour market picture (Batra & Reio, 2016).

Indeed, it should be noted that the marginalisation experienced by women varies in terms of type and severity according to the woman's caste and religious adherence. The differences may play out differently in some segments of the market than in others, yet they invariably lead to the consolidation and perpetuation of caste- or religion-specific limitations within the corresponding social stratum. As elaborated in the literature section, the influence of social customs, local beliefs and practices as well as the long shadow of the caste system and other peculiarities cannot be overlooked, as they directly affect employment outcomes. Although caste-based discrimination has long been officially prohibited by the law, the lingering, deep-rooted system of hierarchy predestining members of society to a priori determined roles remains a fact, and one that has its reflection in the labour market. This phenomenon persists despite the fact that the government has repetitively mustered efforts to enfranchise the historically underprivileged groups by, for example, putting in place employment quotas (Prakash, 2020), yet many of the local habits and traditional modes of social organisation have nonetheless proved difficult to alter, even over the course of many years, and that is especially true for the behaviours that flow from religion, which is woven into the fabric of many Hindus' and non-Hindus' daily lives.

3 Other Labour Force Projections

Although labour force projections are not common, many other models exist, mainly for developed nations. The most customary and straightforward method is to apply predetermined participation rates by age and sex to standard demographic projection outputs.

Those rates are established a priori, using a variety of methods. One normally used method entails keeping the rates by age and sex recently observed constant (Loichinger, 2015; Loichinger & Marois, 2018). The total participation rate of the country would then only depend on the change in the age and sex structure of the population. This type of assumption can, however, prove inconsistent where there are significant changes in trends among cohorts. For that situation, the cohort development approach might be more appropriate (European Commission, 2015; Marois et al., 2019). In the latter approach, future sex- and age-specific rates are calculated by applying exit and entry rates to initial labour force participation rates. Finally, as projections do not necessarily aim at predicting, some benchmark assumptions can be used—such that are based on an objective to achieve (e.g. gender equality in labour force participation) (Loichinger, 2015; Marois et al., 2020). Those scenarios could inform policies by bringing to the fore the potential impact that changes in labour force participation may have on the future workforce. They could, moreover, be of service to a sensitivity analysis of the assumptions concerning labour force participation.

For Europe, the labour force projection of the Aging Report (European Commission, 2015) has given particular attention to the increase in labour force participation of women and, therefore, formulated its assumptions with the use of the cohort-development approach. In the European context, Loichinger (2015) uses a multistate demographic model by age, sex, education and country to specifically address how the increase in educational attainment that is likely to occur can impact the size of future labour force. Marois et al. (2020) have later converted the model into a microsimulation framework in order to take into account more sources of heterogeneity in the modelling of labour force participation, such as the place of birth, the age at the time of immigration and the duration of stay. They modelled labour force participation rates from regression parameters based on individual characteristics, which also allows to take into account cohort-specific behaviours. Microsimulation models using a similar approach have been built for Canada and the United States (Bélanger et al., 2019; Van Hook et al., 2020), while different variants of overlaying participation rates by age and sex (and sometime education) on outputs of multistate or cohort-component models have been made in other developed regions (Cheng & Loichinger, 2017; Peacock & Finlayson, 2009; Toossi, 2006).

In all of the cases, the inclusion of labour force participation in demographic projections has proven relevant, as it has allowed to have a more accurate outlook on future population challenges. For instance, it has shown less daunting consequences of population aging as labour force might decrease slower than the working age population in aging countries as a result of increasing labour force participation in women (European Commission, 2015), or as an effect of increasing both participation rates and productivity (Loichinger, 2015; Marois et al., 2020).

In addition, according to our current knowledge, no labour force projection models have as of yet been conceived for developing regions in the world. The labour force projection provided in this paper is thus a first of this kind not only for India, but also for other developing countries.

4 Definition of Concepts

4.1 Working Age and Labour Force

The working-age population usually includes the population that is more likely to work based on their age. Although far from being etched in stone, most definitions set the minimum age threshold at 15 and the maximum at 65, which corresponds roughly to the age at which people start entering the labour market and the age at which people take their retirement, respectively.

According to the International Labour Organisation, the labour force 'comprises all persons of working age who furnish the supply of labour for the production of goods and services during a specified time-reference period' (International Labour Organization, 2019). The labour force thus refers to the employed population and to those people who are unemployed but who are actively seeking employment. Assessing labour force participation in poorer countries is challenging, as this traditional definition of the labour force underestimates the participation of those who work at home or in the informal sector, with women overrepresented in both these groups (Hirway & Jose, 2011; Verick, 2018).

The Periodic Labour Force Survey (2017/18) of India that is used in this paper to estimate labour force participation helps to capture this type of workers in the numerator

(National Statistical Office, 2019). In addition to salaried employees, the labour force also includes the self-employed in household enterprises (including own-account workers, employers, and helpers) as well as casual labour. Helpers in household enterprises are those who gratuitously assist a person living in the same household in running the household enterprise. Casual workers, for their part, do not have a regular job, but are engaged only casually and receive wages as per a daily or periodic work contract. This category comprises notably those who work under the Mahatma Gandhi National Rural Employment Guarantee Act, which seeks to offer 100 days of work to poor people in rural areas. Finally, the labour force includes both those who are working and available to work for a large part of the year (principal status) and those who have worked for 30 days over the course of the year (subsidiary status). SI Table S1 shows the proportion of informal workers by region and sex and reveals on the one hand the large share those workers occupy among the total labour force of India, in particular among women and in rural areas, and on the other hand, a large heterogeneity among regions.

Despite those efforts, a certain underestimate of economic activity is likely to remain, in particular for women, as informal employment might not be measured correctly because of the difficulty in distinguishing between informal jobs and household tasks (Hirway & Jose, 2011). Indeed, female participation rates come out as significantly higher when they are estimated on the basis of the women's factual daily schedules as opposed to when purely interrogative surveys are used to determine those women's hard-and-fast status as employed or in search of employment (Hirway & Jose, 2011). Moreover, the definition of the labour force used in this study is not broad enough as to cover the quality of employment and underemployment, both of which are crucial in the context of the large gender pay gap and the high segmentation of the job market based on gender. In other words, the contribution of women in the labour force may still not be optimal if they occupy less productive jobs (Verick, 2018).

Nevertheless, for the purpose of our study, the labour force as estimated by Periodic Labour Force Survey (2017/2018) remains the best available definition as it more or less matches the standard definition used internationally, and because it provides information about a large sample of population in all the states of India.

4.2 Dependency Ratios

The decline in fertility leads to a lower proportion of children and a higher proportion of people in the working age group. This generally means fewer people in a situation of economic dependency and, entails the bringing of the demographic dividend to a country. The conventional age dependency ratio (ADR) is widely used to measure this dynamic. For a region r at time t, the ADR is the ratio between the children and the elderly (0–14 + 65 and older) to the traditionally working-age groups (15–64) (Eq. 1). This indicator strictly reflects the age structure of the population.

$$\mathrm{ADR}_r^t = \frac{Pop0-14_r^t + Pop65over_r^t}{Pop15-64_r^t} \tag{1}$$

Although the age of a population is a major determinant of the economic burden, not every person in the working age population works as a matter of fact. In other words, the ADR reflects the burden on potential workers as opposed to factual ones.

As examined in the literature review, most women of working age in India are not workers, and the demographic dividend expected from the decline in fertility might not be optimised. A more accurate indicator of the economic burden of a region would be the labour force dependency ratio which includes all economically inactive persons (I) in the numerator and the active ones (A) in the denominator (Eq. 2), regardless of their age. It thus captures the fact that an important share of people aged 15–64 are not in the labour force (e.g. students, housewives, early retirees).

$$\mathrm{LFDR}_r^t = \frac{I_r^t}{A_r^t} \tag{2}$$

5 Projection Method

The projection model developed for this paper uses a microsimulation approach (Van Imhoff & Post, 1998). A microsimulation model starts from a baseline population that consists of individual actors whose characteristics represent the composition of a given population across chosen dimensions. These individual actors are exposed to the risk of a set of events relevant to their state and specific to their own characteristics—death, births of a child (which generates a new actor inside the model), moving to a different region in a country, leaving the country, achieving the next level of education, entering or exiting the labour market, and so on. Transitions between the particular states are determined stochastically with a random experiment (the Monte Carlo method). Microsimulation thus allows to not only include a larger set of dimensions than the standard multistate population projection models.

5.1 Properties of the Microsimulation model INDIMIC

The model built for this paper is called INDIMIC. It projects the population of India by ages (5-year age groups), sex, region, education, type of residence (urban/rural) and labour force participation status. It is built with the Statistical Analysis System (SAS), following the mechanics described in Marois and KC (2021), and has the following proprieties:

- *Time-based* It simulates the life of all individuals from time t to $t+a$, then repeats from $t+a$ to $t+2*a$ and so on up to the end of the time span.
- *Discrete time* The model only considers the population at specific points in time (by 5-year steps), without considering what could be happening between those points.
- *Stochastic* All events are modelled stochastically using random experiments (the Monte Carlo approach), which involves comparing probability with a random linear number from 0 to 1 in order to determine whether or not the event occurs.

For the purposes of this paper, INDIMIC is built in three steps:

1. *The replication of a projection by state and education from a multistate cohort-component model (*KC et al., 2018*) into a microsimulation framework (n = 846,024)* This allows to use already validated long-term assumptions for the demographic and education components of the projection instead of having to build them from scratch. The

assumptions have been formulated according to past trends, expert judgments, and statistical modelling, a summary of which is displayed in Table 1. Their detailed methodology is available in the "Supplementary information" in KC et al. (2018).

In short, fertility in the whole country is projected to decrease from roughly 2.4 children per woman in 2010 to 1.8 in 2060, although with a large heterogeneity among regions (between 1.2 and 1.9 in 2060) and between educational groups (between 1.2 for women with postsecondary education to 2.0 for women with no education in 2060). Trends in life expectancy are based on the UN World Population Prospect 2015, in addition to which differentials by education, region and type of residence have been applied. The value for the whole country is assumed to pass from 68 years for 2010–2014 to 77 years for 2055–2060.

Assumptions for the future educational attainment are based on the extrapolation of past trends in the progression ratios (i.e. the proportion of those who completed the next level of educational attainment among those at the current level). By 2060, almost everyone in the younger cohorts with a completed education pathway will have had at least basic education. In the 30-34 age group, the proportion with postsecondary education is projected to progress from 15.1% in 2010 to 27.6% in 2060 for men and from 10.1 to 30.2% for women, again with a large heterogeneity among regions. Age- and sex-specific migration rates are assumed to remain constant with what has been observed in the last census. The reclassification rates of rural regions as urban which occurs as a result of urbanisation are region-specific and are assumed to follow the logit trend. For the whole country, the proportion of people living in an urban area should pass from 31.1% in 2010 (ranging from 10.0 to 97.5% between regions) to 46.8% in 2060 (ranging from 14.3 to 99.5%).

The validation of the model as well as more details about its assumptions as well as its mechanic may be found in the 'Projection method' section in *Supplementary information*.

2. *The adjustment of the base population and calibration on the most recent estimates of the United Nations World Population Prospect* (United Nations, 2019b) *for the period 2010–2020* The base population from KC et al. (2018) was based on the last available census from 2011 (with a backward interpolation of 1 year), without adjustments to correct for under- or over-reporting. Furthermore, more than 10 years have passed since that time, and new estimates of demographic components can now be accounted for. Three calibration steps have been taken to arrive at the most up-to-date base population in our projection.

    i. The base population in 2010 is calibrated on the UN World Population Prospect's estimates by age and sex for 2010 for the whole country. These estimates correct for the under- and over-reporting in the census (see SI for details).
    ii. Fertility and mortality rates from between 2010 and 2020 are then adjusted so as to give about the same number of births and deaths at the country level as what was estimated for 2010–2015 and 2015–2020 by the UN World Population Prospect.
    iii. The resulting population of 2020 is finally calibrated on the UN World Population Prospect's estimates by age and sex for 2020 for the whole country. These estimates are calculated from short-term projections based on most up-to-date estimates of population growth (United Nations, 2019a).

Table 1 Summary of assumptions for demographic components and education. *Source*: KC et al. (2018). Compilation by authors

	Period	India	Highest region	Lowest region	Rural	Urban	No education	Post-secondary
Total fertility rate	2010–2015	2.4	3.4 (BR)	1.4 (MN)	2.7	1.9	3.3	1.6
	2055–2060	1.8	1.9 (CT)	1.2 (TR)	1.8	1.6	2	1.5
Life expectancy								
Male	2010–2015	67.2	76.3 (CH)	62.0 (AS)	65.1	71.1	63.2	76.2
	2055–2060	79.0	88.2 (DL)	74.7 (CT)	77.0	81.3	74.2	84.8
Female	2010–2015	70.2	81.7 (CH)	64.9 (UP)	67.9	75.2	66.6	81.5
	2055–2060	84.8	94.9 (CH)	80.6 (CT)	83.1	86.8	80.0	90.7
Sex ratio at birth	2010–2060	1.07	1.13 (JK)	Many = 1.04	–	–	–	–
%no education at 30–34								
Male	2010	22.6%	36.7% (BR)	6.1% (LD)	27.0%	14.6%	–	–
	2060	1.4%	2.0% (PB)	Many < 1%	1.2%	1.7%	–	–
Female	2010	41.3%	61.4% (RJ)	7.5% (KL)	50.5%	23.4%	–	–
	2060	0.6%	All < 1%		0.5%	0.8%	–	–
%postsecondary at 30–34								
Male	2010	15.1%	31.4% (PY)	8.3% (TR)	9.0%	26.3%	–	–
	2060	27.6%	46.1% (PY)	16.1% (AS)	24.0%	31.6%	–	–
Female	2010	10.1%	31.9% (CH)	3.3% (BR)	3.9%	22.1%	–	–
	2060	30.2%	42.3% (PY)	17.7% (BR)	26.4%	35.4%	–	–
%Urban	2010	31.1%	97.5% (DL)	10.0% (HP)	–	–	–	–
	2060	46.8%	99.5% (DL)	14.3% (BR)	–	–	–	–
Total 5-year out-migration rate	2010–2015	5.4%	15.4% (LD)	31.2% (LD)	5.9%	4.2%	–	–
	2055–2060	5.8%	1.7% (ML)	2.3% (MN)	5.1%	6.6%	–	–
Total 5-year in-migration rate	2010–2015	5.4%	22.0% (LD)	1.8% (MN)	4.8%	6.6%	–	–
	2055–2060	5.8%	37.6% (LD)	1.6% (MN)	5.2%	6.6%	–	–

3. *The implementation of a labour force participation module*, which follows the state-of-the-art approach in which a probability of being in the labour force at time *t* is estimated based on sociodemographic characteristics (European Commission, 2015; Loichinger, 2015; Marois et al., 2020, 2021; Van Hook et al., 2020). The labour force participation module is implemented at the end of each period, once the demographic events have reached completion. The labour force participation is itself calculated from logit regression parameters based on data from the Periodic Labour Force Survey 2017/2018 (population aged 15–74; n = 323,092). At the end of each period, the module stochastically determines the labour force participation status, employing a Monte Carlo experiment and using personal characteristics as determinants. Predictors include age, sex, education, and a binary variable stating whether the individual is a woman that gave birth within the last 5 years. Therefore, assumptions in fertility have an impact on the labour force outcome.

Equation 3 below describes the model of labour force participation (P):

$$\begin{aligned}\text{logit}(P) = {} & \beta_{s,0} + \beta_{s,1} AGEGR + \beta_{s,2} AGEGR^2 + \beta_{s,3} EDU \\ & + \beta_{s,4} REGION + \beta_{s=F,5} YOUNG\_KID + \beta_{s=F,6} POSTSEC * YOUNG\_KID \\ & + \beta_{s,7} EDU * AGEGR + \beta_{s,8} EDU * AGEGR^2\end{aligned} \tag{3}$$

Each sex (s) has their own set of parameters and own intercept. The slope for age, education, and having a young child is thus assumed to be the same in all regions. The variable REGION in the model combines the state and the type of residence (rural/urban). It has not been possible to have region-specific parameters for education and age pattern because of the small number of respondents in many categories. Region-specific parameters, however, allow regions to have a gradient of their own. The parameter for the binary variable YOUNG_KID accounts for a lower propensity to work among women who gave birth within the last 5 years and is interacted with the education, as this impact is much larger for women with postsecondary education than for other women.

Detailed parameters and their analysis can be found in *Supplementary Information*. In short, for all education categories and in all age groups, rates for women are 2–3 times lower compared to men. The rates are further reduced for women who gave birth in the last 5 years.

5.2 Definition of Scenarios

In this paper, three scenarios have been built regarding the future labour force. Their resulting labour force participation rate at the national level by gender can be found in Figs. S6 and S7:

1. The Constant Rates Scenario, which assumes no change in labour force parameters. It is the 'business-as-usual' scenario for which no major changes happen in labour force trends. At an aggregated level, labour force participation rates might however evolve from changes in population composition (such as higher education).
2. The BestRegion Scenario, which assumes that by 2060 the participation rates of women will reach at least the ones observed in Goa in the Periodic Labour Force Survey 2017/2018. In concrete terms, in the case of the regions that have lower parameters

than Goa, those parameters are interpolated between 2020 (using the initial value of the regression) and 2060 (using the parameter for Goa, with the urban and rural ones treated separately from each other). Goa is picked as the 'model' region as it is one of the most developed in India, with a relatively high labour force participation of women, a sizable population in both rural and urban areas and a high human development index (Permanyer & Smits, 2020). In other words, this scenario shows a realistic and moderate development pathway in terms of the participation of women for regions that lag behind.

3. The Equality Scenario, which assumes that labour force participation rates of women will gradually increase and by 2060 reach those which are true for men. This scenario is implemented by interpolating parameters between 2020 (using women parameters from Eq. 3) and 2060 (using the parameters for men). It shows what impact a strong and efficient policy aiming at reducing gender inequalities and empowering women would have on the labour force. Although unlikely to happen, this scenario is nevertheless not completely unrealistic, as gender equality in labour force participation has already been reached in some countries such as Sweden (Marois et al., 2020). This scenario shows the maximum plausible gain from an increase in the labour force participation of women.

As a reminder, all these scenarios share the same assumptions as far as the demographic and education-related components of the projection are concerned. Therefore, their outcomes differ only in terms of labour force composition, while the population sizes by age/sex/education/region are roughly identical.

6 Results

6.1 The Future Labour Force Under Current Trends

First, we have examined the outcome of the Constant Rates Scenario (see SI Table S5 in for complete results). That is to say that this scenario shows what the future would be if current demographic trends were to continue and current participation rates by age, sex, education and region did not change. In Fig. 1, we show the projection outcomes by (a) age and by (b) labour force status for India for the time span between 2020 and 2060 as well as their corresponding dependency ratios.

The total population will increase by just over 25% from 2020 to 2060 (from 1.38G to 1.77G). The increase in the total population will at first happen mainly among its working-age segments to then make a gradual shift to the elderly population, which is anticipated to multiply by 4 between 2020 and 2060. Consequently, the age dependency ratio (ADR) will for many years remain close to 0.5, a level similar to what was observed in Western Europe from the mid-80's to the mid-00's, before starting to slowly increase in 2050, finally reaching 0.6 in 2060, as the country will face a population aging resulting from the last stages of the demographic transition. While the process is underway, India could benefit from a demographic dividend for most of this period. In comparison, this ratio exceeds 0.9 in countries less advanced in their demographic transition such as Niger or Mali, and 0.6 in countries facing population aging such as Japan or Finland (United Nations, 2019b).

However, when looking at the projection outcomes by labour force status, the situation is not as favourable. Indeed, the labour force dependency ratio (LFDR) is much higher than the age dependency ratio (ADR) in 2020 (1.7 vs 0.5). In other words, when looking at this more accurate indicator of economic burden, the number of non-workers is 70% higher

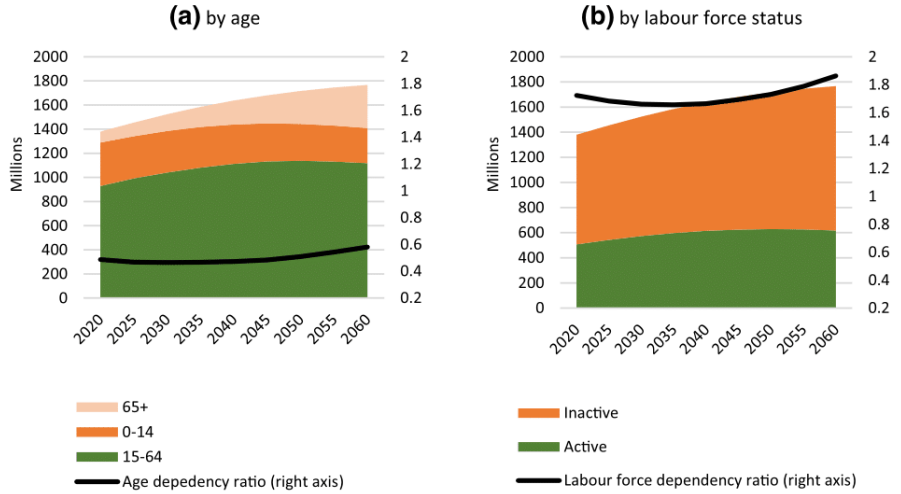

Fig. 1 Projected population by **a** age and **b** labour force status, Constant Rates Scenario, India, 2020–2060

than then number of workers, while the ADR shows much higher numbers of people in the working-age group than outside it. As explained before, this is because a large part of the potential workers (the working-age population), in particular women, do not participate actively in the labour market.

In the future, about 63% of the expected population growth will be among the inactive population, which will move from 798 M in 2020 to 1.1G in 2060, while the workforce will grow from 415 to 617 M. Consequently, the trend in the future LFDR is about the same as that in the ADR, with little change in the next few decades, followed a by a slow uptick afterwards. Contrary to the ADR, because of its very high starting point, the LFDR never reaches very advantageous levels, as it will stay above 1.65 across the whole time span.

By virtue of the fact that India is both very populous and diverse, our projection shows spatial heterogeneity in the projected labour force trends. In Fig. 2, we show the projected change in the population size and labour force size by state between 2020 and 2060 (see SI Table S5 for detailed results). Since, in this scenario, we assume constant labour force participation rates, the growth in the labour force size and the population size follows approximately the same trends, driven mainly by the current and past fertility levels and, to a lesser extent, by domestic migration (KC et al., 2018).

