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Institute for What Works to Advance Gender Equality

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KREA UNIVERSITY

Improving Women's Employment Possibilities: A Sectoral Analysis

Sona Mitra and Bidisha Mondal

Generate new evidence to inform and facilitate the agenda of women's economic empowerment.

About the Publication

The paper, Improving Women's Employment Possibilities: A Sectoral Analysis is an output of the research vertical of the Institute for What Works to Advance Gender Equality (IWWAGE), an initiative of LEAD at Krea University.

This document is not a priced publication.

About IWWAGE

Institute for What Works to Advance Gender Equality (IWWAGE) aims to build on existing research and generate new evidence to inform and facilitate women's economic empowerment agenda. IWWAGE is an initiative of LEAD, an action-oriented research centre of IFMR Society (a not-for- profit society registered under the Societies Act). LEAD has strategic oversight and brand support from Krea University (sponsored by IFMR Society) to enable synergies between academia and the research centre.

Acknowledgement

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Research and Data Support

We would like to acknowledge Suchika Gupta and Aneek Choudhury for their support in the paper. Suchika Gupta and Aneek Choudhury work as Research Associates with IWWAGE.

We would gratefully acknowledge Sharon Buteau for her unequivocal support for developing and completing the paper.

Design: Roots Advertising
Design Support: Karunakar Rao, Communications Manager, IWWAGE

Abbreviation List

FLFPR	Female Labour Force Participation Rate
CPHS	Consumer Pyramid Household Survey
PLFS	Periodic Labour Force Survey
NAS	National Account Statistics
CAGR	Compound Annual Growth Rate
CMIE	Centre for Monitoring Indian Economy
CAPEX	Capital Expenditure/Capacity Expansion
NFHS	National Family Health Survey
ARIMA	Autoregressive Integrated Moving Average
ARIMAX	Autoregressive Integrated Moving Average with Explanatory Variable
MSE	Mean Squared Error
MAPE	Mean Absolute Percentage Error
AR	Autoregressive
MA	Moving Average
ACF	Autocorrelation Function
PCF	Partial Autocorrelation Function
ADF	Augmented Dicky Fuller test
STEM	Science, Technology, Engineering, and Management

Contents

List of Figures

Annexure 2

List of Tables

Annexure 1

Annexure 2

Abstract

Economic sectors often grow unequally depending upon the external and internal factors such as the global and local markets, national and world politics, technological changes, macroeconomic policies including tax and investment policies. Not all sectors of the economy are employment generating or labour-intensive and those that are, may be segregated by occupational hierarchies. This paper is an analysis of the sectoral growth patterns and its associated growth of employment, especially in sectors that have substantial presence of women. The paper highlights the gender-segregated employment generation for different sectors in the Indian economy and attempts to do a forecasting analysis of the employment possibilities across select sectors for women over the period of 2024-27. The paper recommends the actionable points with a particular focus on increasing women's employment in the sectors based on its findings.

The forecasting exercise uses the time-series data from the Consumer Pyramid Household Survey (CPHS) and the CAPEX datasets from the Centre for Monitoring Indian Economy (CMIE) database. The estimates of the employment elasticity of output are calculated, based on the CPHS and CAPEX datasets. The paper has also used the Periodic Labour Force Survey data and National Accounts Statistics data to understand the sectoral distribution of women workers and also the growth of the different sectors.

The findings in general indicate a decline in the overall employment growth the period of 2024-27, with women's employment declining at a much sharper rate on the aggregate. The sectors where a steep decline in women's employment is predicted are agriculture and allied activities, education, information and communication and several manufacturing sectors such as gems and jewellery, textiles, handicrafts and pharmaceuticals. The overall steeper decline in women's employment in manufacturing appears to be in sectors using automation and in agriculture due to mechanisation.

The sectors with increasing trend in women's employment are the wholesale and retail trade, footwear and leather industry, and soap and detergents among the sub-sectors of manufacturing. The rising trend in women's employment in the wholesale and retail trade is due to women-led business ventures taking up the emerging e-commerce space and the emerging opportunities in the retail sector.

The paper concludes that there exists a critical need for upskilling women in several aspects for being more employable in the emerging job markets. This would alone not be sufficient to engage women unless more jobs are created in sectors that can potentially absorb more women, which would require greater investments focussed on such sectors.

Background

The female labour force participation rate (henceforth FLFPR) in India has been one of the lowest among all the countries and has been falling secularly from 1990 onwards till 2018-19. The urban FLFPR has always been lower than rural FLFPR. The low and declining FLFPR has happened despite the country witnessing a long period of economic growth, a declining fertility rate which is otherwise associated with a rise in FLFPR, and increasing educational attainment of women. However, due to the U-shaped relationship between education and FLFPR and the increase in educational attainment among women being majorly driven by increase in primary and secondary educational attainment, absence of higher educational attainment is often cited as one of the reasons behind declining FLFPR. Additionally, increased household earnings caused withdrawal of women from the labour market as women are often considered to be the secondary earners (Klasen, Pieters, 2015). However, the largest factor contributing to the decline in FLFPR is the lack of employment opportunities for women. The occupational and sectoral segregation by gender confines women to particular jobs and often limits their employment growth. With female employment growth taking place in slow-growing occupations and female share declining in the fast-growing sectors, the large degree of occupational and sectoral segregation affects the overall employment opportunities for women (Kapsos et al., 2014). Additionally, the gender-based discrimination in labour market returns also discourages women from labour force participation (Tayal and Paul, 2021; Mathew, 2015; Narayanan et al., 2017). The sectoral distribution of women workers is often attributed to the macroeconomic trends, the broader economic changes in India since the 1990s. The lack of employment diversification of rural women and their confinement to the agricultural activities is attributed to the finance and real estate sector-driven and private consumption-driven growth being urban-centric and not leading to non-farm employment generation in the rural sector. The difference in sectoral distribution of rural and urban women could be related to the significant differences in drivers of employment between rural and urban areas. The tertiary sector-driven growth being urban centric led to greater extent of dynamism and higher diversification among urban women workers as compared to their rural counterparts. However, when digged deeper, it is observed that whereas the rural self-employed women are majorly engaged in the non-remunerative agricultural activities, the urban self-employed women are associated with low-productive manufacturing activities at piece-rate payment under precarious working conditions (Mitra, 2018)

The paper has six major sections, the first section discusses the scenario of sectoral distribution of women's employment and the sectoral growth patterns; the second section describes the database; the third section talks about the methodology; the fourth section consists of model specification results, forecasted trends of gender-segregated employment across different sectors, and the estimates of sectoral employment elasticities; the fifth section discusses the forecasted trends of employment, and the sixth section summarises the findings.

Section 1

Sectoral Patterns of Women's Employment and Sectoral Growth Patterns

1.1 Evidences from CPHS Data

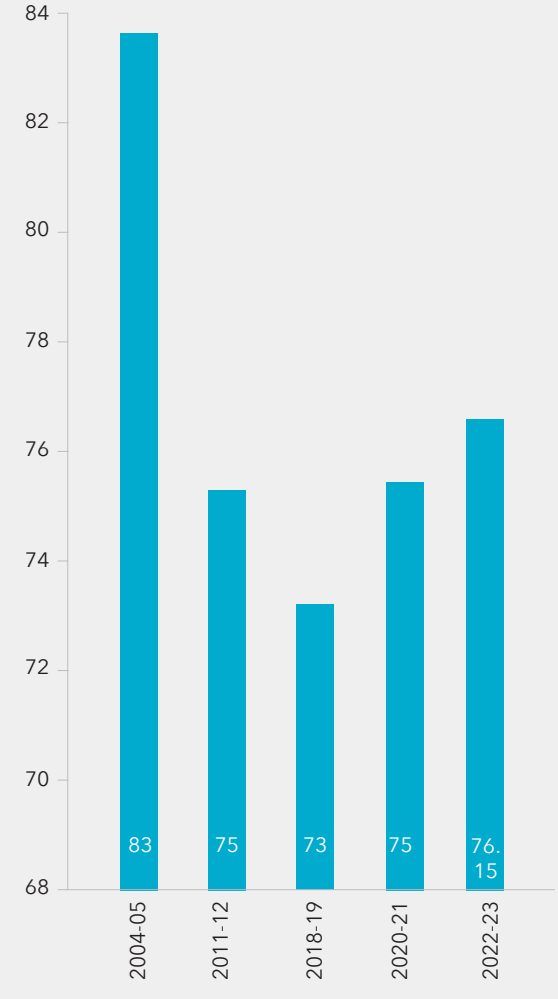
As the Consumer Pyramid Household Survey reveals the major sectors of female employment had been agriculture and allied activities, wholesale and retail trade, finance, education, accommodation and food, manufacturing and health. Over the period of January-April 2015 to September-December 2023, the shares of different sectors in female employment have changed. The share of agriculture and allied activities has increased from 47% in January-April 2015 to 58% during September-December 2020 to September-December 2021 and then again declined to 47% in September-December 2023. The increase in engagement in agricultural activities might be due to the distress driven absorption in this sector as most of the sectors were hard-hit by the pandemic. The share of wholesale and retail trade in female employment has continuously increased over the period of January-April 2015 to September-December 2023, the share has risen from 5% to 12% over the same period. The rise might be in response to the boom in the retail economy, women increasingly participating in customer-facing jobs and women-led businesses venturing into e-commerce space. The share of education, which used to be one of the largest contributors to total female employment, has declined from 10% in January-April 2015 to 6% in September-December 2023. The accommodation and food sector accounted for 6% of total female employment in January-April 2015 and the share had declined significantly during the period of September-December 2020 to May-August 2022 and hovered around 2-3%. From September-December 2022, the share started to rise and it reached 5% in September-December 2023. The decline in this sector's share in female employment is due to the sector receiving the biggest blows during the COVID period due to the contagious nature of the pandemic and associated the travel restrictions. The share of the manufacturing sector in total female employment has gone down from 16% in January-April 2015 to 8% in September-December 2023, and the decline is explained by the adoption of technology replacing women workers. The health sector accounted for 3% of total female employment in January-April 2015 and the share slightly increased to 4% in September-December 2023.

Over the same period, the share of agriculture and allied activities in total male employment has declined from 36% to 31% majorly due to the mechanisation in the sector, but remains the major contributor to employment. The share of manufacturing has fallen from 20% to 11%, due to automation and digitization driven job loss in the sector. The share of the wholesale and retail trade sector in total male employment has increased significantly from 9% to 20%, majorly due to the boom in the retail economy, the expansion of the e-commerce sector etc.

1.2 Evidences from PLFS Data

The sectoral distribution of women workers also differs between rural and urban areas significantly with the agricultural sector contributing to more than 70% of women employment in rural areas, and the secondary and tertiary sector employment being significantly higher in urban areas. The share of rural women workers engaged in agricultural activities had been approximately 83% in 2004-05 which declined to 73% in 2018-19, but tends to be reversing since then. Currently it is at 76% in 2022-23.

Figure 1: Share of Rural Women in Agriculture (PLFS over the years)



Source: Author's calculation using various PLFS rounds

Women's participation is significant at all levels of production in the agriculture sector i.e. pre-harvest, post-harvest processing, packaging, marketing etc and women perform numerous labour-intensive jobs such as sowing, nursery management, transplanting, weeding, applying fertiliser, protecting the plant, harvesting, winnowing, storing, managing and taking care of the poultry and dairy animals, milking the animals, milk processing, preparation of ghee etc.

In the secondary sector, both rural and urban women workers are again clustered into few low-paying sectors like construction activities, manufacture of wearing apparels, textiles, tobacco products, wood and wood products, food products and beverages etc. Although, some changes in these sectoral shares took place over time for example among rural women workers, the share of those engaged in construction of buildings decreased from 18.6% in 2017-18 to 17.5% in 2022-23, the share of apparel industries increased from 15.6% in 2017-18 to 25% in 2022-23; among urban women workers, the share of apparel industries has risen from 27% in 2017-18 to 33% in 2022-23 and further rose up to 35% in 2022-23, the share of textile industries has fallen tremendously from 19% in 2017-18 to 13.5% in 2022-23, the concentration of women workers in the low-paying industries of the secondary sector didn't change much over time.

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Figure 2(a): Share of Women in Secondary Sector - Rural

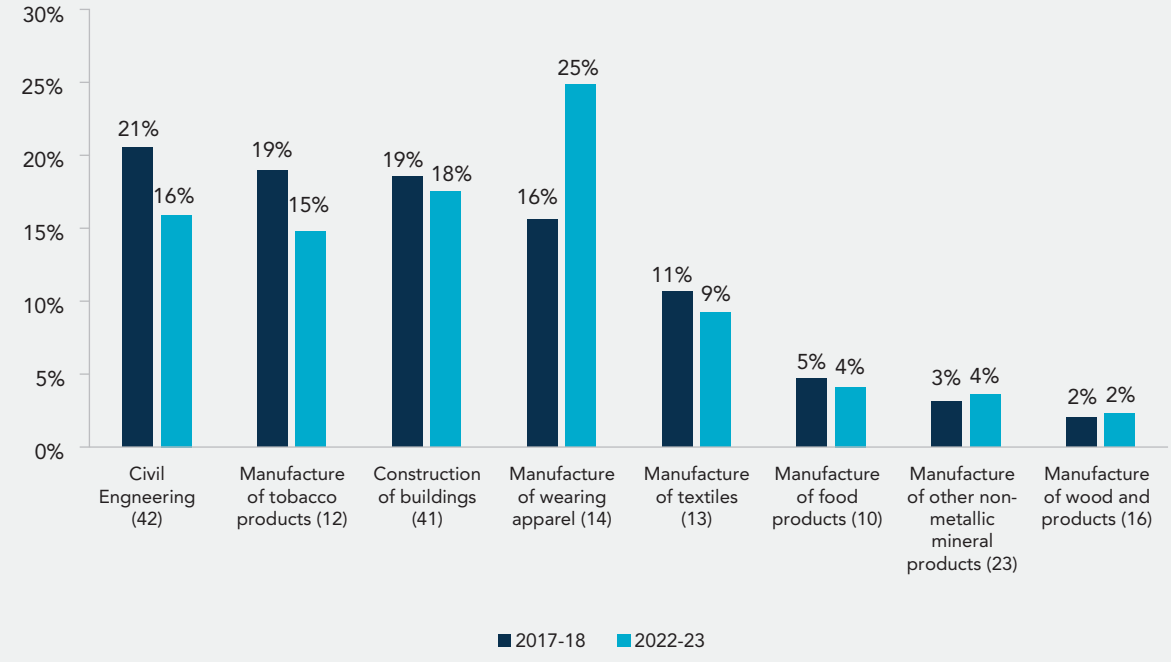
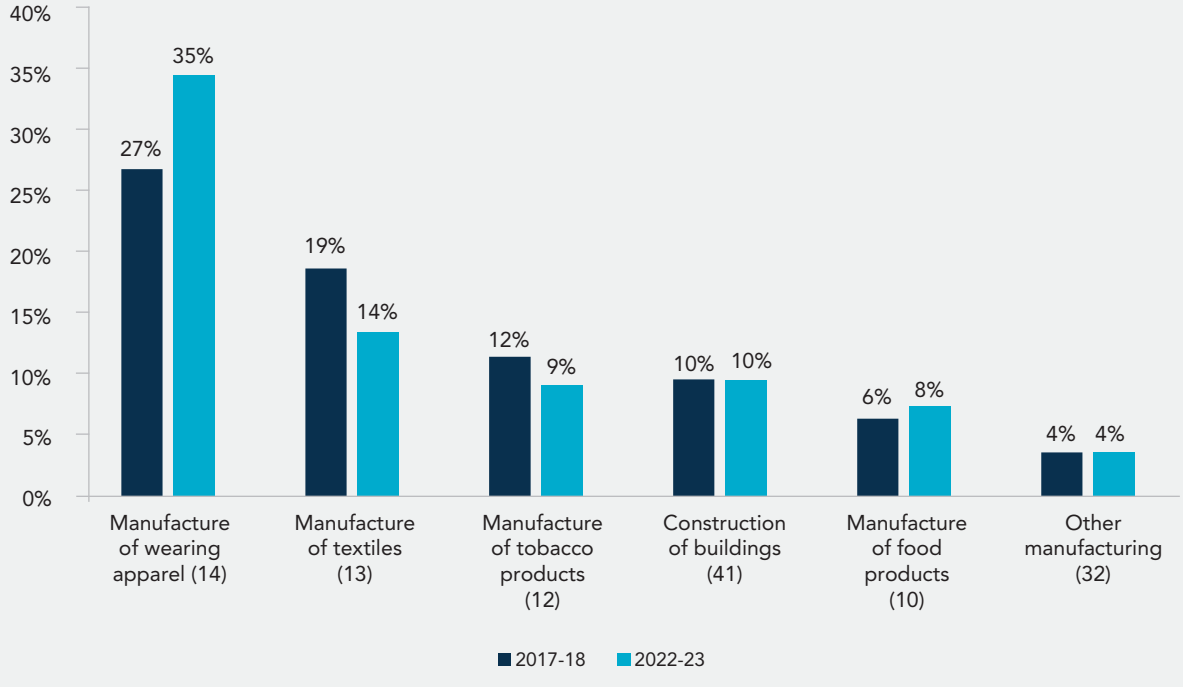


Figure 2(b): Share of Women in Secondary Sector - Urban

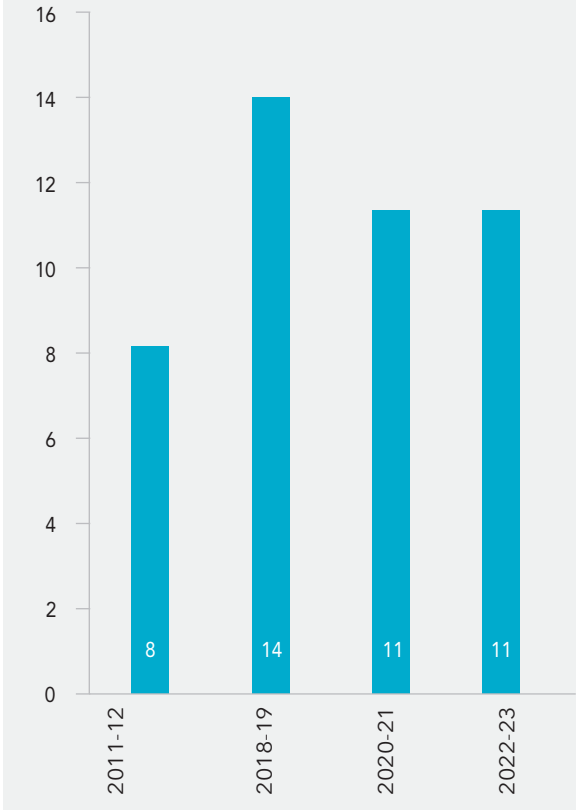


Source: Author's calculation using various PLFS rounds

The share of tertiary sector in providing employment for rural women has increased from 8.32% in 2011-12 to 14% in 2018-19 but the share slightly declined to 11.4% in 2022-23 due to a deceleration in many segments like tourism, trade, hotels, transport, communication etc in the last two years.

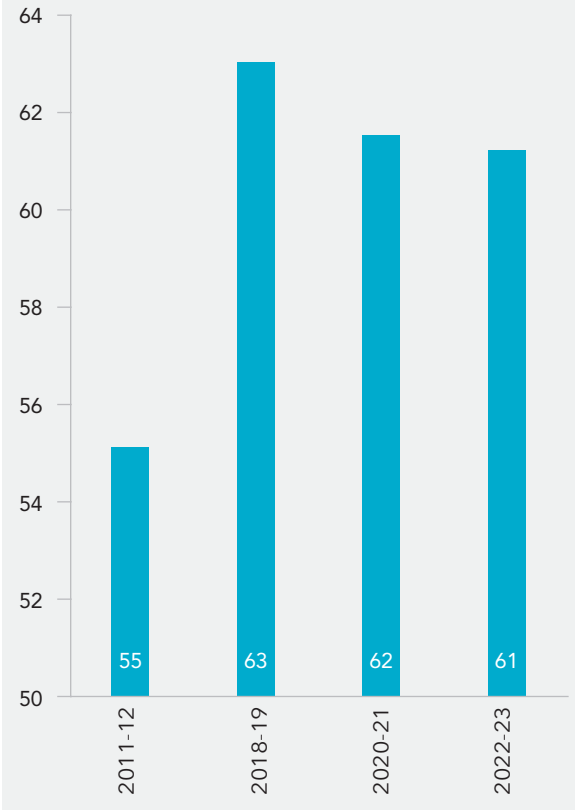
For urban women workers, the share of tertiary sector employment increased from 55.11% in 2011-12 to 63% in 2018-19, and the share declined moderately to 61% in 2022-23 due to the sector being hard-hit by the pandemic.

