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The Prospects of Employment Opportunities in India: A Medium –term Sectoral Analysis

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Abstract

Employment projection, particularly at the micro or sectoral level, is considered as a useful tool for economic planners and policymakers to have a better understanding of future trends and growth, and accordingly, the policies and planning could be designed for the supply side of the labour market. This study finds that there is a lack of literature in the recent past on the above issue in the context of India, hence in this paper, we have tried to estimate employment numbers for seven broad economic sectors for the period 2024-25 to 2030-31. The study uses “Top-down” approach to estimate and project the employment numbers by using the employment-output elasticities and forecasted values of growth rates of gross value added (GVA) at the sectoral level. Three broad conclusions have been drawn from the employment estimates. First, the agriculture and allied sector continued to be the dominant force in creating employment opportunities till 2030-31, however, a surge of employment in the sector in recent years may unlikely continue in the future. Second, the slowing down of economic activities in services sector is expected to dent high employment growth prospects in the sector. Third, a phenomenal rise of employment in industry particularly in manufacturing sector in recent years augurs well for the economy which is expected to remain buoyant in the medium term as well.

Key words: Employment demand, sectoral analysis, projection, India

JEL: J21, J23, F47

1. Introduction

The literature on labour economics suggests that employment plays a critical role in growth-poverty linkage. A set of case studies of ILO/SIDA (Demeke et al., 2003; Huong et al., 2003; Jemio et al., 2003; Kabanankye et al., 2004; Sundaram and Tendulkar, 2002; and Rahma and Nabiul, 2003) suggest that growth may be a necessary condition but not a sufficient one to reduce poverty. They have suggested that “countries which attained high rates of employment growth alongside high rates of economic growth are also the ones who succeeded in reducing poverty significantly”. Employment plays dual roles in growth-poverty nexus. While on one hand high employment growth along with improved labour productivity can spurt economic growth and keep the poverty level down, on the other hand, it helps the distribution of wealth among different

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population groups and puts a check on rising inequality. The objective of this paper is not about examining the role played by employment in growth-poverty nexus or with inequality but about the relationship between growth and employment and what would be the likely scenario of employment in the short to medium term in the case of India, which may be quite useful to draw any informed policy decision on labour market.

Employment or manpower demand projection is considered as useful tool for economic planners, policy makers and training providers to avoid the imbalance of skills in the labour market. Various studies in the past have used different techniques to estimate and project the demand for manpower at the aggregate, sectoral and institutional levels. The literature suggests that there are broadly four categories of approaches are used for manpower or employment projections. These are ‘the time series projection approach’, ‘bottom-up approach’, ‘top-down approach’ and ‘the market signaling approach’ (Wong et al., 2012). The time series projection method is relatively a simple way of projecting the future manpower requirements based on past employment trends. It however requires a long time series data on employment which is difficult to get. The “Bottom-up” approach is otherwise known as the labour multiplier approach. In this approach, both occupation-wise labour demand is estimated by multiplying the labour multiplier and the project expenditures. Even though this method yields a good result, applying this method to every sector of the economy is quite an ambitious task. The market signaling approach deals with collating labour market information on various parameters such as movement of relative wages, enrolment data, occupational employment trends and unemployment rate, job advertisement, etc. through interviews, surveys, focus group discussions and tracer studies. The present study however has used the “Top-down” approach is relatively a popular method being widely used in the literature for labour demand projection at the macro level. The top-down method includes three major steps: Firstly, to project the future level of output of major economic sectors based on the past trends. Secondly, to estimate the employment equation of major sectors with respect to output to get the employment-output elasticities. And finally, to predict the future level of employment demand for each sector by using employment-output elasticities and the predicted output level. The details of all these approaches are explained in the methodology section.

This paper proceeds as follows: in the next section, it presents a brief discussion on trends and growth of output and employment at the sectoral level. Section 3 offers a concise presentation on methodology and data sources of the study. Section 4 explains the analysis and discussion of results. Section 5 concludes the study.

2. Economic Growth and Employment trends in India

2.1 Pattern of Economic Growth Rate²

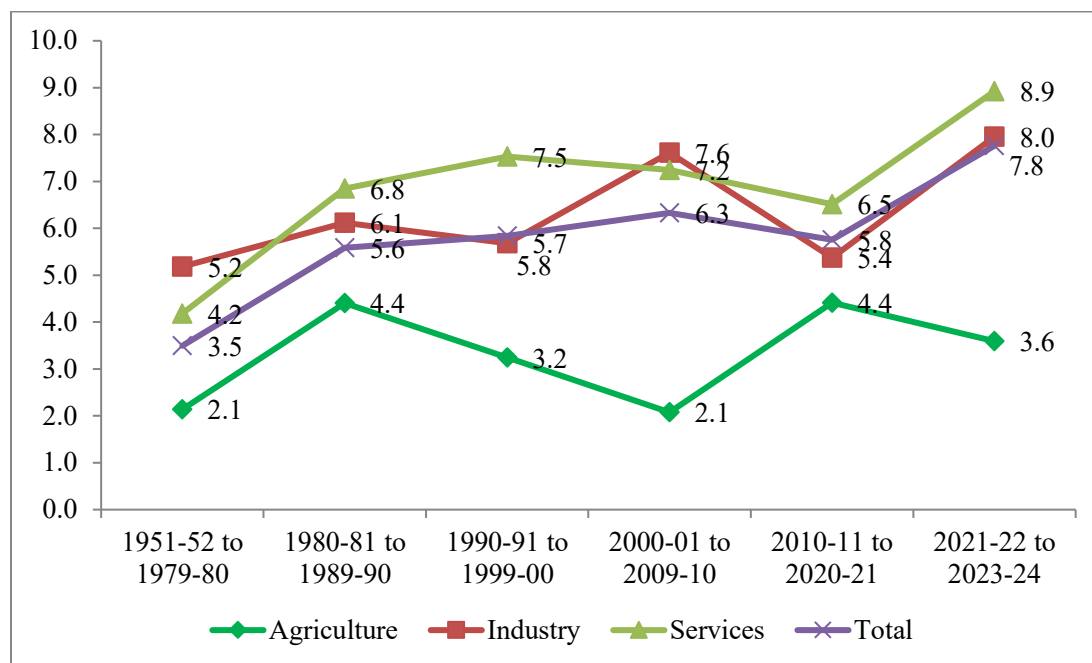
India's economy has pass through many phases of growth cycle during the post-independence era. Of which two notable phases of economic growth are 1950-51 to 1979-80 and 1980-81 and onwards. Nayyar (2006) pointed out that India's GDP and GDP per capita witnessed a structural break around 1980, which is statistically found significant. Although India's economy experienced full-fledged economic liberalization in early 1990s, the industrial reforms that started in 1980s helped the economy to register a quantum jump in economic growth compared to the earlier years. Not only overall growth, but the economy also witnessed a remarkable turnaround in nearly all measures of growth performance like output per capita, output per worker as well as total factor productivity in 1980 (Subramanian, 2007). DeLong (2001) and Rodrik (2004) have also equivocally supported the argument that India's economic growth accelerated in 1980s, much before the launch of full-fledged economic reforms in the early 1990s on account of allowing import of capital goods, relaxation of industrial regulations, rationalization of tax system and change in official *attitudes* about the change in *policies*. In contrast, Panagariya (2004) argued that though the economic growth rate accelerated in the 1980s, it was fragile and unsustainable. On the contrary, a stable and sustainable growth rate was achieved in the 1990s owing to systematic and calibrated reforms. Further, he added that the average economic growth rate of 1990s was relatively higher than the previous decade.

The data presented in **Figure 1** supports the views of both groups. There is no doubt that the economic growth rate took a sharp upward trend in the 1980s compared to the previous decades. It registered an average growth rate of 5.58% in the 1980s, which is around 1.4 percentage points higher than the growth rate that prevailed during 1951-52 to 1979-80. Not only the overall growth rate of the economy, but importantly all three major sectors such as agriculture, industry and services also posted higher growth rates in the 1980s compared to the previous decades. The period of 1990s (1990-91 to 1999-00) witnessed a relatively higher average growth rate (5.84%) compared to the immediately preceding decade, the growth rate at the sectoral level however was quite uneven. While services sector grew at a higher rate in the 1990s compared to the previous decade, the other two sectors posted a lower growth rate during the same period. The next decade i.e. the 2000s (2000-01 to 2009-10) shows a continuous acceleration of overall growth rate to 6.33%. But this period also witnessed an uneven growth rate at the sectoral level, wherein industry recorded a high growth rate of 7.61% and services and agriculture sectors posted a low growth rate compared to the previous decade. In contrast to the last three decades, the recent decade i.e. 2010-11 to 2020-21 shows there has been a slowdown in overall growth rate, largely due to a significant decline in industrial growth rate followed by services growth rate owing to a slowdown of the global economy in 2019-20 and the onset of COVID pandemic in 2020-21. The agriculture sector,

² We have used the growth rate of Gross Value Added (GVA) at constant 2011-12 prices to measure the economic growth rate.

on the other hand, posted a robust growth rate of more than 4% during this period. Since 2021-22, the economy has bounced back and posted a high average growth rate of 7.8% during 2021-22 and 2023-24 contributed largely by services sector (8.9%) and industry (8.0%). A pertinent question arises here is whether this high growth rate be sustainable in the medium term and more importantly how it will affect the prospects of employment generation if the overall growth rate slows down, particularly in employment-generating sectors. To understand these dynamics, the paper uses econometric techniques to estimate structural equations of sectoral growth rates using the available information at the quarterly level to forecast the growth rates of broad economic sectors in the results analysis section.