Regions can be assigned to four broad categories according to their dynamic of projected growth in their respective labour force. First, the small-area regions with high level of urbanisation, for which the increase in the labour force size from 2020 to 2060 is more than three times the country's average (22%). Those regions include Delhi (71%), Chandigarh (73%), Daman and Diu (84%), Dadra and Nagar Haveli (91%) and Lakshadweep (68%). It is also these regions that are seeing the largest relative increase in their total population size as a result of higher fertility and/or a favourable domestic migration dynamic. The second group, whose growth rate is also significantly higher than the country's average includes states in the north-central area. The growth of the labour force thus reaches between 35 to 65% in states such as Bihar (47%), Uttar Pradesh (45%) or Jharkhand (39%). Those states are less developed and have large cohorts of children resulting from higher current and past fertility rates, which drive the future spike in the number of workers. The

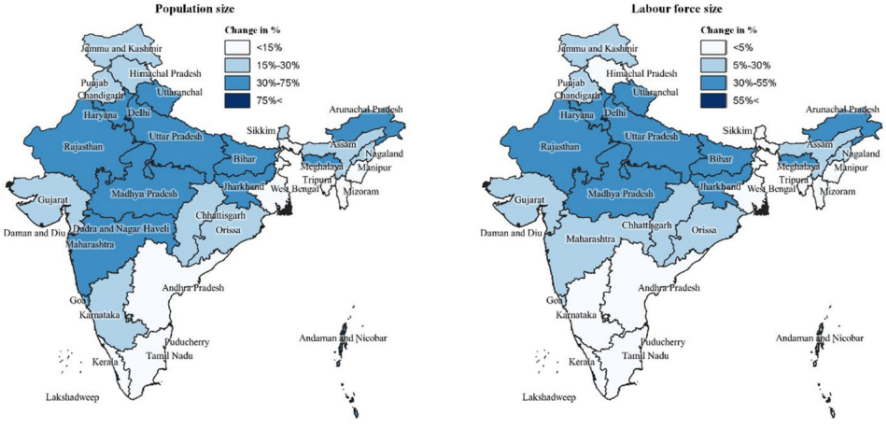

Fig. 2 Projected change in population and labour force size (%) between 2020 and 2060, Constant Rates Scenario, India

third group includes states for which the growth in the labour force is around the country's average. These surround the regions of the second group. Finally, the last group consists of those for which the growth in the future labour force is anaemic, or even slightly negative. This category includes all the regions in the south of India and part of the Bengal region. Those regions are more advanced in their demographic transition and are all characterised by low fertility rates compared to the country's average.

However, an examination of the labour force dependency ratio shows a different picture (see SI Table S5 for numbers). First, despite having the largest increase in their labour force size, small-area regions with high urbanisation levels will have a less favourable labour force dependency ratio in 2060 than in 2020. In Delhi, for instance, the ratio is projected to increase from 1.69 to 1.91, and from 1.16 to 1.49 in Chandigarh. The regions in the north-central part of India (Bihar, Jharkhand, Uttar Pradesh and Rajasthan), which will also experience a significant increase in their labour force size, will be the only ones seeing a better ratio in 2060 than in 2020. This is because they are lagging behind in their demographic transition producing a high proportion of children in 2020. Despite this improvement, their LFDR in 2060 is projected to be either comparable (1.98 in Uttar Pradesh) or still less favourable (2.55 in Bihar) than the country's average (1.86). The southern states, on the other hand, started with more favourable LFDRs in 2020, but will see them deteriorate because the increasing share of the elderly population will contribute to an increase in inactive population in the numerator.

Figure 3 shows the projected age dependency ratio and the labour force dependency ratio in 2060 as per the Constant Rates Scenario. In 2060, regions with the most favourable labour force dependency ratios will be Daman and Diu (1.05), Meghalaya (1.20) and Chhattisgarh (1.22). These regions benefitted from higher fertility rates in 2020, thus postponing the negative effects of population aging and attaining a low age dependency ratio in 2060 (0.48 in Meghalaya; 0.54 in Chhattisgarh; 0.57 in Daman and Diu). They also benefitted from a higher labour force participation of women (see SI Table S4) compared to the country's average, allowing them to have higher numbers of workers within the working-age population. On the contrary, the state of Bihar, despite yielding a similar or even better age-dependency ratio in 2060 (0.52), will have the worst LFDR in all of India in 2060

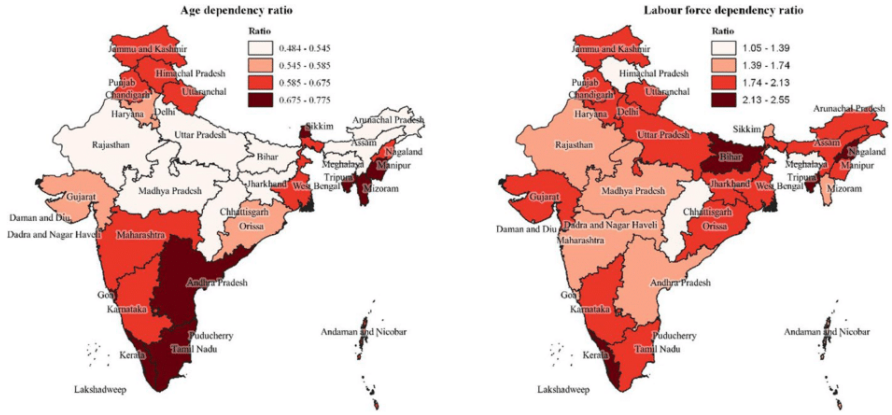

Fig. 3 Projected age dependency ratio and labour force dependency ratio, Constant Rates Scenario, 2060, India

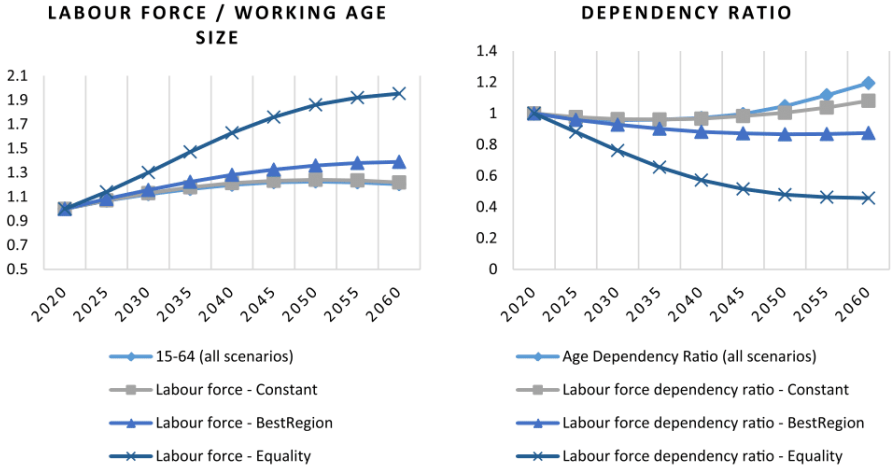

Fig. 4 Projected labour force/working age (15–64) size and dependency ratios according to 3 scenarios (2020 = 1), India, 2020–2060

(2.55) owing to the fact that its female labour force participation is also the lowest in the country. This shows the relevance of including the labour force participation in population projection for a better assessment of the demographic dividend.

6.2 The Impact of Higher Labour Force Participation of Women on the Dependency Ratio

The results presented above come from the scenario which assumed constant parameters in labour force participation. The changes in aggregated labour force participation rates and dependency ratios thus resulted from changes in the population composition. Figure 4 presents the projected size of the labour force and labour force dependency ratios as per the

alternative scenarios on female labour force participation. For the sake of comparison, we have also include the Constant Rates Scenario, the working age and age dependency ratio (which is equal in all the three scenarios), all normalised to 2020 = 1.

As has already been argued, the age dependency ratio is expected to be relatively stable until 2040 when it is expected to ascend so as to reach, in 2060, a level 20% higher than that from 2020. The labour force dependency ratio, assuming constant parameters, follows a similar trend, though it increases less significantly (about 10% higher in 2060 as compared to 2020).

If an increase in the labour force participation rates of women is assumed, the trends change drastically. The scenario assuming a convergence of female labour force participation with what has been observed in Goa (i.e. the BestRegion scenario) manages to reduce the LFDR by 10% from 2035 compared to 2020 and prevents any further significant increase for the rest of the projection period. By 2060, with a labour force size about 15% higher compared to the Constant Rates Scenario, this scenario should yield a 20% lower LFDR. Nevertheless, a strong gender imbalance still remains in this scenario.

The more ambitious Equality Scenario assumes that gender equality in labour force participation will be reached by 2060. This scenario projects a radically different future, with a prominence of professionally active women within the working-age group in 2060. The total labour force size for India would thus increase to be 60% higher in 2060 than that of the Constant Rates Scenario, and about twice as large as that of 2020. By turning a large proportion of economically inactive women into active ones within the working-age group, the LFDR would represent only 40% of what projected in the Constant Rates Scenario. Starting from 2045, it would decline to as little as 50% of the 2020 value. For the whole country, this scenario is the only one that would yield fewer inactive than active population groups (the 2060 LFDR in absolute value is 0.79 for economically inactive per active, compared to 1.51 for the BestRegion scenario and 1.87 for the Constant Rates Scenario; see SI Table S6 for detailed results).

In both alternative scenarios, regions with the lowest female labour force participation rates in 2020 are also those with the largest gains in the size of the labour force and the largest decrease in the LFDR compared to the Constant Rates Scenario. The state of Bihar, where the labour force participation of women is the lowest as of 2020 (only 4%, see SI Table S4), testifies to this. Bihar's labour force size exceeds that of the Constant Rates Scenario by more than 30% in the BestRegion Scenario and by more than 95% in the Equality Scenario. Conversely, the impact is marginal in the BestRegion Scenario for states where the female labour force participation rates were already close to those observable in Goa (such as Andhra Pradesh and Andaman & Nicobar Islands). In all these cases, however, the impact of the Equality Scenario on the labour force size has been substantial, as the labour force size exceeds at least by 30% that of the Constant Rates Scenario in all the regions, including Goa (43%). In that scenario, most regions would have a LFDR below 1 (see SI Table S6).

7 Discussion

This paper has spearheaded novel demographic forecasts of the future of the labour force across all the regions of India up to 2060. This has been achieved by means of devising three different scenarios pertaining to the rates of female labour force participation: the Constant Rates Scenario, the BestRegion Scenario with Goa as the prime example for other

states, and the Equality Scenario, which posits the achievement of gender equality by 2060. Due to the fact that those scenarios result in very different outcomes in terms of labour force all while exhibiting about the same demographic structure, our study highlights the relevance of including the labour force as a dimension in population projection. Indeed, the difference in the LFDR in 2060 between the three scenarios (Constant Rates: 1.86, BestRegion: 1.51; Equality: 0.79) is much broader than the difference in the age dependency ratio (ADR) between the high- and low-variant scenarios in the World Population Prospects (0.57 vs 0.48) (United Nations, 2019b).

With the assumption of constant participation rates (Constant Rates Scenario), the projection shows that the dependency ratio expressed in terms of non-workers/workers (LFDR) is very unlikely to attain favourable levels. While the ADR will be low, circa 0.5, for the next few decades, the labour force dependency ratio will not drop below 1.65 because of the very low female labour force participation. In comparison, the ratio for the European Union was 1.08 in 2015 (based on a narrower definition of 'workers') and is expected to only increase to 1.33 in 2060, despite severe population aging, while assuming no change in labour force participation rates (Marois et al., 2020). In the case of India, the comparison between the high LFDR and the low ADR raises concerns as to the potential demographic dividend that the country could gain from its advantageous age-structure.

At the subnational level, the forecast yields the most favourable LFDR in 2060 in regions that combine both a low-age dependency ratio and a higher participation of women. Conversely, a state such as Bihar, which is projected to have the most favourable age structure in 2060, also displays the worst LFDR in the country, because female labour force participation is much lower there than elsewhere in India. Overall, the negative correlation between the LFDR and the female labour force participation in 2060 is much stronger than with the age structure (-0.59 vs -0.31 for the proportion of 15–64). In summary, our results suggest that female labour force participation is a better driver of the labour force dependency ratio than the age composition, and that, therefore, it is a *conditio sine qua non* in order for a country to expect a demographic dividend from its age structure.

Owing to the importance of female labour force participation, the impact of alternative scenarios in which its rates are increased has been assessed. The BestRegion Scenario, in which the rates for all the regions reach those observed in Goa (which is among the leading states in India in this respect) estimates the ratio to decrease by about 20% by 2060 compared to the Constant Rates Scenario. As a reminder, this scenario still presupposes a modest labour force participation for women: 30% among the working-age group, which is below what is observed today in other South Asian countries (39% in Bangladesh and 39% in Sri Lanka), and which is far from reaching the levels observed in more developed countries such as China (60%), Japan (72%) or South Korea (60%) (International Labour Organization, 2020). Indeed, the projected rate for 2060 in this scenario is equivalent to what was observed in India before 2005. A small and realistic change in the labour force participation of women can thus have a large impact on the labour force dependency ratio and, consequently, on the potential demographic dividend.

If gender equality in the labour force participation rates is achieved, the image will be completely different. In the Equality Scenario, the proportion of workers among the total population would be 60% higher in 2060 than in the Constant Rates Scenario. The consequences of such a change in the composition of the population might be considerable. Assuming a constant returns to scale, this scenario should yield a gain in the GDP equivalent to the gain in the proportion of workers within the population (Solow, 1957; Weil, 2005), which is approximately 60% compared to the Constant Rates Scenario and 40% compared to the BestRegion Scenario. If the population size remains unchanged, this

gender equality scenario is likely to make India a much wealthier nation in terms of GDP per capita. This outcome is additional evidence for the importance of female labour force participation as a driver of growth and development and a pillar of demographic dividend (Esteve-Volart, 2004; Klasen & Pieters, 2012; Verick, 2018).

Our results thus highlight the importance of increasing female labour force participation in order to fully benefit from the demographic dividend. With one of the lowest female labour force participation rates in the world, India is likely to be in the middle of the U-shaped relationship between female labour force participation and economic development, as women have gradually exited the labour market over the past few decades following improvements in their husbands' wages, reducing the need to work to survive (Verick, 2018). While other studies suggest that an increasing female labour force participation rate is generally associated with higher economic growth (Thévenon et al., 2012; Tsani et al., 2013), reaching the next stages of development would be facilitated if gender gaps in the labour market were reduced. Accordingly, the government should make available new dynamic policies to overcome barriers encountered by women in the labour market. India has voiced its commitment to achieve the no. 5 United Nations' Sustainable Development Goals by 2030 to provide quality education as well as decent and productive work opportunities for all. In order to boost the quality of education and promote decent employment, the government has articulated its commitment to protect and promote the educational and employment rights of individuals, and of women in particular, scheduled castes, scheduled tribes, backward castes and minorities through various programmes and policies (Government of India, 2020). As emphasized by Srivastava and Srivastava (2010), these constitute the most underrepresented groups in the labour market.

Over the past few decades, higher education has increased rapidly with a higher enrolment of girls in higher and secondary education (WIC, 2019). This makes India a nation endowed with a huge human capital. However, despite this improvement, the labour force participation of women remains low, which raises questions as to the quality of education and skills. Mahapatro (2013) argues that vocational training in the youth population may be able to improve future work participation in India. Kumar et al. (2019) confirm that vocational training has a positive impact on individuals' economic returns and help increase the wages compared to those lacking vocational training. They also accentuate the need for proper vocational training in rural areas, and indicate the need for a greater inclusion of girls in vocational training schemes.

Technical and vocational training programmes for women should be expanded while trying to break the negative stereotypes linked to the increased representation of women in technical and vocational schools. Furthermore, it is essential to identify sectors which have greater potential to employ women in the future. A substantial regional misbalance in training opportunities and skill development institutions (Planning Commission, 2008) poses further challenges for this mission. Our projection outcomes have confirmed uneven regional patterns for the future, which ought to be given due attention. It is also important to consider that the informal sector constitutes the lion's share of the employment market.

In this paper, we have only included the labour force dimension without considering unemployment, job quality, or earnings. As much as 81% of all working Indians earn their daily bread within the informal sector, while the formal sector and the household sector are manned by 6.5% and 0.8% of the working population respectively (Jammulamadaka, 2019). Despite the significant growth dynamism of India's economy and its significant size on the global scale, the country has for decades kept a stagnant informality incidence which is set to become even more pronounced as more people enter the labour market. In the informal labour market, gender segregation is also argued to be starker than

in the formal labour market, and its ubiquity does not seem to wane even when the level of income increases (Chakraborty, 2021). Our projections have revealed that future workers will be much more educated than they are nowadays as well as much more likely to live in urban areas. The implications of these changes are multitudinous, as education is highly correlated with the sector of professional activity. Indeed, very few workers with no education work in the formal sector, while the opposite is true for workers with postsecondary education (National Statistical Office, 2019). A spike in the prominence of highly-educated workers is likely to reshape the labour market previously dominated by informal jobs by introducing more formal vacancies, thereby increasing the average productivity of the workers at large (Cáceres-Delpiano, 2012; Lau et al. 1991; McCaig & Pavcnik, 2015; Siggel, 2010). Dewan and Peek (2007) point out that the demand for formal jobs will also increase and is likely to lead to much higher official unemployment rates). Indeed, unemployment is not an option in the context of extreme poverty. The concept of unemployment as defined by the international labour organization is barely applicable to the informal sector, which includes a large part of underemployment, casual, and irregular jobs (Dewan & Peek, 2007). Woetzel et al. (2018) note that India's working age population is growing at a pace of approximately 16 million per annum, but according to the ILO statistics fewer than 2 million vacancies are created every year. As for the gender wage gap, which varies across social groups, female informal workers tend to be concentrated towards the lower end of the informal occupational spectrum, which reveals offer some explanation as to why gender pay gaps could be larger in the informal sector than in the formal one (Chakraborty, 2021).

As has rightly been reminded by Goswami (2019), one should tread with caution when analysing FLFP in the Indian context due to the heterogeneity of the different regions and states that could potentially distort the results of such an analysis. Nonetheless, numerous research findings including the ones herein presented serve as reassurance that the analysis of structural economic transformations ought to be reinforced by taking stock of the intricate regional peculiarities that make up the country's social landscape. It is thus only by way of a holistic approach that is cross-disciplinary and keeps in close touch with the realities of Indians' everyday lives that we may eventually be able to outline even more accurate projections into the future of female labour activity in India.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11205-022-02968-9.

Funding Open access funding provided by International Institute for Applied Systems Analysis (IIASA).

Declarations

Conflict of interest The authors declare no competing financial interests.

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2.2. Drivers and Penalties of Gendered Occupational Segregation: A Long-Run Analysis of the Indian Labour Market, 1983-2021

The second paper was submitted to the Journal of Social Policy. Second author Dr. Srinivas Goli, third author Dr. K.S. James. The acknowledgement receipt 13.11.2025.

Abstract: This paper provides a comprehensive, long-run analysis of gendered occupational segregation in India from 1983 to 2021. By constructing a novel pooled dataset of over 2.7 million individuals from NSS and PLFS national surveys, we document a persistent and, in many states, increasing trend in segregation, with urban markets consistently more segmented than rural ones. National averages appear to mask significant state-level heterogeneity. Using state-year panel data and instrumental variable regression to address endogeneity, we identify key structural drivers: rising literacy reinforces gender-typed occupational sorting, higher fertility increases segregation, and economic inequality is a robust positive correlate. In contrast, improved governance and life expectancy modestly reduce segregation. Importantly, we quantify the economic penalty of this segregation, finding that it significantly widens the gender wage gap in rural areas. The findings underscore that educational expansion and economic growth, without complementary demand-side interventions, are insufficient to dismantle gendered occupational barriers. Policy must therefore pair human capital investments with targeted measures—such as equal-opportunity enforcement, childcare, and place-based skilling—to foster occupational integration and mitigate its associated wage penalties.

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Keywords: Gender, Employment, Occupational Segregation, Wages, Gender Empowerment, India

JEL Classification: J16, J21, J24, J31, O15

1. Introduction

The success story of India's economic transformation since the 1990s reforms is a mixed one. While the economy has achieved remarkable and sustained growth, this expansion has been described as "jobless" or characterised by a failure to generate sufficient high-quality employment for its burgeoning youth populations, particularly for female populations (Mehrotra & Sinha, 2017; Mehrotra & Parida, 2017). Within this broader context of uneven growth, the situation of women in the labour market is particularly alarming (Chatterjee et al., 2018; Afridi et al., 2022). Despite the existence of a favourable ecosystem for the inclusion of women in economic activity by virtue of factors such as declining fertility, a narrowing educational participation gap and growing non-form sector, the Female Labour Force Participation Rate (FLFPR) has followed a perplexing trajectory, declining from 42.7% in 2004-05 to a historic low of 23.3% in 2017-18, with only a partial recovery in recent years (PLFS, 2021). This places India among the countries with the lowest female labour force participation rates globally, lagging not only behind advanced economies but also behind peers at similar levels of development (World Bank, 2019). Compounding this crisis of participation is a crisis of compensation. A robust and persistent gender wage gap continues to disfigure the Indian labour market (Sengupta & Das, 2014), recently estimated at around 25-28% (PLFS, 2021).

Determining the dynamics of women's labour force participation in India is analytically challenging, owing to the predominance of informal employment, rigid labour market institutions, pervasive gender discrimination, and ongoing structural transformations in the composition of jobs (Bhalla & Kaur, 2011; Sorsa et al., 2015; Sundari, 2020). Many scholars have advanced arguments that heavily centre around the position of Indian women in society as the point of departure in their reasoning. This "gender argument" is firmly grounded in pre-defined gender norms which create societal constrains in terms of female employment and the way society views it (Batra & Reio, 2016; Chatterjee & Vanneman, 2022;

Jayachandran, 2021). It is expected that with increasing education, there could be changes in gender norms, favouring more participation of women in economic activities. However, simultaneously, it is also found that even with more women attending schools and universities, FLFPR continue to slide down (Chatterjee et al., 2018; Chattopadhyay & Chowdhury, 2022). Literature largely attributed this to continued dominance of reproductive and care-giving burden on women and strong cultural norms about gender roles (Coffey et al., 2018; Fletcher et al., 2018; Li, 2023; Ratho, 2020; Tiwari et al., 2022).

A relatively underexplored dimension of India's labour market challenges is persistent occupational segregation—the unequal distribution of men and women across employment categories (Reddy, & Swaminathan; 2014 Reddy, 2015). This segregation remains a key driver of gender disparities in job quality and career trajectories, imposing significant economic costs (Agrawal, 2020). Specifically, it depresses wage returns and diminishes the "substitution effect," thereby reducing incentives for women to participate in the labour market (Agrawal, 2020; Das & Kotikula, 2019). As Ratho (2020) notes, this leads to a situation where women's employment chances remain low, and those who are employed often receive lower wages, as employers anticipate they may eventually request maternity leave or leave the workforce to assume family roles. This persistent segregation is a structural feature of labour markets globally, and India is no exception. Despite sustained economic growth, market reforms, closing gender gaps in education and health, and a declining reproductive burden (Tiwari et al., 2022), occupational segregation endures. This issue is compounded by India's atypical economic trajectory. As Marois et al. (2022) point out, India experienced a structural shift directly from an agrarian to a service-based economy, largely "leapfrogging" the manufacturing sector. Consequently, the agricultural sector, which traditionally employed the largest share of women, is now rapidly optimising, while the manufacturing sector, which tends to be highly labour-absorbing, never fulfilled its potential (ibid.). A structural gap has emerged in which the service sector's rapid expansion has failed to generate sufficient employment to absorb the workforce, particularly women, displaced from agriculture. This has led to significant employment segregation across gender groups (Agrawal, 2016; Agarwal, 2015; Banerjee & Roy, 2021).