Figure 3(a): Share of rural women in tertiary sector



Source: Author's calculation using various PLFS rounds

Figure 3(b): Share of urban women in tertiary sector

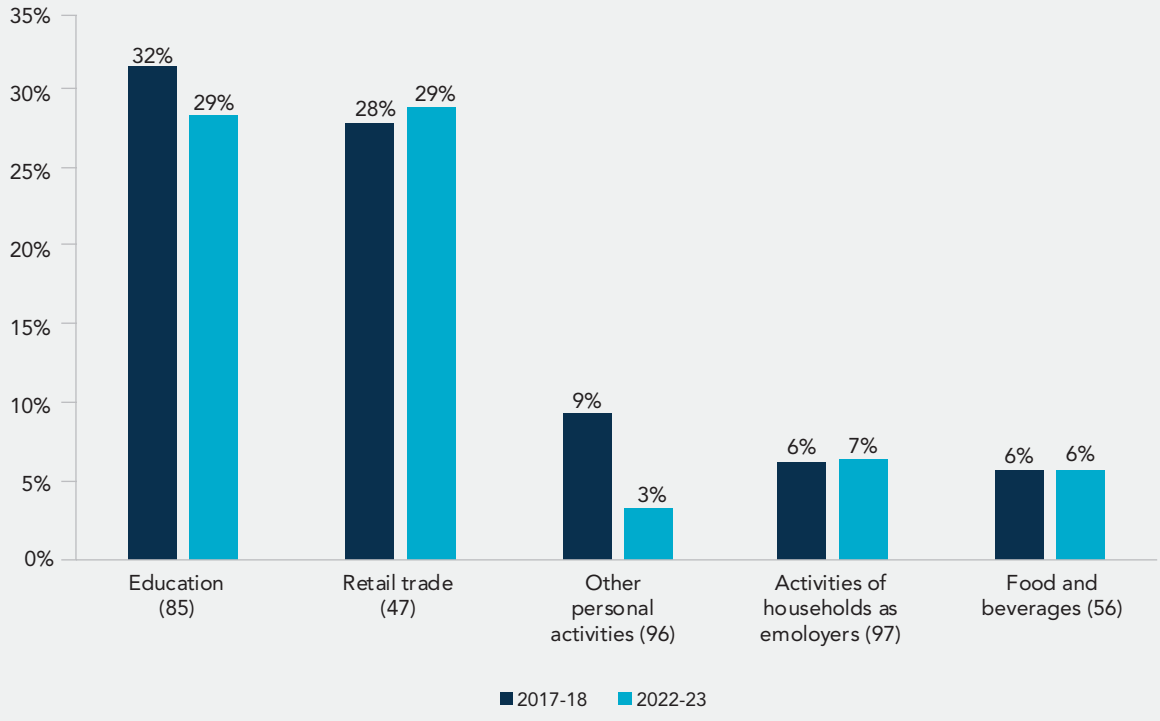


Source: Author's calculation using various PLFS rounds

Whereas for both rural and urban women workers in the tertiary sector, education and retail trade had been the largest employment providers, for urban women activities of households as employers of domestic personnel also contributed significantly. The sectoral segregation often leads to clustering of women workers in low-skill, low-paying industries[2] (see Table 1 and Table 2 in Annexure 1).

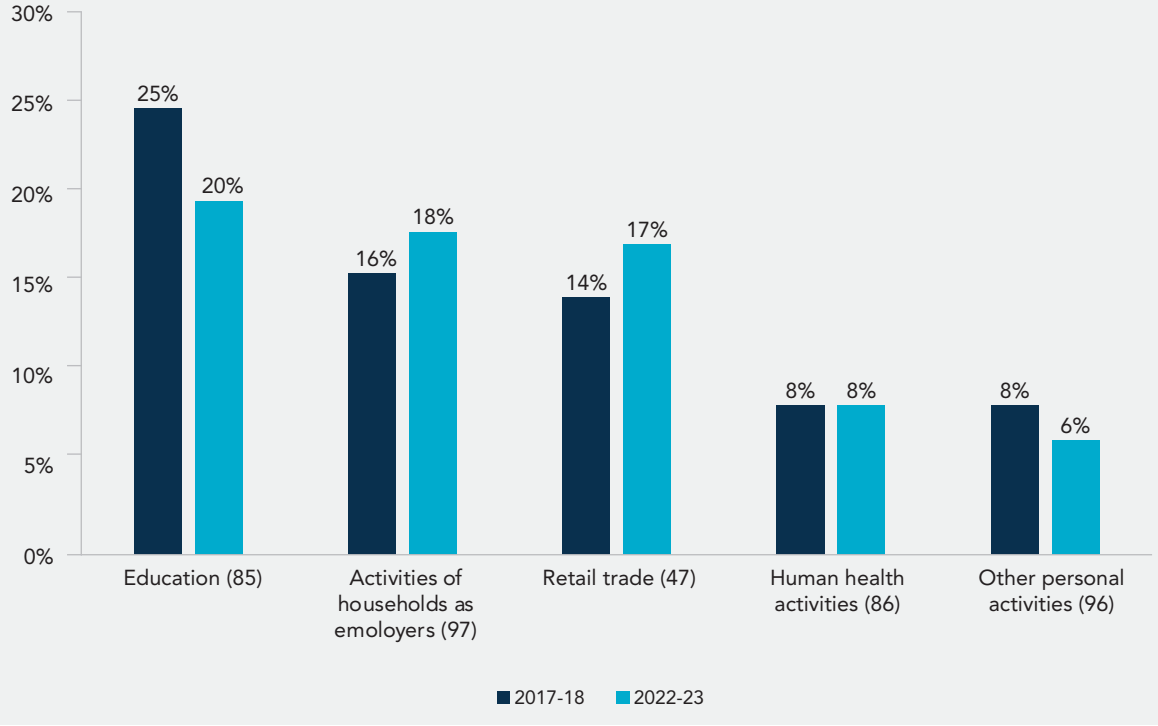
[2] The estimates are made from the 61st, 68th Employment Unemployment Survey Round and the PLFS rounds.

Figure 4(a): Share of rural women in tertiary sector



Source: Author's calculation using various PLFS rounds

Figure 4(b): Share of urban women in tertiary sector

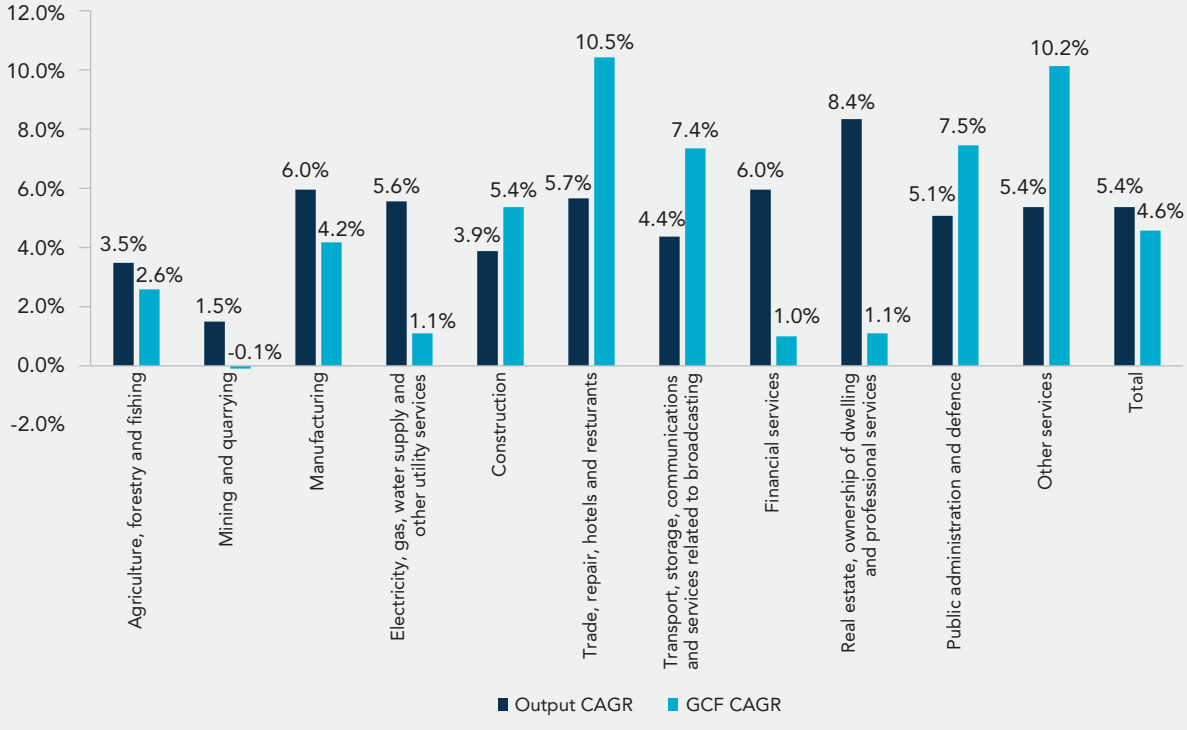


Source: Author's calculation using various PLFS rounds

1.3 Analysing the Variation in Sectoral Growth and their Capacity for Employment Generation for Women

However, due to the gender-based sectoral segregation, different sectors growing at different rates has implications for employment generation for women. The National Account Statistics (NAS) data reveals that over the period of 2011-12 to 2021-22, the Compound Annual Growth Rate (CAGR) in the overall output is 5.4%, whereas the similar growth rate in the overall gross capital formation is 4.6% over the same period with wide variation in the growth rates among the sectors. As we look into the sectoral growth of output, it is found that the output increased by 3.5% in the agricultural sector; 1.5% in the mining and quarrying sector; 6% in the manufacturing sector; 5.6% in the electricity, gas, water supply and other utilities; 3.9% in the construction sector; 5.7% in the trade, repair, hotels and restaurants; 4.4% in transport, storage, communication and services; 6% in financial services; 8.4% in real estate, ownership of dwelling and professional services; 5.1% in public administration and defence; and other services by 5.4%. Over the same period, the gross capital formation increased by 2.6% in the agricultural sector; declined by 0.1% in the mining and quarrying; increased by 4.2% in the manufacturing sector; 1.1% in the electricity, gas, water supply and other utility; 5.4% in the construction sector; 10.5% in the trade, repair, hotels and restaurants; 7.4% in transport, storage, communication and services; 1% in financial services; 1.1% in real estate, ownership of dwelling and professional services; 7.5% in public administration and defence; and 10.2% in other services.

Figure 5: Growth rate (CAGR) of output and gross capital formation from 2011-12 to 2021-22



Source: NAS

The sectors where women cluster in, for example agriculture, construction, are observed to grow at a slow rate in terms of output. In the case of the agricultural sector, the growth in the gross capital formation also occurred to be low. On the other hand, for sectors with low representation of women like trade, repair, hotels, restaurants, transport, storage communication, financial services, real estate, professional services, electricity, gas, and water supply, the output growth rate is much higher and the growth rate of gross capital formation is also high in few of the sectors like trade, repair, hotels and restaurants, transport, storage, communication and services etc.

According to the National Account Statistics database, the share of national value of output (at constant prices) produced in the manufacturing sector by the corporate sector[3] increased by 6% from 2011-12 to 2021-22, with the growth rates varying significantly among the different sub-sectors. Over the period of 2011-12 to 2021-22, the growth in output in the corporate sector has been 7% for manufacture of food products and beverages; 7% for textile, apparel and leather; 7% for metal and metal products; 7% for manufacture of machinery and equipment; 4% for coke, petroleum, rubber; 8% for others including wood and wood products, paper and paper products. Over the same period, the growth in manufacturing output produced in the household[4] sector has increased by 1% for the food products, beverages and tobacco; increased by 10% for textiles, apparel and leather products; 3% for metal and metal products; 5% for machinery and equipment; 6% for petroleum, rubber, chemical products; 9% for others including wood and wood products, paper and paper products, furniture etc.

Due to the gender-based sectoral and occupational segregation in the Indian labour market, the different sectors and sub-sectors growing at varying rates in terms of output, gross capital formation. Is expected to have variations in generation of future job opportunities for women in the economy.

Additionally, technological change also influences the dynamics of intersectoral and inter-occupational job creation. According to a study by McKinsey Global Institute (2019, June), the agricultural sector is likely to face a high level of automation and due to that technological change, women job losses are expected to be around 28% in that sector, much higher than their men counterparts at 16%. The manufacturing sector also being automation prone to a high extent, routine physical tasks and routine cognitive work are expected to be automated. Whereas men are being assumed to lose jobs in routine physical tasks such as machine operators and craft workers in the manufacturing sector, women engaged in service sector routine cognitive work such as clerical support roles and service worker roles are expected to be replaced due to automation. But even after the manufacturing sector being highly automable, there is significant scope for job addition also due to automation-fuelled expansion in certain occupations not being automation-prone. Also, the accommodation, food services, retail and wholesale trade, and construction sectors will probably expand in response to overall growth. It would be interesting to find out the effective measures to make women benefit from the emerging employment opportunities in these sectors.

Given these changes in labour market trends in the recent years, the gender-based segregation by sectors, varying sectoral growth rates and the potential technological changes that would influence the sectors and occupations differently, this paper indulges in the exercise of projecting the growth in the quantum of women's employment in India. for the period of 2023-2026 with the reference period of 2015-22 in certain select sectors. The objectives of the paper is to provide a sense of sectors that may be more labour absorptive for women in the next few years and the kind of various policy initiatives / programmes and investments can be channelized in these sectors to promote women's employment.

[3] This part of the national product denotes the goods and services arising out of the economic activities undertaken in the corporate sector.

[4] This part of the national product includes the goods and services being produced in the households of the economy.

Section 2

Discussing the Database

The study would be using the various large-scale government and private sector databases like National Sample Survey Rounds, Periodic Labour Force Surveys, Census, Economic census, Consumer Pyramids Household Surveys and CAPEX datasets provided by Centre for Monitoring Indian Economy (CMIE). The CMIE database has been the primary source of information in this study and the key datasets from the CMIE are Consumer Pyramid Household Surveys (CPHS) and Capital expenditure/ Capacity expansion (CAPEX). The CMIE dataset provides certain advantages such as availability of comprehensive, accurate and reliable data on labour, employment, unemployment, economic indicators among others and validates its dataset from various sources like surveys, government reports and administrative data; granularity and timeliness of data. Additionally, the ease of accessibility of data with the CMIE providing a user-friendly interface that enables data to be easily retrieved, filtered and manipulated is another advantage of using the database. However, despite its comprehensive coverage of information and high frequency of the data, there are some strong criticisms of the database.[5]

In this study, CPHS and CAPEX datasets are used to capture employment and capital investment related information pertaining to various industries from January-April 2015-16 to September-December 2023-24. The CPHS data is collected on a quarterly basis and each wave of CPHS provides comprehensive information on households in India covering a wide array of variables related to household demographics, income, expenditure, savings, employment, education, health, and various aspects of consumer behaviour etc. The most crucial variable in this study, the industry of employment of the household members, is obtained from CPHS dataset which enabled a gender-disaggregated labour force projection for the different industries for the coming years. A detailed tabular representation of the classification of the industries used in CPHS is provided in the Annexure 2 (refer Table 1).

[5] The CPHS sample is often criticised to be biassed towards the better-off households as the sampling method involves surveying the 'main street' first in each sample village/enumeration block and then moving to the 'inner streets' only if the sample size requires doing so. As a consequence, the poor households are underrepresented in the sample. And this bias is growing over time. Due to the underrepresentation of the poorer households, the estimates of different indicators like adult literacy rate, average labour earnings, access to electricity, safe water etc are often much above the estimates from other nationally representative datasets like NFHS rounds.

Read more at:
https://economictimes.indiatimes.com/opinion/et-commentary/view-the-new-barometer-of-indias-economy-fails-to-reflect-the-deprivations-of-poor-households/articleshow/83696115.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

The CAPEX dataset focuses on capital expenditure and investment related information of companies across various sectors in the Indian economy. Due to the difference in industrial classification between CPHS and CAPEX datasets, an industrial concordance has been done with the guidance from the National Industrial Classification codes-2008. A detailed tabular presentation of the concordance of industries between CPHS and CAPEX is added in the Annexure 2 (refer Table 2).

To consider the effect of COVID pandemic, we have included a time dummy in the time series model. In the case of the CPHS dataset, the time dummy takes the value of 1 for the data points in the period of May-August 2020 to January-April 2022, and 0 otherwise. In the CAPEX dataset, it takes the value of 1 in case of the data points in the period of March 2020 to March 2022, and 0 otherwise.

Section 3

Methodology

3.1 The ARIMA Model and its Wide Application

The first step in forecasting has been performing the log-transformation of the times series on the number of women and men employees and capital expenditure in different sectors to reduce the large fluctuation in the series. We started with checking the stationarity/non-stationarity of the time series data on the number of employees and the net capital expenditure in each industry. The time series on number of employees and capital expenditure for all the industries when plotted against time, showed a trend over time, indicating towards the non-stationarity of both the series. The Autoregressive Integrated Moving Average (ARIMA) model is one of the most widely used methodologies for reoccurring the non-stationary time series data. The advantages of this model are the flexibility it offers to various kinds of time series, the accuracy of forecasting, and the advantage of using its own historical data for analysis. The methodology followed to estimate the ARIMA model is the Box-Jenkins method.

Here is a brief account of the application of the ARIMA model to a diverse set of time series data. A study by Didiharyono and Bakhtiar in 2018 has forecasted tourist visiting in Toraja using the ARIMA model and following the Box-Jenkins method of estimation for the ARIMA model (Didhiharyono, Bakhtiar 2018). Another study by Lip, et.al used various models like ARIMA, Double Exponential Smoothing model, and Holt's model to forecast the unemployment rate in Malaysia and the ARIMA model turned out to be the most appropriate model using various measures of accuracy metrics (Lip, et.al 2021). A study by Didiharyono and Syukri also used ARIMA model to anticipate by forecasting the open unemployment rates in South Sulawesi (Didiharyono; Syukri, 2020). Chen et al. applied an ARIMA model to the population data of Zhejiang province in China from 1978 to 2016, forecasted the population from 2018 to 2022 and the goodness of fit confirms the appropriateness of the forecasting model (Dai, Chen 2019). ARIMA model has also been used in another study for price forecasting for some major crops like paddy, ragi, maize in Karnataka for the year of 2016 using the time series data from 2002 to 2016 and the precision of forecasting is confirmed standard criteria of MSE, MAPE (Jadhav et al., 2017).

Additionally, there are numerous applications of the ARIMA model in forecasting the future employment generation. The National Skill Commission in Australia, which periodically conducts labour force projection studies and predicts employment generation for men and women separately for the different sectors and occupations in the Australian economy, uses ARIMA model as a major projection

method. A study by Alyaha and Hadwan using the dataset of government job advertisements to predict the future employment generation in Saudi Arabia. ARIMA model was applied to the time series data for forecasting and as indicated by different accuracy metrics, the study confirms that ARIMA model fits in as a forecasting tool for employment data (Alyaha; Hadwan, 2022). Another study undertaken by Khongji and Nongkynrih with an attempt to predict state-wise labor force projection separately for men and women for the period of 2011 to 2031 in India, also applied ARIMA model successfully for their forecasting (Khongji; Nongkynrih, 2018).

Thus, in addition to the non-stationarity indicated by the time trends in the variable series in this study due to the wide scale of application of ARIMA model to various types of non-stationary time series data, and the existing empirical evidence of ARIMA being a well-established forecasting tool for labor force projection, we use ARIMA for our forecasting study.

This section gives a brief description of the time series models used in this study. We have adopted the multivariate model of ARIMA i.e the ARIMAX model where a time dummy is also included in forecasting exercises.

The dependent variable in the ARIMAX model, is basically a merger of three simple components: the AR (Autoregressive) part attempting to forecast based on a linear regression model using its own past values of the series with the assumption of stationarity of the series; the MA (Moving Average) part attempts to predict future values based on the past forecasting errors; the integration component which is needed to transform the non-stationary time series models into stationary time series. In this model, we have forecasted the future values of the employment generation in the industries using its past values and the past forecasting errors.

3.2 Estimation of ARIMAX Model

The dependent variable in the ARIMAX model can be expressed with the notation ARIMA (p, d, q) where p denotes the order of the AR model indicating the number of lags of the time series to be used as predictors, d is the number of differencing needed to make the non-stationary data stationary, q is the order of the MA model referring to the number of lagged forecast errors to be incorporated, and d is the number of differencing needed to make the series necessary. The parameter estimation of the ARIMAX model has to be preceded by finding the orders p, d, and q.

An ARIMA process is a mathematical model used for forecasting and the Box-Jenkins method is followed here for the ARIMA forecasting. The Box-Jenkins

method involves i) identification of the appropriate ARIMA model; ii) fitting it to the data for the parameter estimation; and iii) using the fitted model for forecasting. The method consists of the following three steps.

A. Identification of the Model

Differencing

To check the stationarity of the time-series, we have used the Augmented Dicky Fuller test[6] with the null hypothesis being the non-stationarity of the time-series. If the p-value of the test is less than the significance level (here 0.05 as we are taking 5% level of significance), we reject the null hypothesis and infer the time-series to be stationary. The ADF has been repeated after each round of differencing to ensure exact differencing.

Configuring AR and MA

The orders of the ARIMA model are identified with the use of two diagnostic plots: Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF). The idea behind the Autocorrelation analysis is to calculate the correlation coefficient between each set of ordered pairs of the time series, measuring the direction and strength of statistical relationship between those pairs. The ACF plot summarises the correlation of an observation with its lagged values. If the ACF trails off after a lag, then this lag is taken as the value for p. The PAC coefficient gives the correlation between ordered pairs which are drawn from a single series and separated by various time spans. The PACF summarises the correlations of an observation with its lags after excluding contributions from the intermediate lags. The lag value where the PACF trails off, is taken as the value for q.

Model Specification

After finding the orders of p, q, and d, we fit the data into the ARIMA model and choose the model specification with the lowest Akaike Information Criterion (AIC)[7].

B. Estimation and Diagnostic Checking

A non-linear least square method is followed for estimating the parameters of the model in the Box-Jenkins method.

As accuracy metrics for the forecasted values, Mean Absolute Percentage Error (MAPE), Min-max error are used. If a residual is divided by the observed value, we get a percent residual. The MAPE is simply the mean values of these percent residuals.

[6] The Augmented Dicky Fuller test belongs to the category of tests performed to know the presence of unit root/non-stationarity. The ADF test is used instead of Dicky-Fuller test because of its ability to handle more complicated statistical models particularly in presence of serial correlation.

The Dickey–Fuller test involves fitting the model $\gamma_t = \alpha + \rho\gamma_{t-1} + \delta t + u_t$ by ordinary least squares (OLS) when y_t is the dependent time series, α is the drift term, δ accounts for the drift term, and ut is the independently and identically distributed zero mean error term; and then testing whether $\rho=1$, or not . However, in such a regression, the risk of serial correlation might arise. To control for that, the augmented Dickey–Fuller test instead fits a model of the form $\Delta\gamma_t = \alpha + \beta\gamma_{t-1} + \delta t + \zeta 1\Delta\gamma_{t-1} + \zeta_2\Delta\gamma_{t-2} + \cdots + \zeta_k\Delta\gamma_{t-k} + \varepsilon_t$ where k is the number of lags. The ADF tests whether $\beta = 0$ or not and this is equivalent to testing $\rho = 1$ or not,equivalently testing whether y_t involves a unit root process or not.