Figure 1: Average Annual Growth Rate of GVA by Sectors from 1951-52 to 2023-24



Source: author's compilation from MoSPI data.

Besides the discussion on the pattern of the growth rate of different sectors of the economy, it is pertinent to discuss the contribution of various sectors to the overall GVA, which may provide a glimpse of structural changes that took place in the economy and the evolving importance of the sector to the overall growth rate. The data illustrated in **Table 1** draws two important conclusions. First, India's economy was primarily agrarian till the 1970s, wherein the contribution of agriculture to total GVA was more than 50%. This trend, however, changed dramatically since the 1980s, as there has been a continuous decline in the share of agriculture in the subsequent decades and it touched a low value of 15.2% between 2021-22 and 2023-24. Pertinently, the data shows

that a big pie of the agriculture sector's share has been transferred to the services sector which has grown by more than 22 percentage points higher over and above its share during 1950-51 to 1979-80 and it has become the main driving force of India's new economic growth path. Although the share of industry picked up during the 1980s, since then it remained more or less flat till the recent period, suggesting that the new reforms initiated during the 1990s and thereafter have remained ineffective in pushing the growth rate of the sector upward. The second point that emerged from the table is that the percentage points declining of agriculture sector's share was highest in the 1980s and 2000s. The reason for such a sharp decline in agriculture sector's share was largely due to better performance of both industry and services sector in the 1980s and the services sector alone in the 2000s. Now the next important point is that has this structural transformation in shares of sectors witnessed a similar structural transformation in employment generation? This pertinent issue will be discussed in the next sub-section.

Table 1: Contribution to total GVA by Sectors (in %)

Sectors	1950-51 to 1979-80	1980-81 to 1989-90	1990-91 to 1999-00	2000-01 to 2009-10	2010-11 to 2020-21	2021-22 to 2023-24
Agriculture	52.3	39.2	31.8	22.5	16.5	15.2
Industry	23.7	28.8	30.2	31.0	31.4	30.9
Services	29.2	35.5	41.1	46.8	52.1	53.9
Percentage points change						
Agriculture	-	-13.0	-7.5	-9.3	-6.0	-1.3
Industry	-	5.1	1.4	0.8	0.4	-0.5
Services	-	6.2	5.6	5.7	5.3	1.8

Source: author's compilation from MoSPI data

Note: agriculture sector includes: agriculture, livestock, forestry and fishing. Industry = mining and quarrying, manufacturing, electricity, gas, water supply & other utility services and construction. Services = trade, repair, hotels and restaurants, transport, storage, communication & services related to broadcasting, financial services, real estate, ownership of dwellings & professional services, public administration and defence and other services.

2.2 Employment Trends

Creating adequate employment opportunities to absorb the backlog of unemployment and underemployed as well as the current labour force has been one of the important development goals of India's economic policy throughout the post-independence period (Kapila, 2010, pp. 303). In this direction, economic planners of the country have envisaged various strategies to address three complementary issues together such as growth, poverty and unemployment under various Five-Year Plan periods. During the first three plan periods (1951-66), not much success was achieved on the above three counts due to limited resources, war with neighboring countries, high population growth and more rigid and inward-looking policies of the government. However, the

government's strategy to tackle unemployment and poverty took a different turn during the fourth Five Year Plan period, in which the focus was on the trickle-down effect of growth on poverty and unemployment. The government realized that there is a need for special development programmes along with economic growth to address the above two important issues. A similar kind of strategy was also continued in the fifth Five Year Plan period. However, the major success in achieving greater outcomes in unemployment reduction came in the 1980s owing to various new policy initiatives undertaken by the government. Along with a high growth rate target of 5-5.5%, the National Rural Employment Programme (NREP) was launched to achieve 300 to 400 million person days of employment during the sixth Five Year Plan (1980-1985) period. The government had also launched the Rural Landless Employment Guarantee Programme (RLEGP) to offer guaranteed 100 days of work per year to at least one member of every landless household. Similar to this plan, the seventh Five Year Plan (1985-90) period also witnessed high economic growth and continuation of employment programmes. The data reported by Kapila (2010, pp. 306 & 307) suggests that employment increased on an average by 7.09 million per annum between 1983 and 1993-94 which covers the maximum period of both the sixth and seventh Five Year Plans. At the sectoral level, agriculture sector contributed more than 60% of jobs but its share has decelerated over the years. On the other hand, significant improvement in contribution to employment came from services sector followed by construction sector.

In contrast to the 1980s, the employment growth in the 1990s was subdued despite high economic growth. The employment data reported by Kapila (2010, pp. 306 & 307) suggests that employment grew at a slower pace than labour force resulting in the unemployment rate shooting up from 6.1% in 1993-94 to 8.3% in 2004-05. As compared to employment generation of 7.09 million per annum between 1983 and 1993-94, it was about 6.45 million per annum between 1993-94 and 2004-05. Two notable changes appeared during this period as far as employment structure is concerned. One is the employment dependency on agriculture and allied sector rapidly shifted towards non-agriculture sector and second not only informal jobs increased in the unorganized sector, it also grew significantly in the organized sector as well. This was attributed largely to reforms and growth in telecommunications and IT services which encouraged creation of more and more outsourced and contractual jobs in the secondary and tertiary sectors (NCEUS, 2009).

2.2.1 The recent trends

India has done well in creating a large number of jobs particularly in the unorganised sector during the past few years. Kumar (2018) argued that the new economy has created several avenues that have generated a large number of employment in the unorganized sector like membership-based employment of Ola and Uber, online delivery jobs with Amazon, Flipkart, Snapdeal, food delivery jobs with Zomato and Swiggy, and home services such as Urban Clap and Quikr etc. However, he argued that these types of jobs have not been accounted for in any official estimates, which is a matter of debate as all these jobs have already been counted while collecting the information at the household level through a structured questionnaire. Despite these new avenues and employment opportunities, the job requirement is quite huge as around 10-12 million people enter the job

market every year, out of which around 8 million demand for jobs. In addition, there is a huge backlog of unemployment also, hence creating the required number of jobs remains a challenge.

Table 2 demonstrates information on employment from 2004-05 to 2023-24 using two important data sources such as NSSO's quinquennial survey on employment & unemployment for the years 2004-05 and 2011-12 and the annual Periodic Labour Force Survey (PLFS), released by MoSPI from 2017-18 and onwards. For a better assessment of the trends, the entire period has been divided into two parts i.e. period-I (2004-05 to 2011-12, 8 years) and period-II (2017-18 to 2023-24, 7 years). The two data periods throw up some interesting trends of employment although both the data series are not strictly comparable³. As far as the first period is concerned it sums up three important trends. First, there is an absolute decline in employment in the agriculture and allied sector with an average of 4.6 million per annum. Second, the industry sector created 4 million jobs per annum in period-I compared to 2.5 million jobs per annum in the services sector mainly due to higher contribution of construction sector. Third, the overall employment generation was very low with an average of 1.9 million per annum despite of the highest economic growth rate being recorded during this period. In the case of period-II, quite interestingly, there has been a reverse trend (compared to the previous period) in creation of employment opportunities in the agriculture and allied sector, where the sector has added a whopping 12.1 million jobs per annum during 2017-18 and 2023-24. Further, in this period, while the industrial sector continued to add around 5 million jobs per annum, the services sector on the other hand witnessed a quantum jump in employment generation (6.1 million per annum). More importantly, the overall employment generation was very high of 23.5 million per annum during this period, which is largely contributed by agriculture sector. But the larger question is do we consider creating a large number of employment in agriculture sector to be productive and good for the economy? As per the Lewisian development growth model, perhaps it is not.