While gender segregation and its impact on wages have been studied in India, few works have documented these trends from a long-term perspective (Agrawal, 2016; Agarwal, 2015; Banerjee & Roy, 2021; Duraisamy & Duraisamy, 2016). There is also a clear dearth of research on the structural drivers of occupational segregation and its impact on wages and women's empowerment. This study addresses these gaps by documenting long-run trends in gender occupational segregation among wage workers in India using state-year data spanning 1983–2021. Treating the Dissimilarity Index (DI) and Gini Index as measures of segregation across occupational categories, we track the evolution of wage employment structure through periods of liberalisation, service-sector expansion, and uneven structural transformation. The extended timeframe offers a view robust to short-term fluctuations and reveals a persistent urban–rural contrast: although urban labour markets are thicker and more diverse, they remain more segmented by gender than rural markets. We show that improvements in female endowments, such as rising schooling and longevity and fall in fertility rates, have only partially translated into occupational integration, reflecting demand-side sorting, task content, and place-based frictions (e.g., cultural norms, commuting, safety and childcare). The analysis deliberately excludes social-group dimensions to focus strictly on gender segregation among wage workers.

This paper makes several key contributions. It constructs a comprehensive pooled dataset of more than 2.7 million individuals to track gender-wise wage-worker segregation from 1983 to 2021, bridging NSS and PLFS survey methodologies and enabling an unprecedented examination of how entrenched social structures interact with India's rapid economic transformation. This study provides systematic, state-wise analyses for the total, urban, and rural sectors. These analyses reveal a significant heterogeneity that is concealed by national averages, showing that modest all-India declines mask considerable state-level divergence. This underscores the need for region-specific policies. Using a state-year panel dataset derived

from multiple sources beyond NSS and PLFS, it advances methodological rigour by linking the occupation segregation to a comprehensive set of predictors—including state-level per capita income, poverty, inequality, structural transformation, economic opportunity, governance indices, and environmental factors—through fixed-effects and instrumental-variable regression models. Further, it estimates the impact of occupational segregation on gender wage gaps and women's empowerment, yielding a policy-relevant framework that identifies the conditions under which segregation diminishes and the penalties it imposes otherwise. By integrating long-term analysis, spatial disaggregation, and a rigorous examination of drivers, the study provides an essential evidence base for targeted policies to reduce gendered occupational barriers—a crucial step for advancing gender justice and realising India's full economic potential.

2. Background and Literature Review

Research across developing and developed contexts consistently shows that occupational segregation by gender remains a defining and persistent feature of labour markets and is widely regarded as a critical dimension of labour market inequality. Foundational work such as Duncan and Duncan's (1955) methodological treatment of segregation indexes laid the basis for measuring such patterns, and subsequent empirical studies demonstrate their enduring impact on inequality. Occupational segregation typically results in the overrepresentation of women in low-skilled and low-wage occupations, while men dominate higher-return, technical, and managerial tracks.

In developed countries, extensive research highlights that segregation explains a significant share of gender earnings gaps (e.g. Baker & Fortin 2001; Blau & Kahn 2007; Coelli, 2014; Evertsson et al., 2007; Jacobs & Steinberg, 1990). Cross-country analyses show that even as women's educational attainment and labour force participation have improved, occupational segregation has often intensified. Borrowman and Klasen (2020), for instance, find that in developing countries, rising education frequently funnels women into a narrow band of occupations with lower pay and poorer conditions. Comparative studies, including those from South Africa, further reveal how segregation intersects with race and class, relegating marginalised women to the lowest tiers of the labour market despite aggregate progress. Theoretical perspectives ranging from crowding and compensating differentials to devaluation and queuing emphasise that segregation is not simply a matter of preferences or productivity but a structural constraint that systematically allocates women to low-status jobs (Das & Kotikula, 2019).

Although occupational segregation has been extensively studied in developed countries, fewer studies have analysed this issue in the Indian context. Notable contributions include Chattopadhyay, Chakraborty and Anker (2013), Duraisamy and Duraisamy (2014), Reddy (2015), Agrawal (2016) and Agarwal (2015). Chattopadhyay et al., (2013) examined gender-based occupational segregation in the organised manufacturing sector using the Annual Survey of Industries for 1989–90 and 2000–01. They found that a very small number of industries employed women, with 75 percent of female workers concentrated in just five industries: food, tobacco, textiles, apparel, and chemicals. Their analysis revealed a decline in segregation over time, largely due to changes in industrial composition, particularly in food and apparel where women were concentrated. However, the scope of this study was limited to the organised sector, which accounts for a small proportion of India's total workforce.

Using nationally representative Employment and Unemployment Surveys (EUS), Duraisamy and Duraisamy (2014) analysed changes in gender-based occupational segregation in India from 1983 to 2011–12. By employing the dissimilarity index, they found evidence of a decline in segregation over this period. Although, Agarwal (2015) also used EUS data, his analysis was limited to all-India aggregates and did not examine state-level variations or intra-group patterns among female workers.

The study by Das et al. (2023) employs two rounds of national survey data to examine gender-based occupational segregation in India. The findings indicate a rise in this form of segregation at both the national level and within a majority of states. By decomposing the segregation, the authors find that a substantial part is driven by an "unexplained" component, which is frequently linked to discrimination, as opposed to differences in worker endowments. This study further assesses the economic cost, determining that this occupational segregation leads to wage losses for female workers and a consequent drag on the national economy. Verma (2019) also used the National Sample Survey (NSS) Employment-Unemployment unit level data (68th Round, 2011-12) to examine the dual forces of 'Exclusion' and 'Inclusion' shaping women's roles in the Indian labour market. She argued that women are excluded from better jobs through occupational segregation and are instead included primarily in low-skilled, low-productivity work—a form of 'adverse incorporation' (ibid.).While women's lower education levels play a part, Verma contended that this is only a partial explanation, and that both their low skills and their concentration in poor jobs are ultimately nurtured by the stereotypical foundations of the patriarchal system (Verma, 2019).

Taken together, the Indian literature shows that gender-based occupational segregation remains a persistent and defining feature of the labour market. Studies consistently highlight its role as a central mechanism behind the gender wage gap and the declining female labour force participation (Agarwal, 2015; Duraisamy & Duraisamy, 2016; Banerjee & Roy, 2021). While some of these national-level studies suggest a modest decline in segregation over time, these aggregate measures obscure substantial heterogeneity across states. This variation is shaped by regional differences in socio-economic development, industrial structures, and cultural contexts. Women remain systematically concentrated in a narrow band of occupations, most often informal, low-productivity, and low-wage activities such as agriculture, care work, and certain service roles, while being severely underrepresented in high-return technical and managerial tracks.

Educational trajectories further reinforce this dynamic: gendered subject choices channel men into technical and commerce pathways, while women are concentrated in arts and humanities, shaping their eventual occupational profiles and wage outcomes (Lin et al., 2020). This creates two paradoxes. First, despite rising education, female labour force participation has paradoxically declined, reflecting a U-shaped relationship where moderately educated women are excluded from suitable opportunities. Second, gender wage gaps remain strongly mediated by occupational segregation, with much of the differential unexplained even after controlling for education (Chatterjee et al., 2018).

The economic costs of such segregation are considerable (Das et al., 2023; Das et al., 2015; Klasen & Pieters, 2015; Ostry, 2018; Mehrotra & Parida, 2019). At the individual level, it suppresses women's earnings growth, career mobility, and on-the-job learning (Eapen, 2004). At the aggregate level, it represents a profound misallocation of talent, constraining labour supply elasticities and slowing structural transformation (Khera, 2016). Persistently high dissimilarity indices, especially in urban labour markets, signal structural barriers including employer bias, network-driven hiring, childcare deficits, unsafe commuting options, and inadequate housing near job clusters. Addressing these barriers, rather than eliminating all occupational sorting, should be the central policy priority, with solutions ranging from targeted skilling programmes and equal-opportunity incentives to investments in transport, childcare, and affordable housing near employment hubs.

Given this background, the study employs long-term analysis, spatially disaggregated trends, and a rigorous assessment of underlying drivers to provide vital evidence for policies aimed at reducing gendered occupational barriers. Such an approach is crucial for advancing gender equality, expanding women's economic opportunities, and unlocking India's potential for inclusive growth. Specifically, the study addresses three core questions: (i) how have gender segregation levels in India evolved over the past four decades; (ii) what structural factors drive these trends; and (iii) to what extent does occupational segregation contribute to widening gender wage gaps and constrain women's empowerment?

3. Data and Methods

Data

The study pools the individual-level data from data from the National Sample Survey Office's (NSSO) Employment-Unemployment Survey (EUS) and the Periodic Labour Force Survey (PLFS) to capture trends over four decades (38 years) (NSSO EUS 1983-84, 1987-88, 1993-94, 1999-00, 2004-05, 2005-06, 2007-08, 2009-10, 2011-12; NSSO PLFS 2017-18, 2018-19, 2019-20, 2020-21, 2021-22).

Our sample includes all individuals reported as working according to the Usual Principal and Subsidiary Status (UPSS) definition. We then exclude anyone whose occupation was missing or unclassifiable. This group consists of people categorised as *'Workers Not Classified by Occupations'*, such as those with the occupational code X99 in the NCO-1968 and NCO-2004 classifications. This results in a final pooled sample of 2,669,568 individuals for analysis.

Trend analysis of India's occupation requires consistency in occupational classification across NSSO rounds (Table 1). However, the survey has transitioned through three major revisions of the National Classification of Occupations (NCO), introducing discontinuities that complicate temporal comparison. Specifically, the NSSO employed NCO-1968 from 1983 to 2004–05 in its EUS, NCO-2004 from EUS 2007 onwards to PLFS 2021–22, and NCO-2015 from 2022–23 onwards. The shift from NCO-1968 to NCO-2004 was particularly consequential, as it adopted the framework of the International Standard Classification of Occupations (ISCO-88). The NCO-1968 organised the workforce primarily based on a single criterion *i.e.,* the type of work performed. This approach grouped all workers engaged in similar tasks such as 'clerical duties' or 'driving' into the same category, irrespective of the industry or the skill required to perform the job. While pragmatically useful, this one-dimensional framework had a significant limitation. It conflated occupations that, while superficially similar, demanded vastly different levels of expertise, training, and complexity.

The introduction of NCO-2004, which aligned with the ISCO- 88 addressed this limitation by introducing a two-dimensional framework. This revised system classifies occupations not only by the type of work but also by the skill level required for adequate performance. Under this framework, 'skill' is defined by two components viz: skill level, and skill specialisation, leading to a fundamental restructuring of occupational groups. For instance, occupations previously grouped under broad categories like 'clerical work' were reclassified into finer categories reflecting variations in skill complexity.

Table 1. National classification of occupation at 1-digit NCO codes over years in India post harmonisation, 1983 to 2021

Year/Round	NCO	1 Digit NCO Code	Major Occupation
1983	NCO-1968	1	Legislators, Senior Officials and Managers
1987	NCO-1968	2	Professionals
1993	NCO-1968	3	Technicians and Associate Professionals
1999	NCO-1968	4	Clerks
2004	NCO-1968	5	Service Workers and Shop and Market sales Workers
2005	NCO-1968	6	Skilled agricultural and fishery workers
2007	NCO-2004	7	Craft and related trades workers
2009	NCO-2004	8	Plant and machine operators and assemblers
2011	NCO-2004	9	Elementary occupations
2017 to 2021	NCO-2004		

To ensure comparability, occupational codes from NCO-1968 were harmonised to the NCO-2004 standard, which is based on the ISCO-88 framework. This mapping was conducted at the three-digit level using official conversion tables from the Directorate General of Employment, Ministry of Labour and Employment. While the harmonisation is performed at the three-digit level, for the broader analytical purposes of this study, the harmonised three-digit occupational codes are aggregated to the one-digit level of the ISCO-88 framework, resulting in nine major occupational groups.

Variables

Our primary outcome variable is the Gender Occupational Segregation Index (hereafter GSI). Key socio-economic and structural drivers include the literacy rate, Life Expectancy at Birth (LEB), per capita Net State Domestic Product (NSDP), poverty ratio, urbanization, Total Fertility Rate (TFR), Gini coefficient, the agricultural to non-agricultural working population ratio, the workforce participation rate, and a governance index. Rainfall and the export openness index are used as instrumental variables to control for endogeneity. The negative consequences of occupational segregation are assessed using the male-female wage gap and the Gender Empowerment Measure (GEM). Variable used in this study; their description and data source are provided in Table 2.

Table 2. Description of Study Variables and Data Sources

Variable	Data source	Description
Outcome variable		
Gender Occupation Segregation Index	EUS and PLFS (NSSO EUS 1983, 1987, 1993, 1999, 2004, 2005, 2007, 2009, 2011; PLFS 2017, 2018, 2019, 2020, and 2021)	GSI is estimated by Duncan Dissimilarity Index using unit level data from successive rounds of EUS and PLFS during 1983 to 2021.
Predictors		
Literacy rate	Compiled from Census of India (2011), Office of RGI, Government of India and also National Family Health Surveys for the recent years (IIPS and MoHFW, 2021)	According to the Census of India, a person aged seven years and above is considered literate if they can read and write with understanding in any language.
Life Expectancy at Birth (LEB)	Compiled from Sample Registration System Data from Office of RGI, Government of India (Office of Registrar General of India, 2013, Office of Registrar General of India, 2020).	The average years of life that a newborn could expect to live if he or she were to pass through life exposed to the sex and age-specific death rates prevailing at the time of his or her birth, for a specific year, in a given country, territory, or geographic area.
Per capita NSDP	Central Statistical Organization, sourced from EPWRF	Per capita net state domestic product (NSDP) at factor cost (1981 to 2021) (indexed to 2011–12 constant prices)
Poverty ratio	National Sample Survey office (NSSO) Consumer Expenditure Surveys (NSSO, various years: 1991 to 2020)	The state-wise poverty ratio is estimated from the state-specific poverty lines based on the consumption expenditure data collected by the National Sample Survey office (NSSO).
Urbanisation	Census of India (2011) and RGI Projected Population (National Commission on Population 2019)	Proportion of population living in urban areas
Total Fertility rate	Compiled from Sample Registration System Data from Office of RGI, Government of India (Office of Registrar General of India, 2013, Office of Registrar General of India, 2020).	The total number of children that would be born to hypothetical cohort of women if she were to live to the end of her reproductive period and give birth to children in alignment with the prevailing age-specific fertility rates.
Gini coefficient	National Sample Survey office (NSSO) Consumer Expenditure Surveys (NSSO, various years: 1991 to 2020)	Estimated based on the consumption expenditure data collected by the National Sample Survey office (NSSO).
Agriculture/ non-agriculture		Proportion of people employed in agriculture relative to non-agriculture

	NSSO Employment–Unemployment Survey (National Sample Survey) and PLFS 2019-20 (National Statistical Office 2021)	
Workforce Participation Rate (WPR)	Census of India (2011) and PLFS, 2020-21 (National Statistical Office 2021)	Ratio of workers to total population
Governance index	Basu (2002), Mundle et al. (2016), and Good Governance Index, 2020-21 (Government of India 2021)	Index capturing the quality of institutions
Instrument variables		
Rainfall (in millimetres)	Indian Meteorological Department, sourced from Reserve Bank of India (Reserve Bank of India 2024)	Rainfall in millimetres (mm) is measurement of the depth of rain that falls on a flat surface
Export openness index	Ghosh Dastidar & Veeramani (2014)	Index measuring export openness in terms of exports volume
Impact measurement variable		
Wage rates	EUS and PLFS	Wages are estimated by using unit level data from successive rounds of EUS and PLFS during 1983 to 2021.

Descriptive statistics of variables

The descriptive statistics presented in Table 3 provide a summary of the key variables used in our analysis, drawn from a panel of Indian states. The dataset comprises an unbalanced panel, with the number of observations ranging from 116 to 144, reflecting variation in data availability across indicators. Socio-economic segregation, as measured by the Dissimilarity Index, shows considerable variation across states. The average total Dissimilarity Index is 0.347, with a standard deviation of 0.146, indicating meaningful disparities in spatial segregation between states. The index is markedly higher in urban areas (Mean = 0.523, Std. Dev. = 0.067) compared to rural areas (Mean = 0.303, Std. Dev. = 0.176), suggesting that segregation is a more pronounced feature of India's urban landscape.

The data reveals significant state level variation in socio-economic and structural drivers selected as predictors of gendered segregation in occupations. For instance, the average Literacy Rate is 61.5%, but with a wide range (30.11% to 95%), highlighting stark inter-state differences in human capital formation. Fertility rates (mean 3.28) suggest states are at different demographic transition stages, ranging from near replacement to very high fertility. Similarly, the average Poverty Headcount Ratio stands at 29.4%, with values spanning from under 1% to over 65%, underscoring the profound economic disparities between states. Economic inequality, captured by the Gini Coefficient, is moderately high on average. The total Gini coefficient averages 0.303, with urban inequality (Mean = 0.334) consistently exceeding rural inequality (Mean = 0.303). The Per Capita NSDP exhibits extreme variation (Mean = ₹28,176, Std. Dev. = ₹39,183), with the maximum value far exceeding the minimum, pointing to a vast divergence in state-level economic output and prosperity.

Structural economic characteristics also vary widely. The average Worker Participation Rate is 38.3%. The Agriculture to Non-Agriculture GSDP Ratio averages 1.46, indicating that, on aggregate, agricultural output still surpasses non-agricultural output in many states, though the ratio ranges from 0.26 to 3.49, signalling very different stages of economic transformation. The average Level of Urbanisation is 26.4%, confirming India remains predominantly rural, but with states at vastly different points along the urban transition spectrum (10% to 58.6%).

Next, instrumental variables used in the model i.e. institutional and trade factors show substantial spread and wide climatic variation in rainfall. The Governance Index ranges from 1 to 16, and Export Openness varies from 0.022 to 0.272, indicating heterogeneous state-level policies and integration into the global economy. Finally, the impact of gendered segregation in occupations on wage differences among male and female workers and the Gender Empowerment Measure also shows state level variations. In rural areas, average gender wage differences are 28.9%, ranging from parity to extreme gaps of 200%, with wide variability. Urban disparities are larger at 44.6% on average, ranging from –1.4% (rare female advantage) to 210%. Overall, urban labour markets exhibit greater and more volatile wage inequality, underscoring persistent structural and occupational barriers for women. In summary, the descriptive statistics confirm extensive heterogeneity across Indian states in terms of segregation, development outcomes, economic structure, and governance, providing a robust foundation for the multivariate analysis that follows.

Table 3. Descriptive Statistics of the study variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Outcome variables					
Dissimilarity Index (Total)	116	.347	.146	.143	.782
Dissimilarity Index (Rural)	116	.303	.176	.095	.83
Dissimilarity Index (Urban)	116	.523	.067	.387	.655
Predictors variables /Drivers					
Literacy Rate (%)	144	61.533	15.66	30.11	95
Life Expectancy at Birth (Total, years)	144	62.889	6.271	50	75.2
Total Fertility Rate (TFR)	144	3.284	1.153	1.4	5.8
Level of Urbanisation	144	26.439	9.96	10	58.57

Per Capita NSDP	144	28175.90	39182.57	947	177507
Poverty Headcount Ratio (%)	144	29.375	14.353	.79	65.29
Gini Coefficient Total	144	.303	.052	.192	.447
Gini Coefficient Urban	144	.334	.037	.25	.498
Gini Coefficient Rural	144	.303	.052	.192	.447
Worker Participation Rate (%)	144	38.266	5.747	22.234	52.1
Agriculture to Non-Agriculture GSDP Ratio	120	1.462	.685	.257	3.492
Governance Index	120	8.625	4.685	1	16
Instrumental variables					
Export Openness Index	120	.127	.073	.022	.272
Rainfall	112	1293.874	703.896	395.6	3074.52
GSI Impact measurement variables					
Gender differences in wages in Rural	135	28.908	39.371	0	200
Gender differences in wages in Urban	135	44.552	50.761	-1.43	210

Econometric Strategy

The study followed a four-step econometric strategy. First, it estimates the Gender Segregation Index (GSI) to assess trends over time across rural and urban areas, regions, and states. Second, it decomposes the GSI to examine the within- and between-group contributions of gender. Third, it constructs a state-year panel dataset of the GSI and its correlates, compiled from multiple data sources. Using this dataset, the study performs panel data regressions to identify the determinants of GSI, and to address potential endogeneity problems, it employs instrumental variable regression models. Fourth, drawing on the same state-year panel dataset, the study estimates the impact of GSI on male–female wage gaps and levels of gender empowerment. The empirical specifications of the methods used to measure the GSI, its predictors, and its impact on wages and gender empowerment are provided below.

Gender Segregation Index (GSI)

Gender Segregation Index is measured using the Duncan Dissimilarity Index (D) as given below:

$$D = \frac{1}{2} \sum \left(\frac{M_i}{M}\right) - \left(\frac{F_i}{F}\right) \quad (1)$$

where:
- M_i and F_i are the number of men and women in occupation i,
- M and F are the total number of men and women in the labour force,
- D is the proportion of either men or women who would need to change occupations to achieve even distribution.

Because the Duncan dissimilarity index is not suitable for decomposition, we instead estimated the Gini index and decomposed it using the method developed by Pyatt (1976). The full econometric specification for this approach can be found in Pyatt's original work.

Identifying Drivers of GSI

Panel Data Regression Models

By constructing a panel of 18 major states over 8 time points (n=144), the study employed fixed effects regression models to assess the socio-economic and structural drivers of the gendered occupational segregation in India. We converted all variables into logarithmic form; thus, model is performed in a log-linear form.

Fixed Effects Model (FE)

$$Y_{(GSI)it} = \beta_0 + \beta_{i\,(drivers)} X_{it} + \alpha_i + e_{it} \quad (2)$$
$$i=1\ldots.n;\ t=1\ldots T$$

Where, Y_{it} is the GSI; β_0 is unknown intercept for each entity; $\beta_{i\,(drivers)}$ are coefficients of the X_{it} explanatory variable (Literacy rate, LEB, TFR, Level of urbanisation, per capita NSDP, Poverty ratio, Gini coefficient, WPR, Agriculture to Non-Agriculture workers ratio, Governance quality), α_i= entity specific fixed effect, e_{it}= overall error term, i=unit of observation, t=period of time.

Instrumental Variable Regression: Endogeneity check

The panel data allowed us to examine the effect of socio-economic and structural drivers on the gendered occupational segregation. However, the regressors, socio-economic and structural drivers is influenced by the multiple factors (endogeneity problem) and sometimes gendered segregation in employment itself might predict some of these socio-economic factors (chance of reverse causality), increasing the risk of endogeneity bias. Therefore, to eliminate the problems, we employ instrumental variable (IV) regression. The IV estimation divide the regressor into two parts: one part that is corelated with error term (endogeneity), and the other that is uncorrelated with the error term (exogeneity). Then we regress the dependent variable with predicted value of socio-economic variable from equation that does not corelate with error term using ordinary least square (OLS) estimates. In this study, we have implemented two-stage least square (2SLS) estimates.