[7] The Akaike Information Criterion suggests the best-fit statistical model which explains the maximum variation in data with fewest independent variables. It is calculated from the number of independent variables used in the model and its maximum likelihood estimate and widely used for statistical model selection.

3.3 Elasticity Calculation

The employment elasticity with respect to capital expenditure has been calculated for two periods- i) for the period of actual data, and ii) for the forecasting period for all the different sectors. We have estimated the arc elasticity which indicates the percentage change in employment in a particular sector for a particular period for a one percent change in the capital expenditure in that sector for that particular period. The employment elasticity of output growth has been calculated for both men and women employees for all the sectors and also at the aggregate level.

Elasticity Calculation with CPHS and CAPEX Datasets

The elasticity calculation has been done using datasets from CMIE, whereas the gender-disaggregated employment data has been taken out from the Consumer Pyramid Household Survey dataset and the information on capital expenditure for the different sectors are collected from CAPEX dataset.

Section 4

Results

This section contains three sub-sections. The first subsection talks about the results of different tests leading to the model specification for the time series and the goodness of fit of the models. The second section gives us an account of the forecasted values over time. The third subsection includes the elasticity estimation results.

4.1 Results on Model Specifications

Guided by the results from Augmented Dicky-Fuller tests (refer to Table 3 in Annexure 2 for the detailed Augmented Dickey-Fuller results), plotting of the autocorrelation function and partial autocorrelation functions (refer to Table 4 in the Annexure 2 for the lag orders indicated by the plots), and finally diagnostic checking through the minimum Akaike Information Criterion, the following specifications of the models are identified to be the best fit among all the models indicated for the time series (refer to Table 1). The following tables give us the model specifications for the log-transformed time series data on the women employees, men employees, and also the capital expenditure in the different sectors and the Mean Absolute Percentage Error (MAPE) as a measure of the accuracy of forecasting with these models. The rule-of-thumb says that if the MAPE is less than 25%, the forecasting is dependable. It can be observed from the table below that MAPE is much below the 25% level for all the specified models.

Table 1. ARIMA model specifications and accuracy metrics for the times series

	Women	Mean Absolute Percentage Error	Men	Mean Absolute Percentage Error	Capital expenditure	Mean Absolute percentage error
Accommodation and food	(1,1,8)	4.7%	(1,0,9)	0.8%	(0,0,8)	7.9%
Administrative and support service activities	(2,1,1)	5.4%	(1,1,3)	4.4%	*	*
Agriculture and allied activities	(1,1,1)	4.4%	(1,1,9)	4.2%	(0,0,9)	5.2%
Transport	(1,1,1)	6.9%	(1,1,1)	4.9%	(1,0,3)	3.2%
Construction	(1,1,1)	6.8%	(1,1,9)	4.7%	(2,0,2)	11.8%

	Women	Mean Absolute Percentage Error	Men	Mean Absolute Percentage Error	Capital expenditure	Mean Absolute percentage error
Wholesale and Retail Trade	(1,1,4)	4.4%	(1,1,1)	4.3%	(0,0,3)	10.5%
Manufacture	(2,1,1)	4.7%	(1,1,1)	4.4%	(1,0,1)	5%
Finance	(2,1,1)	4.4%	(1,1,1)	4.2%	(1,0,1)	3.9%
Education	(2,1,1)	4.6%	(1,1,1)	4.3%	(0,0,6)	7.6%
Arts and Recreation	*	*	(2,1,4)	8.7%	(0,0,6)	11.5%
Health	(2,1,1)	4.4%	(1,1,8)	4.3%	(2,0,2)	7.4%
Information and Communication	(2,1,1)	4.9%	(1,1,8)	4.3%	(2,0,2)	9.3%
Others	(1,1,1)	4.6%	(1,0,1)	0.9%	NA	NA
Mining	(1,1,8)	6.5%	(1,1,8)	4.4%	(2,0,6)	6.9%
Public Administration and Defence	(1,1,8)	4.6%	(1,1,1)	4.3%	NA	NA
Total	(2,1,1)	4.2%	(1,1,3)	4.1%	(4,0,4)	1.7%

Source: Consumer Pyramid Household Survey and CAPEX database

*denotes results are inconclusive.

Table 2. ARIMA model specifications and accuracy metrics for manufacturing sub-sectors

	Women	Mean Absolute Percentage Error	Men	Mean Absolute Percentage Error
Chemical Industry	(1,1,1)	5.9%	(0,0,10)	0.7%
Footwear and Leather Industry	(1,1,1)	5.75%	(1,1,1)	4.4%
Gems and Jewellery	(1,1,1)	8.3%	(1,1,1)	4.7%
Handicraft Industry	(2,1,1)	6.6%	(1,1,1)	5.8%
Machinery Manufacture	(1,1,9)	5.6%	(1,0,9)	1.1%
Metal Industry	(1,1,9)	5.4%	(1,1,1)	4.5%
Pharmaceutical Industry	(2,1,1)	6.8%	(2,1,6)	4.7%
Soaps and Detergents	(1,0,1)	2.8%	(1,0,9)	4.0%
Textile Industry	(1,1,1)	5.0%	(1,1,9)	4.3%

Table 3: ARIMA model specifications and accuracy metrics for manufacturing sub-sectors under CAPEX

	ARIMA model	Mean Absolute Percentage Error
Miscellaneous Manufacturing	(6,0,8)	15.84%
Machinery	(1,0,1)	6.36%
Metals and Metal Products	(2,0,2)	11.81%
Consumer Goods	(4,0,4)	11.77%
Chemicals and Chemical Products	(1,0,11)	6.70%
Textiles	(1,0,1)	13.21%

4.2 The Forecasted Trends

The forecasted values of the log-transformed time series on women's and men's employment indicates a declining trend for both the series over the period of January-2024 to December 2027. However, the decline appears to be sharper for women as compared to men.

The forecasted CAPEX values indicate a stable capital intensity in aggregate for all the industries. A detailed sector-specific analysis of the trends has some interesting findings. In the case of the wholesale and retail industries, both women's and men's employment are forecasted to be upward rising with women's employment rising at a faster rate, and the forecasted CAPEX showing a stable trend in overall capital investment in this sector over the period of 2024-27. Agriculture being the major contributor of employment particularly for rural women, it is a matter of concern that the forecasted trends show a steeply falling women's employment and a slightly falling trend in men's employment, associated with a stable level of capital expenditure in this sector over the period of 2024-27. In the manufacturing sector, both men's and women's employment are falling but women's employment is falling at a sharper rate over the period of January 2024-December 2027.

In the finance sector, trends in men's and women's employment show a slightly declining trend with the women's trend being relatively sharply falling compared to the men's trend. The forecasted CAPEX in this sector appears to follow a stable trend over the period of January-2024 to December-2027. In the education sector, both men's and women's employment are forecasted to decline over the period of January-2024 to December-2027, but the decline in women's employment is sharper than men's employment. The aggregate capital expenditure in this sector is forecasted to be more or less stable over the same period. In the health sector, both men and women's employment are expected to slightly decline over the period of January 2024-December 2027. The aggregate capital expenditure in this sector is forecasted to remain stable over the period of January-2024 to December-2027. In the accommodation and food industries, the forecasted employment generation for women shows a declining trend over the period of January-2024 to December-2027, whereas the forecasted trend for men's employment in the sector stays stable over the same period. The trend for aggregate capital expenditure in this sector also stays stable over the same period.

4.3 Elasticity Calculation Results

Employment elasticity with respect to capital expenditure estimated from CPHS and CAPEX datasets over the period of 2015-22

The employment elasticity with respect to capital expenditure measures the percentage change in employment due to one percent change in capital expenditure. As a sector becomes more capital intensive, it implies that for each unit of output more capital is being engaged and less employment is taking place.

01 The employment elasticity with respect to capital in the overall economy, taking all the industries together, is -2.62 for women and -0.99 for men workers. The elasticities imply that as the capital intensity increases at the aggregate, the job loss would be more than two times for women as compared to men workers.

02 The employment elasticity with respect to capital expenditure in the agricultural sector is -0.35 for women and -0.19 for men workers. Thus, as the agricultural sector gets more capital intensive in the age of automation, it is supposed to displace women workers in lieu of men workers.

03 Similarly, in the transport and construction sectors too, the employment elasticities indicate that with increasing capital intensity, displacement of women workers would be more as compared to men workers.

04 In the manufacturing sector also, the employment elasticities being -4.8 for women workers and -2.32 for men workers imply much higher displacement of women workers as compared to men workers with increasing capital intensity.

05 In the education sector too, higher capital intensity implies higher displacement of women workers as compared to their men counterparts.
(refer to Table 5. Annexure 2 for detailed results)

Section 5

Discussion

As mentioned previously, the reference period used in CMIE refers to the day of the survey, the previous day, and a broader period particularly for those who might not have worked on those specific days, but had employment, in general. On the other hand, PLFS uses four different reference periods: one year, one month, one week and each day of the reference week. Although the CMIE definition seems to be closest to the daily status interpretation of employment, by allowing persons generally employed but might not have worked on the day of survey or the previous day to be identified as employed, it appears to be more similar to UPSS approach using the yearly and monthly reference period. Thus, there is no one single definition of employment which matches perfectly with CMIE definition of employment, giving rise to the divergence in actual estimates and predicted estimates of labour force indicators from PLFS and CMIE datasets.

Again, as we talk about women's workforce participation, literature suggests underestimation of women's workforce participation due to many factors including women's nature of work, simplistic method of capturing economic participation etc (Fletcher et al. 2017; Verick, 2014; Deshmukh et al., 2019). Due to higher sensitivity of women's work to the differences in reference periods and also the phraseology of questions about economic participation, the divergence in labour force estimates are even higher in case of women (Abraham & Srivastava, 2022). In the case of few categories like unpaid family workers, which tends to be underreported in surveys, CMIE is likely to underestimate even more (Abraham & Shrivastava, 2022).

5.1 Analysis of the Trends in Aggregate Forecasted Values

According to the projection estimates, both the men and women workforce participation are expected to decline over the period of January 2024-December 2027. However, the expected decline in the women workforce is steeper than men (Figure 1, Annexure 2). Among the several constraints of women's workforce participation, the high share of domestic responsibilities and care work contributes significantly to women's low workforce participation. The disproportionate burden of unpaid work on women is expected to rise in the coming years due to our ageing population, rising burden of non-communicable diseases, unless the provisioning of care infrastructure is strengthened by the state. Along with the existing challenges to women's workforce participation, the increasing gender gap in aggregate workforce participation is attributed to women lagging behind in technology adoption when automation is taking place in different sectors to different extent at an accelerating pace. The low technology adoption among women is anticipated to lead to women's declining job opportunities unless a concerted effort is taken to upskill them. Besides, the ongoing digitalization drive will lead

to the requirement of workers with digital skills. As the evidence shows that women are lagging much behind their men counterparts in terms of digital knowledge and access to digital infrastructure. Due to this, women often are able to benefit less of the emerging opportunities in the gig economy, as compared to men. Additionally, the rising incidence of violence against women and girls both in public and domestic realm, is another deterrent for women's workforce participation. Also, lack of gender-sensitive investments in workplaces like availability of separate toilet facilities for women, creche facilities, continue to discourage women's workforce participation. Along with the supply-side factors, the demand-side constraints including the employer's negative bias towards women employees, the gender gap in labour market returns also acting as discouraging factors for women's workforce participation.

5.2. A Sector-Specific Analysis of the Forecasted Trends

Given the existing gender-based industrial segregation, the extent of automation and technology adoption differing among different sectors, and the gender gap in technological skills, digging deeper into the forecasted trends for the different sectors is required to formulate sector-specific policies to address the concerns as the job prospects will get affected differently for men and women.

Agriculture and Allied Activities

As indicated by the CAPEX trend (Figure 4, Annexure 2), the capital expenditure in this sector is expected to remain stable, but the negative employment elasticity with respect to capital expenditure points towards the sector being more capital intensive and automated over time. However, the level of automation is expected to affect the employment prospects of men and women differently, as evident from the graphs of the forecasted employment generation for men and women. Women's employment is forecasted to fall at a sharper rate in this sector as compared to men's employment trend. Agriculture and allied activities include both farming and non-farming activities. Whereas the farming activities are related to crop cultivation, the non-farming activities include livestock management i.e goat, piggery, dairy, fisheries and poultry farming etc. The livestock management involves cleaning the animals and sheds, watering the cattle, milking the animals, collecting fodder, preparing dung cakes, and collecting farm yard waste. With large migration of rural men to cities for non-agricultural employment opportunities, rural women are considered to be the backbone of Indian agriculture. With agriculture providing the largest share of employment to rural women, women are involved in a variety of agricultural tasks. Whereas their pre-harvest activities include land preparation, sowing, nursery management, transplanting, weeding, irrigation, fertiliser application, plant protection, harvesting etc, the post-harvest activities include drying, storing, cleaning, washing, grading, packaging etc. Given the types of tasks performed by women, it is important to understand how mechanisation in the agricultural sector will change these tasks.

Agricultural automation involves use of tractors to pull, push or put into action a range of tools which perform the farm operations, for example using harvesters through it; use of sensors, machines, drones, and satellites and other devices such as smartphones, tablets to monitor soil, water and plants to support human-decision making on agricultural tasks; more advanced application

of artificial intelligence such as weeding robots for spraying herbicides with precision, drones to monitor conditions remotely and apply fertiliser, pesticides and treatments. Thus, automation is occurring at three stages of agricultural activities: diagnosis; decision-making, and performing. Under the impact of automation, there would be an increase in demand for drivers, warehouse workers, machine operators, mechanics, office workers and sales, financial specialists, and technology specialists, whereas the demand for family labourers, hired field workers, and supervisors would decline. The estimates from a study suggested that currently 20% of men workers act as controllers of machines and 80% provide the source of muscular power. It was projected that the situation will significantly change in future and by 2020 about 30% of men workers would work as controllers of machines and 70% would work as a source of muscular power. Similarly, the projections for women workers are 5% as controllers of machines and 95% as a source of muscular power (Mehta et al., 2018). Given the segregation of tasks between men and women in the agricultural sector, it is evident that the demand for women workers would decline at a much faster rate as compared to men.

However, to arrest the decline in participation of women workers in agriculture, promoting innovation and use of women-friendly tools and equipment, would be an effective measure. With the changing scenario of farm technologies, more emphasis on developing tools which gives due consideration to the ergonomical differences between men and women, should be there. Many ICAR and other organisations had undertaken ergonomic evaluation of the agricultural tools to examine the suitability of these tools for women workers (Mehta C. R. et al., 2014; Gite, L.P., 2009; Singh, S.P., 2008; Maiti, R., 2004). However, the invention of the women-suitable design of power operated/self-propelled machines, has to be followed by awareness creation, commercialization, and infrastructural support. It is necessary that the tools are made available to the farm women in villages. The state agricultural departments need to take a lead role in this regard. Skill upgradation programmes need to be there with a focus on women workers. Alongside, training the women workers on operation, repair and maintenance of these tools is important. Since, due to the socio-cultural norms, women often feel hesitant to operate the mechanical tools in the field, the training infrastructure should be provided to them in their own environment, or bringing them to training centres located in close proximity to their houses.

Education

The forecasted trends in employment generation for men and women indicate that both men's and women's employment in the education sector are expected to fall over the period of forecasting, with women's employment falling at a sharper rate in this sector (Figure 5, Annexure 2). However, the capital expenditure trend in the education sector shows that it would be stable for most of the period of forecasting. The decline in women's employment might be due to partial automation taking place in this sector and women lagging behind in the required upskilling to catch up with the advancement and also the tasks with women domination getting automated. Women's engagement in this sector includes teaching at various levels of education like pre-school, elementary, basic and secondary, middle school; working as teaching assistants, librarians. For elementary school teachers, automation would reduce the burden of a few tasks like processing data, collecting data, unpredictable physical activities, and managing people. Also, automation would take place partially in sharing lesson plans, managing the inventory system to ensure classroom supplies, machine learning grading system providing immediate feedback to improve writing skills, an integrated tracking system recording students' data including grades and facilitating one-to-one coaching. In the case of men, along with their participation in other activities in this sector, a major chunk of them are engaged as instructional coordinators who won't face much displacement with automation. With most of the women-dominated tasks being automated in the education sector, it is understandable that women employment would decline at a faster rate as compared to men.

Additionally, COVID pandemic has created a need to adapt to online teaching and the transition to online education has become higher over time. Studies focussing on the impact of this transition on teachers' well-being revealed that many faced difficulties in transitioning to an online mode of education due to lack of access to internet connectivity, smart devices, and lack of training for a smooth transition to online teaching (Dayal, 2023) (Minothi, Chitra, 2022). However, due to the high gender gap in digital literacy, access to digital infrastructure, and adoption of digital technologies, women are expected to lag behind in reaping the benefits of a digitalized world (India Inequality Report, 2022), and a higher transition to online education would imply displacement of women educational professionals from the sector. The measures to bridge the digital gender divide, would be effective to address the concern.

Health

In the health sector too, the forecasted trends tell us that both men's and women's employment are anticipated to decline slightly over the period of January 2024- December-2027, with men's share falling at a slightly sharper rate than women's employment (Figure 7, Annexure 2). As we dig deeper into the occupations where men and women are engaged in the health sector, we find that whereas the occupations of physiotherapists, licensed practical and vocational nurses, nurse practitioners, and orderlies are dominated by women, the men-dominated occupations are physical therapists, physician assistants, emergency medical technicians and paramedics and the gender-neutral occupations are psychiatrists, paediatricians, surgeons. Automation would reduce the time spent on applying expertise, collecting data, processing data, managing people, predictable physical activities for the nurses and also the surgeons. It is anticipated that telehealth would enable remote patient-clinician interaction and help to avoid emergency room visits in less acute cases. Digital pre-registration and the use of wearable monitoring devices to collect vital information would reduce the burden of clerical work. The use of autonomous tugs and wheelchairs would again substitute for staff and help to guide and move patients and equipment and thus reduce the demand for physical labour. The introduction of advanced diagnostic tools is expected to reduce the time spent on diagnosis and expedite the lab results and thus lead to a decline in manpower requirement in these tasks, but the effective use of tools would increase the requirement of human resources with technical skills. The AI supported discharge also is expected to reduce the time spent on issuing the reports and informing the patients about medicine and bills and decrease the clerical work. With a large share of routine clerical works made redundant by AI, the recruitment in few men-dominated professions in this sector like physician assistants, physical therapists, would be reduced, whereas the women-dominated professions like nurses, would get less affected due to the emotional and human touch it involves. The AI-led technological advancements are assumed to support and enhance the nursing care by automating certain routine tasks and leverage the intelligent automation, but it won't replace the care-givers as healthcare isn't purely a matter of technology and science and the need for human interaction is crucial for healing the sick.

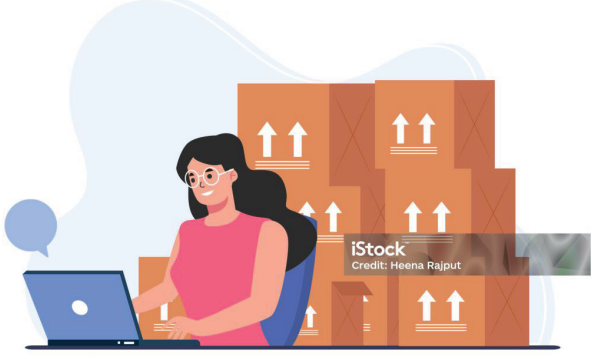
Accommodation and Food

The accommodation and food industry is a labour-intensive one with the employment opportunities being in hotels, restaurants, travel agencies, tourism information offices, shopping outlets, rural inns, guides, cooks etc. As indicated by the trends in forecasted values (Figure 9, Annexure 2), women's employment would fall during the period of January-2024 to December-2027, but men's employment is predicted to remain stable over the same period. According to CAPEX trends, the capital expenditure in this sector is anticipated to remain stable over the period of January 2024 to December 2027. The overall employment in this sector was hard-hit by the slowdown caused by the pandemic (Gerwe, 2021; Xiang et.al, 2021). Women's decreasing participation in this sector often is due to them not being able to defy the prejudices and take up the leadership roles, resulting in lack of

role models in the sector for other women. Another demand-side factor leading to declining women's participation in this sector is technology increasingly replacing human requirements. Although women are emotionally more intelligent and better at anticipating guests' requirements than men and their feminine touch adds to the elegance to the hospitality sector, artificial intelligence taking over many such roles, is leading to the declining trend in forecasted employment for women. Artificial intelligence enhances accommodation services by automation and customization and providing a personalised experience (Samla, et al., 2022). For example, AI technologies like Chatbots and Robots are able to replace human workforce to a large extent.

Wholesale and Retail Trade

The forecasted employment generation in this sector shows rising trends for both men and women, with women's employment trend rising faster than men. Although the traditional Indian retail sector saw a decline during the COVID pandemic, the COVID-19 disruptions also led to a rapid increase in the e-commerce sector with a high penetration of e-commerce in Tier-II and Tier-III cities. According to the CAPEX data, the compound annual growth rate (CAGR) for the wholesale and retail trade sector is 9% for the period of 2014-15 to 2021-22. The growth of the retail sector is riding on several factors like a rising disposable income of the upper and upper-middle income households, increasing urbanisation, exposure of the generation z to the international brands, ease of doing business, and the digital transformation assisting the growth of this sector. With the boom continuing and increasing job opportunities in the retail sector for both men and women, women's increasing participation in entrepreneurial roles, women-led business ventures taking up the e-commerce space, and women's defying the restrictive social norms and entering the jobs in customer-facing services, are expected to lead to a steeper rise in their employment in this sector over time than men.