Table 2: Employment Trends

Sectors	Employment (in millions)								
	2004-05	2011-12	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24
1. Agriculture	268.7	231.9	198.5	196.7	231.0	247.7	247.2	267.2	283.4
2. Industry	83.4	115.2	111.6	116.6	120.1	127.3	135.3	147.6	148.8
3. Services	107.6	127.4	140.0	149.5	155.6	157.7	160.8	168.6	182.6
Total employment	459.4	474.2	450.0	462.8	506.7	532.8	543.4	583.3	614.8
	%Share								
1. Agriculture	58.5	48.9	44.1	42.5	45.6	46.5	45.5	45.8	46.1
2. Industry	18.1	24.3	24.8	25.2	23.7	23.9	24.9	25.3	24.2
3. Services	23.4	26.8	31.1	32.3	30.7	29.6	29.6	28.9	29.7
Total employment	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

³See the Economic Survey, Vol II, GoI, 2020 for more details.

Source: Various Rounds of NSSO and PLFS. Employment measured as per usual status⁴ (principal plus subsidiary status) of age group 15 years and above. Employment numbers are derived using (i) WPR (15 years and above) from PLFS report and (ii) Census population projected data (15 years and above) by the National Commission on Population, Ministry of Health and Family Welfare. Missing Population data between 2011 and 2021, 2021 and 2026, and 2026 and 2031 are derived using the monthly compound annual growth rate projections method. 1st March 2018 projected population is considered for the FY 2017-18 although it deviates slightly from the PLFS data coverage period (July 2017- June 2018).

Besides the analysis at the aggregate level, it will be quite useful to analyse the employment status at the disaggregated level or sub-sectoral level to draw a comparative picture between growth and employment generation and accordingly apply a suitable method for future projection. **Table 3** provides the employment numbers in absolute terms and percentage share contribution to total employment. During the period-I except construction sector, employment generation was very low in other sectors even within industry and also sectors under services. This suggests that the high growth rate recorded by most of these sub-sectors during the period-I was substantially ineffective or inelastic to employment generation. Similarly, the period-II also witnessed a slow growth rate of employment in all the sub-sectors of industry except construction. However, a positive thing that happened during the second period is that services sector recorded nearly a one percentage point higher in its share of total employment compared to the first period.

Table 3: Employment Trends in Major Economic Sub-sectors

Sectors	Employment (in millions)						Share of Sectors (%)					
	2004-05	2011-12	2017-18	2021-22	2022-23	2023-24	2004-05	2011-12	2017-18	2021-22	2022-23	2023-24
Agriculture	268.7	231.9	198.5	247.2	267.2	283.4	58.5	48.9	44.1	45.5	45.8	46.1
Mining and Quarrying	2.7	2.6	1.8	1.6	1.8	1.2	0.6	0.5	0.4	0.3	0.3	0.2
Manufacturing	53.9	59.8	54.5	63.0	66.5	70.1	11.7	12.6	12.1	11.6	11.4	11.4
Electricity, water and gas	1.2	2.5	2.7	3.3	2.9	3.1	0.3	0.5	0.6	0.6	0.5	0.5
Construction	25.6	50.3	52.7	67.4	76.4	74.4	5.6	10.6	11.7	12.4	13.1	12.1
Trade, hotels, transport, communication and services related to broadcasting	67.7	79.2	80.6	96.2	102.1	109.4	14.7	16.7	17.9	17.7	17.5	17.8
Other Services	39.9	48.2	59.4	64.7	66.5	73.2	8.7	10.2	13.2	11.9	11.4	11.9
Total	459.7	474.5	450.0	543.4	583.3	614.8	100.0	100.0	100.0	100.0	100.0	100.0

⁴Usual status (ps+ss) gives an idea about average working condition of an individual for entire reference year. It can further be subdivided in to two categories. One is principal status (ps) and other is subsidiary status (ss). Principal status (ps) measures the activity in which an individual has spent relatively longer time of a reference year (six months and above) while subsidiary status (ss) measures the activity status of an individual who has spent majority of days out of work force but have worked for short period of time (30 days and more) (Annual Report, PLFS 2017-18).

Note: THTC&S= Trade, hotels, transport, communication and services related to broadcasting. As per standard sectoral classifications, industry constitutes of sectors from Sl. No. 1 to 4 in the above table. The rest of the sectors belong to services sector.

Source: Various Rounds of NSSO and PLFS.

3. Methodology

In this section, the study outlines the approaches that are used for making the projection of employment numbers for the medium term. In the literature, different approaches have been used for making employment forecasts. These are classified broadly into four categories as outlined below in **Table 4**.

Table 4: Various Manpower Demand Forecasting Methodologies

Projection Approaches	Input Requirements		Output
	Data	Tool	
Time Series Projection	Historical Records (20 years) of the targeted series	Projection Techniques, e.g. Exponential smoothing, Box-Jenkins (ARIMA) modelling etc.	Short-term aggregated manpower demand forecast; Large forecast error if discontinuities occur within the projected time period
Market Signaling Approach	Labour market signals, e.g. movement of relative wages, enrolment data, occupational employment trends and unemployment rate, job advertisement, etc.	Relative simple analysis, e.g. interviews, surveys, FGD and tracer study, etc.	Existing mismatch signals (qualitative and quantitative) in the labour market; Employer's view on future prospects of individual occupation
Bottom-Up Approach	Detailed labour returns and costs of the past projects breakdown by various sectors	Large size of database but rather simple calculations	Project based occupational manpower demand; Industry-based occupational manpower demand by summing up all project based demand
Top-Down Approach	Extensive macroeconomic statistics, e.g. GDP, sectoral output, unemployment rate, productivity, interest rate, etc.	Extrapolations, advanced econometrics modelling e.g. co-integration, vector error correction modelling, simulation, sensitivity analysis, etc.	Long-term industry-based aggregate manpower demand; Occupational and regional manpower demand can be obtained by extrapolating, using labour productivity factors or experts' judgment.

Source: Wong et al., 2012

To begin with “time series projection method”, is fairly a reliable and relatively simple way of projecting the future employment generation based on past employment trends. The time series

extrapolation uses stochastic information by examining a relationship solely between past behaviour and time and then extrapolating the trend into the future (Bezdek, 1975; Goh and Teo, 2000). This method includes the use of simple deterministic models such as linear extrapolation to complex stochastic models like the Box-Jenkins model for adaptive forecasting. However, the major limitation of using this method is that these forecasts are more suitable for producing only short-term forecasts and it does not give insights into the factors causing the changes in manpower requirements and occupational structure. Extrapolation produces large forecast errors if discontinuities occur within the projected period. Further, we require at least twenty-five or more data points of employment numbers for estimation and projection. Since it is hard to get a long span of time series data for employment, the use of this method is not feasible.

The second method is the market signaling approach which deals with collection and analysis of labour market information through field visits or primary-based survey. There are various tools being used to collate the information such as focus group discussions, structured questionnaires, direct interviews, tracer studies etc. Since the analysis of the present study is based on secondary information, this method is not suitable in the present context. This method is used mostly in dealing with specific cases like manpower demand estimation of an organization, sector, firm or industry.

The “Bottom-up” approach is otherwise known as the labour multiplier approach. In this approach, both occupation-wise labour demand is estimated by multiplying the labour multiplier and the project expenditures. The labour demand forecasting model by Chan et al. (2002) is representative of this approach. This method is widely used for forecasting construction and health sector employment across countries. For example, Rosenfeld and Warszawski (1993) in Israel, Proverbs et al. (1999) in UK, CWDFC (2002) in Alberta have used this approach to forecast the labour demand in the construction sector. Even though this method yields good results, applying this method for each and every sector of the economy is quite an ambitious task.

The “Top-down” approach is the most suitable method among the various methodologies used to derive employment forecasts. This method uses macro-level information on output, investment, employment etc. to forecast future labour demand. This approach is widely used by many researchers (Eijs, 1994; Dekker et al., 1994; Willems, 1996 and 1998; Campbell, 1997; and Hopkins, 2002).

The top-down method includes three major steps: Firstly, to project the future level of output of major economic sectors based on past trends or using econometric techniques. Secondly, to estimate the employment equation of major sectors with respect to output to get the employment-output elasticities. And finally, to predict the future level of employment demand for each sector by using employment-output elasticities and the predicted output level.

The sectoral employment elasticity is estimated using equation (1) where employment of the i^{th} sector in period t is determined by the employment level in period $t-1$ and output level in period t .