First stage of 2SLS:

$$Y_{(\text{Per Capita NSDP})} = \beta_0 + \beta_1 X_{(\text{exogenous variables})i} + \beta_2 Z_{(\text{Rainfall})1} + \beta_i X_{(\text{other covaraites})i} + \mu_i \quad (3)$$

Second stage of 2SLS:

$$Y_{(\text{GSI})1} = \alpha_0 + \alpha_1 X_{(\text{exogenous variables})i} + \alpha_2 \bar{Y}_{(\text{Per Capita NSDP})2} + \varepsilon_i \quad (4)$$

Where, Y_2 = Per Capita NSDP (Assuming it has correlation with error term), Y_1 =dependent variable (GSI), Z_i =instrument variable (Rainfall), $\bar{Y}$ = predicted value of Per Capita NSDP from equation (3) that does not corelate with error term μ_i, X_i = exogeneous variables, and ε_i and μ_i = the error terms.

Measuring the impact of GSI on Gender differences in Wage

Since it is very clear from estimates using equations (2, 3 and 4) that the indicators selected for the models suffers from endogeneity and reverse causality problem. Therefore, we have fit a dynamic panel data regression model to estimate the impact of GSI on gender differences in wages. The empirical specifications of the model are given below.

Dynamic Panel Data Regression Models with Fixed Effects

Usual panel data fixed effect estimates can become biased if the explanatory variable is correlated with the unobserved component of the gendered segregation measure. To address this potential endogeneity, we employ the Arellano–Bond Generalized Method of Moments (GMM). This estimator is particularly suited for "small T, large N" panel data, i.e., few time periods and many observational units. Instead of relying on conventional external instruments, GMM exploits the assumption that differenced residuals are uncorrelated with lagged differences (or levels) of the endogenous variables (Arellano & Bond, 1991; Blundell & Bond, 1998). In this framework, lagged values of the variables themselves serve as valid instruments. The corresponding statistical specification is given as follows:

$$\Delta \log wages_{it} = \alpha \Delta GSI_{it} + \beta \Delta X_{it} + \Delta v_t + \Delta \varepsilon_{it} \quad (5)$$

Where $\log wages_{it}$ is the natural logarithm of the gender differences in wages in states i in period t, GSI_{it} is the mean of Gender Segregation index. X_{it} is a vector of other socio-economic control variables.

4. Result

The results of this study are organised into four sections: (1) descriptive statistics, which outline long-term trends in the occupational distribution of male and female workers across rural and urban areas, as well as trends in gendered occupational segregation using the dissimilarity index; (2) trends in gendered occupational segregation using the Gini index and its decomposition, assessing within- and between-gender contributions to overall segregation; (3) panel data regression analyses and robustness checks, which identify the drivers of the Gender Segregation Index; and (4) the impact of GSI on gender wage differences and the Gender Empowerment Measure. Below we have presented the findings in the above said sequence.

Trends in occupational distribution of male and female workers

The occupational structure of the Indian workforce between 1983 and 2021 reflects the country's gradual shift from an agrarian to a diversified economy, with clear gendered patterns of change (Figure 1). Women and men both moved away from agriculture and elementary work, but the pace and direction of their transitions differ in important ways.

For women, one of the most notable shifts is the increase in participation in higher-skill occupations. Female professionals rose from less than 1% in 1983 to nearly 6% by 2021, while their presence in managerial roles also climbed from just 0.5% to around 4%. Clerical and service sector jobs, traditionally male-dominated, also saw steady female entry. At the same time, female employment in agriculture, which once absorbed over half of all women (51% in 1983), has stagnated around 47% by 2021. Importantly, the share of women in elementary occupations fell from more than a third in 1983 to below 25% in 2021, pointing to a gradual exit from the lowest-skill segments.

Men's trajectory reveals a different story. Managerial and professional roles expanded from about 1.6% and 1.9% in 1983 to 8.5% and 4.6% in 2021, respectively. Unlike women, however, men did not experience a sharp decline in semi-skilled and industrial roles. Instead, they consolidated their presence in plant and machine operations, which rose from 3.6% to 7.3% during this period. Male agricultural work dropped substantially, from 41% to 30%, underscoring the farm-to-nonfarm transition, while elementary work shrank from nearly 28% to 23%.

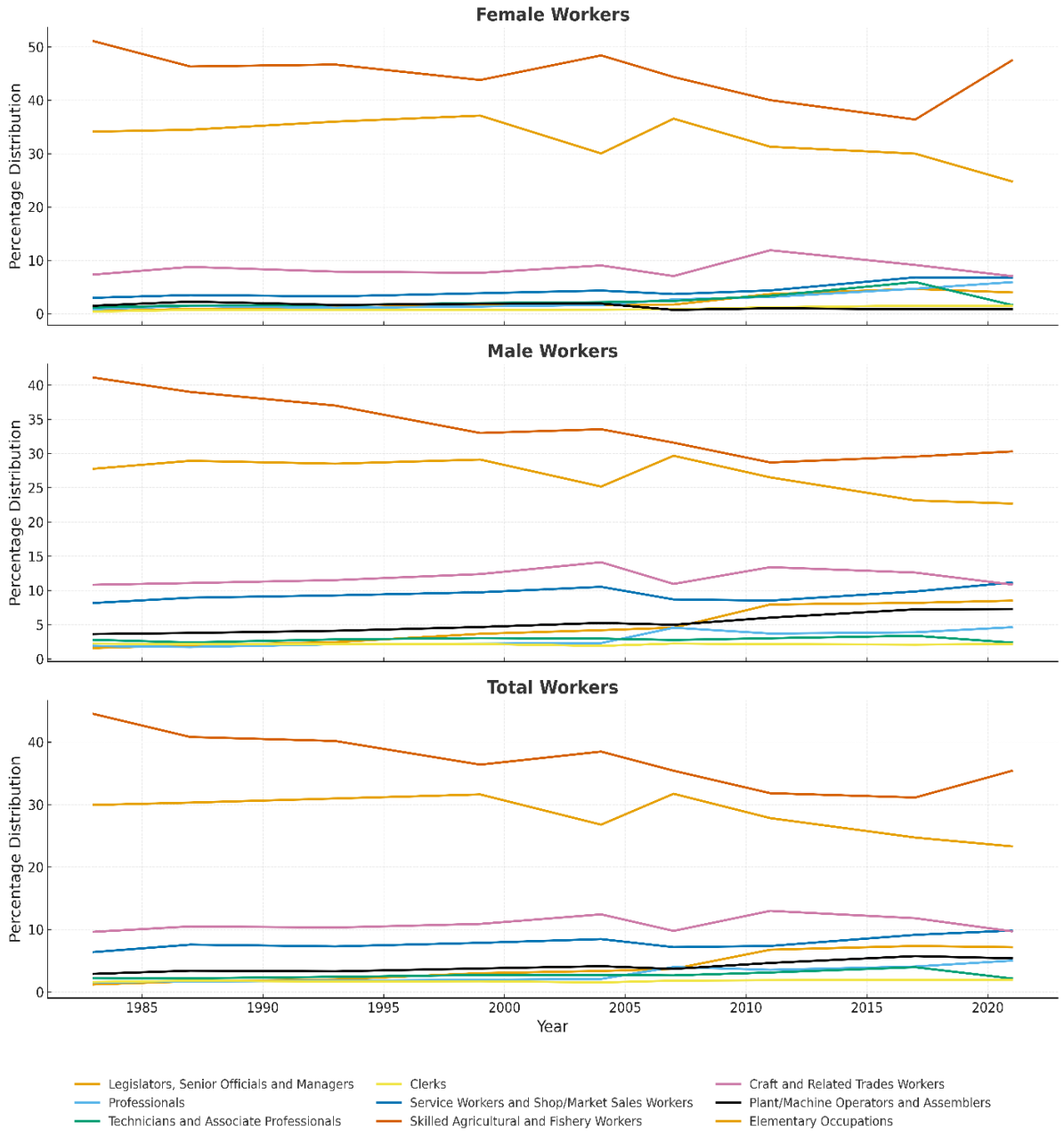
When both genders are considered together, the aggregate workforce highlights India's broader transformation. Agriculture's share in total employment fell from 45% to 35%, while professionals and managers expanded from just over 2% combined to more than 12%. Service and clerical roles also grew modestly. Yet, the persistence of large numbers in agriculture and elementary work shows the coexistence of modern and traditional sectors, with structural change still incomplete.

In short, women have made larger relative gains in professional and service roles, men have strengthened their hold in semi-skilled industrial occupations, and both groups are gradually moving out of agriculture. These patterns underline both progress in occupational diversification and the enduring challenge of gendered segmentation in India's labour market (Table A1).

Trends in Gendered Segregation in Occupations

The Dissimilarity Index data reveals a clear and concerning trend of increasing gender segregation in India's workforce from 1983 to 2021 (Figure 2). The all-India index rose substantially from 0.22 to 0.35, indicating that over a third of either men or women would now need to switch occupations to achieve a gender-balanced distribution. This demonstrates that despite decades of economic development, the Indian labour market has become more, not less, segmented by gender, with women increasingly concentrated in a narrower set of fields.

Figure 1. Gender Segregation in Occupational Distribution of Workers in India, 1983–2021

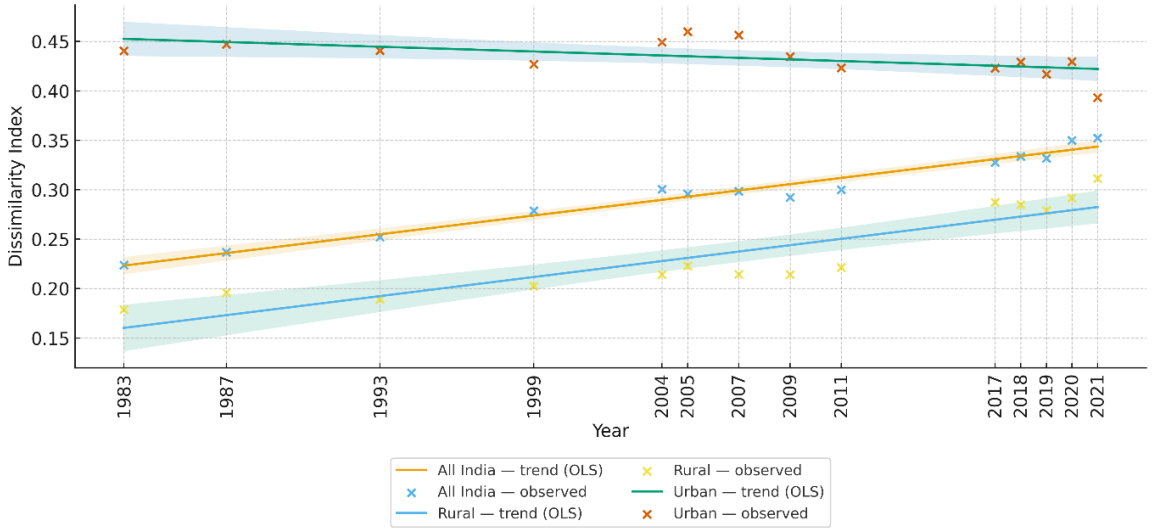


A critical finding is the persistent and growing divide between rural and urban areas. Urban employment has remained consistently more segregated than rural employment, a fact attributed to a more diverse and specialised occupational structure that has historically been highly gendered. However, the most dramatic change has occurred in rural India, where the index more than doubled. This suggests a crisis in traditional agrarian employment, where women are exiting the workforce or being funnelled into a limited number of sectors without accessing new, diverse job opportunities, thereby increasing measured segregation.

While urban segregation has been high but volatile, the noticeable decline in the urban index to 0.39 in 2021 offers a potential, though cautious, point of optimism. This may signal the beginning of a shift where women are gradually entering previously male-dominated professional sectors such as services and technology. Nonetheless, the overarching narrative remains one of a deeply segregated labour

market, which perpetuates gender inequality by reinforcing occupational stereotypes and likely contributing to the gender pay gap.

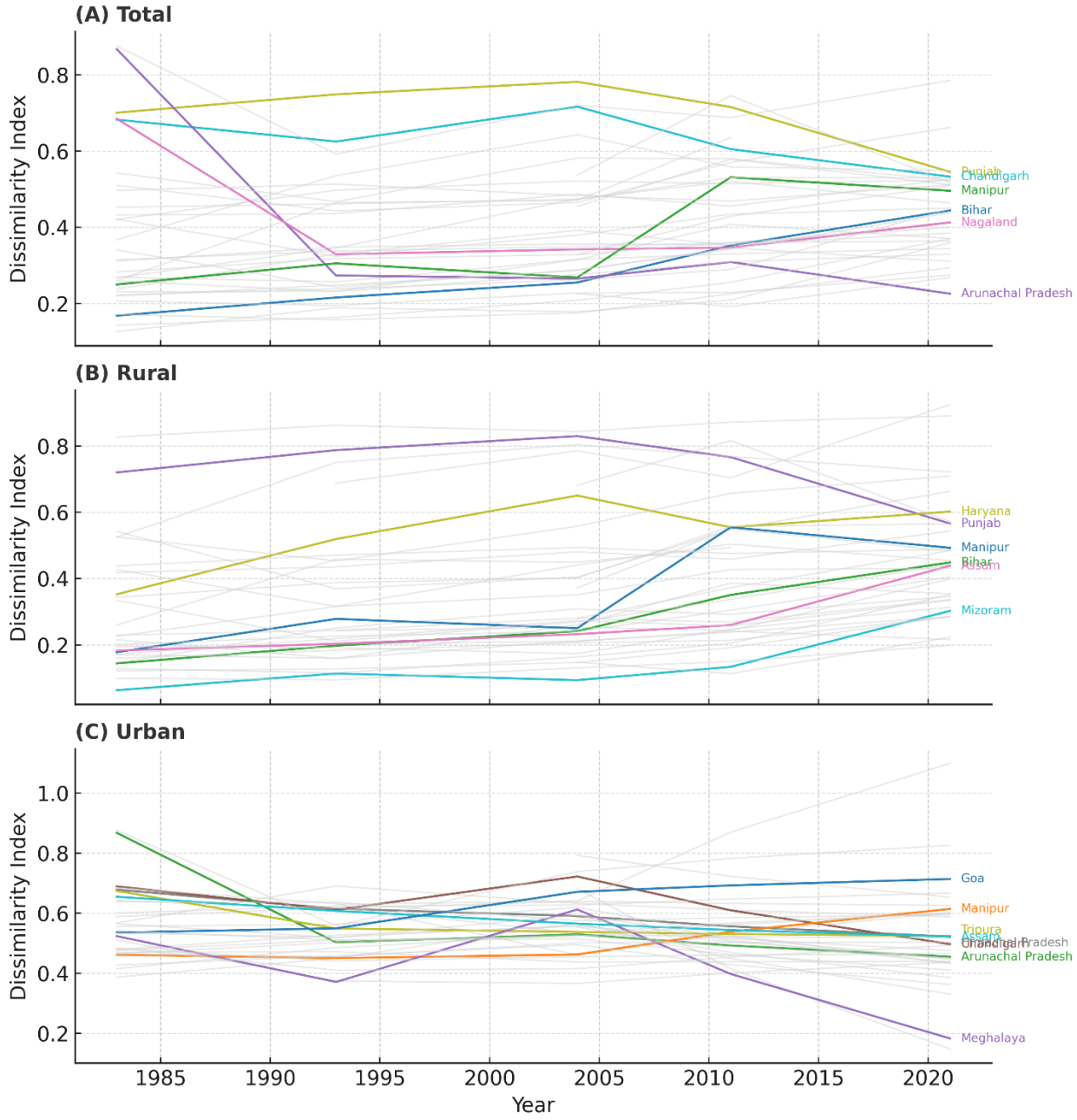
Figure 2. Trends in Gender Segregation of Employment in India by Place of Residence, 1983 to 2021



The trends in gender segregation of employment across Indian states from 1983 to 2021 highlight persistent but varied patterns by region and place of residence (Figure 3). At the all-India (total) level, segregation levels generally increased over time in most states. Punjab consistently recorded the highest levels, peaking above 0.75, reflecting entrenched occupational divides. States like Bihar and Uttar Pradesh witnessed a sharp rise, especially after the mid-1990s, suggesting limited occupational mobility for women in expanding labour markets. In contrast, states such as Gujarat and Karnataka exhibited more stable trajectories, indicating slower changes in occupational structures.

In the rural sector, segregation was generally lower compared to urban areas but exhibited notable increases over time. Punjab again remained an outlier with extremely high segregation throughout, followed by Haryana and Rajasthan, where the divide widened sharply during the 1990s and 2000s. In states like Kerala, Tamil Nadu, and Andhra Pradesh, rural segregation levels were relatively moderate and showed gradual increases, reflecting incremental changes in agricultural and non-agricultural work distribution between men and women. Rural Madhya Pradesh and Odisha, starting from very low levels, experienced modest increases, though their absolute values remained among the lowest. In urban areas, segregation levels were consistently higher than rural regions, underlining stronger gender divides in formal and semi-formal occupations. Assam, Kerala, and Bihar displayed high and fluctuating segregation levels, while Punjab, Haryana, and Rajasthan sustained high values throughout. States such as Tamil Nadu and Karnataka recorded lower but stable segregation, suggesting that diversification of urban occupations somewhat mitigated extremes. Notably, Jharkhand's urban figures after 2000 show high segregation, reinforcing structural barriers in newly industrialising states. Overall, these trends confirm that gender-based occupational segregation remains deeply rooted, with rural-urban differences narrowing in some states but widening in others. High and rising segregation suggests persistent barriers to equal employment opportunities, constraining both female labour force participation and broader economic efficiency.

Figure 3. Trends in Gender Segregation of Employment in India by Place of Residence across States of India, 1983 to 2021



Between and within groups contribution for gendered segregation in occupations

The Pyatt decomposition results reveal that gender-based occupational segregation in India has been remarkably persistent over the past four decades. The overall Gini index of segregation shows a mild U-shaped pattern: relatively high in the early 1980s, declining slightly through the 1990s and 2000s, before rising again in the late 2010s and returning to levels close to those of the early period by 2021 (Table 4). This indicates that structural shifts in the labour market have not translated into sustained reductions in gender segregation.

Breaking down the components, the within-group share remains the largest contributor throughout, accounting for nearly half of overall segregation. This underscores that much of the gender divide is generated within occupational categories, rather than solely across them. The between-group

component, which captures differences in occupational concentration between men and women, rose steadily until 2017, indicating widening occupational divergence, but eased somewhat in recent years. Meanwhile, overlap between male and female occupations decreased to its lowest point around 2017, reflecting limited shared participation, before recovering modestly thereafter. Overall, the findings suggest limited progress in dismantling gender barriers. Occupational segregation remains entrenched, with temporary convergence giving way to renewed divergence, highlighting the persistence of structural inequalities.

Table 4. Between and within groups contribution for gendered segregation of occupations among wage workers

Year	Gini	Between	Within	Overlap	Between (%)	Within (%)	Overlap (%)
1983	0.270	0.070	0.127	0.072	26.0	47.2	26.8
1987	0.276	0.070	0.130	0.075	25.4	47.3	27.4
1993	0.270	0.074	0.127	0.069	27.4	46.9	25.7
1999	0.259	0.075	0.120	0.063	29.0	46.5	24.4
2004	0.279	0.073	0.131	0.075	26.0	47.0	27.0
2007	0.261	0.078	0.120	0.063	29.9	46.1	24.0
2009	0.257	0.083	0.117	0.056	32.5	45.6	21.9
2011	0.259	0.083	0.118	0.058	32.1	45.6	22.3
2017	0.240	0.089	0.107	0.045	37.0	44.4	18.6
2018	0.245	0.086	0.110	0.049	35.1	44.8	20.0
2019	0.260	0.081	0.119	0.060	31.3	45.7	22.9
2020	0.268	0.079	0.124	0.066	29.3	46.2	24.5
2021	0.269	0.079	0.124	0.066	29.2	46.2	24.7

Key Drivers of Gendered Segregation of Occupations

Table 5 reports fixed effects regression estimates where both the dependent variable (Gender Segregation Index, GSI) and explanatory variables are expressed in natural logarithms. Coefficients therefore capture elasticities: the percentage change in GSI associated with a one percent change in the regressor, holding other factors constant. The most consistent finding is the strong positive association between literacy rates and GSI. A one percent increase in literacy raises occupational segregation by roughly 0.9 to 1.3 percent across specifications. This counterintuitive result highlights that educational expansion in India has reinforced, rather than reduced, gendered occupational sorting. Women with higher education are concentrated in socially sanctioned fields such as teaching, healthcare, and clerical work, while men continue to dominate technical and managerial occupations.

Fertility is another robust driver. In rural areas, a one percent rise in fertility increases segregation by 0.4–0.5 percent, confirming that higher reproductive burdens constrain women to less mobile and lower-return occupations. Life expectancy exerts a negative elasticity, particularly in total models, suggesting that improvements in health and longevity reduce gender segregation by 0.5–0.6 percent per one percent gain in life expectancy.

Economic structure and inequality also matter. The rural and total Gini coefficients are strongly positive, with elasticities around 0.26–0.32, implying that rising inequality reinforces gendered labour divides. The agriculture–non-agriculture ratio is positively linked to segregation in urban areas, with elasticities up to 0.19, showing that structural transformation intensifies segregation when women are excluded from emerging high-productivity jobs. By contrast, per capita NSDP and poverty ratios display weak or inconsistent effects, underscoring that growth and poverty reduction alone do not dismantle segregation. Governance coefficients are negative but small, pointing to a limited role of institutional quality in shaping gender outcomes. Overall, the fixed-effects estimates highlight that literacy, fertility, and inequality are the dominant structural forces perpetuating occupational segregation, while economic growth and governance provide only marginal counterweights.