Information and Communication

As indicated by the trend in forecasted values, both the men and women employment generated in this sector are anticipated to decline over the period of 2024-2027, with women's share declining at a faster pace (Figure 15, Annexure 2). The capital expenditure in this sector shows a stable trend for the coming years. The information and communication sector include two sub-sectors, namely the information technology and information technology-enabled services. The declining trend in women's participation might be more due to supply-side constraints. The share of women pursuing STEM (Science, Technology, Engineering, and Management) is already less than men and even among those undertaking STEM, more women are observed to opt for life sciences in comparison to courses on technology. An inadequate supply of skilled women for this sector might be a factor behind women's declining share in this sector. Specifically, in the ICT sector, often the lack of understanding about the sectoral job opportunities, gender stereotyping, and lack of women role models lead to discouraging women's participation in the sector (Dimitriadi, 2013; Bernhardt 2014; Fisher et al., 2015; Castano and Webster, 2011; Ferreira, 2017; Clayton et al., 2009). Alongside, the recruitment and promotional process in this sector require continuous updation of the technical skills of the professionals needing constant refresher training, long unpredictable working hours; need for remote working on client premises, which women often find challenging due to their high commitment to household responsibilities (Morgan 2012; Warne et al., 2011; Ahuja 2002). Additionally, the career breaks due to childbearing responsibilities,

marriage, and other family obligations hampers progression in the job ladder more significantly in this sector as compared to other sectors (Burke et al., 2000; Griffiths et al., 2006).

Manufacturing

Manufacturing is the most labour-intensive sector with the highest potential of labour absorption. However, the growth of the sector in the past has not been encouraging leading to a slump in the sector's ability to create employment. That has also had its impact on how women engaged in manufacturing. The forecasted trends indicate that both men's and women's employment would decline in this sector, whereas women's employment would fall at a steeper rate (Figure 17.A, Annexure 2).

Women are affected differently from men in the sector as they remain concentrated in select and fewer sectors in comparison to the men workers. Women are majorly employed in apparel, textile, leather, food and tobacco. On the other hand, the share of women in the faster growing sectors like chemical and chemical products, rubber and plastics, pharmaceuticals and medicinal products, basic and fabricated metals, other non-metallic minerals, automobile industries and repair of motor vehicles, computer and opticals etc are quite low. women-dominated sectors like textile industries are anticipated to slow down due to India's shrinking share in the global market of textile export with the lack of free trade agreements and increase in peer competitiveness (for example, Vietnam, Bangladesh) being the major factors. The lack of diversification in terms of industry and also occupation would explain a major part of the decline in women's employment in the manufacturing sector. The barriers to avail of the job opportunities in the sub-sectors like automobile industries, computer and opticals, engineering sector, chemical and chemical products, often consist of lack of skilling, gender-stereotyping and employers' negative bias towards women, lack of women role models in these sectors (ICRW, 2020; cite). Studies suggest that women's enrolment in the it is would be much higher in the traditional sectors where the job losses are much more likely in the coming years (EY and FICCI, 2016). The lack of skilling efforts both from the demand and supply-side is leading to a gendered structure across the economy including the manufacturing sector (Gothoskar, 2016).

Automation is also supposed to play a role in declining women's employment in this sector as according to the forecasted values, there would be an increasing trend of capital expenditure over the same period (Figure 17.B.1 in Annexure 2). A large share of women is often engaged in the repetitive low-end jobs like packaging and labelling of products, record keeping etc, and the introduction of low-cost technologies would reduce the demand for these workers in this sector (Madgavkar et al., 2019; McKinsey Report, 2020). Although men workers are also involved in routine physical works which technology can replace, but given the low-wage for these tasks in India and the relatively costlier investment in heavy machinery needed to replace these workers, automation is expected to cause less displacement of men workers as compared to women workers in this sector. Given the complexity of the sector, it is important to engage in a sub-sectoral analysis.

A Sub-sectoral Analysis of the Manufacturing Sector

Among the sub-sectors in the manufacturing sector, in the footwear and leather industry, women employment shows an upward trend whereas men employment appears to decline slightly (Figure 17.A.2, Annexure 2). This upward trend in the footwear and leather industry can be due to its labour-intensive nature which requires a significant amount of manual labour and attention to detail which are often suited for women. Also, this industry requires intricate handwork, stitching, embroidery, and embellishments which often aligns with the skills possessed by many women. This is further accompanied by the effective implementation of the Indian Footwear and Leather Development Programme (IFLDP) which has directly benefited women's employment generation through developing infrastructure and skill enhancement.

In the gems and jewellery sector, both men's and women's employment are anticipated to decline slightly (Figure 17.A.3, Annexure 2). This industry

is capital-intensive and the forecasted decline in both men's and women's employment engagement can be attributed to the rapid adoption of artificial intelligence in jewellery manufacturing. In an era of technology and automation, the jewellery industry is embracing the technologies in various ways like AI algorithms analysing the latest fashion trends, customer preferences and then using the historical jewellery pieces to generate innovative designs, AI scrutinising gems for quality assessment, and even AI-driven logistics in the sector.

In the handicraft industry, both men and women employment are expected to decline as the industry gets automated and substituted with machine-made modern products (Figure 17.A.4, Annexure 2). In addition to automation leading to a decreased demand for manual labour, the drop in both men's and women's employment in the sector is also linked to the supply-side factors as the informal nature of jobs, lack of decent work conditions, lack of professional growth etc act as the discouraging factors.

In the case of machinery manufacturing, the trend in women's employment is rising moderately over the period of 2024-2025 and then it declines over the period of 2025-2027. The trend in men's employment stays stable/marginally declines over the period (Figure 17.A.5, Annexure 2). The forecasted trends show an increasing trend for capital expenditure for this sector over the time period, indicating increasing automation in the sector (Figure. 17.B.1 in Annexure 2). Thus, along with the rising automation replacing women more than men, this increased gender gap can be explained by the lack of technical education and skills among women perpetuated by traditional gender stereotypes and negative employer's biases against women. The other constraints include masculinised work space, coupled with physically laborious work and safety concerns in the workplaces which are often not considered suitable for women.

In the pharmaceutical industry, both men's and women's employment are forecasted to decline moderately over the period (Figure 17.A.7, Annexure 2). In line with the fast-paced adoption of technology across the sectors, manufacturers in the pharmaceutical sector too are introducing automation, digitization, and advanced technologies in the production process, business models, replacing the labour requirements in few works like manual data entry. The influx of digital technologies would lead to an integration of smart sensors, advanced analytics which are expected to optimise operational efficiency and enhance product quality control but at the same time causing the decline in employment generation.

In the soap and detergent industry, both men's and women's employment are forecasted to rise over the period of 2024-2027, with men's employment rising at a faster rate (Figure 17.A.8, Annexure 2). The rising employment in this sector is driven by the growing population, increasing urbanisation, the changing lifestyle patterns leading to an increase in demand for cleaning and hygiene products. Additionally, the government's initiatives of promoting cleanliness and awareness of hygiene among the rural population and also the growth in the export market lead to the growing employment generation in this sector.

In the textile industries too, both men's and women's employment are forecasted to fall, but women's employment is forecasted to decline more sharply as compared to men (Figure 17.A.9, Annexure 2). According to the forecasted CAPEX values, the capital expenditure in this sector is forecasted to rise over the time period. This might be due to increasing automation in this sector. In addition to the rising automation affecting women more than men, this decline in women's workforce can be attributed to the concentration of women in certain occupations within the industry such as embroidery or stitching, which is often less paying work and discouraging women to engage further in this industry. Also, the wage gap, exploitative labour practices, particularly in the informal sector, and underrepresentation of women in higher-paid positions discourages women's engagement in these industries.

Table 4: Summarises the analysis of the forecasted trends of employment for men and women across the sectors

Trends	Forecasted Employment trends	CAPEX trends	Reasons
Aggregate Trends for Men and Women in the Economy	◆ Decline for both men and women ◆ Steeper decline for women		◆ Automation and digitalization leading to replacing labour requirements ◆ Employer's negative bias, less share of women in fast-growing sectors ◆ Supply-side constraints expected to rise for women due to ageing population, rising burden of non-communicable diseases, rising incidence of gender-based violence, gender gap in technological and digital skills
Agriculture and Allied Activities	◆ Decline for both men and women ◆ Sharper decline for women	Steady trend	◆ Automation would increase the demand for certain jobs like machine operators, technology specialists, warehouse workers, financial specialists ◆ Automation would cause decline in demand for family labourers, field workers etc ◆ The current segregation of tasks would lead to a decline in demand of women workers at a faster rate
Education	◆ Decline for both men and women ◆ Sharper decline for women	Steady trend	◆ Automation in sharing lesson plans, managing the inventory system, grading system, integrated tracking system would displace women more because of their higher engagement in these tasks
Wholesale and Retail Trade	◆ Increase for both men and women ◆ Sharper increase for women		◆ Boom in the retail sector due to rapid urbanisation, rising consumerism among the upper-income quintiles, adoption of digital transactions increasing the ease in business ◆ Women-led business ventures increasingly taking up the e-commerce space
Health	◆ Decline for both men and women ◆ Sharper decline for men	Steady trend	◆ Automation would reduce the time spent on collecting and processing data, managing people, and predictable physical activities ◆ Telehealth promoting remote patient-clinician interaction and avoid visit in less acute cases ◆ Digital pre-registration and the use of monitoring devices collect vital information reducing the burden of clerical work

Trends	Forecasted Employment trends	CAPEX trends	Reasons
			• Advanced diagnostic tools reduce the time spent on diagnosis and expedite the lab results leading to a decline in manpower requirement • The AI-supported discharge and the use of autonomous tugs and wheelchairs would again substitute for the staff • Women-dominated professions like nurses get less affected due to its non-substitutability because of the emotional and human touch it involves
Accommodation and Food	• Decline for women • Stable trend for men	Steady trend	• AI technologies like Chatbots and Robots are able to replace human workforce to some extent • Lack of role models for women adding to the existing challenges
Information and Communication	• Decline for both men and women • Slightly sharper decline for women	Steady trend	• Less women pursuing STEM • Career breaks due to marriage, childbearing hampering promotional opportunities more in this sector thus discouraging women to enter the sector • The requirement of continuous updation of technical skills in the sector creating challenges due to their higher domestic responsibilities
Finance	• Decline for both men and women • Steeper decline for women	Steady trend	• Lack of role models • gender stereotypes leading to less women pursuing this sector for job opportunities • employers' negative bias • lack of flexibility
Manufacture	• Decline for both men and women • Steeper decline for women	Increasing trend	• Women's share very low in fastest growing sectors like chemical and chemical products, pharmaceuticals, basic and fabricated metals, automobile industries, repair of motor vehicles, computer and opticals etc due to lack of skilling, gender-stereotyping and employer's negative bias • Women-dominated sectors like textile industries anticipated to slow down due to India's shrinking share in the global market of textile export due to free-trade agreements and peer-competitiveness

Trends	Forecasted Employment trends	CAPEX trends	Reasons
			• Women engaged in repetitive low-end jobs in manufacturing sector would get replaced with the introduction of low-cost technologies • Displacing men from the routine tasks would require costlier investment in machineries causing less displacement of men as compared to women
Sub-sectoral analysis in the manufacturing sector			
Footwear and Leather Industry	• Increase in women's employment • Stable trend in men's employment	NA	• Indian Footwear and Development Programme directly contributing to women's employment through developing infrastructure and skill development • Intricate handwork, stitching embroidery, and embellishments are often aligned with the skills possessed by many women
Gems and Jewellery Sector	• Slight decline for men and women	NA	• Rapid adoption of AI in jewellery manufacturing i.e use of AI in innovative designs, quality assessment of gems, and logistics
Handicraft Industry	• Decline in men's and women's employment trends	NA	• Automation and substitution with machine-made modern products leading to decline in employment • Informal nature of jobs, poor working conditions discouraging workers
Machinery Manufacturing	• Decline in women's employment over 2025-27 • Men's employment trend stable	• Increasing trend	• Lack of technical education for women • Employer's negative gender bias • Masculinised workplace and safety concerns
Pharmaceutical Industry	• Decline in both men's and women's employment	NA	• Digital technologies in the production process, business models reducing the labour requirements in the sector
Soap and Detergent	• Increase for both men and women • Faster increase for men	NA	• Rapid urbanisation, increasing awareness of hygiene and cleanliness due to changing lifestyle and government's initiatives to promote so in rural areas • Increasing export demand leading to expansion in the sector
Textile Industry	• Decline for both men and women • Faster decline for female	Increasing trend	• Occupational segregation leading to women's concentration in low-paid jobs • Discriminatory labour practices against women leading to discouraging women to join the sector

*For few of the sub-sectors of manufacturing, lack of perfect concordance between CAPEX and CPHS industries is the reason behind non-availability of CAPEX models for those sub-sectors.

Section 6

Summary

The forecasting exercise reveals that in case of the wholesale and retail industries, both women's and men's employment are expected to rise with women's employment rising at a faster rate; in health sector, both men's and women's employment would be falling slightly over the period; in accommodation and food industries, women's employment shows a declining trend with men's employment being stable; and in most of the other major employment generating sectors like agriculture, manufacturing, finance, education, both the men's and women's employment are forecasted to decline with women's employment falling at a faster rate than men's. However, in the footwear and leather industry and the soap and detergent industry, two of the sub-sectors in manufacturing, women's employment is forecasted to rise.

The trends show that including women in employment is an uphill task in the near future with the right kind of policy backed by adequate investments in the sectors. The sectoral analysis provides us the scope of a sector-specific policy framework. Here are a few recommendations mentioned below to arrest the declining women employment trend.

Facilitate Growth of the Sectors with Rising Women Employment

As the forecasted trends show that the wholesale and retail trade sector would become a significant contributor to women's employment, measures to facilitate the growth of this sector and ensuring quality of employment in terms of better wages, job security, social security benefits in this sector, would enhance women's participation and quality of their engagements. The Indian retail sector consists of the organised and unorganised part being determined on the basis of enterprise type, turnover, working conditions etc. As the unorganised retail sector is characterised by lack of labour laws, lack of gender-friendly workplace infrastructure, irregular income, casualization of labour etc, ensuring better working conditions and labour market returns for the unorganised sector workers through a legal framework, would not only benefit the women workers here but also enhance women's participation at a faster rate. Also, women's increasing participation in the sector through the e-commerce space has to be leveraged through a multifaceted approach which include reducing the gender gap in digital access and technologies, providing skill-training and financial support etc.

Within the manufacturing sector, women's employment is forecasted to rise in two sub-sectors, soap and detergent and footwear and leather industry. The Indian Footwear and Leather Development Programme scheme which aims at developing the infrastructure, addressing the environmental concerns, facilitating investments, promoting quality employment generation especially among women, needs to be strengthened through more fund allocation and efficient use of the funds. Also, the availability of raw materials has to be enhanced for the smooth operations of the sector. As

mentioned before, the rising awareness about health and hygiene and growing urbanisation are causing increasing product demand thus rising employment trends in the sector for both men and women. To facilitate the growth of this sector, there is a need for continuous product innovation among the Indian companies. For example, these are opportunities due to the growing demand for environment-friendly, organic products and measures to tap this market should be taken by the Indian firms. Since the sector is monopolised by a few firms, the micro and small enterprises engaged in this sector need to be promoted through support in product design, marketing strategies etc.

Invest in Skill-building Efforts

With more automation and digitalization of the economy, the traditional sectors like agriculture and different sub-sectors of manufacturing like handicraft, textile, gems and jewellery sector which have a high presence of female workers, are supposed to face more job losses because of being sectors dominated with manual jobs. Also, in sectors like education and health where a high share of women workers is present, automation is leading to job losses. As a consequence, women face higher risks of job losses as compared to their male counterparts.

In case of the agricultural sector, training women on use of the agricultural equipment and tools which automation involves, like use of sensors, machines, drones, satellites and other devices such as smartphones, tablets and advanced application of artificial intelligence for various agricultural tasks, would arrest the decline in women's participation and ensure quality employment opportunities for them in this sector.

In the case of the manufacturing sector, with the advent of the 'Make in India' initiative aiming to double India's manufacturing focussed employment potential, the skill-training programmes should consider the changes in demand for different jobs/tasks in the sector. To arrest the decline in women's employment, the skilling landscape has to shift its focus from training women for the traditional livelihoods to skilling them for the non-traditional sectors as the shifting job landscape implies newer jobs being created requiring newer skill-sets in these non-traditional sectors (EY, 2020; Madgavkar et al., 2019; Empower, 2010). Training women for the fast-growing sub-sectors like the chemical and chemical products, rubber and plastics, pharmaceutical and medicinal products, basic and fabricated metals, other non-metallic minerals, automobile industries, repair of motor vehicles, computer and optical, would be effective.

In the accommodation and food sector, getting women trained in the artificial intelligence technologies like Chatbots and Robots, would open up new job opportunities for women in this sector because of the continuous automation drive faced by the sector. In the finance sector too, there is an increasing use of artificial intelligence in various activities like credit-scoring. Thus, upskilling women with artificial intelligence would lead to increased job opportunities for them in this sector.

In the education sector, women-dominated tasks being automated leads to a faster decline in women's employment as compared to men's employment in this sector. However, encouraging women to enter the men-dominated occupations in this sector like instructional coordinators which are to some extent insulated from automation, providing the upskilling to women to catch up with the automation drive, and providing the digital skills to women to enable them to benefit from the job opportunities in the digitised education sector, would be effective to arrest the decline in women's employment in this sector. Similarly, in the health sector too, updating women with the AI-led technological advancements would open up opportunities in telehealth and other emerging opportunities in this sector.

Along with the skill-training initiatives driven by the government, the private sector's engagement has to be leveraged to advance the efforts of skill-training in NTL sectors. In the skilling ecosystem, a greater focus has to be on employer-driven prioritisation of skills (IWWAGE Policy Brief; Ghosh, 2022). Few of the private sector's skill-training initiatives for women in non-traditional sectors are i) Women

on Wheels by Azad Foundation to help resource-poor women to become professional drivers; ii) TechSaksham by Microsoft aiming to skill women in the disciplines of web designing, digital marketing, cloud computing and artificial intelligence; iii) Archana Women's Centre's initiatives in training women in activities like construction, plumbing, electric work etc; iv) SMART initiative by Tech Mahindra Foundation offering advanced courses in areas of healthcare, digital technologies, logistics, and supply chain management. The success stories of these initiatives should be highlighted for up-scaling these programmes and encouraging more and more private sector's participation in these kinds of programmes.

Along with providing training to women for the fast-growing non-traditional sectors where women's presence is still low, other complementary measures should include reskilling opportunities for the mid-career women who needs to return to the workforce or switch their occupations due automation taking over the previous tasks performed by them; the transition costs which involves the reskilling, childcare subsidies for parents undergoing reskilling or pursuing higher education, have to be subsidised by the government and the corporates etc.

Promote STEM Courses among Girls, Reduce Gender Stereotypes among the Employers

Given the gender-based sectoral and occupational segregation, there is a need to increase public visibility of women role models in men-dominated sectors and occupations. Women's representation in STEM courses has to be increased since in the age of automation job prospects are expected to be more for people trained in these streams. To promote women's increased enrolment in these courses, effective measures should include increasing exposure to STEM opportunities for girls and women, offering internships, apprenticeship, and mentoring programmes for women in STEM, and sponsoring of women pursuing advanced degrees in STEM etc. However, along with equipping women with the skills needed for the technical jobs, employers' negative bias for women in the growing sectors like ICT, engineering and architecture, computer and opticals, has to be changed. The gender-based discrimination faced in obtaining a job opportunity, performance evaluation, and career progression in masculinized sectors like ICT, engineering etc often discourages women to plan a career path in these sectors (Dimitriadi, 2013; Bernhardt 2014; Fisher et al., 2015; Castano and Webster, 2011; Ferreira, 2017; Clayton et al., 2009). Along with the gender stereotyping for the industry of employment, women face the brunt of gender stereotyping while entering few occupations too. The negative impact of gender stereotyping often hampers women's selection and career progression in managerial and leadership positions. Studies found that characteristics indicating leadership abilities like competitiveness, self-confidence, objectivity, aggressiveness, authoritativeness are often perceived to be associated with men. The feminine characteristics like being affectionate, sympathetic, and interpersonally sensitive are often assumed to be barriers to be a strong leader (Koenig et al., 2011; Kang, 2012; Eagly and Carli, 2007; Brescoll, 2016).

Address the Social Norms and Safety Concerns

The disproportionate share of unpaid work responsibilities often act as a supply-side constraint for women's workforce participation. In the coming years the unpaid work responsibility is expected to increase due to an ageing population and rising burden of non-communicable diseases. To enable a higher participation of women in economic activities,

strengthening of the state provisioning of care facilities would be much needed. Additionally, employers' policy changes to promote flexible working hours, hybrid mode of work, and telecommuting work options are expected to enhance women's workforce participation. Other supply-side constraints are women's safety concerns at public spheres and unavailability of safe and affordable transportation. Studies have shown the significance of accessible, reliable, and safe transportation enabling women to accept job opportunities beyond their immediate vicinity and increase their workforce participation (Uteng, 2011; Peters, 2013; Chaturvedi, Sahai, 2019; Dobbs, 2007). Incentivising more women to join the transportation system as bus drivers/ conductors, introducing more women-only options in the public transport system, implementing free public transport for women, popularising apps like Safetipin which guides women to choose the safest route for commuting, increasing police patrolling in the identified unsafe places, could be effective measures to women's perception of safety in public transport. Along with these steps, raising awareness about gender violence, and strict grievance redressal mechanisms, would enhance women's safety and facilitate their workforce participation. In addition to enhancing safe transportation, ensuring a safe and gender sensitive environment at the work premise is also very important to increase women's workforce participation. With the amendment in 2014 to the Factories act, 1948 allowing women to work on night shifts provided that the employers ensure safe workplaces, women's employment opportunities increased significantly in the special economic zones, textiles, garments, handicrafts, leather, and the IT sector (Night shift for women: Growth and opportunities: ASSOCHAM). However, encouraging women workers to take up the jobs with night shifts and also convincing their families for this, needs a concerted effort of governments, the State Transport Corporations, the NGOs, the employers, to enhance women's safety in both workplaces and while commuting.