A double-log regression model can be used to estimate the elasticity. To estimate the future level of employment of the i^{th} sector, equation (2) can be used where the rate of growth of employment of the i^{th} sector is multiplied with the current level of employment in the sector. The rate of growth of employment in the i^{th} sector is computed by multiplying the growth rate of output in the i^{th} sector with the corresponding sectoral elasticity of output and employment.

$$\ln E_{it} = \alpha + \beta \ln E_{it-1} + \gamma \ln Y_{it} + \varepsilon \dots \quad (1)$$

$$E_{it} = E_i (1 + r_{ei})^t \dots \quad (2)$$

Where $r_{ei} = g \times u_i \times \eta_i$

r_{ei} = Annual rate of increase in employment in i^{th} sector

g = Annual rate of growth of GDP

u_i = Sectoral growth elasticity (i.e., elasticity of i^{th} sector output with respect to GDP)

η_i = Sectoral employment elasticity (i.e., rate of increase in i^{th} sector employment due to unit change in i^{th} sector output)

E_{it} = Employment of the i^{th} sector at the end of period t

E_i = Employment of the i^{th} sector during the benchmark year

Y_{it} = Output of the i^{th} sector at the end of period t

ε = stochastic disturbance term

This study uses “top-down” method for projecting the sectoral employment demand for the medium term (2022 to 2030). As indicated above, we need three components for employment projection – (i) employment growth, (ii) employment-output elasticity and (iii) forecasted values of output growth. In the case of employment elasticity, the present study used the employment elasticity estimation made by Misra and Suresh (2014)⁵ for the period 1999-00 to 2011-12. The study also uses recent years (2017-18 to 2023-24) data on Gross Value Added and employment to estimate employment-output elasticity and compare the results of two baseline scenarios. The reason for using employment elasticity for two different periods is to understand how structural changes are happening in the economy as far as employment is concerned and the way forward.

To get the forecasted values of economic growth, the study estimates the following structural linear form of value-added growth equations of seven major sub-sectors using quarterly data from Q1:2012-13 to Q4:2023-24 (48 data points or observations)⁶. Given the constraints of the availability of high-frequency data, the study has selected some of the key explanatory variables to estimate the growth equations.

⁵RBI working paper series

⁶The terms output and growth equations are used synonymously in this paper.

Agriculture and allied sector

$$GAFF_t = \alpha_0 + \beta_1 GAFF_{t-1} + \beta_2 GGFCF_t + \beta_3 RAIN_DEV_t + \beta_4 D2013Q3AGL + \beta_5 D2014Q3AGL + \beta_6 D2015Q3AGL + \beta_7 D2016Q34AGL + \beta_8 D2017Q34AGL + \beta_9 D2018Q4AGL + \beta_{10} D2019Q4AGL + \beta_{11} D2022Q34AGL + \epsilon_1 \dots \quad (3)$$

Where, α_0 is intercept, β_t are slope coefficients and ϵ_1 is a random error term. GAFF = growth rate real value added of agriculture, forestry and fishing, GGFCF = growth rate of real gross fixed capital formation, RAIN_DEV = rainfall deviation from normal rainfall, D_i = symbol of all dummy variables. Except dummy variable, all other variables in the above equation and as well equations below are estimated in the form of their respective growth rates. Hence, the general problem of non-stationarity in time series data has been taken care of.

Mining and Quarrying sector

$$GMQ_t = \alpha_1 + \delta_1 GMQ_t(-1) + \delta_2 GGFCF_t + \delta_3 GPFCE_{t-1} + \delta_4 D2014Q1MQ + \delta_5 D2017Q4MQ + \epsilon_2 \dots \quad (4)$$

Where GMQ = growth rate of real value added of mining and quarrying, GPFCE = growth rate of real private final consumption expenditure.

Manufacturing sector

$$GMFG_t = \alpha_2 + \phi_1 GGFCF_t + \phi_2 GPFCE_t + \phi_3 GUSGDP_t + \epsilon_3 \dots \quad (5)$$

Where GMFG = growth rate of real value added of manufacturing, GUSGDP = growth rate of real gross domestic product of US.

Construction sector

$$GCONSTRUC_t = \alpha_3 + \gamma_1 GGFCF_t + \gamma_2 GPFCE_{t-1} + \epsilon_4 \dots \quad (6)$$

Electricity, gas, water supply & other utility services sector

$$GEGW_t = \alpha_4 + \eta_1 GGFCF_t + \eta_2 GPFCE_t + \epsilon_5 \dots \quad (7)$$

Trade, hotels, transport, communication and services related to the broadcasting sector

$$GTHTCS_t = \alpha_5 + \phi_1 GGFCF_t + \phi_2 GPFCE_{t-1} + \epsilon_6 \dots \quad (8)$$

Other Services sector

$$GOTHSER_t = \alpha_6 + \lambda_1 GOTHSER_{t-1} + \lambda_2 GGFCF_t + \lambda_3 GUSGDP_t + \epsilon_7 \dots \quad (9)$$

Usually, high-frequency production and price data demonstrate variation over time partly due to seasonal factors. Without adjusting such factors may lead to biased estimates. Hence, the study

uses Census X-11 method to deseasonalise the quarterly series. Except USGDP, data for all other variables are taken from National Account Statistics, Ministry of Statistics and Programme Implementation, Government of India and RBI's Handbook of Statistics. Data on USGDP is extracted from IMF's database. Data on rainfall is taken from the Indian Metrological Department, Government of India.

4. Results and Discussion

4.1 Analysis of Growth Scenario

The results of estimated growth equations illustrated in the previous section are given in tables A1 to A7 in the Appendix. In the case of agriculture and allied sector (Table A1) the results show that the current year's growth rate of the sector is positively and significantly influenced by factors such as its past year growth rate, rainfall and year dummies. Gross fixed capital formation also plays an important role in influencing the growth rate of the sector, however, its t-value is found significant close to 10% significance level. In the case of mining and quarrying sector, we found that the sector's current year growth rate is influenced by its immediate past year growth rate, growth rate of gross fixed capital formation and one year lagged growth rate of private final consumption expenditure (Table A2). The results of manufacturing sector show that the growth rate of the sector is positively and significantly influenced by growth rate of gross fixed capital formation. The growth rates of private final consumption expenditure and GDP of US although show a positive sign but are not statistically significant (Table A3). In case of construction sector, the results show that the growth rate of gross fixed capital formation is statistically significant and for the utility sector, the growth rate of both gross fixed capital formation and private final consumption expenditure are significant (Tables A4 and A5). Like manufacturing sector, services sector's (Trade, Hotels, Transport, Communication and Services Related to Broadcasting) growth rate is also positively and significantly influenced by growth rate of gross fixed capital formation (Table A6). In case of other services (Financial, Real Estate and Professional Services, and Public Administration, Defence and Other Services), the results show it is positively and significantly influenced by its immediate past year's growth rate, growth rates of gross fixed capital formation and US GDP. One common conclusion that is drawn from all these equations is that the value of F-statistic is found statistically significant in all the cases suggesting the estimated models fit better to the given data set.

Forecasting

In the next step, the study forecasts future values of GVA growth rates of seven broad economic sectors from 2024-25 to 2030-31. For this, certain assumptions are being made on exogenous variables that are incorporated in various growth equations. These variables are given in **Table 5**.

Since quarterly data is used to estimate sectoral growth equations, we have made assumptions on quarterly growth rate of each of these exogenous variables. For illustration, we have demonstrated quarterly values only for 2024-25 in the table below. These quarterly values of 2024-25 are derived by using the moving average of each quarter for the period 2015-16 to 2019-20⁷. Then the same quarterly values have been repeated for the rest of the future years.

Table 5: Assumptions on Exogenous Variables

Period	GGFCF	GPFCE	GUSGDP	Rainfall
2024Q1	8.59	7.75	2.51	1.03
2024Q2	6.29	7.13	2.49	1.00
2024Q3	6.95	7.07	2.52	1.04
2024Q4	6.40	5.75	2.06	1.05
2024-25	7.06	6.93	2.40	1.03
2025-26	7.06	6.93	2.40	1.03
2026-27	7.06	6.93	2.40	1.03
2027-28	7.06	6.93	2.40	1.03
2028-29	7.06	6.93	2.40	1.03
2029-30	7.06	6.93	2.40	1.03
2030-31	7.06	6.93	2.40	1.03

Using the estimated equations and the above values of exogenous variables, we derived the forecasted values of GVA growth rate of each sector. The results are illustrated in figures A1 to A7. All these figures show the trend growth rate of actual series and forecasted series. Further, the figures point to the fact that the forecasted series are trending quite similar to actual series, suggesting the goodness-of-fit of estimated models. This can be judged using three important statistics – root mean square error (RMSE), Theil inequality coefficient, Bias Proportion and Variance proportion. The values of all these statistics are given in different tables in Appendix. The smaller is the value of RMSE, the better is predicting ability of the model. Bias proportion indicates how far the mean of the forecast from the mean of the actual series and variance proportion implies how far is the variance of the forecasts from the variance of the actual series –

⁷ Post-2019 years are not taken into account due to the presence of high volatility in macro indicators owing to COVID and other global factors.

smaller is the value of these statistics, better is the fit of the model. Overall, all these statistics point to the conclusion that the estimated models/equations are best fit to the data series.