Table 5. Fixed Effects Regression Model Estimates: Drivers of Gendered Occupational Segregation in India

VARIABLES	(1) GSI (Total)	(2) GSI (Total)	(3) GSI (Rural)	(4) GSI (Rural)	(5) GSI (Urban)	(6) GSI (Urban)
Ln Literacy Rate	0.890***	1.272***	1.105***	1.286***	0.261***	0.176*
	(0.136)	(0.167)	(0.185)	(0.238)	(0.0726)	(0.0960)
Ln LEB	-0.655**	-0.479*	-0.613	-0.499	-0.0606	-0.0333
	(0.293)	(0.287)	(0.392)	(0.405)	(0.165)	(0.173)
Ln TFR	0.265**	0.136	0.450***	0.410**	0.167**	0.162*
	(0.108)	(0.144)	(0.149)	(0.204)	(0.0644)	(0.0858)
Ln Level of Urbanisation	0.0185	0.271	-0.176	-0.124		
	(0.155)	(0.178)	(0.207)	(0.250)		
Ln Per Capita NSDP	0.0236	0.0471	0.0301	0.0112	0.0257	-0.0444
	(0.0316)	(0.0834)	(0.0418)	(0.120)	(0.0191)	(0.0517)
Ln Poverty Ratio	-0.0319	-0.0728*	-0.0330	-0.0609	-0.0271	-0.0201
	(0.0424)	(0.0415)	(0.0560)	(0.0574)	(0.0177)	(0.0232)
Ln Gini Coefficient Total	0.259**	0.0899				
	(0.111)	(0.136)				
Ln Gini coefficient Rural			0.324***	0.0490		
			(0.116)	(0.173)		
Ln Gini Coefficient U					0.0633	0.0184
					(0.0785)	(0.0895)
Ln WPR Total	0.0736	0.190*	0.0395	0.0776	-0.0435	-0.0553
	(0.108)	(0.113)	(0.145)	(0.159)	(0.0598)	(0.0702)
Ln Agriculture to Non-Agriculture Ratio	0.132	0.288***	-0.0133	0.00957	0.194***	0.146**
	(0.0832)	(0.107)	(0.114)	(0.151)	(0.0500)	(0.0661)
Ln Governance	-0.00860	-0.0129	-0.0374	-0.0453	-0.00725	-0.0136
	(0.0197)	(0.0199)	(0.0264)	(0.0282)	(0.0113)	(0.0123)
Entity Fixed Effects	No	Yes	No	Yes	No	Yes
Time Fixed Effects	No	Yes	No	Yes	No	Yes
Constant	-4.281***	-8.304***	-4.908**	-6.315**	-3.247***	-1.937
	(1.536)	(1.969)	(2.047)	(2.760)	(0.935)	(1.175)
Observations	112	112	112	112	112	112
R-squared	0.706	0.771	0.688	0.730	0.325	0.363
Number of Groups	14	14	14	14	14	14

Robustness Checks: Instrument variable regression model

Table 6 presents instrumental variable regressions that account for potential endogeneity, with both dependent and independent variables expressed in logs. The IV elasticities broadly confirm the fixed-effects patterns but sharpen the role of certain drivers. Literacy remains the strongest predictor of segregation: a one percent increase in literacy raises GSI by 1.1–1.8 percent in total and rural models. This reinforces the paradox that human capital accumulation, absent inclusive labour market structures, amplifies gendered occupational divides. Fertility shows weaker effects in IV estimates, though in rural areas a one percent increase in fertility still raises segregation by about 0.4 percent, consistent with the constraints imposed by family size and caregiving burdens.

Economic inequality is again central. The total and rural Gini coefficients yield elasticities of 0.30–0.35, indicating that a one percent rise in inequality increases segregation by nearly a third of a percent. This result is robust to instrumentation and highlights how unequal income distributions exacerbate occupational stratification along gender lines. Structural transformation yields a different pattern than in fixed-effects estimates: the agriculture–non-agriculture ratio is negatively signed in rural specifications (elasticity around –0.43), suggesting that diversification away from agriculture can reduce segregation if women access new opportunities. In urban areas, however, coefficients are insignificant, reflecting the complexity of city labour markets.

Governance coefficients are negative and statistically significant in total and rural specifications (elasticities of –0.05 to –0.13), suggesting that improvements in institutional quality reduce segregation by making labour markets more equitable and enforcing rights. Per capita NSDP effects are mixed but lean negative, implying that growth may reduce segregation only when accompanied by broader reforms. Diagnostic statistics (Durbin and Wu–Hausman) confirm the presence of endogeneity and validate the IV approach.

Taken together, the IV estimates strengthen confidence that literacy, inequality, and governance are structural levers shaping gendered occupational segregation in India, while fertility and structural change exert context-specific influences.

Table 6. Instrument Variable Regression Estimates: Drivers of Gendered Occupational Segregation in India

VARIABLES	(1) GSI (Total)	(2) GSI (Total)	(3) GSI (Rural)	(4) GSI (Rural)	(5) GSI (Urban)	(6) GSI (Urban)
Ln Per Capita NSDP	-0.183*	-0.627	-0.308*	-0.732	-0.0789	-1.006
	(0.110)	(0.508)	(0.161)	(0.629)	(0.114)	(0.660)
Ln Literacy Rate	1.292***	1.063***	1.795***	1.138***	0.341**	-0.205
	(0.250)	(0.291)	(0.362)	(0.391)	(0.134)	(0.367)
Ln LEB	-0.326	-0.369	0.0514	-0.353	0.242	0.355
	(0.447)	(0.443)	(0.657)	(0.571)	(0.324)	(0.477)
Ln TFR	-0.00688	0.166	-0.00957	0.421*	-0.0536	0.145
	(0.190)	(0.186)	(0.288)	(0.241)	(0.237)	(0.207)
Ln Level of Urbanisation	0.311	0.600*	0.363	0.291		
	(0.226)	(0.321)	(0.343)	(0.394)		
Ln Poverty Ratio	-0.0718	-0.0769	-0.0900	-0.0845	-0.0544	-0.133
	(0.0582)	(0.0543)	(0.0777)	(0.0685)	(0.0360)	(0.0899)
Ln Gini Coefficient Total	0.306**	-0.284				
	(0.155)	(0.271)				
Ln Gini Coefficient Rural			0.353**	-0.278		
			(0.156)	(0.325)		
Ln Gini Coefficient Urban					0.324	0.317
					(0.249)	(0.279)
Ln WPR Total	-0.0727	0.324**	-0.236	0.238	-0.153	0.0430
	(0.162)	(0.156)	(0.239)	(0.202)	(0.125)	(0.181)
Ln Agriculture to Non-Agriculture Ratio	-0.142	0.166	-0.433*	-0.0484	0.0137	-0.0976
	(0.169)	(0.189)	(0.256)	(0.236)	(0.210)	(0.244)
Ln Governance	-0.0566*	-0.0948	-0.108**	-0.132*	-0.0253	-0.111
	(0.0308)	(0.0601)	(0.0455)	(0.0749)	(0.0257)	(0.0727)
Entity Fixed Effects	No	Yes	No	Yes	No	Yes
Time Fixed Effects	No	Yes	No	Yes	No	Yes
Constant	-2.403	-1.189	-2.755	0.748	-0.837	11.20
	(2.043)	(5.906)	(2.902)	(7.446)	(2.879)	(9.484)
Observations	104	104	104	104	104	104
Number of Groups	14	14	14	14	14	14
Adjusted R-squared	0.9940	0.9938	0.7359	0.9940	0.9915	0.9930
Durbin (score) chi2(1)	36.93***	40.44***	27.08***	31.21***	5.97**	6.27**
Wu-Hausman F (1,92)	50.67***	52.17***	32.40***	35.16***	5.66**	5.33**
2SLS size of nominal 5% Wald test	16.38	16.38	16.38	16.38	16.38	16.38

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The effect of gendered segregation on male-female wage differences

Table 7 estimates dynamic Arellano–Bond models of the gender wage gap with all variables in log form, so coefficients are elasticities. The core result is that GSI measurably widens rural wage gaps but shows no robust effect in urban labour markets. In rural estimates, the elasticity on the (log) Dissimilarity Index is small, positive, and significant: a 1% rise in GSI raises the rural gender wage gap by about 0.02% in the short run, with a similar long-run effect after accounting for dynamics given the modest lag coefficient. In contrast, the urban elasticity is negative and imprecise; statistically, GSI does not move the urban wage gap.

Other covariates map cleanly to economic structure. Inequality (Gini) is a powerful correlate of wider gender wage gaps in both rural and urban settings. Urban income growth (per-capita NSDP) is associated with larger urban wage gaps, while the rural coefficient is negative and imprecise—growth alone does not equalise. Work participation has opposite signs: higher participation coincides with wider rural gaps (likely crowding into low-return work) but narrower urban gaps (perhaps better matching and formalisation). Higher literacy and life expectancy are associated with narrower urban gaps (human capital and health quality effects), and structural change (a lower agriculture/non-agriculture ratio) narrows urban gaps—consistent with movement into higher-productivity, less gender-segregated sectors. Diagnostics suggest the AR(2) test and Sargan test are passed, which reveals that the model specification is correct and the instruments are valid and exogenous, respectively.

Table 7. Dynamic Panel GMM estimates: The effect of GSI on Gender differences in Wages among workers

Variables	Rural workers	Urban workers
Ln Rural Wage Differences	0.157*	
	(0.094)	
Ln Urban Wage Differences		0.044
		(0.069)
Ln Dissimilarity Index	0.017**	
	(0.010)	
Ln Dissimilarity Index		-0.532
		(0.509)
Ln Per Capita NSDP	-0.481	0.654***
	(0.518)	(0.247)
Ln Poverty Ratio	-0.273*	0.115
	(0.149)	(0.198)
Ln Work Participation Rate	0.883**	-0.613**
(Total)	(0.394)	(0.283)
Ln Literacy Rate	-0.154	-1.238***
	(0.987)	(0.457)
Ln Life Expectancy at Birth	1.676	2.039***
	(1.702)	(0.713)
Ln Agriculture / Non-Agriculture Ratio	-0.424	-0.590***
	(0.440)	(0.158)
Ln Governance	-0.110	-0.043
	(0.107)	(0.052)
Ln Gini Coefficient	2.769***	1.438**
	(0.695)	(0.586)
Time Fixed Effects	Yes	Yes
Observations	66	74
Number of groups	16	16

Number of instruments	34	35
AR (1) p-value	0.0171	0.0596
AR (2) p-value	0.8761	0.1999
Sargan p-value	0.0812	0.0654
Wald χ^2 (joint)	326.558	461.263
Estimator	Arellano–Bond (1-step), robust SE	Arellano–Bond (1-step), robust SE

Notes: Coefficients with robust standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

5. Discussion and Conclusion

This study builds a long-horizon, pooled cross-sectional dataset and state–year panel of India's wage structure. This study analyses Indian workers from 1983 to 2021 by harmonising the NSS-EUS and PLFS datasets. This involved reconciling changing occupational codes (from NCO-1968 to NCO-2004/ISCO-88) and aggregating detailed codes into nine comparable groups, yielding a pooled file of nearly 2.7 million individuals.

Using the Duncan dissimilarity index and a decomposable Gini-based measure, we find that trends show persistent—and in many states, rising—gendered occupational segregation. Urban markets are more segmented than rural ones, with sharp heterogeneity across states. These conclusions are in line with Agrawal's (2016) findings based on the NSSO's employment and unemployment survey data, which reveal that occupational segregation for both males and females is higher in the urban areas than in the rural areas, with females appearing more segregated than their male counterparts in both settings. Another analysis (Das et al., 2023) based on two rounds of the NSSO data also found a rise in gender-based occupational segregation both at the national level and across most Indian states. Decomposition results further suggest that approximately 30 percent of the segregation observed in the 61st round and 22 percent in the 68th round can be attributed to unexplained factors (ibid.). Although an all-India study by Chattopadhyay et al. (2013) recorded a decrease in segregation from 0.59 in 1989-90 to 0.51 in 2000-01, most of this decline was caused by the shifts in industrial structure, while the direct redistribution of workers contributed only slightly to this change. Gender-based occupational segregation, however, is not unique to India nor is it confined to developing countries. It persists across the world and has also been examined in cross-regional comparative contexts. Although occupational segregation remains a significant concern within the South Asian context, its global magnitude is mitigated by the relatively lower level of segregation in rural areas. A study by Anker et al. (2003), which employed the dissimilarity index to analyse the levels of segregation, showed segregation tends to be lower in Asia especially compared with the Middle East, where the highest level of segregation is found.

Further, we have estimated log-log fixed-effects models and, to address endogeneity, 2SLS models with exogenous instruments (i.e. rainfall). Diagnostic tests (Durbin-Wu-Hausman) support the validity of the instrumentation. The resulting elasticities indicate that literacy is strongly and positively associated with segregation, consistent with education expanding along gender-typed tracks (e.g., women in socially sanctioned services and men in technical/managerial roles). Overall, the role of education in reducing occupational gender segregation is rather ambiguous. Borrowman and Klasen (2020), who analysed 69 developing countries using conducted from 1980 and 2011, concluded that higher levels of education lead to greater, rather than reduced, occupational segregation. Similarly, Agrawal (2020) found that, in urban India, education has an "enhancing effect" on occupational segregation. Khan et al. (2023) also confirm that higher education does not contribute to diminishing occupational segregation in the labour market, as both men and women with higher educational attainment tend to exhibit greater occupational segregation than those with lower levels of education. In other developing countries a similar pattern has been observed, where education segregation has reduced, this has not been followed by a reduction in occupational segregation. Using the adjusted version of the Duncan and Duncan dissimilarity index, Sookram & Strobl (2009) find that occupational segregation remained unchanged despite the significant drop in educational segregation in Trinidad and Tobago during 1991-2004.

Fertility increases occupational segregation—especially in rural India—while higher life expectancy generally reduces it. This finding aligns with the work of Preston (1974), who documented that fertility acts as a trigger, generating and deepening societal hierarchies. In the U.S. context, Preston highlighted how differential fertility across social classes shapes long-term occupational stratification: when lower-status groups have higher fertility than upper-status groups, the future labour force composition shifts toward lower occupational strata, reinforcing economic inequality and reducing upward mobility. Beyond these demographic factors, our analysis also shows that inequality (measured by the Gini coefficient) is a robust and economically meaningful driver of segregation, whereas better governance only modestly lowers it.

Structural change has an asymmetric effect: a higher agriculture/non-agriculture ratio increases urban segregation in the fixed-effects models, but the relationship turns negative in the rural instrumental variable models. This implies that economic diversification reduces segregation only when women can access new opportunities. Finally, dynamic Arellano–Bond models show that segregation widens rural gender wage gaps, with a statistically weaker urban effect. Inequality amplifies wage gaps in both rural and urban areas. Higher urban income correlates with larger urban wage gaps, while higher work participation narrows gaps in cities but widens them in rural areas—a finding consistent with women crowding into low-return work. Duraisamy and Duraisamy's (2014) decomposition results reveal that occupational and sectoral segregation explain a large share of the gender wage differential. Merfeld (2021) further finds that rural sectorial segregation is indeed the main driver of wage gaps between men and women in societies where agricultural and informal employment prevail. In addition, he notes that the overall sectoral wage gaps for females are approximately 17 percent, while wage gaps for males are absent (ibid.). However, it is not just the wage gap and potential earning loss that arise from occupational segregation. There is also a macroeconomic loss. For instance, Das et al. (2023) calculated that gender-based segregation led to the lowering of India's GDP by 11 percent in 2004-2005.

Taken together, four messages emerge. First, India's labour markets remain durably gender-segregated, with within-occupation segregation doing much of the work; national aggregates understate sharp state-level divergence. Second, literacy gains without commensurate shifts in labour demand have reinforced gender-typed sorting; education is necessary but not sufficient. Third, inequality and demographic constraints (especially fertility in rural areas) materially raise segregation, while better governance nudges it down. Fourth, segregation translates into wider rural gender wage gaps, confirming that barriers in occupational assignment carry tangible earnings penalties. Policy should therefore pair human-capital investments with demand-side reforms: equal-opportunity enforcement and audits in public procurement and large firms; sector-specific hiring targets; childcare, safe transport, and housing near job clusters; and place-based skilling tied to local demand in manufacturing and modern services. In particular, reducing occupational segregation and income inequality is central to narrowing gender wage gaps, especially outside cities. Reducing gendered segregation in employment and improving institutional quality are complementary, but they are insufficient on their own. Given that even some progressive socio-economic indicators and structural changes are associated with higher segregation, we argue that without intentional, state-specific policies designed to integrate women into high-productivity sectors, occupational segregation—and the wage penalty it causes—will persist.

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APPENDIX

Table A1. Gender Segregation in Occupational Distribution of Workers in India, 1983– 2021

Occupation	1983	1987	1993	1999	2004	2007	2011	2017	2021	Remarks
Female Workers										
Legislators, Senior Officials and Managers	0.5	0.9	1.12	1.58	1.67	1.7	3.69	4.65	3.99	Increased
Professionals	0.87	1.45	1.11	1.37	1.63	2.68	3.14	4.69	5.92	Increased
Technicians and Associate Professionals	1.2	1.54	1.59	2.0	2.17	2.4	3.36	5.93	1.63	Increased
Clerks	0.39	0.73	0.69	0.75	0.77	0.84	1.2	1.52	1.5	Increased
Service Workers and Shop and Market sales Workers	2.99	3.5	3.25	3.84	4.34	3.68	4.37	6.82	6.72	Increased
Skilled agricultural and fishery workers	51.09	46.34	46.7	43.81	48.42	44.37	40.04	36.4	47.48	Stagnated
Craft and related trades workers	7.34	8.78	7.89	7.67	9.05	7.06	11.9	9.14	7.05	Stagnated
Plant and machine operators and assemblers	1.5	2.27	1.65	1.86	1.89	0.72	1.01	0.85	0.9	Decreased
Elementary occupations	34.13	34.49	36.01	37.13	30.04	36.56	31.3	30.0	24.8	Decreased
Male Workers										

Legislators, Senior Officials and Managers	1.59	1.97	2.45	3.67	4.2	4.56	7.95	8.19	8.51	Increased
Professionals	1.89	1.74	2.14	2.23	2.31	4.56	3.71	3.89	4.63	Increased
Technicians and Associate Professionals	2.79	2.41	2.85	3.05	2.97	2.77	3.02	3.38	2.38	Decreased
Clerks	2.23	2.15	2.15	2.17	1.91	2.24	2.15	2.09	2.17	Stagnated
Service Workers and Shop and Market sales Workers	8.17	8.94	9.28	9.73	10.53	8.69	8.52	9.85	11.16	Increased
Skilled agricultural and fishery workers	41.09	38.99	37.0	32.99	33.54	31.58	28.69	29.55	30.3	Decreased
Craft and related trades workers	10.83	11.08	11.51	12.39	14.12	10.95	13.4	12.61	10.86	Stagnated
Plant and machine operators and assemblers	3.63	3.79	4.11	4.66	5.26	4.99	6.03	7.24	7.29	Increased
Elementary occupations	27.77	28.93	28.51	29.11	25.17	29.67	26.51	23.14	22.69	Decreased
Total Workers										
Legislators, Senior Officials and Managers	1.21	1.7	2.01	3.01	3.36	3.7	6.77	7.37	7.17	Increased
Professionals	1.54	1.67	1.8	1.96	2.09	4.0	3.55	4.08	5.02	Increased
Technicians and Associate Professionals	2.24	2.19	2.43	2.72	2.71	2.66	3.12	3.97	2.16	Stagnated
Clerks	1.6	1.8	1.67	1.72	1.53	1.81	1.89	1.96	1.97	Increased
Service Workers and Shop and Market sales Workers	6.39	7.58	7.3	7.87	8.47	7.18	7.37	9.15	9.84	Increased
Skilled agricultural and fishery workers	44.52	40.83	40.19	36.4	38.49	35.43	31.83	31.14	35.42	Decreased
Craft and related trades workers	9.63	10.5	10.32	10.9	12.43	9.78	12.99	11.81	9.72	Stagnated
Plant and machine operators and assemblers	2.9	3.41	3.3	3.77	4.13	3.7	4.65	5.75	5.39	Increased
Elementary occupations	29.95	30.32	30.98	31.63	26.79	31.74	27.84	24.73	23.32	Decreased

Source: Authors estimation from Employment and Unemployment Surveys (1983 to 2011) and Periodic Labour Force Survey (PLFS, 2017 to 2021)

Table A2. Trends in Gender Segregation of Employment in India by Place of Residence, 1983 to 2021

	Dissimilarity index			Total sample (Rural and Urban)
Year	All India	Rural	Urban	
1983	0.2239	0.179	0.4406	251354
1987	0.2367	0.196	0.4472	223993
1993	0.2521	0.1893	0.4409	225144
1999	0.2787	0.2026	0.427	225033
2004	0.3004	0.2142	0.4494	243554
2005	0.2957	0.223	0.46	146052
2007	0.2985	0.2144	0.4565	223487
2009	0.2924	0.2141	0.4346	172134
2011	0.3001	0.2215	0.4233	171668
2017	0.3276	0.2873	0.423	150018
2018	0.3338	0.2849	0.4293	148823
2019	0.3319	0.2789	0.4169	157487
2020	0.35	0.2917	0.4295	161904
2021	0.3522	0.3114	0.3933	168917

Table A3. Trends in Gender Segregation of Employment in India by Place of Residence across States of India, 1983 to 2021

Total	1980-85	1985-90	1990-95	1995-00	2000-05	2005-10	2010-15	2015-20
Andhra Pradesh	0.22	0.22	0.25	0.25	0.29	0.29	0.35	0.35
Assam	0.22	0.22	0.24	0.24	0.26	0.26	0.29	0.29
Bihar	0.17	0.17	0.22	0.22	0.25	0.25	0.35	0.35
Gujarat	0.31	0.31	0.35	0.35	0.36	0.36	0.35	0.35
Haryana	0.37	0.37	0.54	0.54	0.64	0.64	0.56	0.56
Jharkhand					0.33	0.33	0.43	0.43
Karnataka	0.26	0.26	0.23	0.23	0.28	0.28	0.31	0.31
Kerala	0.43	0.43	0.44	0.44	0.49	0.49	0.46	0.46
Madhya Pradesh	0.21	0.21	0.19	0.19	0.23	0.23	0.23	0.23
Odisha	0.14	0.14	0.16	0.16	0.21	0.21	0.26	0.26
Punjab	0.70	0.70	0.75	0.75	0.78	0.78	0.72	0.72
Rajasthan	0.24	0.24	0.33	0.33	0.39	0.39	0.35	0.35
Tamil Nadu	0.28	0.28	0.32	0.32	0.33	0.33	0.36	0.36
Uttar Pradesh	0.23	0.23	0.23	0.23	0.31	0.31	0.41	0.41
West Bengal	0.42	0.42	0.32	0.32	0.38	0.38	0.43	0.43
Rural								
Andhra Pradesh	0.17	0.17	0.16	0.16	0.21	0.21	0.24	0.24
Assam	0.18	0.18	0.20	0.20	0.23	0.23	0.26	0.26
Bihar	0.14	0.14	0.20	0.20	0.24	0.24	0.35	0.35
Gujarat	0.17	0.17	0.22	0.22	0.27	0.27	0.26	0.26
Haryana	0.35	0.35	0.52	0.52	0.65	0.65	0.55	0.55
Jharkhand					0.28	0.28	0.37	0.37
Karnataka	0.20	0.20	0.19	0.19	0.17	0.17	0.25	0.25
Kerala	0.42	0.42	0.44	0.44	0.48	0.48	0.46	0.46
Madhya Pradesh	0.10	0.10	0.09	0.09	0.13	0.13	0.15	0.15
Odisha	0.13	0.13	0.12	0.12	0.16	0.16	0.21	0.21
Punjab	0.72	0.72	0.79	0.79	0.83	0.83	0.77	0.77
Rajasthan	0.15	0.15	0.25	0.25	0.31	0.31	0.29	0.29
Tamil Nadu	0.20	0.20	0.23	0.23	0.24	0.24	0.30	0.30
Uttar Pradesh	0.22	0.22	0.16	0.16	0.26	0.26	0.39	0.39
West Bengal	0.43	0.43	0.32	0.32	0.35	0.35	0.43	0.43
Urban								
Andhra Pradesh	0.46	0.46	0.46	0.46	0.50	0.50	0.50	0.50
Assam	0.65	0.65	0.61	0.61	0.57	0.57	0.54	0.54
Bihar	0.39	0.39	0.45	0.45	0.57	0.57	0.45	0.45
Gujarat	0.47	0.47	0.50	0.50	0.53	0.53	0.49	0.49
Haryana	0.60	0.60	0.62	0.62	0.63	0.63	0.65	0.65
Jharkhand					0.58	0.58	0.51	0.51
Karnataka	0.48	0.48	0.44	0.44	0.46	0.46	0.46	0.46
Kerala	0.53	0.53	0.52	0.52	0.56	0.56	0.50	0.50
Madhya Pradesh	0.43	0.43	0.46	0.46	0.49	0.49	0.43	0.43
Odisha	0.48	0.48	0.51	0.51	0.51	0.51	0.46	0.46
Punjab	0.64	0.64	0.62	0.62	0.64	0.64	0.63	0.63
Rajasthan	0.56	0.56	0.56	0.56	0.62	0.62	0.53	0.53
Tamil Nadu	0.47	0.47	0.47	0.47	0.44	0.44	0.44	0.44
Uttar Pradesh	0.48	0.48	0.53	0.53	0.56	0.56	0.52	0.52
West Bengal	0.56	0.56	0.52	0.52	0.59	0.59	0.52	0.52

2.3. What are the Odds? Understanding the Probability of Women Joining the Labour Market in South Asia

The third paper was submitted to the Journal of Development Policy and Practice. Single-authored. The acknowledgement receipt 01.09.2025.