Promoting Access to Digital Technologies

In addition to addressing the gender gap in digital skills, measures are needed to increase women's access to digital devices and internet infrastructure, as women lag behind men in the possession of digital devices like smartphones etc. Given the enormous employment opportunities in the emerging gig economy encompassing different sectors like education, health etc; the forecasted trends showing increasing employment prospects in the wholesale and retail sector through expansion of the e-commerce space; increasing application of digital technologies in the production process of the pharmaceutical sector; increasing use of digital technologies to improve business operations, enhance customer experiences, creating new products and services etc. and digitization of the finance leading the expansion of the fintech sector; access to digital devices and internet infrastructure are going to be crucial enablers for facilitating women's participation in the economy.

References

1. Alfaki, M. M. A., & Masih, S. B. (2015). Modelling and Forecasting by using Time Series ARIMA Models. International Journal of Engineering Research and Technology, V4(03). https://doi.org/10.17577/ijertv4is030817
2. Alyahya, M., & Hadwan, M. (2022). Applying ARIMA Model to Predict Future Jobs in the Saudi Labor Market. International Research Journal of Innovations in Engineering and Technology (IRJIET), 6(4), 1–8.
3. Aynalem, S., Birhanu, K., & Tesefay, S. (2016). Employment Opportunities and Challenges in Tourism and Hospitality Sectors. Journal of Tourism and Hospitality, 05(06). https://doi.org/10.4172/2167-0269.1000257
4. Bagshaw, M. L. (1987a, June). Univariate and Multivariate ARIMA versus Vector Autoregression Forecasting. https://fraser.stlouisfed.org/files/docs/historical/frbclev/wp/frbclv_wp1987-06.pdf
5. Bagshaw, M. L. (1987b, December 1). Estimating Multivariate ARIMA Models: When is Close Not Good Enough? https://www.clevelandfed.org/en/publications/working-paper/1987/wp-8711-estimating-multivariate-arima-models--when-is-close-not-good-enough
6. D. Walsh, W. (1982). A Time Series Analysis of Female Labour Force Participation Rates Disaggregated by Marital Status. Industrial Relations, 37(2), 367–384. http://id.erudit.org/iderudit/029259ar
7. Dai, J., & Chen, S. (2019). The application of ARIMA model in forecasting population data. Journal of Physics, 1324(1), 012100. https://doi.org/10.1088/1742-6596/1324/1/012100
8. Dangal, R. (2021). Impact of Globalisation on Women Workers in the Agricultural Sector: An Analysis. Indian Journal of Law and Justice, 12(2), 269–278. https://ir.nbu.ac.in/bitstream/123456789/4215/1/Journal%20Section_SEPTEMBER%202021%20VOL.%2012%20NO.%202%20_18.pdf
9. Didiharyono, D., & Ismail, N. (2018). Forecasting Model with Box-Jenkins Method to Predict the Number of Tourists Visiting in Toraja. JEMMA (Journal of Economic, Management and Accounting), 1(1), 62. https://doi.org/10.35914/jemma.v1i1.75
10. Didiharyono, & Syukri, M. (2020). Forecasting with ARIMA Model in anticipating open unemployment rates in South Sulawesi. International Journal of Science and Technology Research, 9(3), 3838–3841.
11. FAO. (2022). The State of Food and Agriculture 2022. In FAO eBooks. https://doi.org/10.4060/cb9479en
12. Hyndman, R. J. (2001, May). Box-Jenkins modelling. https://robjhyndman.com/. https://robjhyndman.com/papers/BoxJenkins.pdf

13. Ismail, N., Ramzi, N. A., & Mah, P. J. W. (2022). FORECASTING THE UNEMPLOYMENT RATE IN MALAYSIA DURING COVID-19 PANDEMIC USING ARIMA AND ARFIMA MODELS. Malaysian Journal of Computing, 7(1), 982. https://doi.org/10.24191/mjoc.v7i1.14641
14. Januri, S. S., Nasir, N., Malek, I. A., & Yasin, Z. a. M. M. (2022). Forecasting Unemployment Rate in Malaysia Using Box-Jenkins Methodology during Covid-19 Outbreak. International Journal of Academic Research in Business & Social Sciences, 12(7). https://doi.org/10.6007/ijarbss/v12-i7/13164
15. Khongji, P., & Nongkynrih, D. (2018). Labour Supply and Unemployment Projections for North East India (2011 - 2031). Arthshastra : Indian Journal of Economics & Research. https://doi.org/10.17010/aijer/2018/v7i6/141432
16. Kumari, R. V., Ramakrishna, G., Panasa, V., & Sreenivas, A. (2019). An application of ARIMAX model for forecasting of castor production in India. 36(4), 244–249.
17. Lip, N. M., Rizuan, N. L. N. M., Iezudin, N. I., Mohamad, N. I., Rasyid, N., Hassan, F. A., & Ithnin, H. (2021). Comparative study of smoothing methods and box-jenkins model in forecasting unemployment rate in Malaysia. Journal of Science and Technology, 4(1). https://ir.uitm.edu.my/id/eprint/46118/
18. Liu, Z., Zhu, Z., Gao, J., & Xu, C. (2021). Forecast Methods for Time Series Data: A Survey. IEEE Access, 9, 91896–91912. https://doi.org/10.1109/access.2021.3091162
19. Marois, G., Zhelenkova, E., & Ali, B. (2022). Labour Force Projections in India Until 2060 and Implications for the Demographic Dividend. Social Indicators Research, 164(1), 477–497. https://doi.org/10.1007/s11205-022-02968-9
20. McKinsey. (2019). The future of women at work: Transitions in the age of automation. mckinsey.com. https://www.mckinsey.com/~/media/mckinsey/featured%20insights/gender%20equality/the%20future%20of%20women%20at%20work%20transitions%20in%20the%20age%20of%20automation/mgi-the-future-of-women-at-work-exec-summary-july-2019.pdf
21. McKinsey. (2020). India's turning point: An economic agenda to spur growth and jobs. mckinsey.com. https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/India/Indias%20turning%20point%20An%20economic%20agenda%20to%20spur%20growth%20and%20jobs/MGI-Indias-turning-point-Executive-summary-August-2020-vFinal.pdf
22. Mehta, B. S. (2015). A Decent Work Framework: Women in the ICT sector in India. Information Development, 1–12. https://doi.org/10.1177/0266666915623249
23. OECD. (2021). Artificial Intelligence and Employment: NEW EVIDENCE FROM OCCUPATIONS MOST EXPOSED TO AI. www.oecd.org. http://www.oecd.org/future-of-work/
24. Mitra, Sona 2018. Dynamics of women's employment in India 1993-94 to present, Unpublished Ph.D. thesis, JNU, New Delhi
25. Pankratz, A. (1983). Forecasting with Univariate Box - Jenkins Models: concepts and cases. In Wiley eBooks. http://ci.nii.ac.jp/ncid/BA00856978
26. Peter, D., & Silvia, P. (Eds.). (n.d.). ARIMA vs. ARIMAX – which approach is better to analyse and forecast macroeconomic time series? Proceedings of 30th International Conference Mathematical Methods in Economics. http://mme2012.opf.slu.cz/proceedings/pdf/024_Durka.pdf
27. Sirohi, S., & Verma, U. (2016). ARIMA versus ARIMAX modelling for sugarcane yield prediction in Haryana. International Journal of Agricultural and Statistical Sciences, 12(2), 327–334. https://www.cabdirect.org/cabdirect/abstract/20173041746

28. Zhang, G. (2003). Time series forecasting using a hybrid ARIMA and neural network model. Neurocomputing, 50, 159–175. https://doi.org/10.1016/s0925-2312(01)00702-0

29. Chaudhury, Ruchika (2021). Working or Not: What determines women's labor force participation in India?, IWWAGE Working Paper

30. Klasen & Pieters (2013). What explains the stagnation of female labor force participation in urban India?, IZA Discussion Paper No. 7597

31. Kapsos, S., A. Silberman and E. Bourmpoula (2014). Why is female labour force participation declining so sharply in India?, ILO Research Paper, No. 10

32. Fletcher, E., R. Pande and C.M.T Moore, 2017. Women and work in India: Descriptive evidence and a review of potential policies. SSRN Electronic Journal.

33. Verick, S. (2014). Women's labour force participation in India: Why is it so low?. International Labour Organization

34. Deshmukh, Neerad, Sonalde Desai, Santanu Pramanik, Dinesh Tiwari. 2019. 'Improving measurement of women's work participation: Sensitivity of work participation to questionnaire design.' NCAER Data Innovation Centre Measurement Brief No. 2020-1. NCAER, New Delhi

35. Abraham, Rosa & Srivastava, Anand (2022). How comparable are India'a labour market surveys?. The Indian Journal of Labour Economics

Annexures

Annexure 1

Table 1: Distribution of women workers across the broad three sectors

	Rural			Urban		
	Primary	Secondary	Tertiary	Primary	Secondary	Tertiary
2004-05	83.2	10.17	6.63	17.7	32.59	49.71
2011-12	74.94	16.74	8.32	10.91	33.98	55.11
2017-18	73.19	13.69	13.13	9.07	30.13	60.81
2018-19	71.06	15.31	13.63	7.81	29.18	63.01
2019-20	75.72	13.12	11.16	8.19	28.03	63.78
2020-21	75.37	13.36	11.27	10.38	28.07	61.55

Source: National Sample Survey Employment Unemployment rounds and Periodic Labour Force Survey Rounds

Table 2: Distribution of women workers across different industries in the primary, secondary and tertiary sector

Industry (NIC 2-Digit)	2017-18		2022-23	
	Rural	Urban	Rural	Urban
Crop and animal production, hunting and related service activities (1)	73.0%	8.9%	75.8%	11.6%
Forestry and logging (2)	0.1%	0.0%	0.2%	0.1%
Fishing and aquaculture (3)	0.1%	0.1%	0.1%	0.0%
Mining of coal and lignite (5)	0.0%	0.1%	0.0%	0.0%
Extraction of crude petroleum and natural gas (6)	0.0%	0.0%	0.0%	0.0%
Mining of metal ores (7)	0.0%	0.0%	0.0%	0.0%
Other mining and quarrying (8)	0.2%	0.1%	0.0%	0.0%
Mining support service activities (9)	0.0%	0.0%	0.0%	0.0%
Manufacture of food products (10)	0.6%	1.9%	0.5%	2.0%
Manufacture of beverages (11)	0.1%	0.1%	0.1%	0.0%

Industry (NIC 2-Digit)	2017-18		2022-23	
	Rural	Urban	Rural	Urban
Manufacture of tobacco products (12)	2.6%	3.4%	1.8%	2.5%
Manufacture of textiles (13)	1.4%	5.5%	1.2%	3.7%
Manufacture of wearing apparel (14)	2.1%	7.9%	3.1%	9.4%
Manufacture of leather and related products (15)	0.1%	0.4%	0.0%	0.6%
Manufacture of wood and products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials (16)	0.3%	0.6%	0.3%	0.3%
Manufacture of paper and paper products (17)	0.1%	0.2%	0.0%	0.4%
Printing and reproduction of recorded media (18)	0.0%	0.2%	0.0%	0.2%
Manufacture of coke and refined petroleum products (19)	0.0%	0.0%	0.0%	0.0%
Manufacture of chemicals and chemical products (20)	0.1%	0.4%	0.1%	0.6%
Manufacture of pharmaceuticals, medicinal chemical and botanical products (21)	0.0%	0.2%	0.0%	0.6%
Manufacture of rubber and plastics products (22)	0.0%	0.5%	0.0%	0.4%
Manufacture of other non-metallic mineral products (23)	0.4%	1.0%	0.5%	0.4%
Manufacture of basic metals (24)	0.0%	0.2%	0.0%	0.1%
Manufacture of fabricated metal products, except machinery and equipment (25)	0.0%	0.3%	0.1%	0.3%
Manufacture of computer, electronic and optical products (26)	0.0%	0.3%	0.0%	0.1%
Manufacture of electrical equipment (27)	0.0%	0.5%	0.0%	0.2%
Manufacture of machinery and equipment (28)	0.0%	0.2%	0.0%	0.2%
Manufacture of motor vehicles, trailers and semi-trailers (29)	0.0%	0.3%	0.0%	0.1%
Manufacture of other transport equipment (30)	0.0%	0.1%	0.0%	0.2%
Manufacture of furniture (31)	0.2%	0.0%	0.0%	0.0%
Other manufacturing (32)	0.0%	1.1%	0.4%	1.6%
Repair and installation of machinery and equipment (33)	0.0%	0.1%	0.0%	0.0%
Electricity, gas, steam and air conditioning supply (35)	0.0%	0.2%	0.0%	0.2%
Water collection, treatment and supply (36)	0.0%	0.0%	0.0%	0.0%
Sewerage (37)	0.0%	0.1%	0.0%	0.0%
Waste collection, treatment and disposal activities; materials recovery (38)	0.0%	0.3%	0.1%	0.2%
Remediation activities and other waste management services (39)	0.0%	0.0%	0.0%	0.0%
Construction of buildings (41)	2.5%	2.8%	2.2%	2.6%
Civil engineering (42)	2.8%	1.0%	2.0%	0.3%
Specialised construction activities (43)	0.1%	0.3%	0.0%	0.2%
Wholesale and retail trade and repair of motor vehicles and motorcycles (45)	0.1%	0.3%	0.0%	0.4%
Wholesale trade, except of motor vehicles and motorcycles (46)	0.1%	1.1%	0.1%	1.1%
Retail trade, except of motor vehicles and motorcycles (47)	2.9%	8.8%	3.3%	10.5%
Land transport and transport via pipelines (49)	0.1%	0.4%	0.0%	0.2%
Water transport (50)	0.0%	0.1%	0.0%	0.1%
Air transport (51)	0.0%	0.0%	0.0%	0.0%

Industry (NIC 2-Digit)	2017-18		2022-23	
	Rural	Urban	Rural	Urban
Warehousing and support activities for transportation (52)	0.0%	0.1%	0.0%	0.2%
Postal and courier activities (53)	0.1%	0.2%	0.0%	0.2%
Accommodation (55)	0.1%	0.4%	0.0%	0.3%
Food and beverage service activities (56)	0.9%	2.5%	0.7%	3.0%
Publishing activities (58)	0.0%	0.2%	0.0%	0.1%
Motion picture, video and television programme production, sound recording and music publishing activities (59)	0.0%	0.0%	0.0%	0.0%
Broadcasting and programming activities (60)	0.0%	0.1%	0.0%	0.0%
Telecommunications (61)	0.0%	0.3%	0.0%	0.2%
Computer programming, consultancy and related activities (62)	0.1%	1.4%	0.1%	3.9%
Information service activities (63)	0.0%	0.5%	0.0%	0.5%
Financial service activities, except insurance and pension funding (64)	0.2%	2.0%	0.1%	1.6%
Insurance, reinsurance and pension funding, except compulsory social security (65)	0.0%	0.2%	0.0%	0.4%
Other financial activities (66)	0.0%	0.4%	0.0%	0.3%
Real estate activities (68)	0.0%	0.1%	0.0%	0.2%
Legal and accounting activities (69)	0.0%	0.9%	0.0%	0.8%
Activities of head offices; management consultancy activities (70)	0.0%	0.1%	0.0%	0.1%
Architecture and engineering activities; technical testing and analysis (71)	0.0%	0.1%	0.0%	0.1%
Scientific research and development (72)	0.0%	0.1%	0.0%	0.1%
Advertising and market research (73)	0.0%	0.1%	0.0%	0.0%
Other professional, scientific and technical activities (74)	0.0%	0.3%	0.0%	0.3%
Veterinary activities (75)	0.0%	0.0%	0.0%	0.0%
Rental and leasing activities (77)	0.0%	0.1%	0.0%	0.0%
Employment activities (78)	0.0%	0.1%	0.0%	0.2%
Travel agency, tour operator and other reservation service activities (79)	0.0%	0.1%	0.0%	0.1%
Security and investigation activities (80)	0.0%	0.1%	0.1%	0.0%
Services to buildings and landscape activities (81)	0.1%	0.4%	0.1%	0.2%
Office administrative, office support and other business support activities (82)	0.1%	1.0%	0.5%	0.8%
Public administration and defence; compulsory social security (84)	0.5%	2.4%	3.3%	2.2%
Education (85)	5.1%	15.1%	1.0%	12.0%
Human health activities (86)	0.9%	5.1%	0.1%	4.8%
Residential care activities (87)	0.1%	0.5%	0.0%	0.2%
Social work activities without accommodation (88)	0.4%	0.4%	0.3%	0.5%
Creative, arts and entertainment activities (90)	0.0%	0.2%	0.0%	0.1%
Libraries, archives, museums and other cultural activities (91)	0.0%	0.1%	0.0%	0.0%
Gambling and betting activities (92)	0.0%	0.0%	0.0%	0.1%
Sports activities and amusement and recreation activities (93)	0.0%	0.0%	0.0%	0.1%

Industry (NIC 2-Digit)	2017-18		2022-23	
	Rural	Urban	Rural	Urban
Activities of membership organisations (94)	0.1%	0.2%	0.1%	0.2%
Repair of computers and personal and household goods (95)	0.0%	0.1%	0.1%	0.2%
Other personal service activities (96)	0.5%	4.7%	0.4%	3.9%
Activities of households as employers of domestic personnel (97)	0.8%	9.6%	0.7%	10.9%

Source: Periodic Labour Force Survey Rounds

Annexure 2

Table 1: Classification of CPHS industries based on NIC-2008

Industries	Classification								
Accommodation and Food	Food Industries	Hotels and restaurants							
Administrative and Support Service Activities	Travel and Tourism								
Agriculture and Allied Activities	Crop Cultivation	Fishing	Fruits and Vegetable Farming	Poultry Farming, Animal Husbandry and Ve	Agriculture-allied activities	Forestry including wood cutting	Plantation crop cultivation		
Arts and Recreation	Entertainment and Sports								
Construction	Cement, Tiles, Bricks, Ceramics, Glass and construction materials								
Education	Education								
Finance	Financial Services	Real Estate & Construction							
Health	Health Care								
Information and Communication	Communication, Post & Courier	IT & ITES	Media and Publishing						
Manufacture	Chemical Industries	Footwear and other Leather Industries	Handicraft industries	Gems & Jewellery	Machinery Manufacturers	Metal Industries	Pharmaceutical Manufacturer	Textile Industries	Soaps, Detergents, Cosmetics, Toiletries
Mining	Mines								
Others	Personal Professional Services	Personal Non-Professional Services	Utilities						
Public Administration and Defence	Defence Services	Public Administrative Services							
Transport	Automobiles and Other Transport Equipments								
Wholesale and Retail Trade	Retail Trade	Wholesale Trade							

Table 2: Concordance between CPHS and CAPEX

CPHS	CAPEX					
Accommodation and food	Hotels & restaurants					
Administrative and support service activities	Tourism					
Agriculture and allied activities	Food & agro-based products					
Transport	Transport equipment	Transport services				
Construction	Construction materials					
Wholesale and retail trade	Wholesale & retail trading					
Manufacture	Miscellaneous man-ufacturing	Machinery	Metals & metal products	Consumer goods	Chemicals & chemical products	Textiles
Finance	Construction & real estate					
Education	Education					
Arts and recreation	Recreational services					
Health	Health services					
Information and communi-cation	Communication services	Information technology				
Others	X					
Mining	Mining					
Public Administration and Defence	X					
	ELECTRICITY					

Table 3: ADF results

Variable	Level			First Difference			Remarks
	Test Statistics	5% critical value	Probability	Test statistics	5% critical value	Probability	
WOMEN							
Accommodation and food	-1.914	-2.997	0.325	-4.069	-3	0.001	I(1)
Administrative and support service activities	-0.923	-2.997	0.780	-5.525	-3	0.000	I(1)
Agriculture and allied activities	-1.569	-2.997	0.499	-5.712	-3	0.000	I(1)
Transport	-1.847	-2.997	0.357	-4.425	-3	0.000	I(1)
Construction	-2.609	-2.997	0.091	-5.643	-3	0.000	I(1)
Wholesale and retail trade	-2.45	-2.997	0.128	-5.474	-3	0.000	I(1)

Variable	Level			First Difference			Remarks
	Test Statistics	5% critical value	Probability	Test statistics	5% critical value	Probability	
WOMEN							
Manufacture	-1.162	-2.997	0.689	-4.946	-3	0.000	I(1)
Finance	-1.551	-2.997	0.508	-5.484	-3	0.000	I(1)
Education	-1.285	-2.997	0.636	-5.093	-3	0.000	I(1)
Arts and recreation	-3.547	-2.997	0.006	-7.164	-3	0.000	I(1)
Health	-1.684	-2.997	0.439	-5.47	-3	0.000	I(1)
Information and communication	-1.32	-2.997	0.619	-5.961	-3	0.000	I(1)
Others	-2.386	-2.997	0.145	-5.064	-3	0.000	I(1)
Mining	-1.26	-2.997	0.647	-6.694	-3	0.000	I(1)
Public Administration and Defence	-1.423	-2.997	0.571	-6.33	-3	0.000	I(1)
Total	**-1.458**	**-2.997**	**0.554**	**-5.368**	**-3**	**0.000**	**I(1)**
MEN							
Accommodation and food	-3.019	-2.997	0.033				I(0)
Administrative and support service activities	-1.513	-2.997	0.527	-6.158	-3	0.000	I(1)
Agriculture and allied activities	-1.339	-2.997	0.611	-5.151	-3	0.000	I(1)
Transport	-2.379	-2.997	0.147	-5.071	-3	0.000	I(1)
Construction	-1.936	-2.997	0.315	-5.019	-3	0.000	I(1)
Wholesale and retail trade	-2.776	-2.997	0.061	-5.437	-3	0.000	I(1)
Manufacture	-2.276	-2.997	0.179	-4.918	-3	0.000	I(1)
Finance	-2.009	-2.997	0.282	-5.093	-3	0.000	I(1)
Education	-1.805	-2.997	0.377	-4.506	-3	0.000	I(1)
Arts and recreation	-1.197	-2.997	0.674	-5.406	-3	0.000	I(1)
Health	-2.34	-2.997	0.159	-5.553	-3	0.000	I(1)
Information and communication	-1.304	-2.997	0.627	-4.75	-3	0.000	I(1)
Others	-3.175	-2.997	0.021				I(0)
Mining	-2.191	-2.997	0.209	-5.317	-3	0.000	I(1)
Public Administration and Defence	-1.705	-2.997	0.428	-5.872	-3	0.000	I(1)
Total	**-1.361**	**-2.997**	**0.6**	**-4.993**	**-3**	**0.000**	**I(1)**