Table 6: Projected growth rate of GVA at the Sectoral level from 2024-25 to 2030-31

Sectors	2023-24	2024-25*	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31
Agriculture, Forestry and Fishing	1.44	3.23	3.19	3.19	3.19	3.19	3.19	3.19
Mining & Quarrying	7.09	2.84	2.73	2.72	2.72	2.72	2.72	2.72
Manufacturing	9.86	6.85	6.85	6.86	6.86	6.86	6.87	6.87
Electricity, Gas, Water Supply & Other Utility	7.53	6.42	6.42	6.42	6.42	6.42	6.42	6.43
Construction	9.94	7.03	7.04	7.05	7.05	7.06	7.07	7.08
Trade, Hotels, Transport, Communication and Services Related to Broadcasting	6.41	7.99	8.00	8.01	8.02	8.03	8.04	8.05
Other Services	8.19	7.62	7.56	7.56	7.56	7.56	7.56	7.56
Total GVA at basic prices	7.22	6.74	6.73	6.76	6.79	6.82	6.84	6.87

Note: * projected values start from 2024-25 and onwards

The forecasted values of GVA growth rate of each sector for the period 2024-25 to 2030-31 are reported in **Table 6**. We predict that the overall growth rate of the economy for 2024-25 is 6.7% and thereafter it will grow on an average in the range of 6.7-6.9% till 2030-31. At the sectoral level, the highest growth rate will be recorded in trade, hotel, transport and communication sector followed by other services and manufacturing sector.

4.2 Analysis of Employment Scenario

In this section, we analyse two different employment baseline scenarios. One scenario (baseline-1) is employment growth projection based on the forecasted economic growth rate and employment-output elasticity for the period 1999-00 to 2011-12 and the second (baseline-2) is employment growth projection based on the forecasted economic growth rate and employment-output elasticity for the recent period i.e 2017-18 to 2023-24. These two baseline scenarios will help us to understand how the Indian economy has endured structural shifts as far as employment at the sectoral level is concerned.

4.2.1 Baseline-1 Employment Scenario

The study estimates employment numbers for key economic sectors for the period 2024-25 to 2030-31 using employment-output elasticity and projected GVA growth rates. The estimated values of employment elasticity by Misra and Suresh (2014) for the period 1999-00 to 2011-12,

and the projected values of employment numbers and the percentage share of each sector in total employment are reported in Table 7 and Figure 2 respectively.

Three important conclusions could be drawn from the projected numbers. First agriculture and allied sector continued to be the dominant sector till 2030-31 as far as employment opportunities is concerned. However, the sector's share in total employment will gradually fall over the period and will touch around 40% by 2030-31 from 46.1% in 2023-24. Second, the expected slowdown of economic activities in services sector does not augur well for employment creation in the medium term. The current employment share of services sector would witness a marginal decline in the medium term unless the government comes to the rescue by creating a large number of employment opportunities in the public sector. The third important point is that except the construction sector, the employment creation in the secondary sector will also remain subdued, more so in the manufacturing sector, which is a matter of concern as the sector has been offering a large proportion of blue-collar jobs over the period.

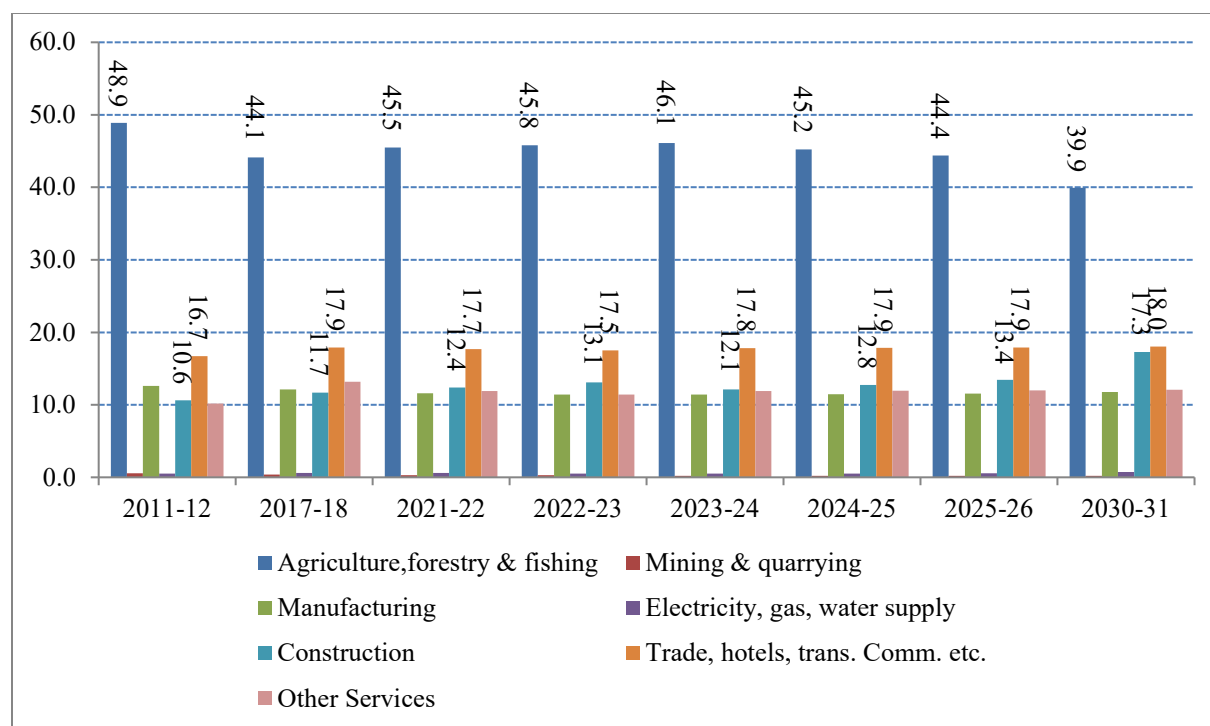
Table 7: Baseline-1 Employment Scenario from 2024-25 to 2030-31 (in Millions)

	Elasticity	Actual numbers				Projected numbers			
	1999-00 to 2011-12*	2011-12	2017-18	2022-23	2023-24	2024-25	2025-26	2026-27	2030-31
1. Agriculture, forestry & fishing	-0.08	231.9	198.5	267.2	283.4	282.7	282.0	281.3	278.4
2. Mining & quarrying	0.34	2.6	1.8	1.8	1.2	1.2	1.3	1.3	1.3
3. Manufacturing	0.33	59.8	54.5	66.5	70.1	71.7	73.3	75.0	82.0
4. Electricity, gas, water supply & other utility services	1.17	2.5	2.7	2.9	3.1	3.3	3.6	3.8	5.1
5. Construction	1.01	50.3	52.7	76.4	74.4	79.7	85.3	91.4	120.4
6. Trade, hotels, transport, communication and services related to broadcasting	0.25	79.2	80.6	102.1	109.4	111.6	113.9	116.1	125.8
7. Other Services	0.27	48.2	59.4	66.5	73.2	74.6	76.1	77.7	84.1
Total (15 yrs and above)	0.20	474.5	450.0	583.3	614.8	624.9	635.4	646.5	697.1
WPR (15 yrs and above)			46.8	56.0	58.2	58.3	58.5	58.8	60.3

Note* employment-output elasticity is estimated by Misra and Suresh (2014)

Source: Author's estimation

Figure 2: The share of employment at the sectoral level from 2011-12 to 2030-31(%)



4.2.2 Baseline-2 Employment Scenario

In baseline-2, the study estimates employment-output elasticities using the current years' data i.e. from 2017-18 to 2023-24. The estimated elasticities and the employment numbers are illustrated in Table 8.