Abstract: The significant rise in women's educational attainment in South Asia was anticipated to increase women's participation in the labour market, but female employment failed to improve and at times even fell. The objective of the present research is to assess the probability of women joining the labour market in the three most populated South Asian countries. Using the most recent data from the Demographic and Health Surveys for Bangladesh, India and Pakistan, logistic regression is applied to examine the effects brought about by the strongest drivers of female employment such as women's education, their partners' education and household wealth. Separate models are run to calculate the odds ratio for female age groups 30-34, 35-39, 40-44 and 45-49. Logistic regression results reveal a J-shaped pattern of female employment by level of education. Neither a woman's partner's education nor household wealth has a positive effect on that woman's employment. The higher the education of a woman's partner and the larger the household wealth, the lower the odds of that woman being in employment. Higher education among women is determined to be the only driver that realistically improves the odds of female employment.

What Are the Odds? Understanding the Probability of Women Joining the Labour Market in South Asia

ABSTRACT

The significant rise in women's educational attainment in South Asia was anticipated to increase women's participation in the labour market, but female employment failed to improve and at times even fell. The objective of the present research is to assess the probability of women joining the labour market in the three most populated South Asian countries. Using the most recent data from the Demographic and Health Surveys for Bangladesh, India and Pakistan, logistic regression is applied to examine the effects brought about by the strongest drivers of female employment such as women's education, their partners' education and household wealth. Separate models are run to calculate the odds ratio for female age groups 30-34, 35-39, 40-44 and 45-49. Logistic regression results reveal a J-shaped pattern of female employment by level of education. Neither a woman's partner's education nor household wealth has a positive effect on that woman's employment. The higher the education of a woman's partner and the larger the household wealth, the lower the odds of that woman being in employment. Higher education among women is determined to be the only driver that realistically improves the odds of female employment.

Keywords: South Asia; gender; employment; education; development.

INTRODUCTION

Due to its growing population, South Asia is set to become one of the most significant regions for labour force in the world. In 2023, the total labour force in South Asia amounted to 776,968,229 people, of which female labour made up as little as 28.4 percent (World Bank, 2024). The region of South Asia has consistently retained one of the lowest percentages of female labour force participation over the past 30 years and has maintained that share at a relatively constant level despite the region's substantial economic growth. This phenomenon is especially compelling because of the significant increase in female education across the region, a factor that was widely expected to translate into a surge in women's employment, but which proved to not carry over to changes in the workforce makeup. The major factors conditioning female employment have been determined to stem from education and wealth (Lincove, 2008; Mammen and Paxson, 2000; Schultz, 2001), which are argued to have been shaped by a traditional socio-cultural environment that directs these factors and that forms the constraints to the entry of women into the labour market (Goldin, 1994; Kapsos et al., 2014; Unni, 2001). However, modernisation and improved education, including among men, stimulate the diffusion of new perceptions of gender roles, and are the anticipated drivers of an ideational change conducive to increasing women's probability of working (Pampel, 2011; Zaidi and Morgan, 2017). It is thus hypothesised that younger, more progressive cohorts of women have a higher likelihood of working and the constraints linked to social frameworks have a lesser influence on shaping women's labour market engagement. This research, therefore, aims to determine the odds of female employment in the top three countries by female population in South Asia, and that by investigating the main inherent employment determinants such as a woman's education, her partner's education, and wealth, inform further inquiry into labour market analytics. It is designed to reduce the gap in the understanding of female employment deterrents and the trajectory of the inroads towards improving the gender equality in workforce. The paper is structured as follows: first, the "Background" section offers a preliminary outline of what is known about the problems of female employment in South Asia. Then, the "Data and Methods" section explains the research design, selected data and research procedure. The following "Results" section sets out the results obtained from the regression model. Lastly, the "Conclusion" section develops an interpretation and contextualisation of the study's findings.

BACKGROUND

Much light has been shed in the media on the unusual employment patterns and labour force discrepancies in South Asia. The region has been falling behind in terms of labour market balance due to its largest and most populous countries not taking advantage of the potential offered by female labour. According to World Bank estimates, Bangladesh, India and Pakistan are trailing behind even the low- and middle-income brackets both in terms of female labour force participation, which is the sum of all

working-age employed and unemployed (seeking employment) women, as well as in terms of the female employment-to-population ratio, which is the sum of all working-age employed women.

Table 1. Female employment estimates for 2023, in percent

Country	Female labour force participation	Female employment to population ratio
Bangladesh	**47**	**42**
India	**34**	**30**
Pakistan	**26**	**22**
Low income	56	52
Low and middle income	52	45
Lower middle income	43	38
Middle income	51	45
Upper middle income	61	51

Source: Author's calculation based on ILOSTAT data https://ilostat.ilo.org/data

This attention has prompted scientists to revisit the culture-specific tendencies that have historically been linked to the style of labour market engagement in the region. The available research is in agreement that the sluggish female employment activity as well as the inadequate response of the female labour to economic transformation could be approached from a socio-cultural explanatory standpoint, whereby cultural norms are hypothesised as lying at the core of both women's inability and unwillingness to join the labour market (Agarwal, 2001; Jayachandran, 2021; Heintz et al., 2018). This standpoint centres on the traditional gender value system that is fundamentally built on the idea of women's main occupation revolving around family, household and children. In South Asia, this is all the more pronounced as women are seen as caregivers first and foremost, and as 'belonging in the home' (Fletcher et al., 2018). Family responsibilities have been reported to be chief deterrents in career-related decision-making among female workers, with their responsibilities towards family being a key hindrance to their ability to advance professionally (Buddhapriya, 2009). An attempt to put career ahead of family is likely to lead to social disapproval and rejection as well as to increasing pressure to conform to societal norms (ibid.). In addition, women's reproductive behaviour also comes under the influence of community and culture. Because society views reproduction as the alpha and omega of women's existence, their social value is intrinsic to their capacity to bear children (UNFPA, 2013b). This means that there is implicit social pressure from families on newlyweds to prove fertility (Scott et al., 2021), which leaves less room for a woman to begin or continue to work, and could eventually divert a woman's motivation away from exploring career options altogether.

With some exceptions to be found in the Buddhist-dominated regions (Yeung et al., 2018), the family structure is largely patrilocal and patriarchal across all of South Asia. This further implies that pressure on family-related arrangements is grounded in sex-biased inheritance norms and expectations as to the intergenerational transfer of wealth. This leads to parents benefitting most from sons and little from daughters, because daughters move away from their natal families upon marriage and the burden of old-age support falls on the sons (Mercer-Blackman et al., 2022). This, from an economic vantage point, strongly incentivises investment in sons while simultaneously reducing the value of daughters and, by extension, of their future career aspirations (Das Gupta et al., 2003). Sudarshan and Bhattacharya (2009) also stress the operation of the social contract, whereby women play a crucial role in maintaining kinship ties, which fuels the lack of independence in decisions about work. All these arrangements shape the gender dynamic from a woman's birth and on throughout her life, leaving limited room for truly free and unhindered employment decision-making.

Nevertheless, the governments of Bangladesh, India and Pakistan have begun to foster many initiatives to stimulate investment in female human capital. The rationale behind such initiatives does not lie merely in these governments' ambition to advance gender equality, but also in the reasonable expectation of an economic benefit that would accompany the engagement of more women in the workforce. That, however, undoubtedly requires the provision of better education to women to increase their value as workers. As a result, female education has been on the rise and at an all-time high across all education levels and throughout all of South Asia. In Bangladesh, net enrolment among girls reached 98.1% in primary schools and 53.9% in secondary schools in 2018, while the dropout percentage among girls decreased significantly, falling from 45.1% to 18.6% in primary education and from 64.3% to 40.1% in secondary education between 2009 and 2018 (Bangladesh Bureau of Statistics, 2020). In India, net enrolment among girls reached 90% in primary schools and 48% in secondary schools in the 2021-2022 period (Ministry of Education, 2023). As for Pakistan, net primary school enrolment in girls rose from 58.1% to 71.4%, while secondary school enrolment surged from 27.6% to 40.6% in the period from 2006 to 2016 (CEIC, 2016). Much evidence suggests that women's education tends to have a positive impact on female employment in developing countries (Psacharopoulos and Tzannatos, 1989). Moreover, female education is argued to also be instrumental in various social change aspects that eventually lead to greater female employment. That is because better education stimulates greater independence in decision-making as well as reduces a woman's dependence on her husband (Murtaza, 2012). Access to wage employment is particularly important because it brings greater job stability and contribution to economic growth, among other things. Higher education among women helps to boost women's share in wage employment, especially in the non-agricultural sector (Kabeer, 2005) which is of significant importance in Bangladesh, India and Pakistan given that agriculture's share in their economies has been declining due to the rapid expansion of the industrial and services sectors, which has been particularly salient in India (Asian Development Bank, 2023; Singh and Pal, 2010; Valdes,

2013). Women's education has been found to contribute to an increase in the mobility of girls and young women in remote regions in Pakistan, which has been helpful in bridging the gaps in rural employment suffering from an undersupply of good workers remedied through the employment of now better-educated girls (Voigt and Spies, 2020). This eventually helps in cultivating social acceptance for both women's higher education and women's employment (ibid.). There is a robust and well-established body of research that attests that greater female education helps shift collective values and beliefs and is able to mould social-cultural narratives. The upsurge in women's education has, over the past decades, challenged the traditional family model founded on the dichotomy between the genders, updating it with new ideas about norms and values (Goldin and Katz, 2008; Goldscheider et al., 2015; McDonald, 2000).

However, an investigation of female employment ought not to limit itself to pure questions of women's education. It cannot be neglected that a woman's family plays an important role in her employment choices, which calls for an examination of the woman's life partner's education and of how it impinges on her career choices. The importance of inspecting the influence of a partner's education lies in the need to understand a family's perception of gender and its permissiveness towards autonomous female behaviours such as employment. There remains limited research dedicated to investigating all the different dimensions in which a partner's education can constitute a variable in a woman's employment choices. The husband's education, which is often used in combination with household income, has not been subject to sufficient scholarly investigation and has received limited interest because of its proximity to wealth indicators (Afridi et al., 2018; Tayal and Paul, 2021). An inquiry into the relationship between a partner's education and a woman's employment is crucial for mapping out a larger picture of the societal stance on the changes in gender dynamics and for assessing the trajectory of ideational change. As argued by Papps (2010), a husband's attitude towards gender roles offers a valuable measure of the preference for a particular division of labour between the members of the household and higher educational attainment among men could lead to greater acceptance of women working outside the home. However, the literature overview conducted by Das and Zumbyte (2017) reveals that women whose partners have more education are less likely to be employed, though the authors of that study do not inquire into the attitudes of men towards female employment per se. Their findings conclude that the odds of a woman being in work did not undergo any major variation over the three decades between 1983 and 2011, finding no substantial alterations in terms of the influence exerted by partner's education and asserting that a woman with a partner holding post-secondary education was three times less likely to be in employment compared with a woman whose partner had no education. Klasen and Pieters (2013) find that a partner's rising education level has contributed to a withdrawal of women from the labour market in India. In comparison, research in other regions characterised by low female employment rates such as the Middle East and North Africa, revealed that when a woman had a lower than secondary education, the more educated her partner, the less likely she

was to work (Sayre and Yousef, 2016). A male partner's higher level of education leads to higher earnings, which in turn translates into more flexibility in terms of female work choices. A male partner's higher education, similarly to a woman's education, should be expected to contribute to the diffusion of new perspectives and could encourage ideational change towards a greater acceptance of women being in the labour market, however, only limited causal inquiry has been conducted to this effect.

Within this framework, the most discussion has normally been afforded to the role of the income effect theory**,** which in the context of labour force refers to a situation where increased household income leads to a decrease in female employment. In the past 30 years, average household incomes have substantially risen across all South Asian countries, and the region is expected to continue topping the rankings as the fastest-growing emerging market and developing economy ("EMDE") region over the next two years (World Bank, 2024). The literature demonstrates that the rising levels of household income have indeed had a significant impact on the decline in the rates of women's labour force participation (ILO, 2018; Sarkar et al., 2019; Verick, 2014). The available evidence confirms that there is a negative income effect exerted by men's earnings on female employment (Pieters and Klasen, 2011). Women from wealthier families are less likely to join the labour market across South Asia, while in regions where patriarchal norms are more dominant, this income effect is expected to be more pronounced (Chatterjee et al., 2018). Rising incomes lower the need for additional income on the part of women. Therefore, families can now 'afford' to withdraw women from the labour force (Gunatilaka, 2013), which further disincentivises them from seeking employment. Furthermore, when women stay out of the labour market, it is recognised as a marker of a household's social status, thus signalling to society that a family fares well enough to not feel the need to involve their women in professional activity. Female employment tends to epitomise lower social status and could therefore be heavily stigmatised whilst a household's upward social mobility is associated with employment activity in men coupled with a simultaneous inactivity in women, who in turn substitute labour with status production activities such as children's education, family care and the like (Abraham, 2013). Although scholars argue that economic transformation, which brings about a proliferation of white-collar jobs, might prod better educated women to attempt joining the labour force (Goldin, 1994; Mammen and Paxson, 2000; Olivetti, 2013), research remains divided on the purported correlation between women's education and their workforce participation, with studies painting an uneven and contrasted picture. Some studies highlight a negative relationship between female education and their employment, particularly in South Asia (Das and Desai, 2003; Dasgupta and Goldar, 2005; Kingdon and Unni, 1997). Neff et al. (2012) find that the decline in India's rural women's labour force participation has been a mixture of the income effect and the education effect. Studies from Bangladesh show a moderate impact of female education on employment (Tanaka et al., 2020). A study from Pakistan (Andrabi et al., 2012) which samples three districts in the most populated area of the country, finds no causal link between female education and female employment. However, a single-district-level case study from Pakistan demonstrates that

participation in the labour market increased as educational attainment rose (Faridi et al., 2009). Although the literature is in agreement that improving female education can certainly benefit individuals and society, it is difficult to unequivocally establish if and how it affects labour market involvement in the South Asian context, as a paucity of macro-level studies that would cover the regional and national scopes hinders visualising how the trend plays out more widely. Understanding wealth as a variable is vital because of the work optionality and economic necessity of female employment. In the context of contemporary South Asia, it is especially nuanced given the conjunction of socio-cultural expectations with increased family wealth, which create both supply and demand discouragement towards a woman's employment. On the other hand, higher income also entails wider accessibility to a more diverse networks and variegated ways of living, which could help accept and normalise more egalitarian attitudes and practices.

DATA AND METHODS

This research utilises the Demographic and Health Surveys (DHS), which are nationally representative surveys that provide demographic data collected across 90 countries. These surveys are primarily focused on low- and middle-income countries and offer comprehensive and up-to-date household data on population and their characteristics. Because DHS uses a rigorous, multi-stage sampling methodology, the data it gathers is nationally representative and therefore reliable for examining complex relationships between variables and for generating accurate and generalisable regression results. DHS provides questionnaire models that probe into wealth, employment and education of participants, which serve as a rich source of information for this analysis.

The present study relies on data from the most recent surveys for Bangladesh, India and Pakistan - countries that have historically struggled with gender disparities, especially in the labour force and education. What makes these countries a unique case study is that their remarkable expansion in female education has failed to result in the projected labour market returns. Despite some differences in female labour absorption, for example, Bangladesh has managed to utilise a larger share of its female labour than India or Pakistan, the percentage of women in the labour market in these three countries is below the average for every low- and middle-income bracket in the world.

Since in most DHS surveys the sample is selected with an unequal probability, in order to expand the number of cases at hand, it is advisable that weights be applied to make the data more representative and accurate, to account for the non-response rate, and to get a better set of statistical findings that are generalisable to the wider population (Bell et al., 2012; Croft et al., 2023; Groves et al., 2009). Therefore, all the analyses have been weighted.

This study focuses on all adult women aged 30 to 49 who were interviewed within the survey. Table 2. shows the number of women included in the study by country (disaggregated by women's level of education).

Table 2. Women included in the study

Country	Survey year	Women's education level	N weighted
Bangladesh	2017-2018	No education	2567
		Primary	3669
		Secondary	2944
		Higher	899
India	2019-2021	No education	23203
		Primary	8631
		Secondary	21218
		Higher	5075
Pakistan	2017-2018	No education	3532
		Primary	1112
		Secondary	1303
		Higher	916

Source: Author's own calculations using the DHS data.

This study investigates the relationship between female employment by taking into account the woman's own education, her partner's education and household wealth. Its aim is to understand how each of these influences a woman's employment and analyse how that influence plays out in different age groups.

Explanatory variables

Women's Age Groups

In DHS, women's age groups are categorised in 5-year intervals and range from 15 to 49. For the purpose of this research, the following age groups are used: 30-34, 35-39, 40-44 and 45-49. Women in these age groups have had enough time to complete their education and establish a career, which makes them representative of the core workforce and thus allows for more representative results. This is also consistent with recent studies that highlight the delay among the graduates in the entry into the labour force and securing stable positions (Aina and Casalone, 2020; Wachter, 2020).

The Woman's Education

Information on women's education level is collected by asking women about the highest level of schooling they have attended and is reported as "the highest level of education attended" (but not necessarily completed) in the following categories – "no education", "primary education", "secondary education", "higher-than-secondary education" (in this paper it refers to as "higher education") and is

inclusive of university level education. The analysis excludes women whose response to education was "do not know". The categories correspond with the education categories for the women's partners.

The Partner's Education

DHS collects the women's partners' education by asking women about their partners' levels of education. The partner's education is defined as the highest level of education attended (but not necessarily completed) in the following categories – "no education", "primary education", "secondary education", "higher-than-secondary education" (in this paper it refers to just "higher education") and is inclusive of university level education. The analysis excludes the responses "do not know" since the aim is to accurately determine the level of education of a woman's partner and its effect on that woman's employment.

The Wealth Index

The Wealth Index (WI) is a composite measure of a household's cumulative living standard and is calculated using data on a household's ownership of selected assets (such as cars, television sets etc.) and a household's characteristics (such as building materials etc.), access to utilities (such as electricity, water etc.) and sanitation facilities (DHS n.d.). The DHS data separate all surveyed households into five wealth quintiles – "lowest", "second", "middle", "fourth", and "highest", which are referred to in this study as "wealth index poorest" (first), "wealth index poorer" (second), "wealth index middle" (middle), "wealth index richer" (fourth) and "wealth index richest" (highest). DHS does not collect direct income/salary data; therefore, the WI is the best suitable measure of economic status.

Outcome variable

Female Employment

The female employment status is registered by asking women whether they are currently working (excluding housework). This includes women who worked in the past 7 days but also those who did not work in the past 7 days but who were otherwise regularly employed (being on leave due to illness, holidays etc.). The categories for this measure are "yes" or "no".

The study utilises the employment variable and not female labour force participation (which includes unemployed individuals) for the purpose of more precise and direct insight into actual employment.

Logistic Regression Model

This paper employs a logistic regression model. This technique is considered to be one of the most widely employed models to examine the independent effect of a variable on a binomial outcome (Zhang, 2016). This relationship is computed into a predictive model which can be used to estimate not just the probability of an event occurring, but also to quantify the effect of each individual input variable's

effect, along with the measure of certainty associated with that effect. The model facilitates simplified conclusions on female employment and calculates the odds ratio vis-à-vis a woman's education, her partner's education and her household's wealth. Because of the diversity within the data, the model is run separately for each country. The logistic model employed in relation to each country is defined as:

$$\log\left(\frac{p}{1-p}\right) = \beta_{0(a:d)} + \beta_{1i(a:d)} \cdot EDU_{wi(a:d)} + \beta_{2j(a:d)} \cdot EDU_{pj(a:d)} + \beta_{3k(a:d)} \cdot WI_{k(a:d)},$$

where:

p is the probability of the event occurring. The event of interest is whether the woman in the sample was employed within the last 7 days at the time of the survey and $a:d$ are the women's age groups, where a is the age group 30-34, b is 35-39, c is 40-44 and d is 45-49.

The intercept for this model is β_0. The corresponding coefficients for the predictor variables are:

β_{i1} for the highest level of woman's education ($EDUwi$),

β_{2j} for the highest level of education of the partner ($EDUpj$),

β_3 for the wealth index (WIk).

RESULTS

Bangladesh

The odds ratios (ORs) for primary and secondary education across all age groups are close to 1, indicating that having primary and secondary education has little to no effect on the odds of a woman working. Only higher education has been found to have a positive impact on women's participation in the labour market – and that solely in two age groups: women in the age groups 35-39 and 45-49 had a 1.99 (ORs= 1.99; 95%CI; 1.32, 3.01) and a 2.46 (ORs=2.46; 95%CI; 1.34, 4.53) times higher likelihood of being employed, respectively. With regard to the women's partners' education, the outcome indicates either no effect or reductions in the odds of a woman working. This is particularly notable among women in the 45-49 age group with higher-educated partners where the partners' education shows reductions in the odds of those women working (ORs=0.47; 95%CI; 0.3, 0.73). As for wealth, a strong and consistent pattern is observed across age groups, showing that a lower wealth index is associated with a considerable reduction in the odds of a woman's employment. The odds ratios decrease as wealth increases, signifying a strong negative association between them.