Manufacturing sub-sector ADF results in CPHS Data

Variable	Level			First Difference			Remarks
	Test statistics	5% critical value	Probability	Test statistics	5% critical value	Probability	
WOMEN							
Chemical Industry	-2.228	-2.9	0.196	-4.982	-3	0.000	I(1)
Footwear and leather Industry	-1.464	-2.9	0.551	-5.614	-3	0.000	I(1)
Gems and Jewellery	-3.163	-2.9	0.022	-6.534	-3	0.000	I(1)
Handicraft Industry	-1.979	-2.9	0.295	-7.155	-3	0.000	I(1)
Machinery Manufacture	-2.742	-2.9	0.067	-6.48	-3	0.000	I(1)
Metal Industry	-2.438	-2.9	0.131	-7.077	-3	0.000	I(1)
Pharmaceutical Industry	-1.825	-2.9	0.368	-5.988	-3	0.000	I(1)
Soaps and Detergents	-3.06	-2.9	0.029				I(0)
Textile Industry	-1.047	-2.9	0.735	-5.748	-3	0.000	I(1)
MEN							
Chemical Industry	-3.376	-2.9	0.011				I(0)
Footwear and leather Industry	-1.726	-2.9	0.417	-4.057	-3	0.001	I(1)
Gems and Jewellery	-2.251	-2.9	0.188	-5.029	-3	0.000	I(1)
Handicraft Industry	-2.298	-2.9	0.172	-5.362	-3	0.000	I(1)
Machinery Manufacture	-3.857	-2.9	0.002				I(0)
Metal Industry	-2.289	-2.9	0.175	-4.718	-3	0.000	I(1)
Pharmaceutical Industry	-1.465	-2.9	0.55	-5.111	-3	0.000	I(1)
Soaps and Detergents	-3.371	-2.9	0.012				I(0)
Textile Industry	-1.477	-2.9	0.544	-5.102	-3	0.000	I(1)

CAPEX	Level			Remarks
Variable	Test statistics	5% critical value	Probability	
Accommodation and food	-4.66	-2.9	0.000	I(0)
Administrative and support service activities	-4.293	-2.9	0.000	I(0)
Agriculture and allied activities	-5.923	-2.9	0.000	I(0)
Transport	-3.464	-2.9	0.000	I(0)
Construction	-4.998	-2.9	0.000	I(0)
Wholesale and retail trade	-4.603	-2.9	0.000	I(0)
Manufacture	-6.449	-2.9	0.000	I(0)
Finance	-3.529	-2.9	0.000	I(0)
Education	-4.991	-2.9	0.000	I(0)
Arts and recreation	-4.549	-2.9	0.000	I(0)

CAPEX	Level			Remarks
Variable	Test statistics	5% critical value	Probability	
Health	-5.83	-2.9	0.000	I(0)
Information and communication	-5.309	-2.9	0.000	I(0)
Mining	-5.283	-2.9	0.000	I(0)
Electricity	-5.015	-2.9	0.000	I(0)
Total	**-6.206**	**-2.9**	**0.000**	**I(0)**

Manufacturing sub-sector ADF results in CAPEX data

Variable	Level			Remarks
	Test statistics	5% critical value	Probability	
Miscellaneous manufacturing	-5.706	-2.97	0.000	I(0)
Machinery	-6.301	-2.97	0.000	I(0)
Metals & metal products	-5.667	-2.97	0.000	I(0)
Consumer goods	-6.176	-2.97	0.000	I(0)
Chemicals & chemical products	-7.764	-2.97	0.000	I(0)
Textiles	-6.539	-2.97	0.000	I(0)

Table 4: Identifying the AR and MA component

	WOMEN		MEN		CAPEX	
	AC	PAC	AC	PAC	AC	PAC
Accommodation and food	(1,2)	(1,8,10)	1	(1,3,9,11)	0	(8,16)
Administrative and support service activities	(1,2)	(1,3,11)	1	(1,3,11)	0	14,15
Agriculture and allied activities	1	(1,3,11)	1	(1,3,6,9)	0	(9,14)
Transport	(1,2)	(1,5,9,11)	1	(1,10,11)	1	(1,3,11,13)
Construction	1	(1,4,7,8)	1	(1,8,9)	2	(2,14,15,16)
Wholesale and retail trade	1	(1,4,11)	1	(1,11)	0	(3,10,15)
Manufacture	(1,2)	(1,10,11)	1	(1,11)	0	1
Finance	(1,2)	(1,10,11)	1	(1,9,11)	(1,7)	(1,12,13,14,15)
Education	(1,2)	(1,11)	1	(1,11)	0	1
Arts and recreation	0	11	(1,2)	(1,4,10)	0	(4,6,14,15)
Health	(1,2)	(1,11)	1	(1,8,10)	2	(2,16)
Information and communication	(1,2)	(1,5,8,11)	(1,2)	(1,8,11)	0	0

	WOMEN		MEN		CAPEX	
	AC	PAC	AC	PAC	AC	PAC
Others	1	(1,10,11)	1	(1,11)	-	-
Mining	(1,2)	(1,8)	1	(1,8,11)	2	(2,6,8,10,12)
Public Administration and Defence	(1,2)	(1,8,11)	1	(1,11)	-	-
Total	**(1,2)**	**(1,11)**	**1**	**(1,3,10)**	**4**	**(4,5,15)**

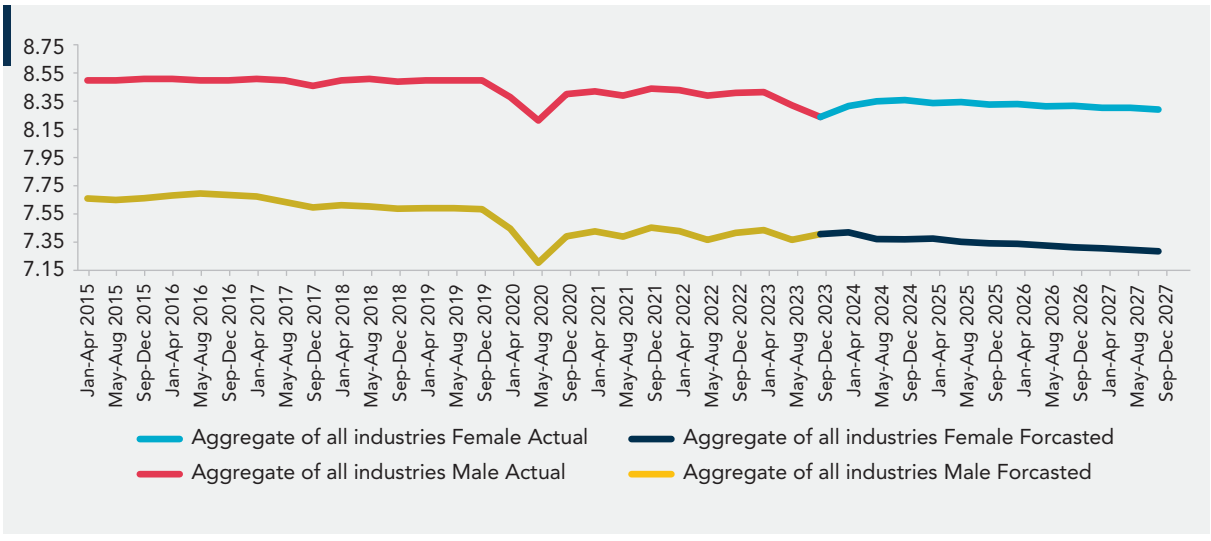
Table 5: Elasticity calculations

Industry	CPHS-CAPEX	
	Employment elasticity for women (2015-22)	Employment elasticity for men (2015-22)
Accommodation and food	-2.32	-2.17
Administrative and support service activities	-0.34	-0.14
Agriculture and allied activities	-0.35	-0.19
Arts and recreation	3.33	2.32
Construction	-1.2	-0.77
Education	-0.48	-0.07
Finance	-8.27	-1.92
Health	2.48	5.08
Information and communication	-0.61	-0.33
Manufacture	-4.8	-2.32
Mining	-22.78	-5.58
Others		
Public Administration and Defence		
Total	-2.62	-0.99
Transport	-1.02	-0.79
Wholesale and retail trade	0.62	2.83

Source: CPHS, CAPEX databases

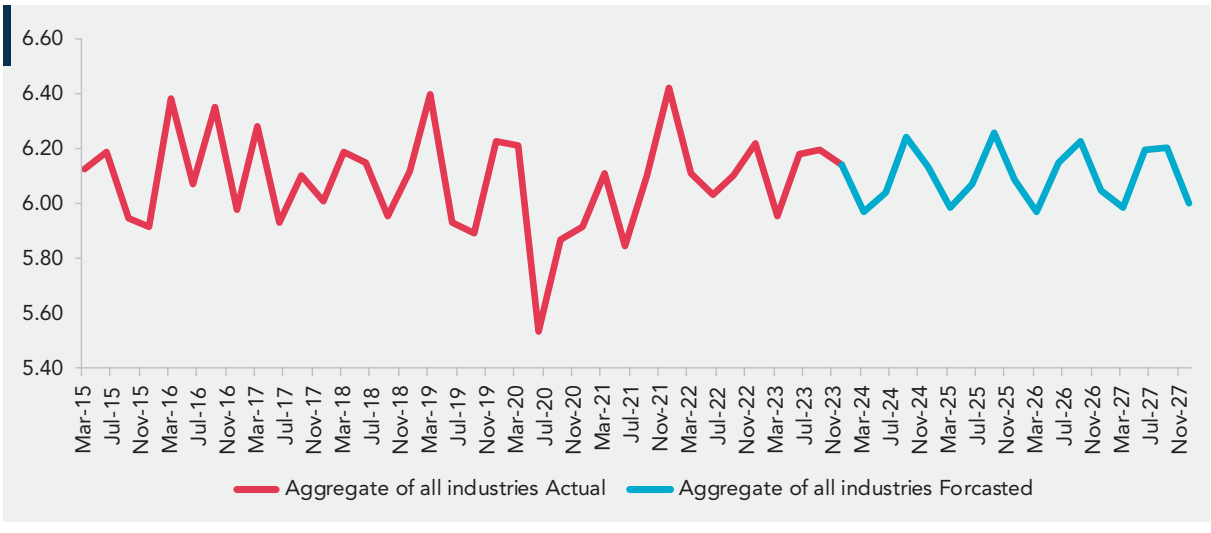
Figures: Forecasted Graphs Across Industries

Figure 1: All industries (CPHS)



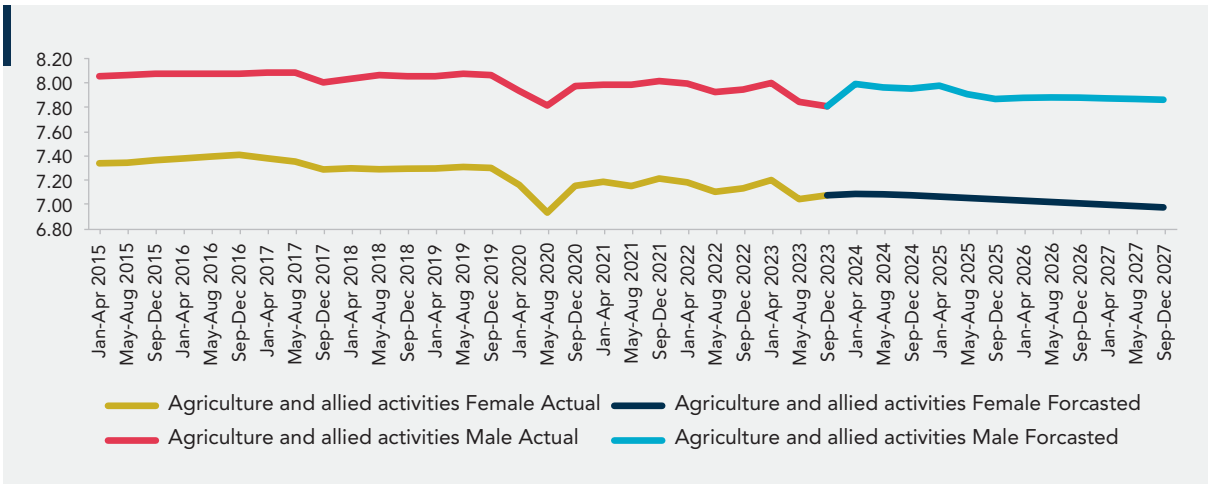
Source: CPHS & CMIE

Figure 2: All industries (CAPEX)



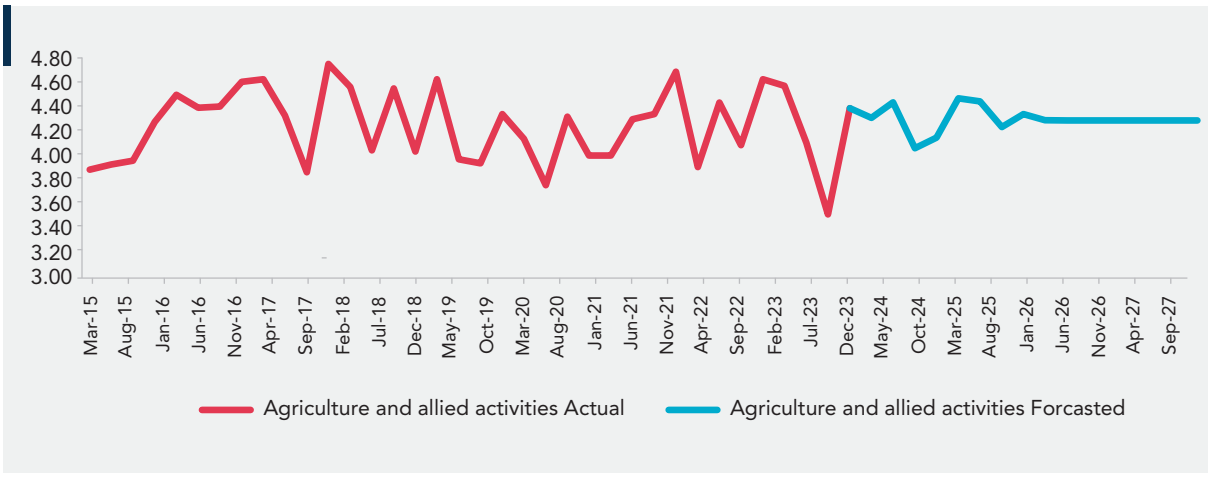
Source: CPHS & CMIE

Figure 3: Agriculture and other allied activities (CPHS)



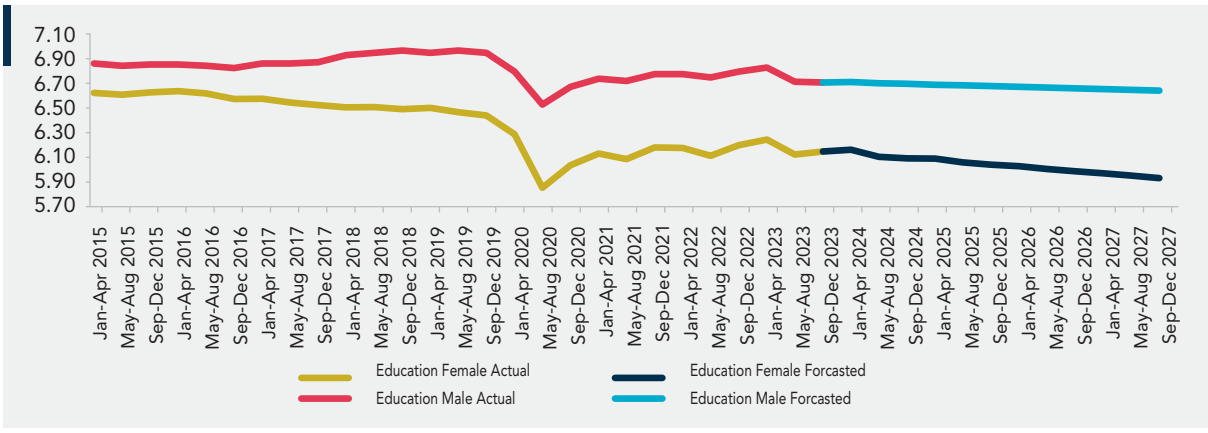
Source: CPHS

Figure 4: Agriculture and other allied activities (CAPEX)



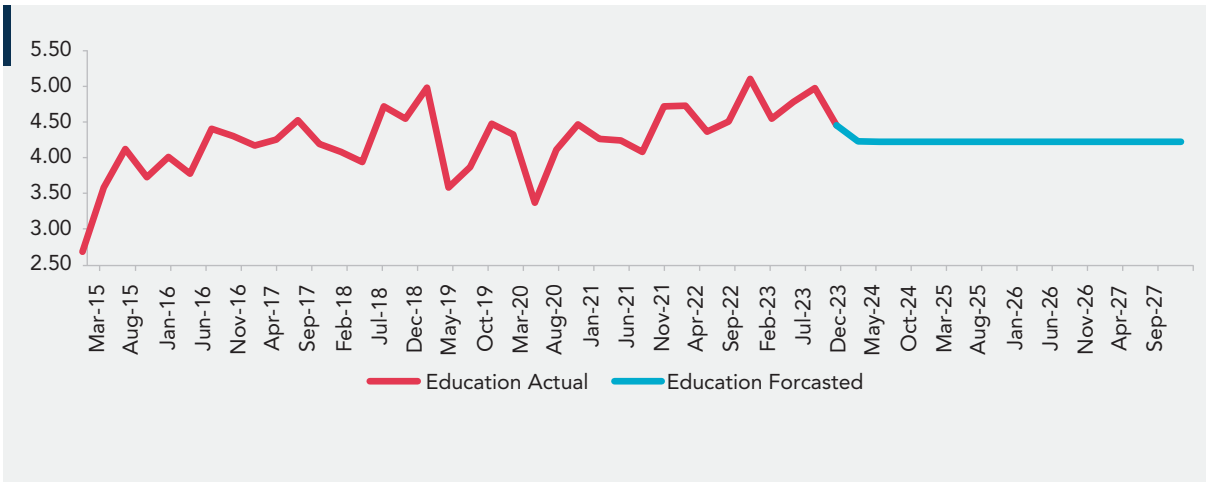
Source: CAPEX

Figure 5: Education (CPHS)



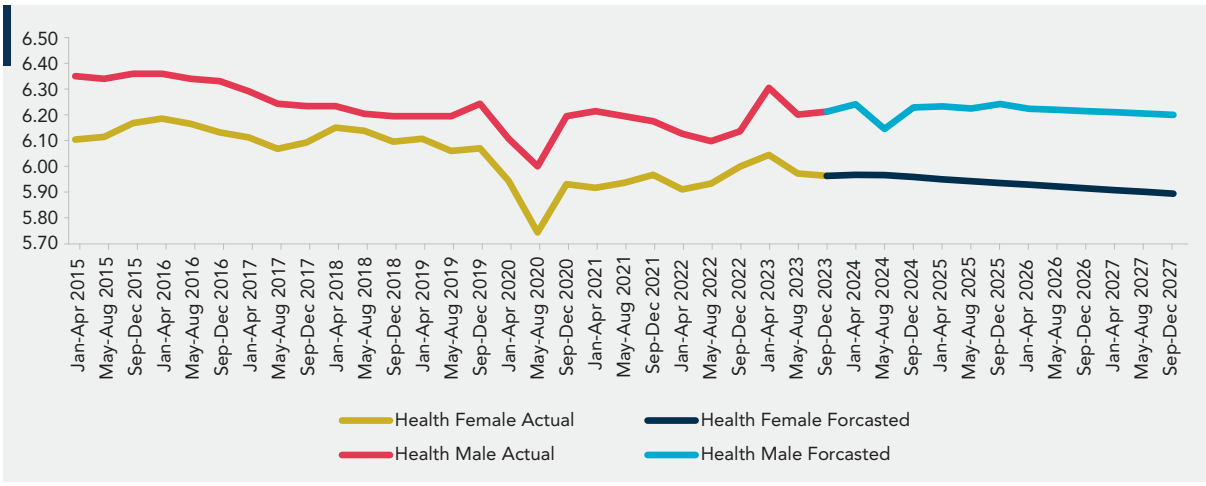
Source: CPHS

Figure 6: Education (CAPEX)



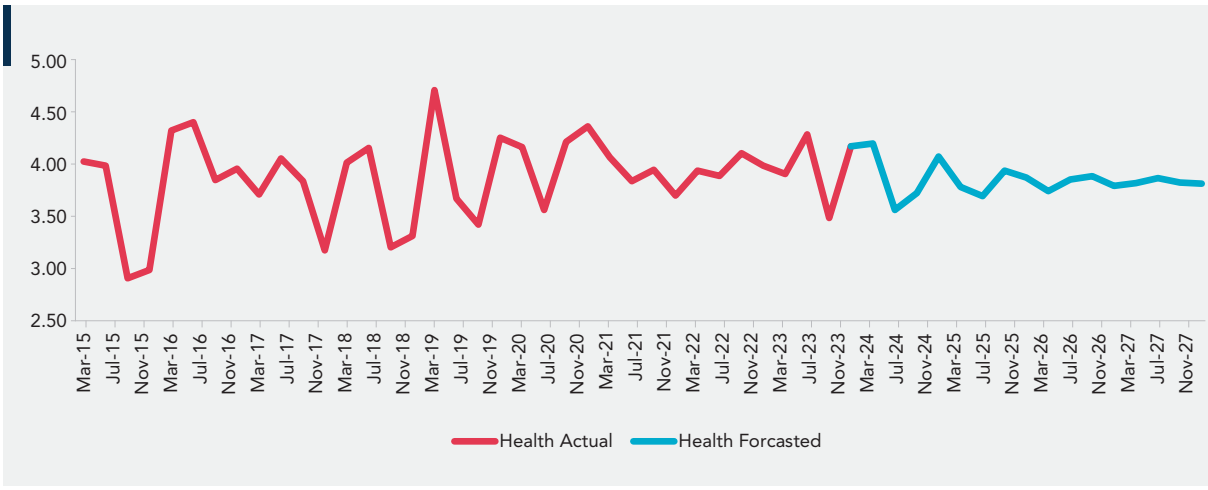
Source: CAPEX

Figure 7: Health (CPHS)