Table 8: Baseline-2 Employment Scenario from 2024-25 to 2023-31 (in Millions)

	Elasticity	Actual numbers				Projected numbers			
	2017-18 to 2023-24*	2011-12	2017-18	2022-23	2023-24	2024-25	2025-26	2026-27	2030-31
1. Agriculture, forestry & fishing	1.54	231.9	198.5	267.2	283.4	297.5	312.1	327.4	396.4
2. Mining & quarrying	-0.60	2.6	1.8	1.8	1.2	1.2	1.2	1.2	1.1
3. Manufacturing	1.17	59.8	54.5	66.5	70.1	75.7	81.8	88.3	120.3
4. Electricity, gas, water supply & other utility services	0.22	2.5	2.7	2.9	3.1	3.1	3.2	3.2	3.4
5. Construction	0.83	50.3	52.7	76.4	74.4	78.7	83.3	88.1	110.6
6. Trade, hotels, transport, communication and	0.63	79.2	80.6	102.1	109.4	114.9	120.7	126.7	154.3

services related to broadcasting									
7. Other Services	0.52	48.2	59.4	66.5	73.2	76.1	79.1	82.2	96.0
Total (15 yrs and above)	1.07	474.5	450.0	583.3	614.8	647.2	681.3	717.1	882.0
WPR (15 yrs and above)			46.8	56.0	58.2	60.4	62.7	65.2	76.3

Source: *Estimated by author

Several noticeable changes are evidenced between the two baseline results. First, the overall employment-output elasticity at the country level has gone up significantly from 0.20 in baseline 1 to 1.07 in baseline 2, which implies that the argument put forth by scholars and researchers that there is jobless growth in the country based on past data does not hold for the recent years. High employment elasticity suggests that a one per cent increase in economic growth rate will lead to a more than one per cent (1.1%) increase in employment. Second, a significant increase in overall employment elasticity is largely driven by a paradigm shift in employment elasticity of agriculture and allied sector from (-)0.08 in baseline 1 to 1.54 in baseline 2. The results suggest that the trend of shifting workers from Farm to Non-farm sector during the baseline 1 period has reversed in the recent period (baseline 2). The sector has added on an average a whopping 12.14 million workers every year between 2017-18 and 2023-24. Third, visible changes are also evidenced in employment elasticities of Mining & Quarrying, Utilities and Manufacturing sectors. While the employment elasticity has declined for the first two sectors, it has gone up significantly for the third sector (Manufacturing) in baseline 2 over baseline 1, which is good for the economy and the people since the sector generates a large number of blue-collar jobs with high remuneration compared to the Farming sector.

4.2.3 Baseline-2.1 Employment Scenario

Baseline 2.1 is an alternative version of baseline 2. We have made only one change i.e. the elasticity of agriculture and allied sector remains the same as in baseline 1. The reason is that according to the development theory and experience from developed countries, in a developing or growing economy labour transition happens from the subsistence or traditional agricultural sector to the modern sector like manufacturing/services sector. This is what exactly happened between 1999-00 and 2011-12 when the agriculture sector witnessed an absolute decline in the workforce. The recent period, however, witnessed a reverse trend in employment in agriculture sector as there was a huge influx of reverse migration from urban to rural areas during the COVID and many of them are not willing to return to urban areas in the post-COVID period. But this phenomenon could be temporary or for a short period, eventually, they will move from agriculture to other sectors due to higher wages and a better standard of living. Therefore, in baseline 2.1 we assume that for the agriculture sector, a negative employment elasticity is more reasonable than a positive elasticity in the long run. The results of baseline 2.1 are reported in Table 9.

Table 9: Baseline-2.1 Employment Scenario from 2024-25 to 2033-31 (in Millions)

	Elasticity	Actual numbers				Projected numbers			
	2017-18 to 2023-24	2011-12	2017-18	2022-23	2023-24	2024-25	2025-26	2026-27	2030-31
1. Agriculture, forestry & fishing	-0.08*	231.9	198.5	267.2	283.4	282.7	282.0	281.3	278.4
2. Mining & quarrying	-0.60	2.6	1.8	1.8	1.2	1.2	1.2	1.2	1.1
3. Manufacturing	1.17	59.8	54.5	66.5	70.1	75.7	81.8	88.3	120.3
4. Electricity, gas, water supply & other utility services	0.22	2.5	2.7	2.9	3.1	3.1	3.2	3.2	3.4
5. Construction	0.83	50.3	52.7	76.4	74.4	78.7	83.3	88.1	110.6
6. Trade, hotels, transport, communication and services related to broadcasting	0.63	79.2	80.6	102.1	109.4	114.9	120.7	126.7	154.3
7. Other Services	0.52	48.2	59.4	66.5	73.2	76.1	79.1	82.2	96.0
Total (15 yrs and above)		474.5	450.0	583.3	614.8	632.4	651.1	671.0	764.0
WPR (15 yrs and above)			46.8	56.0	58.2	59.0	59.9	61.0	66.1

Source: * estimated by Misra and Suresh (2014) for the period 1999-00 to 2011-12. For other sectors, author's own estimation is used.

The projected total employment under this scenario looks quite reasonable which is expected to increase from 614.8 million in 2023-24 to 632.4 million in 2024-25 and to 764.0 million in 2030-31. The worker population ratio (WPR) is expected to increase from 58.2 in 2023-24 to 59.0 in 2024-25 and to 66.1 in 2030-31. By contribution of sectors to total employment, while the share of agriculture and allied sector is expected to decline from 46.1% in 2023-24 to 36.4% in 2030-31, the share of industry and services sector on the other hand would increase from 24.2% to 30.8% and 29.7% to 32.8% in the same period respectively.

4.2.4 Employment scenarios under different elasticities of Agriculture Sector

Agriculture and allied sector has witnessed a wide variation in employment elasticity ranging from (-)0.08 during 1999-00 and 2011-12 to 1.54 during 2017-18 and 2023-24, and since these are two extreme values may unlikely continue in the future, the study assumes a few alternative employment elasticity values for the sector to derive some in-between employment scenarios. We assume three alternative employment elasticity values such as 0.0, 0.5 and 1.0 for agriculture and allied sector. Under these alternative elasticities, the employment scenarios for the sector and all sectors together are calculated and presented in **Table 10**.

Table 10: Alternative Employment Scenarios for Agriculture and Allied Sector from 2024-25 to 2030-31 (in Millions)

	Elasticity	Actual numbers				Projected numbers			
	2017-18 to 2023-24	2011-12	2017-18	2022-23	2023-24	2024-25	2025-26	2026-27	2030-31
Baseline – 2.1									
Agriculture, forestry & fishing	-0.08*	231.9	198.5	267.2	283.4	282.7	282.0	281.3	278.4
Total (15 yrs and above)		474.5	450.0	583.3	614.8	632.4	651.1	671.0	764.0
Alternative -1									
Agriculture, forestry & fishing	0.0	231.9	198.5	267.2	283.4	283.4	283.4	283.4	283.4
Total (15 yrs and above)		474.5	450.0	583.3	614.8	633.2	652.6	673.2	633.2
Alternative -2									
Agriculture, forestry & fishing	0.5	231.9	198.5	267.2	283.4	288.0	292.6	297.3	316.7
Total (15 yrs and above)		474.5	450.0	583.3	614.8	637.8	661.8	687.0	802.3
Alternative -3									
Agriculture, forestry & fishing	1.0	231.9	198.5	267.2	283.4	292.6	301.9	311.6	353.2
Total (15 yrs and above)		474.5	450.0	583.3	614.8	642.3	671.1	701.3	838.8
Baseline – 2.0									
Agriculture, forestry & fishing	1.54**	231.9	198.5	267.2	283.4	297.5	312.1	327.4	396.4
Total (15 yrs and above)		474.5	450.0	583.3	614.8	647.2	681.3	717.1	882.0

Source: * estimated by Misra and Suresh (2014) for the period 1999-00 to 2011-12. ** Author's own estimation.

5. Conclusion

In this study, we make an effort to estimate and project employment numbers at the sectoral level in the case of India. For this, the study used “top-down” method, which consists of three components such as (i) employment growth, (ii) employment-output elasticity and (iii) forecasted values of output growth. In the case of employment elasticity, the present study used the employment elasticity estimation made by Misra and Suresh (2014) for the period 1999-00 to 2011-12 and the present study's estimation for the period 2017-18 to 2023-24. For deriving the forecasted values of economic growth rates, the study estimates output equations at the sectoral level and makes the future projection of growth rates. The findings of the study suggest that India's economy would register around 6.7% growth rate in 2024-25 and would grow on an average between 6.7-6.9% till 2030-31, which is slightly lower than the average growth rates (7.8%) recorded during 2021-22 and 2023-24. This would in turn impact the growth rate of employment in the medium term, posing a policy challenge for the government in creating and sustaining high employment growth, which was witnessed in the recent past. The focus must be given to improving economic activities in the services sector, particularly in the retail trade and transportation sector where a large number of people with low or semi-skilled are working. Similarly, focus should be

given to expanding the base of manufacturing sector particularly the labour intensive units may be protected and given the utmost attention in sustaining economic activities and creating employment opportunities. Agriculture and allied sector has witnessed a significant rise in employment opportunities in recent years, and since the sector offers low quality jobs with less income, diversification of agricultural labourers to non-farm sectors is critical in the medium to long term.