Table 3. Coefficients table, Bangladesh

Variables	30-34	35-39	40-44	45-49
Intercept	3.081[2.392,3.991]***	2.72[2.149,3.461]***	3.008[2.324,3.926]***	2.209[1.728,2.841]***
Woman's education none	RC	RC	RC	RC
Woman's education primary	1.001[0.783,1.277]	0.935[0.751,1.164]	0.988[0.788,1.238]	1.099[0.878,1.378]
Woman's education secondary	0.909[0.705,1.171]	0.889[0.686,1.152]	0.938[0.692,1.272]	0.886[0.634,1.239]
Woman's education higher	1.232[0.856,1.774]	1.998[1.329,3.017]***	0.969[0.58,1.619]	2.461[1.345,4.531]**
Partner's education none	RC	RC	RC	RC
Partner's education primary	0.808[0.659,0.991]*	0.917[0.741,1.135]	0.72[0.569,0.912]**	0.797[0.626,1.015].
Partner's education secondary	0.725[0.578,0.907]**	0.852[0.665,1.094]	0.782[0.59,1.038].	0.87[0.654,1.159]
Partner's education higher	0.749[0.554,1.011].	0.774[0.54,1.107]	0.644[0.421,0.984]*	0.472[0.3,0.738]**
Wealth index poorest	RC	RC	RC	RC
Wealth index poorer	0.673[0.527,0.858]**	0.949[0.725,1.241]	1.098[0.801,1.503]	1.159[0.84,1.598]
Wealth index middle	0.475[0.373,0.604]***	0.543[0.416,0.707]***	0.609[0.447,0.828]**	0.688[0.503,0.94]*
Wealth index richer	0.405[0.317,0.516]***	0.368[0.279,0.482]***	0.417[0.304,0.571]***	0.567[0.411,0.78]***
Wealth index richest	0.194[0.149,0.253]***	0.182[0.134,0.246]***	0.279[0.198,0.391]***	0.289[0.204,0.407]***

*** p < 0.001; ** p < 0.01; * p < 0.05; Reference Category (RC)

India

Similarly to Bangladesh, the odds ratios for primary and secondary education across all age groups among women in India demonstrate no association between these levels of education and a woman's employment. Only higher education shows a positive association with a woman being in work, and that across all the women's age groups: women in the age group 30-34 had a 1.77 (ORs=1.77; 95%CI; 1.51, 2.08) times higher likelihood of being employed, women in the age group 35-39 had a 1.88 times higher likelihood of being employed (ORs=1.88; 95%CI; 1.58, 2.23), women in the age group 40-44 had a 1.98 times higher likelihood of being employed (ORs= 1.98; 95%CI; 1.63, 2.40), and women in the age group 45-49 had a 4.49 (ORs= 4.49; 95%CI; 3.55, 5.68) times higher likelihood of being employed. As for the women's partners' education, it is associated with lower odds of the woman working across all

of these age groups, with a progressively negative effect as the partner's education increases. With regard to wealth, higher wealth categories are consistently associated with lower odds of the woman working, though women in the lowest wealth quintile in the age group 35-39 appeared to be 1.21 (ORs= 1.21; 95%CI; 1.08, 1.36) times more likely to work.

Table 4. Coefficients table, India

Variables	30-34	35-39	40-44	45-49
Intercept	0.561[0.51,0.617]***	0.696[0.634,0.764]***	0.705[0.64,0.777]***	0.652[0.591,0.719]***
Woman's education none	RC	RC	RC	RC
Woman's education primary	1.077[0.961,1.206]	1.026[0.921,1.142]	0.964[0.861,1.079]	1.051[0.936,1.179]
Woman's education secondary	0.938[0.848,1.036]	1.033[0.937,1.139]	1.007[0.907,1.117]	0.847[0.753,0.953]**
Woman's education higher	1.777[1.513,2.088]***	1.885[1.586,2.239]***	1.983[1.638,2.401]***	4.493[3.557,5.688]***
Partner's education none	RC	RC	RC	RC
Partner's education primary	0.828[0.733,0.934]**	0.793[0.709,0.888]***	1[0.893,1.121]	0.995[0.891,1.111]
Partner's education secondary	0.728[0.656,0.809]***	0.618[0.56,0.683]***	0.73[0.659,0.808]***	0.773[0.696,0.858]***
Partner's education higher	0.567[0.483,0.665]***	0.414[0.351,0.486]***	0.541[0.455,0.644]***	0.358[0.29,0.44]***
Wealth index poorest	RC	RC	RC	RC
Wealth index poorer	0.991[0.885,1.11]	1.216[1.085,1.364]***	1.027[0.907,1.164]	0.912[0.803,1.036]
Wealth index middle	1.11[0.988,1.246].	1.157[1.029,1.301]*	0.99[0.874,1.121]	1.009[0.89,1.143]
Wealth index richer	0.805[0.712,0.91]***	0.849[0.751,0.96]**	0.866[0.762,0.985]*	0.748[0.655,0.853]***
Wealth index richest	0.53[0.461,0.61]***	0.614[0.534,0.705]***	0.464[0.401,0.537]***	0.451[0.386,0.526]***

*** p < 0.001; ** p < 0.01; * p < 0.05; Reference Category (RC)

Pakistan

The data for Pakistan exhibit a similar pattern to that of India, with higher education among women showing higher odds of working. Women in the age group 30-34 had a 2.92 times higher likelihood of being employed (ORs=2.92; 95%CI; 1.8, 4.75), women in the age group 35-39 had a 3.49 times higher likelihood of being employed (ORs=3.49; 95%CI; 2.18, 5.62), women in the age group 40-44 had a 3.25 times higher likelihood of being employed (ORs=3.25; 95%CI; 1.81, 5.85), and women in the age group 45-49 had a 5.59 (ORs=5.59; 95%CI; 2.7, 11.88) times higher likelihood of being employed. As for partner's education, there is either no relationship or there is a negative association, indicating that a partner's higher education reduces the odds of a woman's employment. With regard to wealth, the "poorer" and "middle" wealth quintiles show lower odds of employment, particularly in the 30-34 and 45-49 age groups. The "richer" and "richest" wealth quintiles display a strong negative association across most age groups, with the odds of a woman being in work decreasing sharply as wealth increases.

Table 5. Coefficients table, Pakistan

Variables	**30-34**	**35-39**	**40-44**	**45-49**
Intercept	0.51[0.405,0.64]***	0.377[0.292,0.483]***	0.321[0.23,0.441]***	0.595[0.434,0.809]**
Woman's education none	RC	RC	RC	RC
Woman's education primary	1.363[0.963,1.921].	1.019[0.736,1.402]	0.889[0.557,1.39]	1.318[0.801,2.129]
Woman's education secondary	1.21[0.81,1.797]	0.665[0.443,0.986]*	1.082[0.631,1.817]	1.447[0.759,2.684]
Woman's education higher	2.924[1.8,4.757]***	3.497[2.189,5.626]***	3.251[1.816,5.851]***	5.595[2.7,11.88]***
Partner's education none	RC	RC	RC	RC
Partner's education primary	0.818[0.581,1.145]	1.422[1.014,1.989]*	1.066[0.707,1.593]	0.987[0.641,1.501]
Partner's education secondary	0.501[0.365,0.685]***	1.08[0.796,1.466]	0.645[0.44,0.94]*	0.461[0.295,0.71]***
Partner's education higher	0.757[0.505,1.128]	1.014[0.675,1.513]	0.418[0.236,0.723]**	0.438[0.234,0.789]**
Wealth index poorest	RC	RC	RC	RC
Wealth index poorer	0.64[0.461,0.884]**	0.897[0.649,1.239]	0.833[0.527,1.31]	0.57[0.37,0.875]*
Wealth index middle	0.454[0.314,0.651]***	0.898[0.635,1.271]	1.125[0.728,1.744]	0.419[0.258,0.675]***
Wealth index richer	0.19[0.119,0.299]***	0.333[0.214,0.513]***	0.898[0.55,1.464]	0.397[0.231,0.674]***

Wealth index richest	0.186[0.113,0.303]***	0.173[0.102,0.29]***	0.548[0.304,0.978]*	0.288[0.148,0.547]***

*** p < 0.001; ** p < 0.01; * p < 0.05; Reference Category (RC)

CONCLUSION

Female employment carries fundamental importance in the task of defining not just a more inclusive model of societal development, but also a more sustainable and balanced path of economic development that ought to be pursued. It is evident that developing countries benefit substantially from including the female labour component in their economies (Klasen and Lamanna, 2009; Verick, 2018). At the same time, South Asia's unique case of economic growth with the absence of concomitant expansion in female employment has led to bewilderment among scholars as – unlike many other developing countries – South Asian economies did not involve much female labour in their periods of major economic shifts. The case has been particularly striking in India and has since been explained by the country's accelerated structural shift from an agrarian to a service economy (Marois et al., 2022). The question of women's employment appeared to be more nuanced in South Asia than elsewhere, and that from multiple social, cultural and economic factors. Female employment, unlike male employment, is more contingent on the surrounding societal and cultural environment which can create explicit or implicit barriers to its materialisation (Jayachandran, 2021). In particular, married women are more likely to adhere to social practices and expectations for fear of judgment and sanctions and due to their reluctance to face the consequences of pursuing careers of their own (Bussolo et al., 2022). Therefore, an analysis of older age groups is not just beneficial due to the fact that these women have had more time to conclude their education and to therefore find roles for themselves within the workforce, but also because these women are more vulnerable, suggesting that changes in their situation could serve as litmus tests for wider shifts and which can in turn aid in arriving at more robust conclusions.

The present study investigated female employment in Bangladesh, India and Pakistan for the latest available survey years. The results have shown a J-shaped pattern of female employment by level of education, with those having attained secondary education scoring lowest in terms of employment rates, and those with higher education having the highest employment rates. This trend proves consistent for the majority of age groups in all three countries. The findings suggest that, across all South Asian countries, any education lower than higher does not tangibly increase female participation in the workforce. Higher education among the female portion of society is the only driver that realistically improves the odds of working for women with the exception of age groups 30-34 and 40-44 in Bangladesh, where higher education among women appears to have no association. Though it was anticipated that younger age groups with the highest level of education would be more likely to work, it is the 40-49 age group that has the highest likelihood of working across all three countries. The possession of higher education by a woman's partner, on the other hand, decreases the probability of that woman working. In India, a clear trend indicates that the more education a woman's partner has,

the less likely she is to work. Though this pattern is less strong in Bangladesh and Pakistan, the partner's education still either decreases the odds or has no effect on female employment. As far as wealth is concerned, Bangladesh clearly exhibits a sharp decline in female employment with an increase in wealth across all age groups, whereas Pakistan and India demonstrate a similar trend with the exception of the 35-39 and 40-44 age groups within the poorer and middle-income brackets, where there is no association. The only exception is found in India, where women in the lower wealth brackets have higher odds of working, although that only holds true for the 35-39 age group.

Figure 1. Odds Ratio for Bangladesh

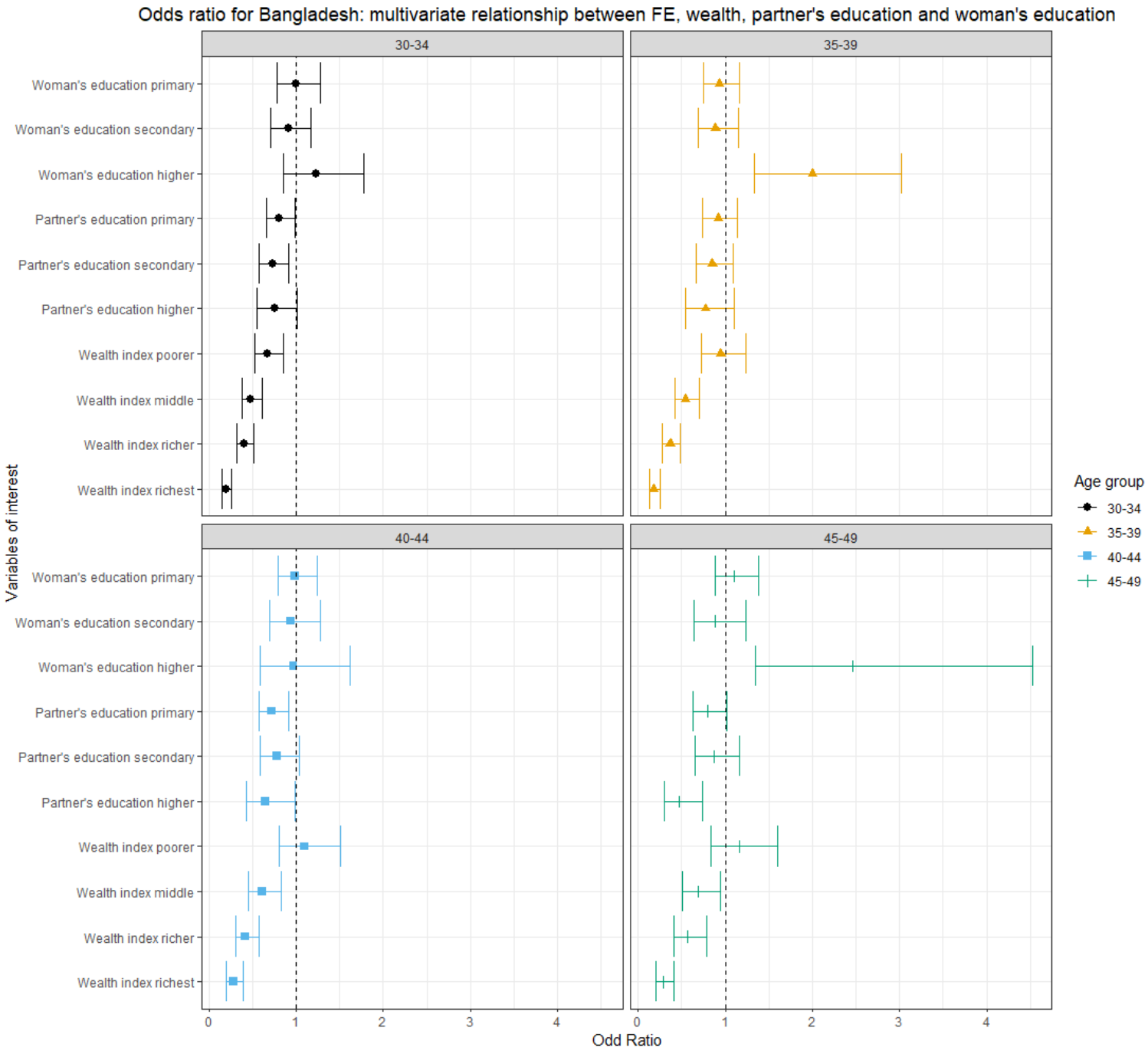


Figure 2. Odds Ratio for India

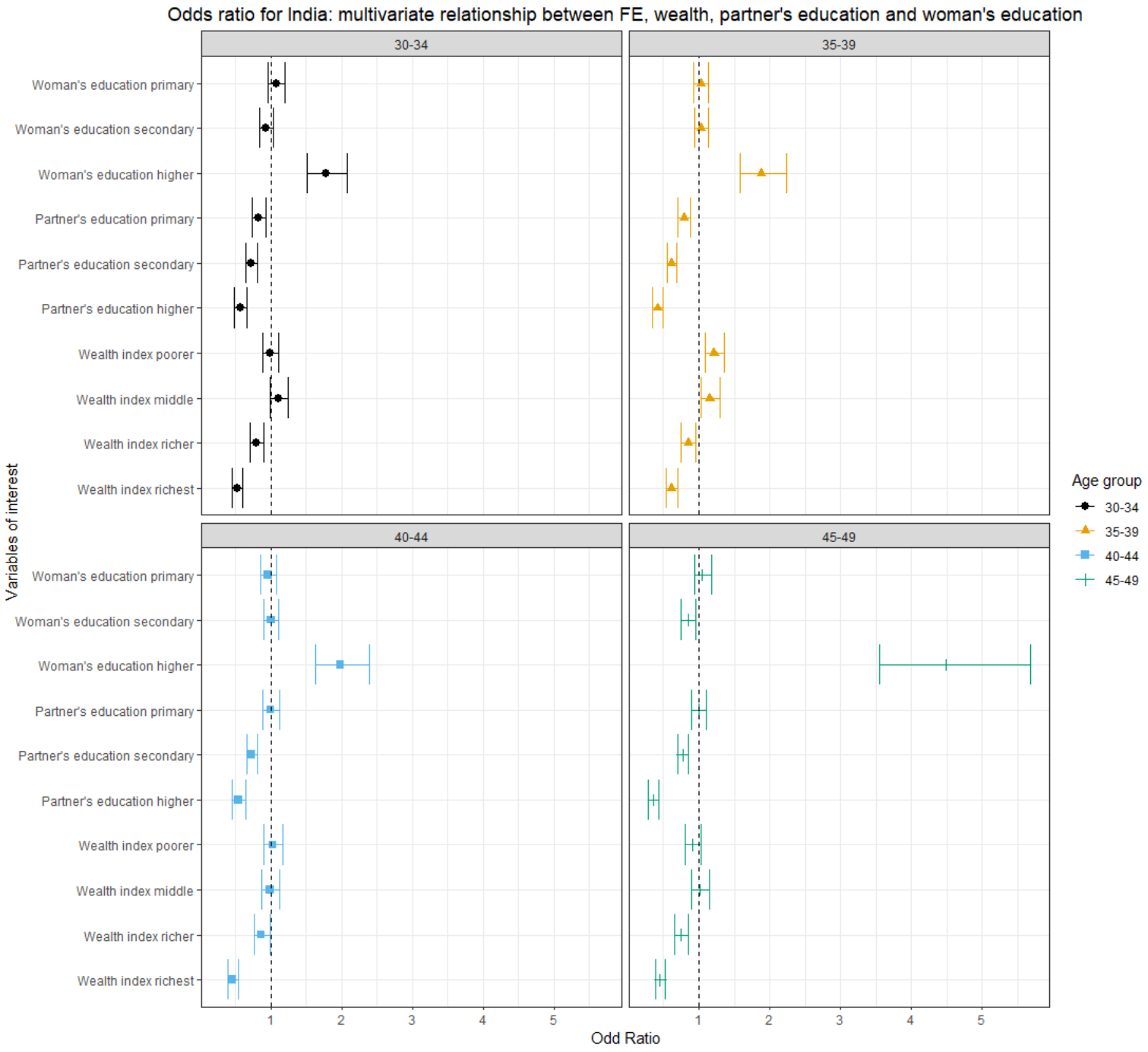
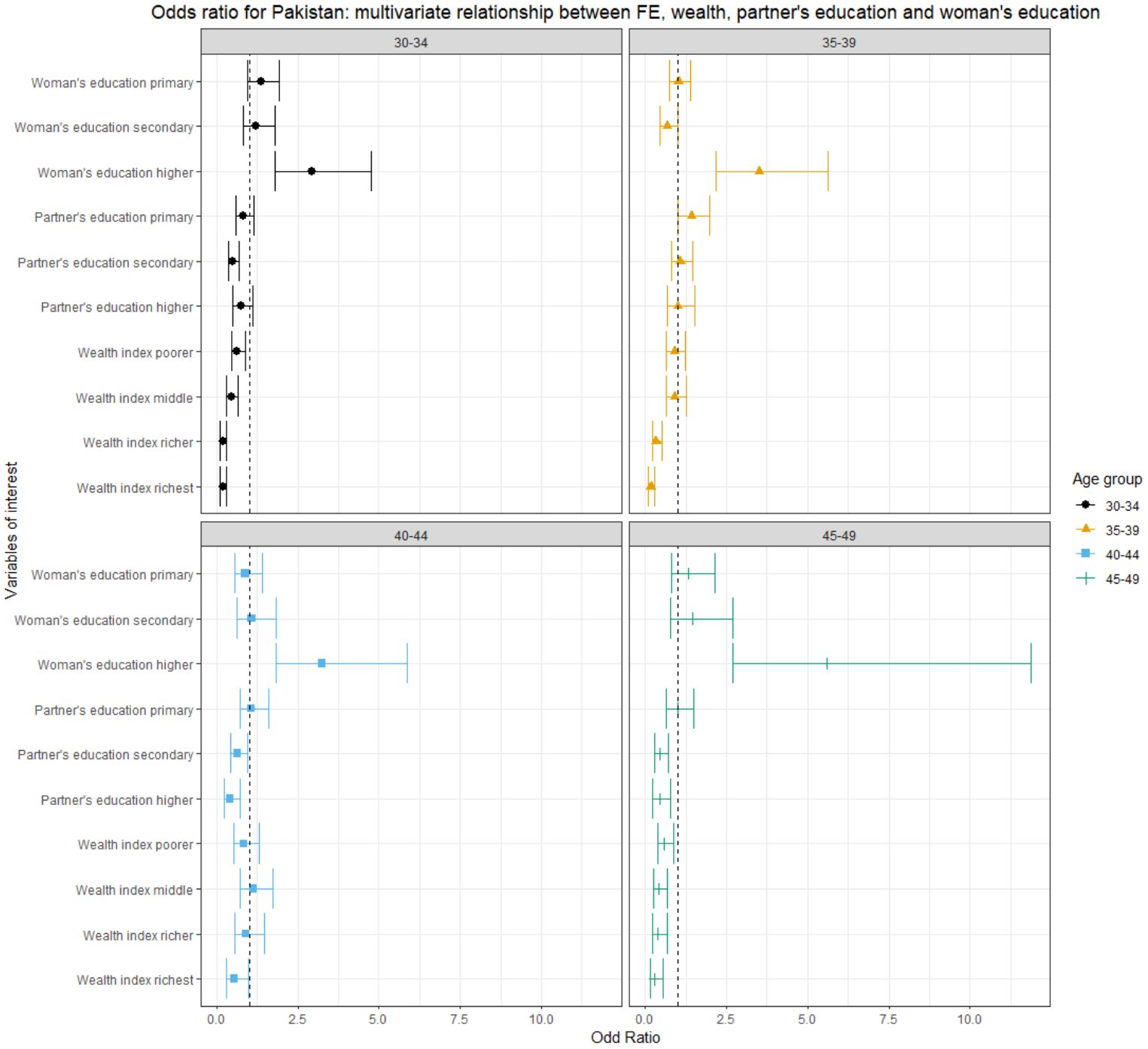


Figure 3. Odds Ratio for Pakistan



It is evident that the only parameter that actually improves the odds of a woman working is her education, yet – crucially – exclusively higher education, as even the fact of having completed secondary education has no effect on a woman's employment odds (in fact, in age group 40-49, secondary education among Indian women showed a slight decrease in terms of employment odds). It is therefore clear that with the ongoing economic transformations, the future of employment will lie less and less in sectors which require no to little education. These sectors, such as agriculture, are thus

shrinking under the pressure of modernisation and the accompanying automation work. It follows from there that, as a matter of course, the acquisition of higher levels of education will be needed to operate more advanced tools and technology. And while the rising and expanding white-collar sector could help attenuate the stigma surrounding female employment, it does not change the fact that women must be able to compete for those types of jobs on a more or less equal footing with men. Such competition promises to be fierce because, first, men continue to remain the more educated gender group overall and, second, because the societies that are here under scrutiny have still not fully come to terms with the idea of gender equity in the labour market. For these reasons, multiple barriers and glass ceilings still stand in place before women hoping to join the workforce on a par with men. It also becomes clear that wealth continues to play a leading role in causing women to withdraw from the labour market – a phenomenon that can be observed even among younger women, who are frequently viewed as theoretically more progressively-minded as it is usually among those younger age groups that ideational change is the most palpable. In any event, trite as it may appear, education once again does not fail to prove itself as the most powerful driver of change, and, in the circumstances here discussed, it is specifically female education, with its potential for decisiveness and for making a difference, that plays first fiddle in the orchestra of social development henceforth.