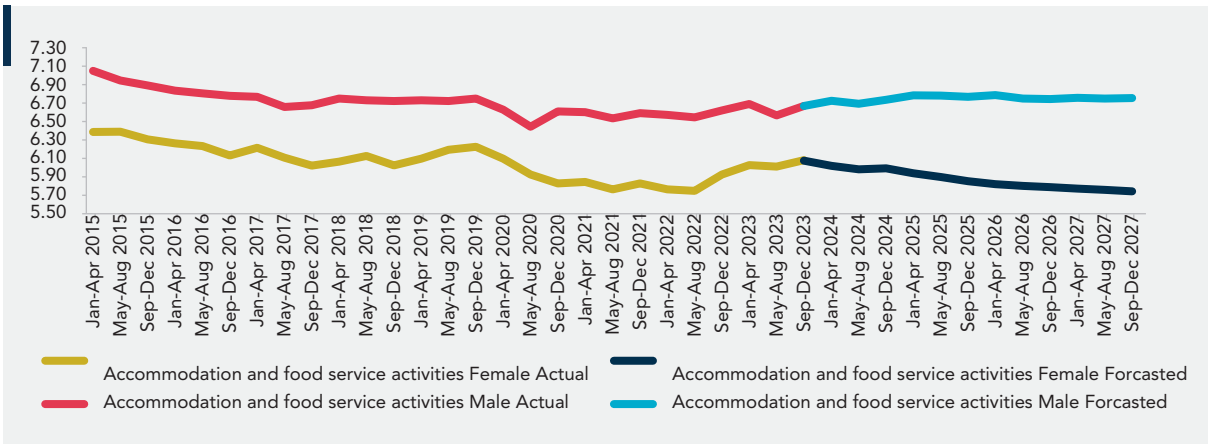
Source: CPHS

Figure 8: Health (CAPEX)



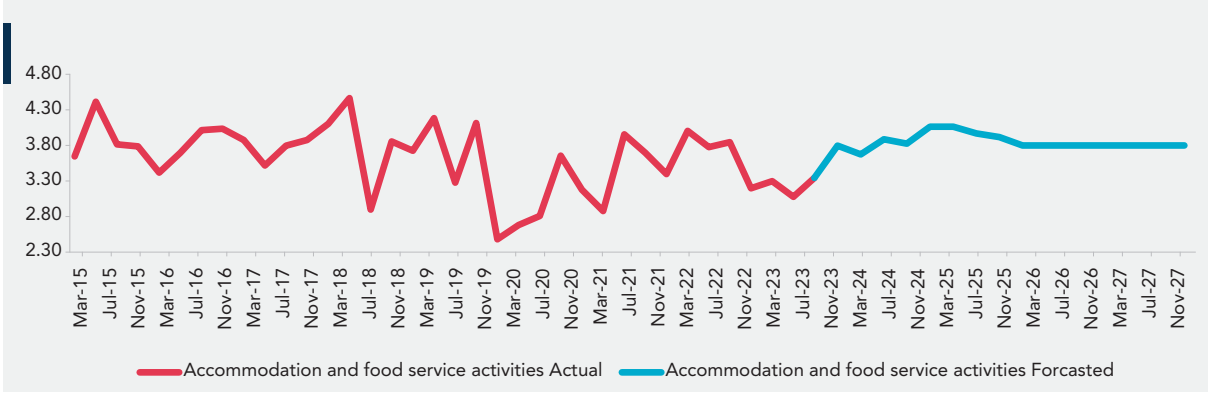
Source: CAPEX

Figure 9: Accommodation and food service activities (CPHS)



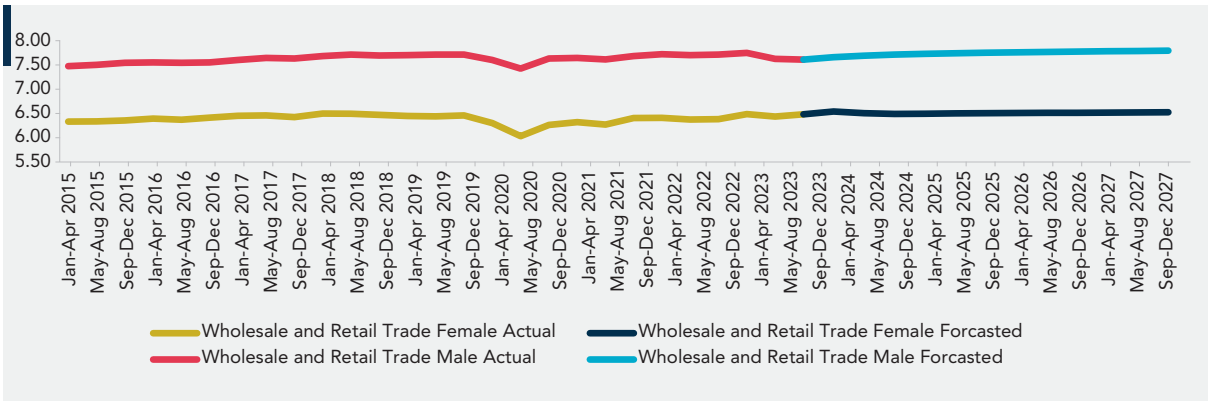
Source: CPHS

Figure 10: Accommodation and food service activities (CAPEX)



Source: CPHS

Figure 11: Wholesale and retail trade (CPHS)

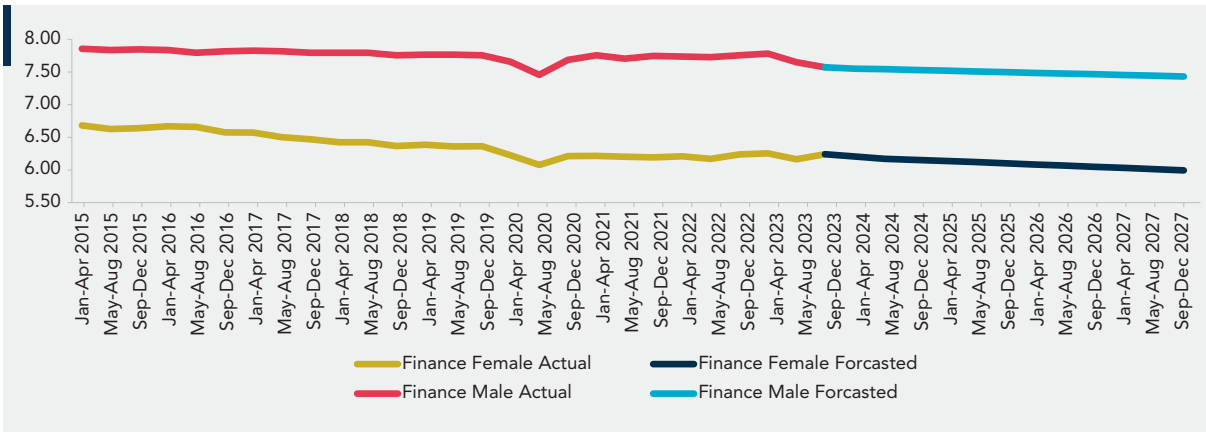


Source: CPHS

Figure 12: Wholesale and retail trade (CAPEX)

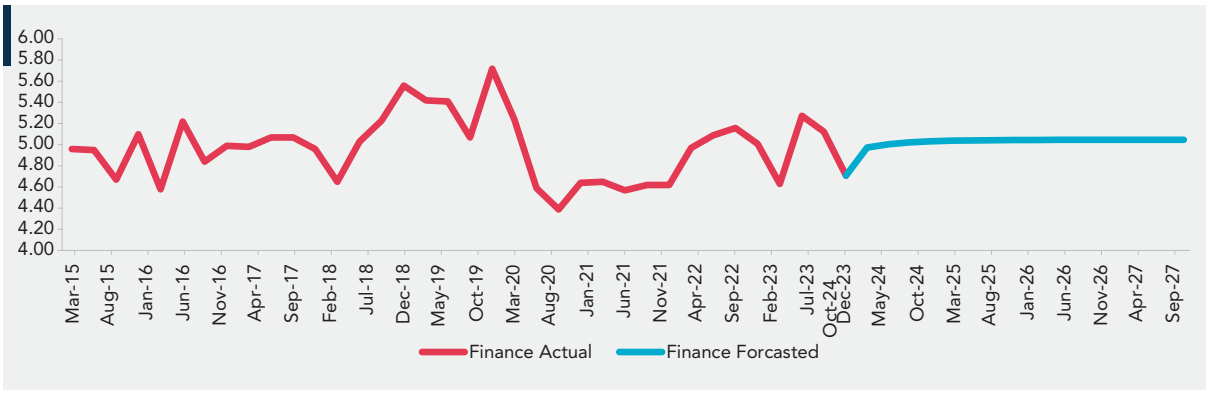
Source: CAPEX

Figure 13: Finance (CPHS)



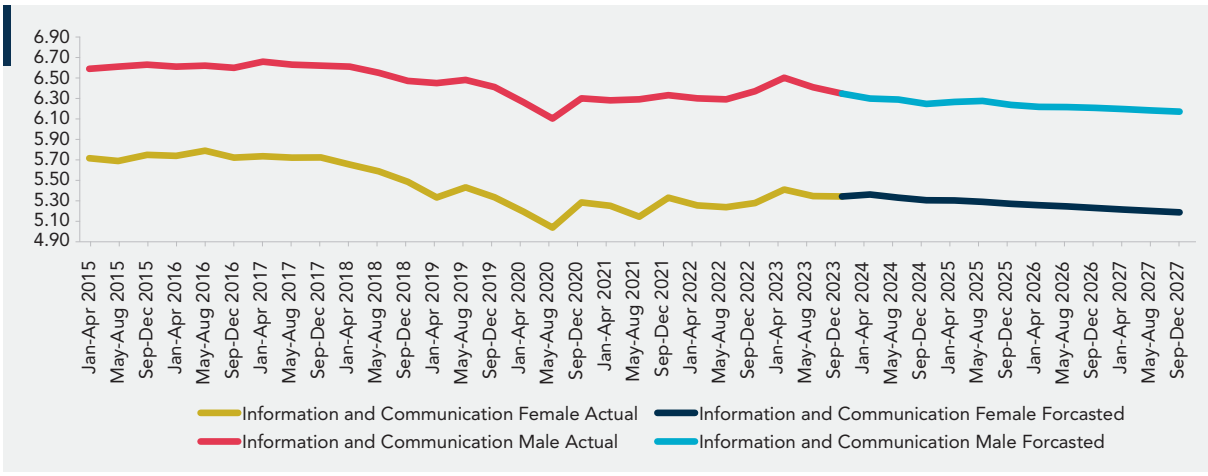
Source: CPHS

Figure 14: Finance (CAPEX)



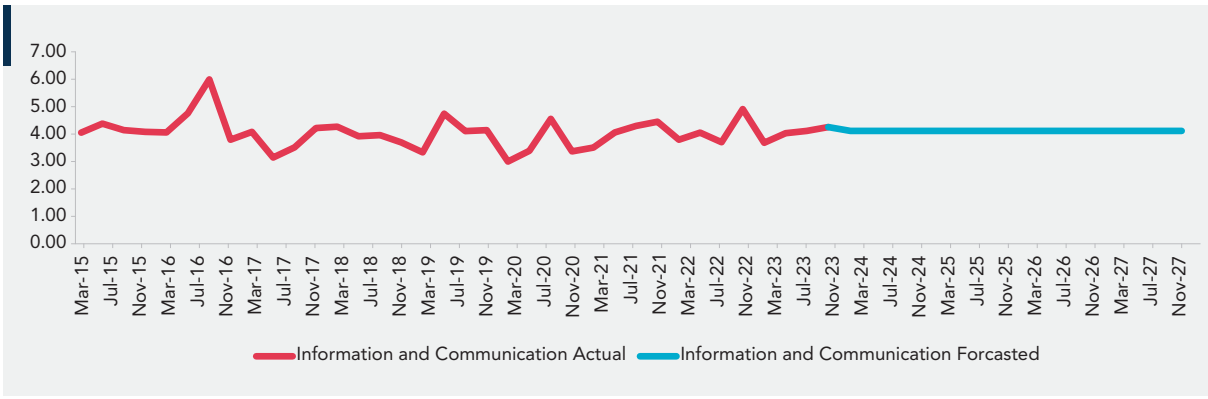
Source: CAPEX

Figure 15: Information and communication (CPHS)



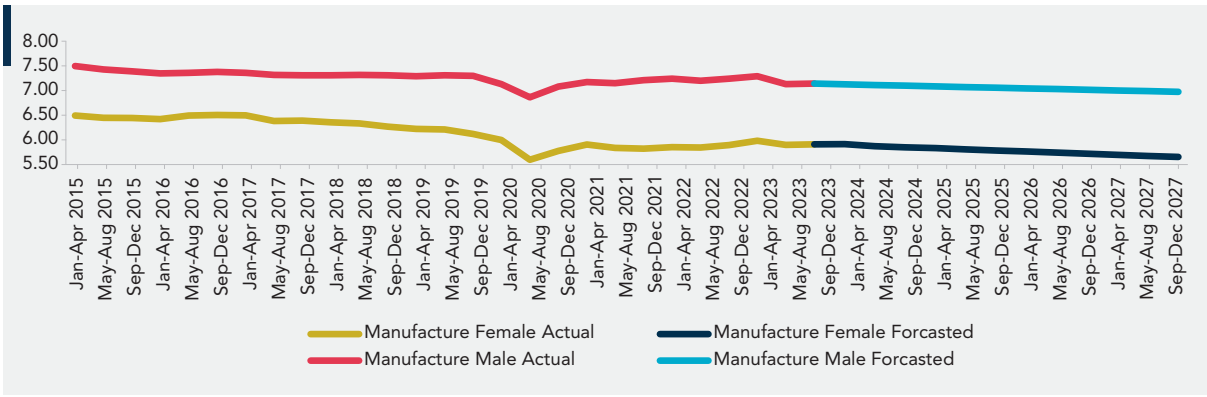
Source: CPHS

Figure 16: Information and communication (CAPEX)



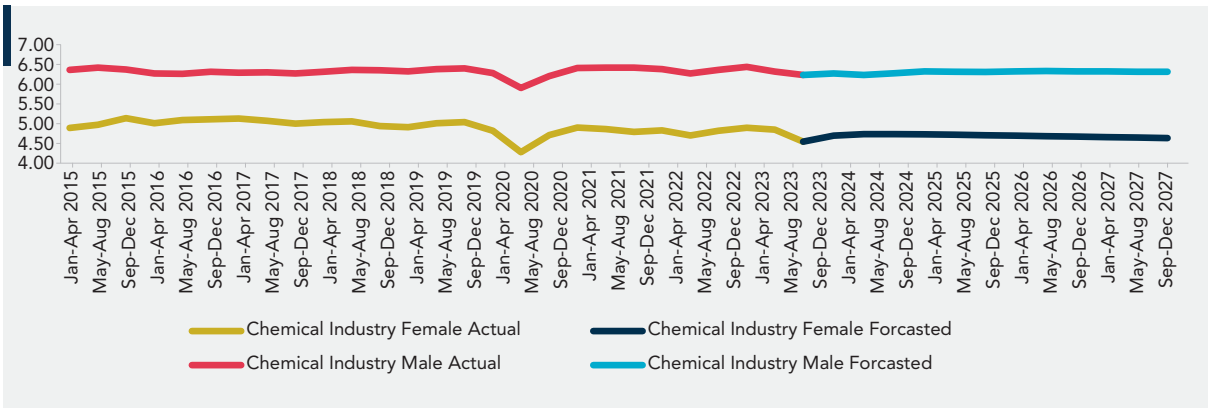
Source: CAPEX

Figure 17.A: Manufacture (CPHS)



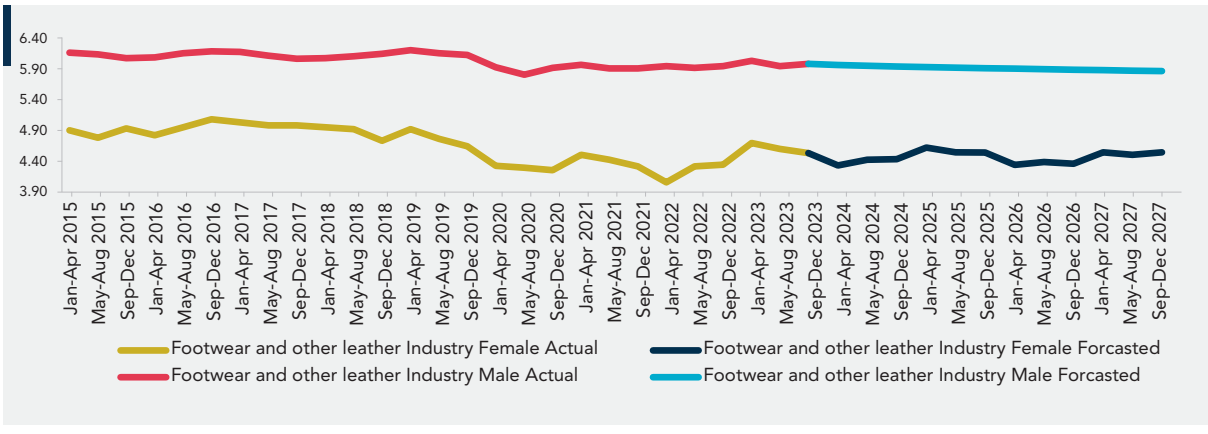
Source: CPHS

Figure 17.A.1: Manufacture - chemical industry (CPHS)



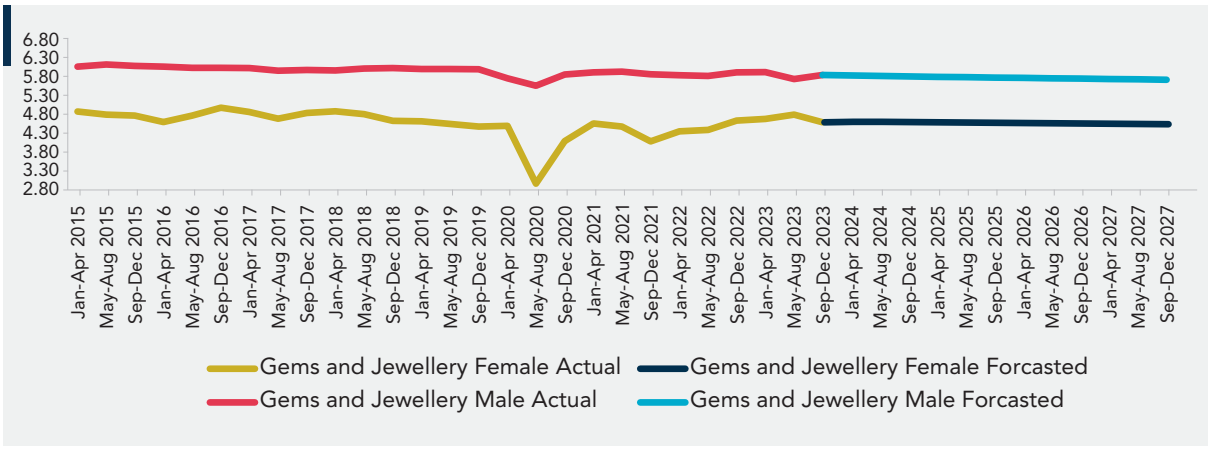
Source: CPHS

Figure 17.A.2: Manufacture - footwear and other leather industry



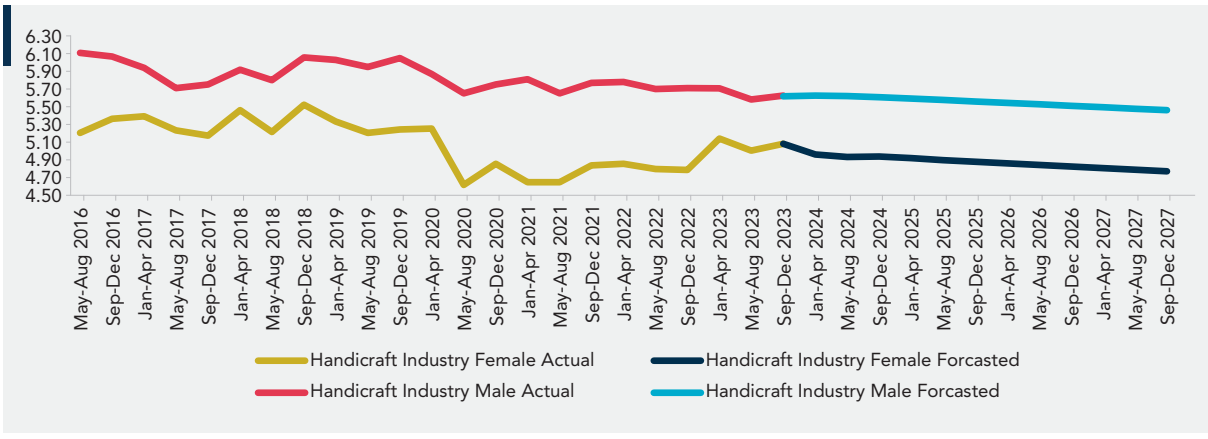
Source: CPHS

Figure 17.A.3: Manufacture - gems and jewellery



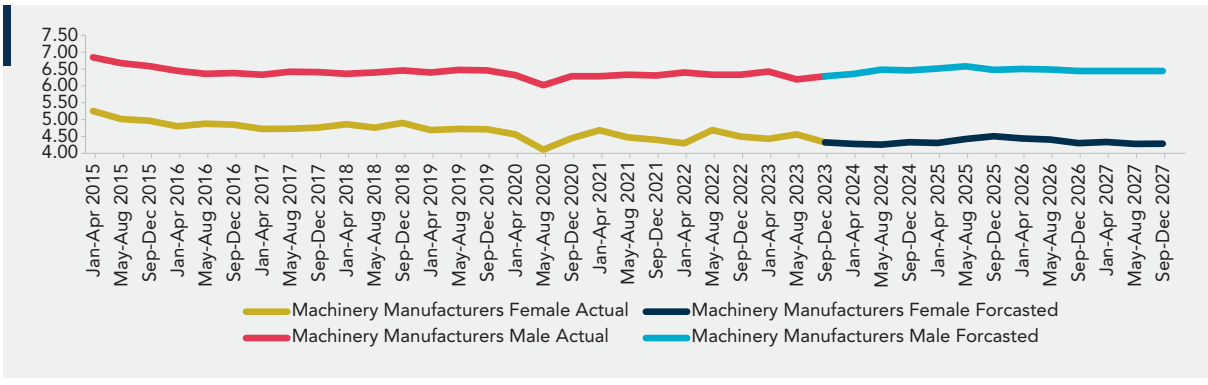
Source: CPHS

Figure 17.A.4: Manufacture - handicraft industry (CPHS)