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Appendix

Growth Equation Estimation

Table A1: Estimated growth rate equation of agriculture and allied sector

Dependent Variable: GAFF				
Method: Least Squares				
Sample (adjusted): 2012Q2 2023Q4				
Included observations: 47 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.496	1.635	-0.915	0.367
GAFF(-1)	0.454	0.084	5.376	0.000
GGFCF	0.027	0.016	1.660	0.106
RAINFALL	2.959	1.574	1.880	0.068
D2013Q3AGL	4.295	1.365	3.146	0.003
D2014Q3AGL	-4.850	1.388	-3.495	0.001
D2015Q3AGL	-3.683	1.376	-2.678	0.011
D2016Q34AGL	3.468	1.012	3.427	0.002
D2017Q34AGL	2.333	1.006	2.320	0.026
D2018Q4AGL	-3.554	1.362	-2.609	0.013
D2019Q4AGL	3.395	0.992	3.424	0.002
D2022Q34AGL	2.887	0.971	2.973	0.005
R-squared	0.806	Forecasted Indicators		
Durbin-Watson stat	1.565	RMSE	1.364	
Durbin-h statistics	1.830	Bias Proportion	0.002	
F-statistic	13.187	Variance proportion	0.154	
Prob(F-statistic)	0.000	Theil inequality coefficient	0.156	

Note: GAFF = Growth of value added of Agriculture, Forestry and Fishing, GGFCF = Growth rate of Gross Fixed Capital Formation, RAINF_DEV = Deviation from actual rainfall from normal rainfall, and other variables are year-wise dummies. RMSE = Root Mean Squared Error

Figure A1: Actual and projected growth rate of Agriculture and allied sector

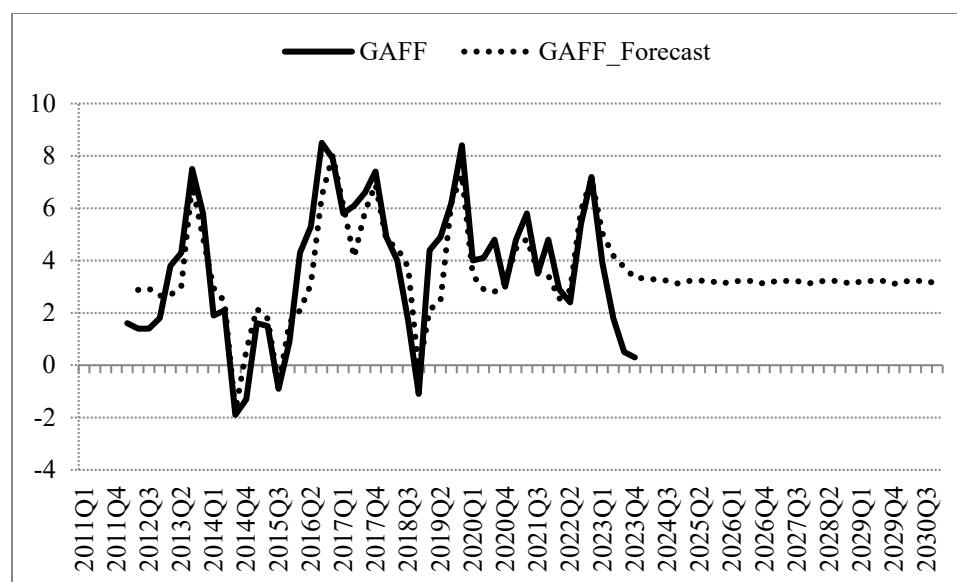


Table A2: Estimated growth rate equation of Mining and Quarrying sector

Dependent Variable: GMQ				
Sample (adjusted): 2012Q2 2023Q4				
Included observations: 47 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	-2.082	1.074	-1.938	0.061
GMQ(-1)	0.230	0.127	1.814	0.079
GGFCF	0.293	0.053	5.552	0.000
GPFCE(-1)	0.246	0.143	1.721	0.095
D2014Q1MQ	6.095	1.888	3.229	0.003
D2017Q4MQ	-9.401	3.081	-3.051	0.005
R-squared	0.750	Forecasted Indicators		
Durbin-h statistics	-1.062	RMSE	3.906	
F-statistic	19.186	Bias Proportion	0.000	
Prob(F-statistic)	0.000	Variance proportion	0.070	

Note: GMQ = Growth of value added of Mining and Quarrying. GPFCE = Growth of Private Final Consumption Expenditure

Figure A2: Actual and projected growth rate of Mining and Quarrying sector

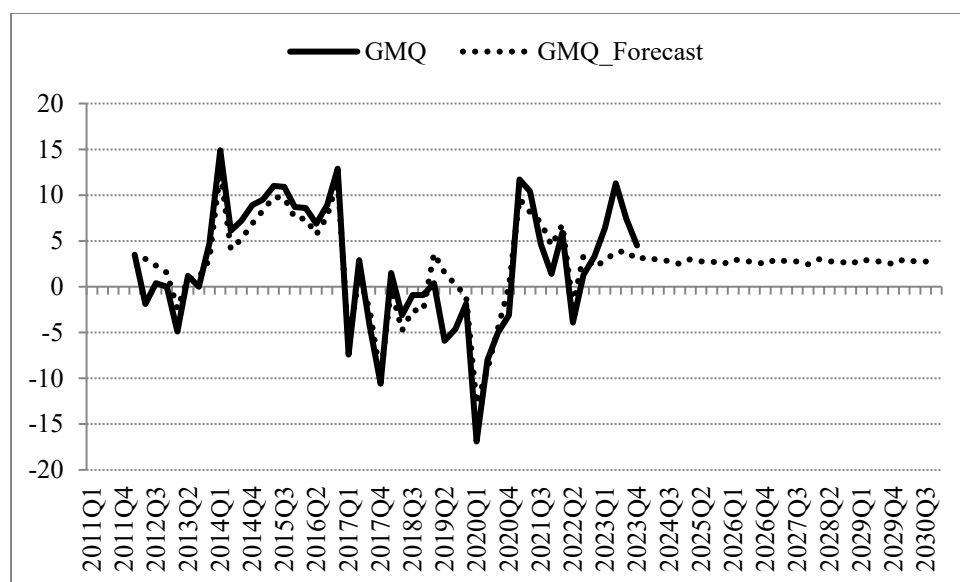


Table A3: Estimated growth rate equation of Manufacturing sector

Dependent Variable: GMFG				
Sample: 2012Q1 2023Q4				
Included observations: 48				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.807	2.080	0.388	0.700
GGFCF	0.679	0.085	7.968	0.000
GPFCE	0.126	0.109	1.154	0.255
GUSGDP	0.014	0.576	0.024	0.981
AR(1)	0.705	0.140	5.037	0.000
SIGMASQ	14.736	3.225	4.570	0.000
R-squared	0.853	Forecasted Indicators		
Durbin-Watson stat	1.843	RMSE		5.698
F-statistic	48.608	Bias Proportion		0.014
Prob(F-statistic)	0.000	Variance proportion		0.032

Note: GMFG = Growth of value added of Manufacturing. GUSGDP = Growth rate of US GDP

Figure A3: Actual and projected growth rate of Manufacturing sector

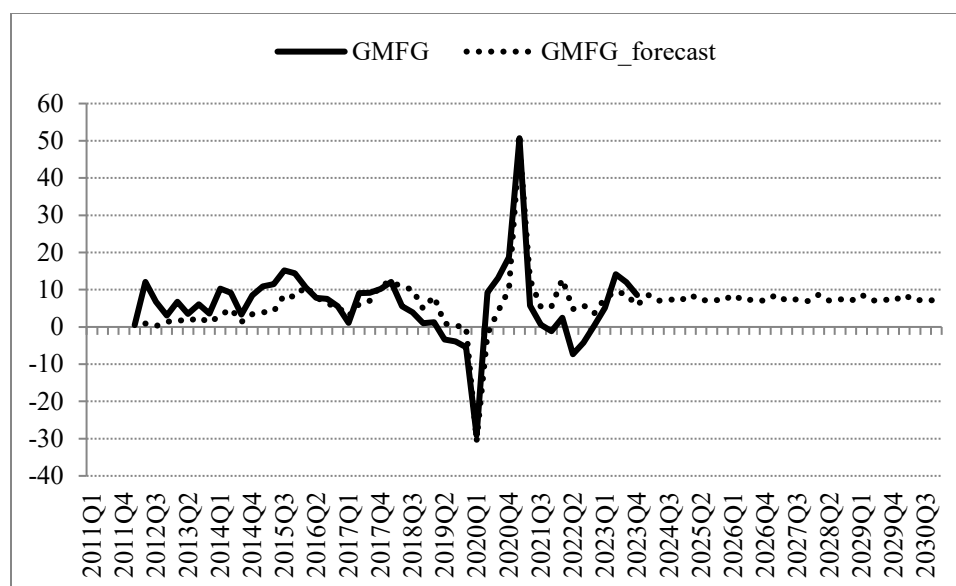


Table A4: Estimated growth rate equation of Construction sector

Dependent Variable: GCONSTRUC				
Sample: 2012Q1 2023Q4				
Included observations: 47				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	-2.141	1.544	-1.386	0.173
GGFCF	1.179	0.025	46.994	0.000
GPFCE(-1)	0.125	0.131	0.950	0.348
AR(1)	0.533	0.137	3.877	0.000
SIGMASQ	13.110	3.437	3.814	0.000
R-squared	0.940	Forecasted Indicators		
Durbin-Watson stat	2.360	RMSE	3.350	
F-statistic	165.248	Bias Proportion	0.009	
Prob(F-statistic)	0.000	Variance proportion	0.000	

Note: GCONSTRUC = Growth of value added of Construction.