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APPENDIX

For the purpose of data sensitivity, two additional models have been run. These checks have been conducted in order to explore the sensitivity of the findings to alternative specifications. First, I reran the model using variables for the woman's education and the partner's education. Second, I reran the model using the variables for the woman's education and the wealth index. None of these brought any noticeable change to the results. The results of the additional sensitivity analyses are available upon request.

Table 6. Coefficients table for the first sensitivity check, India

Variables	30-34	35-39	40-44	45-49
Intercept	0.559[0.516,0.606]***	0.739[0.688,0.794]***	0.687[0.641,0.737]***	0.599[0.562,0.64]***
Woman's education none	RC	RC	RC	RC
Woman's education primary	1.054[0.943,1.178]	0.992[0.892,1.102]	0.893[0.799,0.996]*	0.972[0.867,1.088]
Woman's education secondary	0.817[0.745,0.897]***	0.899[0.82,0.985]*	0.83[0.753,0.915]***	0.671[0.601,0.749]***
Woman's education higher	1.267[1.093,1.468]**	1.341[1.144,1.571]***	1.312[1.097,1.568]**	2.899[2.328,3.618]***
Partner's education none	RC	RC	RC	RC
Partner's education primary	0.828[0.734,0.934]**	0.797[0.713,0.891]***	0.977[0.873,1.093]	0.954[0.855,1.064]
Partner's education secondary	0.69[0.622,0.765]***	0.587[0.532,0.646]***	0.654[0.592,0.722]***	0.686[0.62,0.76]***
Partner's education higher	0.473[0.405,0.553]***	0.358[0.305,0.419]***	0.435[0.367,0.515]***	0.283[0.23,0.346]***

*** p < 0.001; ** p < 0.01; * p < 0.05; Reference Category (RC)

Table 7. Coefficients table for the second sensitivity check, India

Variables	30-34	35-39	40-44	45-49
Intercept	0.495[0.455,0.538]***	0.595[0.547,0.647]***	0.66[0.603,0.722]***	0.621[0.566,0.681]***
Woman's education none	RC	RC	RC	RC
Woman's education primary	1.012[0.906,1.129]	0.928[0.836,1.03]	0.912[0.817,1.018]	0.996[0.89,1.113]
Woman's education secondary	0.826[0.753,0.906]***	0.836[0.765,0.915]***	0.863[0.783,0.95]**	0.722[0.647,0.806]***
Woman's education higher	1.382[1.198,1.593]***	1.238[1.064,1.439]**	1.429[1.21,1.687]***	2.408[1.984,2.92]***
Wealth index the poorest	RC	RC	RC	RC
Wealth index poorer	0.963[0.861,1.078]	1.141[1.019,1.277]*	1[0.884,1.132]	0.897[0.79,1.019].
Wealth index middle	1.049[0.936,1.176]	1.07[0.954,1.201]	0.942[0.833,1.065]	0.979[0.865,1.108]

Wealth index richer	0.749[0.664,0.845]***	0.764[0.678,0.862]***	0.808[0.712,0.916]***	0.697[0.612,0.794]***
Wealth index richest	0.473[0.413,0.542]***	0.514[0.449,0.589]***	0.407[0.353,0.468]***	0.384[0.33,0.447]***

*** p < 0.001; ** p < 0.01; * p < 0.05; Reference Category (RC)

3. Conclusion

3.1.Main findings

The present doctoral work has aimed for a better understanding of female employment and of its contribution to the demographic dividend in South Asia. It has attempted to shed light on the unusual course of low participation of women in the labour market in light of accelerated female educational attainment, and to offer insight into the drivers of change in female employment. It has also presented comprehensive and first-of-its-kind labour force projections for the most populous country in the world – India – with an attempt to present a realistic situation of the different demographic scenarios, which have the potential to inform more robust and better-tailored blueprints for harnessing the demographic dividend. The preceding three publications have supplied answers to the research questions formulated in the introductory part, with the following paragraphs providing a comprehensive summary of those answers.

The first publication (co-authored with Dr. Guillaume Marois and Balhasan Ali) presents a labour force projection up to the year 2060 for all the regions of India and assesses the impact of female labour force participation and its implications on the potential demographic dividend. A survey of the projected Constant Rates Scenario, which aims to project the future based on the assumption of unchanging demographic trends and rates of participation by age, sex, education and region, reveals the following.

The total population of India is expected to increase by just over 25% from 2020 to 2060. This increase will first appear primarily among its working-age segments, before making a shift to the elderly population, which is projected to multiply by 4 over the same timespan. The age dependency ratio (ADR) will for many years remain close to 0.5, before beginning to slowly rise in 2050, eventually reaching 0.6 in 2060. This will result in population aging in India, stemming from the final stages of the demographic transition. It is precisely within that timeframe that the nation stands to profit the most from its demographic dividend.

However, the projected outcomes by labour force status reveal are not as promising as might have been expected. The labour force dependency ratio (LFDR) is much higher than ADR in 2020 (1.7 vs 0.5), which translates into the number of non-workers being 70% higher than the number of workers, while the ADR displays much higher numbers of people in the working-age group than outside of it. The reason for that lies in the fact that a large part of the potential workers, particularly women, are not engaged in the labour market. It is expected that

approximately 63% of the projected population growth will be found in the inactive population segment shifting from 798 million in 2020 to 1.1 billion in 2060, while the workforce is anticipated to increase from 415 million to 617 million. As a result, the trend of the future LFDR is similar to that observed in ADR, with insignificant variation until 2060. The LFDR is not anticipated to reach advantageous levels, remaining above 1.65 throughout the timeframe of interest.

A scrutiny of the impact made by the higher labour force participation of women on the age dependency ratio permits to conclude that trends change significantly when an increase in the labour force participation rates of women is assumed. In the scenario where female labour force participation aligns with the levels observed in Goa (referred to as the Best Region scenario), the LFDR is projected to decrease by 10% from 2020 to 2035, effectively preventing any substantial increase throughout the remaining estimated period. By 2060, this scenario is expected to result in a labour force that is approximately 15% larger than that in the Constant Rates Scenario, leading to a 20% reduction in LFDR. However, a significant gender imbalance is anticipated to persist even under this scenario.

A different projection – the Equality Scenario – assumes that gender equality in labour force participation will be reached by 2060, by which point it is predicted that the labour market will be filled with professionally active women. Thus, if the Equality Scenario is assumed, India's total labour force is expected to grow, becoming 60% larger than in the Constant Rates Scenario and nearly double the size observed in 2020. This expansion would result from integrating a large share of non-working women into the labour market. Consequently, the LFDR would decrease to 40% of the level projected in the Constant Rates Scenario and, by 2045, it could fall to 50% of the 2020 figure. The findings reveal that, at the national level, this is the only scenario predicting the surpassing of the inactive part of the population by the active one by 2060, with an LFDR of 0.79 inactive individuals per active person – compared with 1.51 in the Best Region scenario and 1.87 in the Constant Rates Scenario. In both alternative scenarios, the regions that had the lowest female labour force participation rates in 2020 also experienced the most significant increases in labour force size and the greatest reduction in LFDR compared to the Constant Rates Scenario.

The paper attests that female labour force participation is a more effective stimulus to the labour force dependency ratio than age composition, which places FLFP as a condition *sine qua non* for a country's expectation of pocketing the demographic dividend from its age structure.

These three scenarios converge on the conclusion that India's harnessing of its demographic dividend is an unlikely feat without the inclusion of women in its labour force. The importance of having identified this relationship now lies in the ability to change the course of the future if only the appropriate measures and policies are adopted. The present study has truly cemented the legitimacy of the notion that giving weight to female labour force can be key to defying projections and reaping the demographic dividend, as well as to cementing the truthfulness of the counterproposition that the dividend will remain unfulfilled if the trends remain constant. The here presented assessment of the impact exercised by a higher female labour force participation confirms that women's labour force is instrumental to the completeness and sustainability of the work landscape, and that it thereby plays a critical role in living up to the United Nations Sustainable Development Goal No. 5 for gender equality and female empowerment (United Nations 2016).

Finally, the inclusion of labour force participation in demographic projections has proven relevant by offering a detailed overview on future population challenges that are currently gaining traction within the scientific community but also in the media. It has shown that the effects of population aging may be less severe, as the labour force could decline at a slower rate than the working-age population in aging countries due to higher labour force participation among women or a combination of rising participation rates and productivity.

The second paper (co-authored with Dr. Srinivas Goli and Dr. KS James) takes a different approach to investigating female employment and builds a long-horizon, pooled cross-sectional dataset and state–year panel of India's wage structure. It has analysed Indian workers from 1983 to 2021 and has yielded a pooled file of almost 2.7 million individuals. The findings have revealed an upward trend in gender-based occupation segregation, meaning despite remarkable economic advancement, the Indian labour market has become more, not less, segmented by gender, with women increasing concentrated in a narrower range of occupations. The Dissimilarity Index has confirmed the increase in gender segregation; the all-India index has increased from 0.22 to 0.35. This implies that more than one third of women (and men) would now need to switch occupations to reach gender-balanced distribution. As for rural-urban assessment, in rural India the index has more than doubled, pointing towards a crisis in traditional agrarian employment where women are leaving the workforce without accessing new employment opportunities. Despite urban employment remaining consistently more segregated – a feature attributed to a more assorted and specialised occupational structure – the noticeable decline in the urban index to 0.39 in 2021 provides a modest yet hopeful outlook. It

could potentially signal the start of the shift toward women entering previously men-dominated occupations, in technological sector, for example.

Furthermore, economic structure and inequality also play a crucial role. The rural and total Gini coefficients have appeared strongly positive, with elasticities around 0.26-0.32, indicating that increasing inequality reinforces occupational sorting. As for agriculture–non-agriculture ration, it is positively linked to segregation in urban India, with elasticities up to 0.19. This signifies that structural transformation intensifies segregation when women are not included in emerging high-productivity employment. On the contrary, per capita New State Domestic Product and poverty ratios have shown weak or inconsistent effecting, highlighting that growth and reduction of poverty do not eradicate segregation. As for governance coefficients, these are genitive but small, suggesting institutional quality plays only a modest role in influencing gender outcomes.

The most consistent revelation is the strong positive association between literacy and Gender Segregation Index. A one percent increase in literacy increases occupational segregation by approximately 0.9 to 1.3 percent. This result is counterintuitive and underscores that the expansion of education has actually reinforced gendered occupational sorting. Higher educated women tend to cluster in occupations that are socially accepted for their gender, such as teaching, healthcare and clerical work.

Fertility is another driver of occupational segregation. In rural setting, a one percent increase in fertility increases segregation by 0.4-0.5 percent, attesting that higher reproductive burdens restrict women to occupations with lower mobility but also offer reduced economic returns. As for life expectancy, it exerts a negative elasticity, especially in total models, indicating that improvements in health and longevity diminish gendered segregation by 0.5-0.6 percent per one percent gain in life expectancy.

Overall, the fixed-effects estimates accentuate that literacy, fertility and inequality are the dominant structural forces upholding gendered occupational segregation, while economic growth and governance afford only marginal counterweights. Robustness checks mostly confirm the fixed-effect results but sharpen the role of certain drivers. Literacy remains the strongest predictor of gendered occupational segregation – a one percent increase in literacy increases GSI by 1.1-1.8 percent in total and rural models. Economic inequality still plays a key role. The total and rural Gini coefficients produce elasticities of 0.30-0.35, demonstrating that a one percent increase in inequality increases segregation by almost a third of percent.

Unequal income distribution intensifies gender-based occupational stratification. However, structural transformation shows different results. The agriculture–non-agriculture ratio has negative association in rural setting, with elasticity -0.43. This indicated that the shift from agriculture might reduce segregation if women gain access to new professional occupations. As for urban setting, coefficients are not significant. Governance coefficients are negative and statistically significant in total and rural settings with elasticities of -0.05 and -0.13. This suggest that improvements in institutional quality might reduce occupational segregation by improving the equitability of labour markets. Per capita New State Domestic Product effects show a mixed picture but tilt negative, suggesting that growth might reduce segregation only when complemented by wider reforms. Fertility displays weaker effects though in rural setting a one percent increase in fertility still increases segregation by approximately 0.4 percent, which is in line with the limitations imposed by the burdens of caregiving and broader natal responsibilities. To sum up, the IV estimates reinforce the view that literacy, inequality and governance function as key structural drivers of gendered occupational segregation in India, whereas fertility and structural transformation have more context-specific effects.

The findings challenge conventional wisdom by revealing that educational expansion could paradoxically reinforce, rather than diminish, occupational segregation. The study has also provided robust evidence on how demographic drivers shape labour market structures, directly targeting the central focus and interests of demographic scholarship. By identifying the conditions under which segregation diminishes and the penalties it imposes, the study's framework suggests that policy should pair human capital investments with targeted measures in order to foster occupational integration and mitigate associated limitations. The proposed solutions include, but are not limited to, skill development programmes for women, investments in transportation, childcare and related facilities near employment hubs.

While the first paper emphasises how instrumental it would be for the Indian economy to strive for a greater inclusion of women in the labour market with a view to realising the demographic dividend, this paper extends the investigation of the roots and drivers of the continuous exclusion of women from the labour market. The results carry significant implication for understanding India's prospects of realising its demographic dividend. Persistent gendered occupational segregation offsets potential productivity gains from a growing working-age population by constraining female labour allocation. The gendered occupational segregation identified in the study represents a friction that reduces the efficiency of demographic capital

utilisation. Advancing women's participation across diverse, high-return occupation is therefore essential for maximising the demographic dividend.

The third paper investigates the probability of women joining the labour market in the three most populated South Asian countries – Bangladesh, India and Pakistan. It has revealed that these countries fall behind the low- and middle-income brackets in terms of female labour force participation as well as in terms of female employment-to-population ratio. It has also confirmed the increase in school enrolment rates among females, attesting that women's education is now at an all-time high across all educational levels. The regression models present an insightful breakdown of the factors influencing women's participation in the labour force. The findings for Bangladesh show that having primary and secondary education has little to no effect on the odds of a woman working and that only higher education has a positive impact (though only in two age groups: *35-39* and *45-49*). As for the influence of the women's partners' education, the results display either the absence of any effect or even decreases in the odds of a woman working. The most momentous finding concerns women in the age group *45-49* with higher-educated partners. In that case, the partners' education significantly reduces the odds of those women joining the labour market. Finally, the wealth inquiry reveals a robust and consistent pattern of the odds ratios decreasing as wealth increases, signifying a strong negative association between them. In the case of India, the findings show a similar pattern. The odds ratios for primary and secondary education across all age groups reveal no association between these levels of education and employment. Notably, for women across all age groups, higher education exhibits a positive association with a woman's employment. As for the women's partners' education, the higher that partner's education, the lower the odds of the woman working, which is also consistent across all of the age groups considered. Wealth has also been associated with lower odds of the woman being in work, with the exception of women in the lowest wealth quintile in the age group *35-39*. These women are the only ones whose probability of joining the labour market increases. Finally, the findings for Pakistan, which display more trend similarity with India rather than Bangladesh, also show that women with the highest level of education have increased odds of working across all the age groups. At the same time neither a woman's primary nor secondary education affects her likelihood of being employed. The education of a woman's partner displays no relationship with that woman's participation in the workforce, demonstrating that a partner's higher education decreases the likelihood of the woman's employment. The inquiry into the role of wealth uncovers that women in the two lowest wealth quintiles have lower odds of working, especially in the *30-34*

and *45-49* age groups. The uppermost wealth quintiles show a strong negative association across most age groups, with the likelihood of a woman working decreasing sharply as wealth increases.

The study has uncovered the existence of a J-shaped pattern with regard to female employment by educational level, with women having completed secondary education demonstrating the lowest employment rates, while the employment rates of those highest-educated were the most significant.

These findings are consistent for the majority of age groups in all the considered countries. Any educational level lower than higher does not tangibly increase female participation in the workforce, a conclusion that draws attention to the persisting challenge faced by all women who have acquired more than just primary education but still fall short of making it across the threshold of higher education and into higher probabilities of professional work. With the exception of age groups *30-34* and *40-44* in Bangladesh, higher female education is the only driver that realistically improves the likelihood of women's entry into the labour market. The findings of this paper have contradicted the common assumption that the younger-aged groups with higher level of education should be more likely to work. It has previously been hypothesised that younger, more progressive cohorts of women could come to enjoy a higher probability of working professionally, given the prevalence of more reformed perceptions of gender roles among younger generations. Yet the *40-49* age group displays the highest likelihood of working across all the countries investigated. As for higher education among men, it has also been found to decrease the probability of female work. Though this trend is found in all three countries, the pattern whereby the more education a woman's partner has, the less likely she is to work, persists most determinedly in India. With men also obtaining more higher education (Tewari 2024) and the mating expectations still hinging on the man possession of an equal or higher educational level (Sarkar 2022), this reinforces the challenges and incentives regarding the improvements in women's employment. Higher household wealth also does not improve the likelihood of a woman joining the labour market, as clearly exemplified in the analysis of Bangladesh. The decline in female employment with an increase in wealth remains prominent across all age groups. A few exceptions have been identified in Pakistan and India, where among the *35-39* and *40-44* age groups in the two lowest income brackets, no such association was discovered. The only particularly striking exception has been identified in India, where women in the lower wealth brackets have higher chances of employment, though this proves to only be the case for the *35-39* age group.

This study underscores that in view of the ongoing economic transformations in Bangladesh, India and Pakistan, the future of employment in these countries will lie less and less in sectors requiring little to no education. Although these countries have previously been heavily dependent on agriculture, the modernising economy has diluted its relevance and the future of this sector will no longer be able to accommodate as large a share of employees as it used to, which should also be framed in the context of an ever-growing population. In addition to these new conclusions, the present research has supported the existing findings regarding the social dynamics that to date strongly affect the decisions of women joining the labour force. Despite the results explicating men's education and household wealth as the predominant factors defining the limits of women's employment, the path to mitigating those restricting influences can to a large extent be paved by providing women with higher education. Together with the previous study, the findings illuminate a structural inefficiency in the transition of demographic potential into productive employment. The region's demographic advantage remains underutilised due to the persistently limited absorption of women into the workforce and the concentration of women in low-return sectors.

3.2. Concluding remarks

As the 2030 horizon for the attainment of the sustainable development goals (SDGs) looms large for nations worldwide, increased attention is paid among governments and policymakers to matters linked to human capital development and utilisation in search of the holy grail of more sustainable economies. The ongoing transition on the demographic plane is making far-reaching and profound alterations to the life of modern society and its reverberations are felt across the most fundamental kernels of human and societal life, the family structure, the status and role of women, and the way and extent to which humans engage with work. It is, however, evident that the numerous problems brought to the fore by this transition have the undeniable power to halt the acquisition of demographic dividend benefits. It is therefore essential to study how to effectively optimise the demographic shifts and, crucially, to consistently act on them. Scholars and policymakers alike have increasingly been willing to widen the discourse on human capital capitalisation. Yet due consideration ought to be given not just to the very real challenges surrounding the surplus of working-age individuals and the accommodation of those challenges in the present, but also to the ways in which to support a growing elderly population, and attenuate the significant pressures on pension systems, healthcare services, and social security mechanisms. Population ageing is considered an especially complex challenge in the

context of developing countries since they are usually less economically resilient, struggling with poverty, have limited welfare systems, and underdeveloped pension structures. Unlike developed countries, they are thus more likely to lack the resources to support large aging populations. In South Asia in particular, the universal social security system tends to suffer from inadequacies, with limited public pension schemes and irregular social benefits (Goswami 2002; Kabeer & Cook 2010; Rajan 2014). Therefore, population dynamics need to be synchronised with economic and developmental strategies for the most optimal extraction of demographic dividend. As summarised by Bloom et al., "[a] failure to act on these issues could have a damaging effect on future prospects, as unemployment rises, the social fabric crumbles, and rising numbers of old people begin to overwhelm available resources… Embracing and understanding demographic challenges must therefore be a priority for all governments, as they build the broad partnerships that will be necessary to secure change." (2003, p. 82).

As explained in the present work, the demographic dividend in South Asia is now largely contingent on gender, i.e., the female dividend and the role of the female component is instrumental in successfully reaping the benefits of the demographic dividend. However, the low numbers of women currently in employment pose a hazard for the successful reining in of the dividend. This low employment of women is all the more puzzling given the unprecedented numbers of women attaining increasingly higher levels of education, which should intuitively lead to the assumption that more women should join the workforce as, traditionally, a higher education drives higher labour force participation. However, with the opposite result being true, it is essential to reconsider this *idée reçue* and the accepted understanding of the peculiar role of female education and its applicability to the contemporary labour market mosaic in South Asia.

In order to effectively overcome the challenges here described, it is important to devise economically and politically realistic action plans, which, due to their nature, fall outside the purview of this thesis. However, taking stock of the observations formulated in the preceding paragraphs, immediate suggestions could include promoting a greater implementation of flexible working hours and remote work. This could help attract and accommodate a considerable share of women across different levels of education and family arrangements. Such amenities could find application not just in the services sector, but could also be useful when it comes to manufacturing – a sector that is still large and powerful in South Asia. The optimisation of working hours and work-from-home schemes could thus be convenient for women who want to enter the labour market or remain in employment while also attending to

their household duties. More flexible working hours would put women more in charge of their time and more in control of how they allocate and split it between work and family. Remote employment would also help alleviate the stigma common among the more conservative communities who might hesitate to allow their women to go to work outside the home, but who would not mind it if they worked remotely. As the recent COVID-19 pandemic has shown, much of the work once thought to require physical presence in the workplace can be carried out just as well from home, and the flexibility of working hours customised by workers according to their individual circumstances could in turn make them more productive. Long-term solutions, however, must include investments in skill development and in facilities that help women alleviate their caregiving burdens. Equal-opportunity enforcement can help foster occupational integration and is therefore vital at this moment if South Asia wishes to increase its benefits from the demographic dividend. With the necessary government backing in the form of favourable policy adjustments and prudent legislation that would mitigate potential concerns among employers, such amenities would be a boon to women individually, and to the economy at large.

The present thesis has intended to push the boundaries of existing knowledge and advance the understanding of the demographic dividend and human capital as well-timed and forward-looking debates are gaining momentum due to the time-sensitive and far-reaching consequences. This work aspires to contribute to the presentation of a better-informed social and employment landscape for the benefit of policymakers and other actors working on issues here discussed, be it further research or devising policies and agendas to be applied in practice.

Furthermore, this research journey has shone light on the struggles of women entering the labour market and conceptualised the major challenges that lie before them as well as how those challenges hinder their professional fulfilment. This thesis has bridged the currently pressing questions of demographic, social and economic relevance in the name of, and in furtherance of, greater gender equity, sustainable growth, and tangible socio-economic development.

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