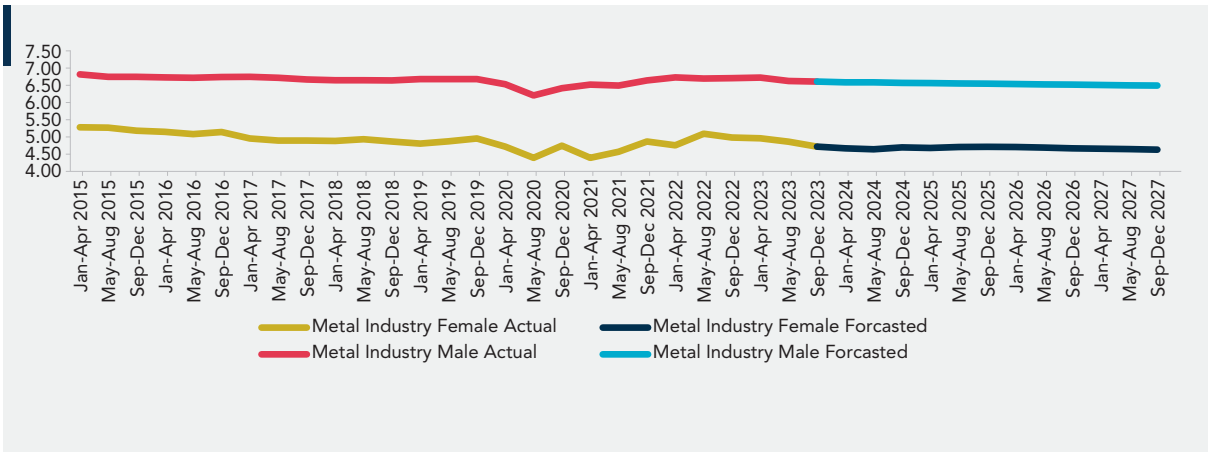
Source: CPHS

Figure 17.A.5: Manufacture - machinery manufacturer (CPHS)



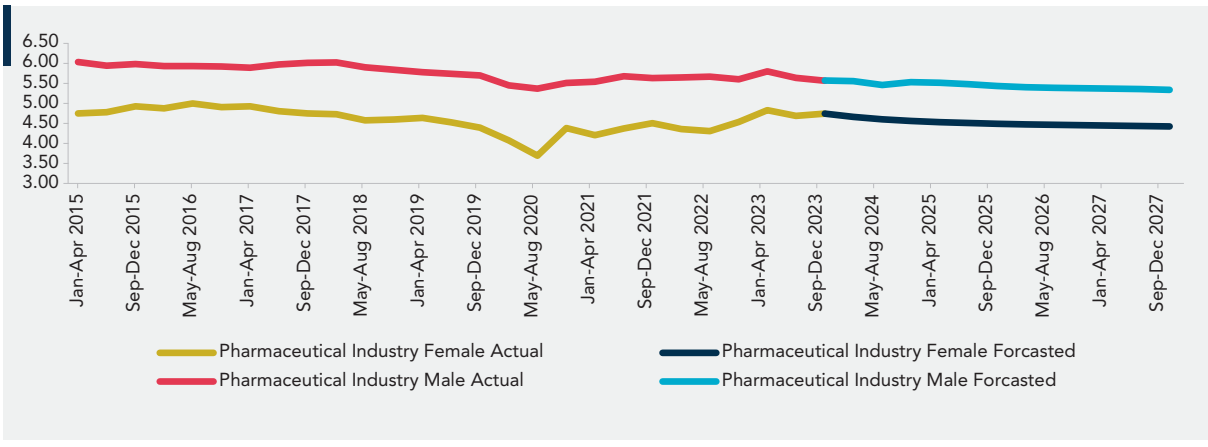
Source: CPHS

Figure 17.A.6: Manufacture - metal industry (CPHS)



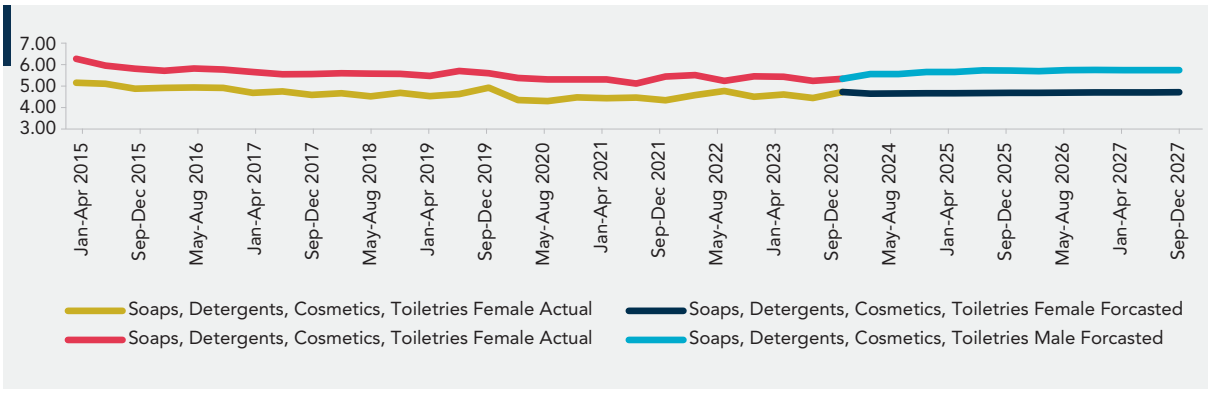
Source: CPHS

Figure 17.A.7: Manufacture - pharmaceutical manufacturer (CPHS)



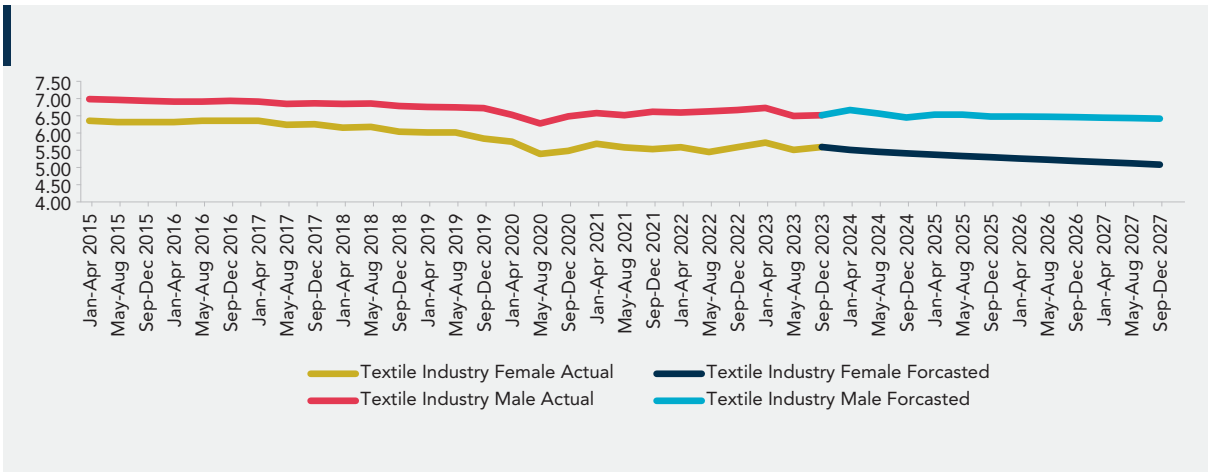
Source: CPHS

Figure 17.A.8: Manufacture - soaps, detergents, cosmetics, toiletries (CPHS)



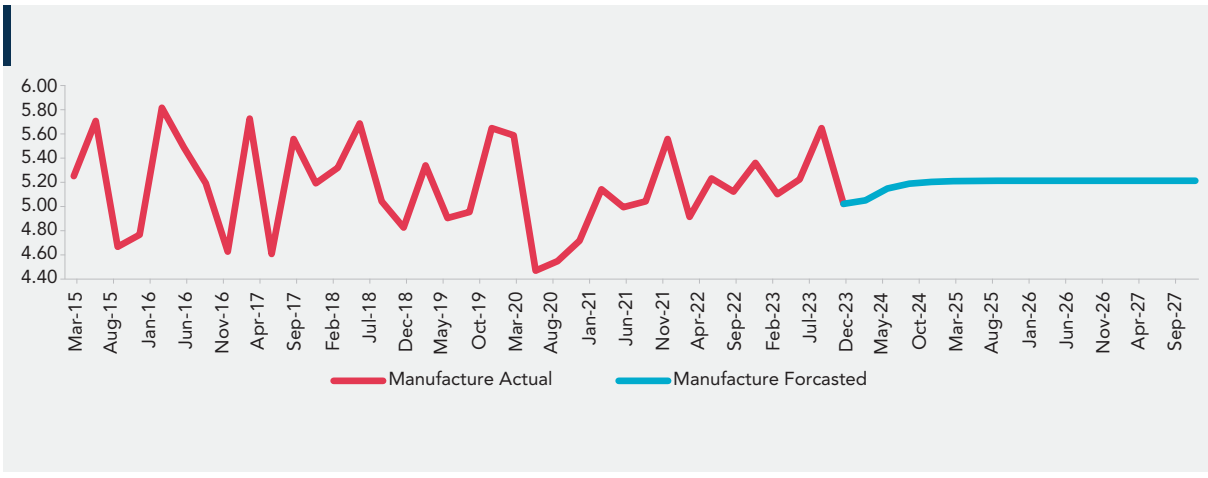
Source: CPHS

Figure 17.A.9: Manufacture - textile industry (CPHS)



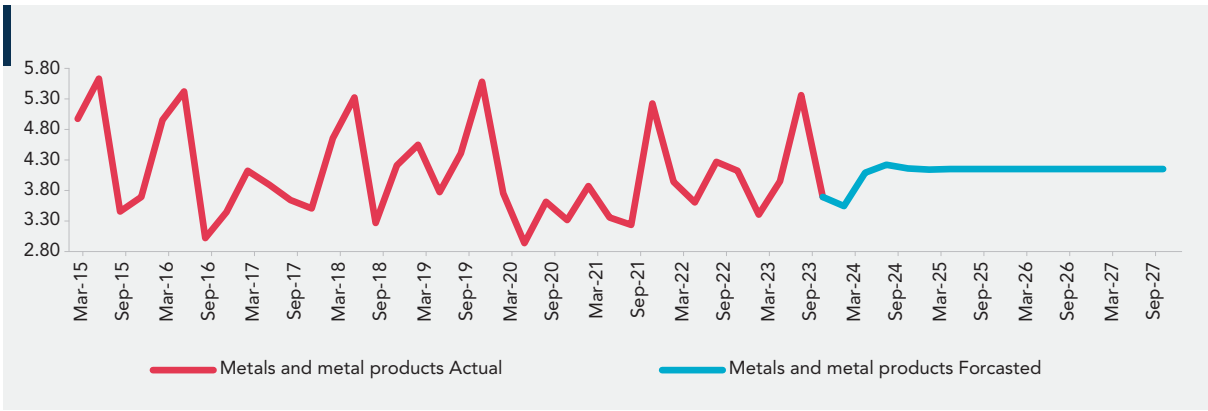
Source: CPHS

Figure 17.B: Manufacture (CAPEX)



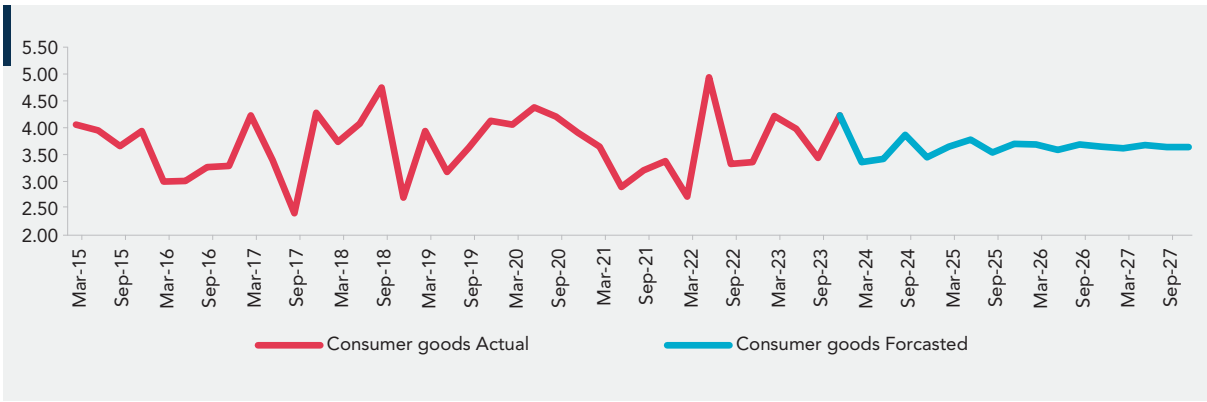
Source: CAPEX

Figure 17.B.1: Manufacture - metals and metal products (CAPEX)



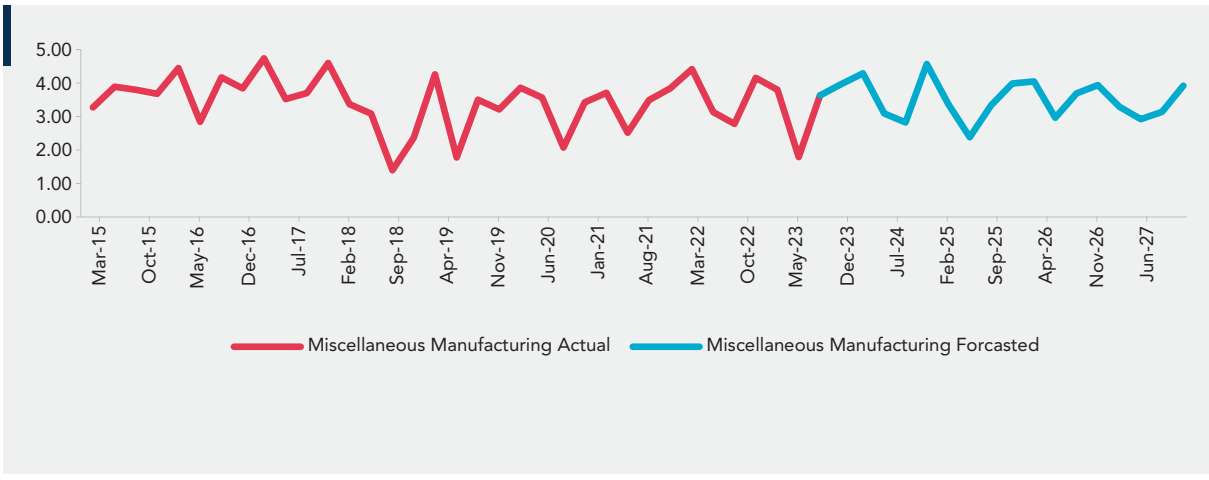
Source: CAPEX

Figure 17.B.2: Manufacture - consumer goods (CAPEX)



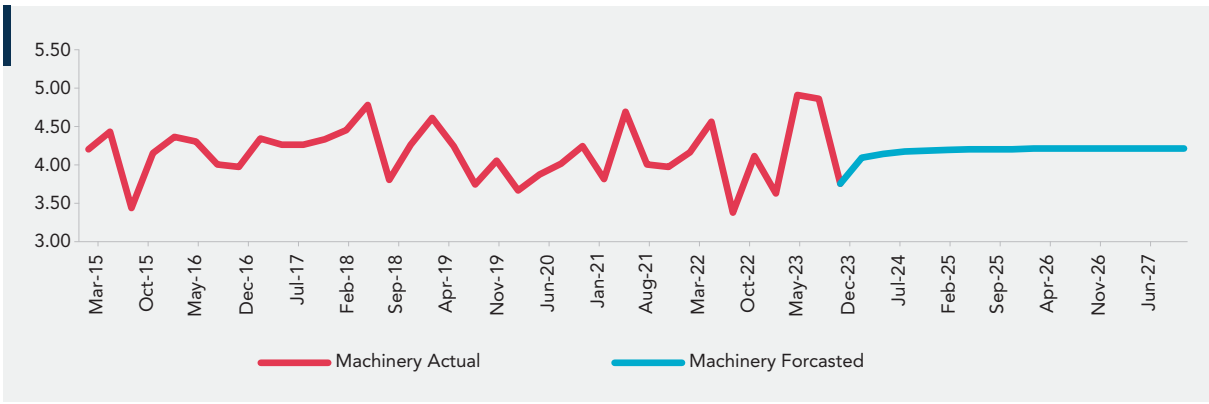
Source: CAPEX

Figure 17.B.3: Manufacture - miscellaneous manufacturing (CAPEX)



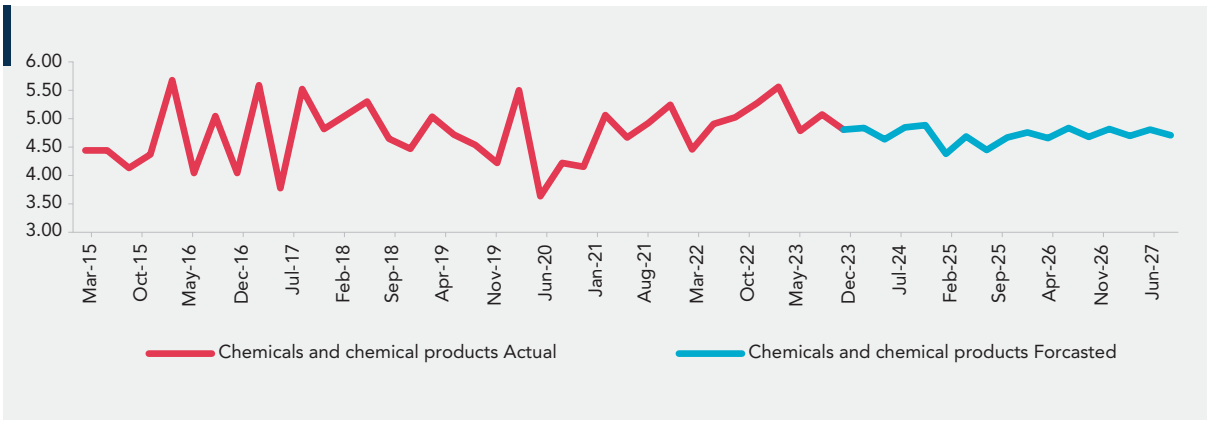
Source: CAPEX

Figure 17.B.4: Manufacture - machinery (CAPEX)



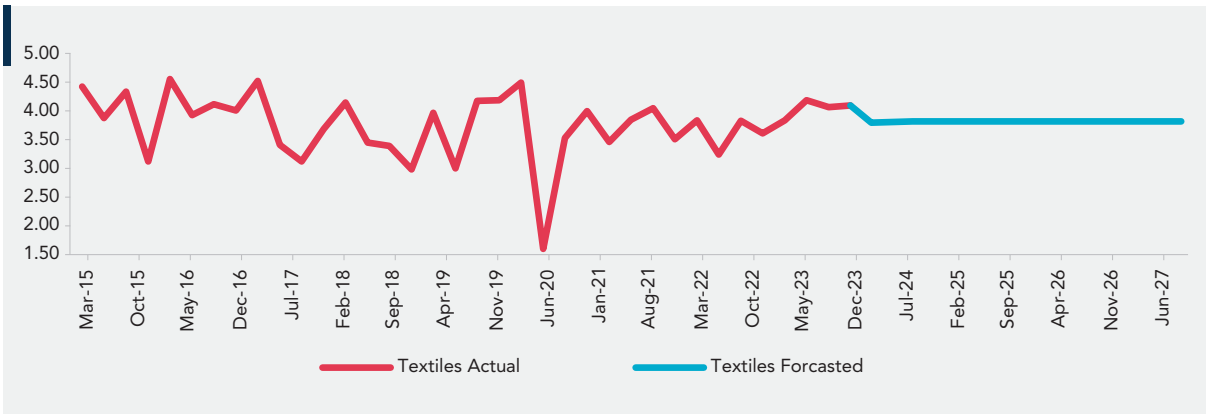
Source: CAPEX

Figure 17.B.5: Manufacture - chemicals and chemical products (CAPEX)



Source: CAPEX

Figure 17.B.6: Manufacture - textiles (CAPEX)



Source: CAPEX

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