Figure A4: Actual and projected growth rate of Construction sector

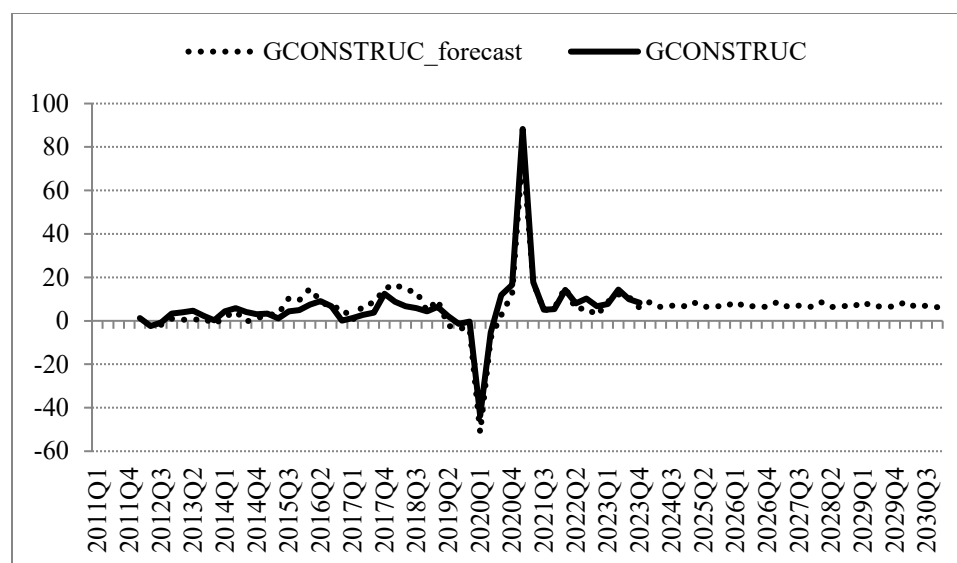


Table A5: Estimated growth rate equation of Electricity, Water and Gas sector

Dependent Variable: GEGW				
Sample: 2012Q1 2023Q4				
Included observations: 48				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	2.856	1.014	2.817	0.007
GGFCF	0.179	0.052	3.414	0.001
GPFCE	0.331	0.103	3.219	0.002
AR(1)	0.504	0.137	3.668	0.001
SIGMASQ	6.896	2.125	3.245	0.002
R-squared	0.741	Forecasted Indicators		
Durbin-Watson stat	2.144	RMSE	3.101	
F-statistic	30.829	Bias Proportion	0.000	
Prob(F-statistic)	0.000	Variance proportion	0.192	

Note: GEGW = Growth of value added of Electricity, Gas and Water supply.

Figure A5: Actual and projected growth rate of Electricity, Water and Gassector

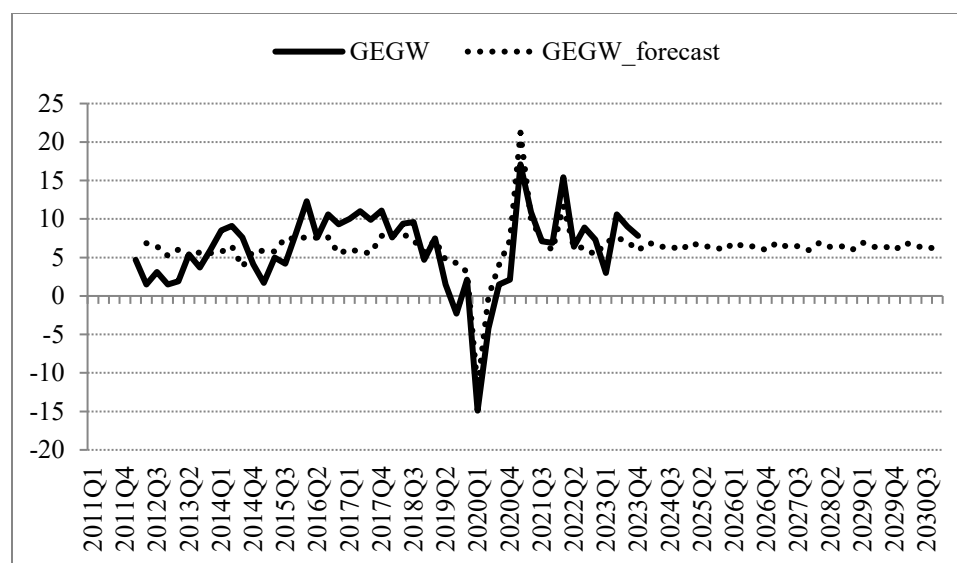


Table A6: Estimated growth rate equation of Trade, Hotels, Transport, and Communication sector

Dependent Variable: GTHTCS				
Sample (adjusted): 2012Q2 2023Q4				
Included observations: 47 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	-2.141	1.544	-1.386	0.173
GGFCF	1.179	0.025	46.994	0.000
GPFCE(-1)	0.125	0.131	0.950	0.348
AR(1)	0.533	0.137	3.877	0.000
SIGMASQ	13.110	3.437	3.814	0.000
R-squared	0.940	Forecasted Indicators		
Durbin-Watson stat	2.368	RMSE	4.238	
F-statistic	165.248	Bias Proportion	0.009	
Prob(F-statistic)	0.000	Variance proportion	0.000	

Note: GTHTCS = Growth of value added of Trade, Hotels, Transport, Communication and Services Related to Broadcasting.

Figure A6: Actual and projected growth rate of Trade, Hotels, Transport, and Communication sector

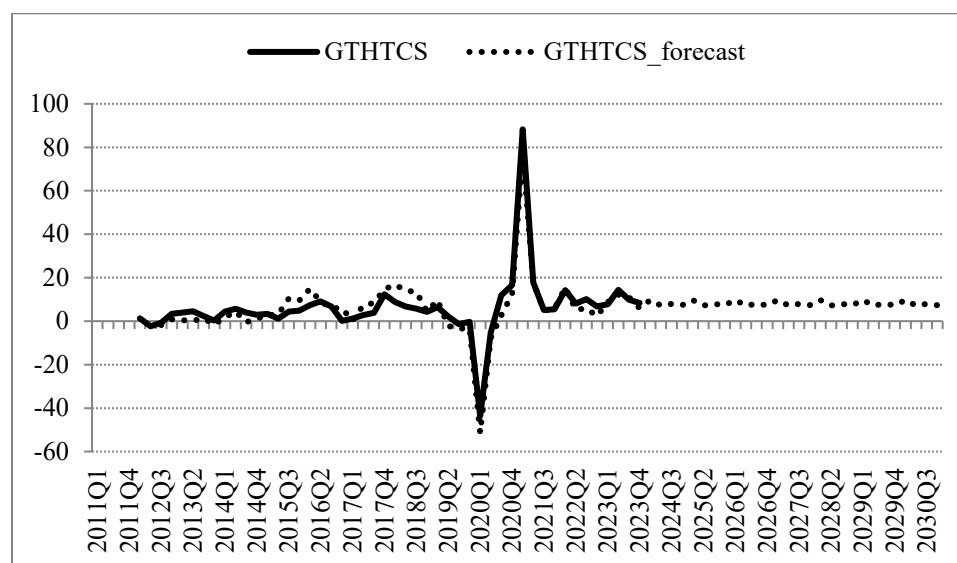


Table A7: Estimated growth rate equation of Other Services sector

Dependent Variable: GOTHSER				
Sample: 2012Q2 2023Q4				
Included observations: 47				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.717	0.789	0.909	0.368
GOTHSER(-1)	0.459	0.086	5.320	0.000
GGFCF	0.221	0.078	2.848	0.007
GUSGDP	0.749	0.435	1.721	0.092
Forecasted Indicators				
R-squared	0.824			
Durbin- h statistics	2.379	RMSE	3.951	
F-statistic	45.897	Bias Proportion	0.000	
Prob(F-statistic)	0.000	Variance proportion	0.048	

Note: GOTHSER = Growth of value added of Financial, Real Estate and Professional Services, and Public Administration, Defence and Other Services

Figure A7: Actual and projected growth rate of Other Services Sector

