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Contents

Impact of Foreign Direct Investment (FDI) on Economic Growth of India

M. SYED IBRAHIM

Foreign Direct Investment (FDI) plays an important role in global business and it affords a firm with new marketing channels, cheaper production facilities, access to technology transfer, and financing. With the advent of globalisation and strong governmental support, foreign investment has lent a hand and the Indian economy has grown tremendously. India has constantly sought to attract investment from the world's major investors. In 1998 and 1999, the Government of India announced a number of reforms designed to encourage and promote a constructive business environment for investors. FDI means an investment through which the non-resident investor and foreign company can start a new company or can acquire shares in an existing Indian company. Foreign investments in the country can take the form of investments in listed companies i.e., Foreign Institutional Investors (FIIs), Investments in listed/unlisted companies other than through stock exchanges i.e., through the FDI or private equity/foreign venture capital investment route, investments through American Depositary Receipts (ADR), Global Depositary Receipts (GDR), investments by Non-Resident Indians (NRIs) and Persons of Indian Origin (PIOs) in various forms. This paper attempts to review the impact of FDIs in Indian economy, particularly after a decade of economic reforms, and analyse the role played by FDI in the economic development of the country. The study is diagnostic and exploratory in nature and makes use of secondary data. The study finds and concludes that the FDIs in India have significantly improved and have developed the economy as well.

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Introduction

The history of foreign investments in India can be traced back to the establishment of East India Company of Britain. Britain's capital came to India during their colonial era. Before independence, major amount of foreign investment came from the British companies. British companies setup their units in mining sector and in those sectors that suited their own economic and business interests. After the Second World War, Japanese companies entered Indian market and enhanced their trade with India, yet UK remained the most dominant investor in India. Keeping in mind the national interests, the policymakers designed the FDI policy which aimed it as a medium for acquiring advanced technology and to mobilise foreign exchange resources.

FDI is an investment by a party in one country to an enterprise or company in another country with the purpose of establishing lasting benefits. It can be made by expanding the business abroad or by becoming a company owner in another company. Early FDI policies were limited to allowing only Bangladesh and Pakistan to pass through governmental channels in all sectors. The revised rules now place companies from China under the government route filter.

Developing countries like India need foreign capital on account of the following reasons:

a) When domestic capital is inadequate, it is necessary to invite foreign capital.

b) There may be potential savings in a developing economy like India, but this may come to fruition only at a higher level of economic activity. It is, therefore, necessary that foreign capital helps in speeding up economic activity in the initial phase of development.

c) It may be difficult to mobilise domestic savings for the financing of projects that are badly needed for economic development; the capital market is itself underdeveloped. During the period in which the capital market is in the process of development, foreign capital is essential as a temporary measure.

d) Foreign capital, in fact, brings with it other scarce productive factors, such as technical know-how, business experience and knowledge which are equally essential for economic development of any country.

OBJECTIVES OF THE STUDY

The present study has been undertaken to conduct empirical analysis of the status of FDIs in India. Thus, the objectives of the present study are enumerated as follows:

1) To review the FDIs attracted by the country,

2) To analyse the trends of FDI and

3) To assess the impact of FDI in the economic growth of a country.

HYPOTHESES OF THE STUDY

(i) H01: Country-wise inflow of FDI does not influence the sector-wise inflow of FDI,

(ii) H02: Total inflow of FDI has no positive impact on the GDP of a country,

(iii) H03: Total inflow of FDI has no positive impact on the NNI of a country and

(iv) H04: Total inflow of FDI does not influence the exports made by a country.

REVIEW OF EXISTING LITERATURE

The literature obtained by investigators, in the form of reports of various committees, commissions and working groups established by the Union Government, the research studies, articles of researchers, is reviewed as follows:

Stanley Morgan (2002) has examined in his paper that FIIs have played a very important role in building India's forex reserves, which have enabled a lot of economic reforms.

Lin et al., (2006) concluded that the investment performance of FIIs high-holding stocks is significantly better than that of FIIs' low-holding stocks. They presented evidence that FIIs' trading behaviour has generated better returns and portfolio performance since the stock market's full liberalisation.

Krishna Prasanna (2008) in his study examined the relationship between foreign institutional investment and firm specific characteristics in terms of ownership structure, financial performance and stock performance.

Sumana Chatterjee (2009) in his dissertation investigated different aspects of FDI at the macroeconomic level using aggregated data of FDI.

Sapna Hooda (2011) in her dissertation analysed the trends and patterns of FDI flows at the global level.

Sarbapriya Ray (2012) in his study assessed empirically the relationship between FDI and economic growth in India using annual data over a period of 20 years from 1990–91 to 2010–2011.

Shib et al., (2019) in their study suggested the economic policyholders to rejuvenate the primary sectors of India so that it can attract and absorb more FDIs and ensure sustainable economic growth.

Shikha Singh (2019), the major conclusion of his study was that inflow of FDI has helped the country in advancement of technology, skill upgradation, employment generation, better infrastructure and management.

METHODOLOGY

The present study is analytical in nature and is based on secondary data. The information has been retrieved from the publications of Government of India, publications of the Reserve Bank of India, Handbook of Statistics on the Indian Economy, Economic Survey, Government of India—various issues, Department of Industrial Policy and Promotion (DIPP), Central Statistics Office (CSO), investment reports published by UNCTAD etc. In addition, various FDI-related journals have also been referred to. In order to analyse the data and draw conclusions on this study, various statistical tools like growth rates, regression and correlation have been used through EXCEL and SPSS Software.

PERIOD OF THE STUDY

The reference period is restricted from 2015–16 to 2019–2020.

LIMITATIONS OF THE STUDY

Following are the main limitations of the study:

i. The study is based on secondary data. These data are based on historical accounting concepts, which ignore the impact of inflation.

ii. The study, as limitations, is confined only to the selected and restricted indicators, only for a period of five years.

iii. The result is based on secondary data which has its own limitations.

ANALYSIS AND DISCUSSION

1. Country-wise Inflows of FDI

FDI is considered to be an important driver for economic growth, and it is a vital source of non-debt finance for the country's economic development. Besides, it is a means of achieving technical know-how and employment generation. However, many are of the view that FDI is a big threat to the sovereignty of host and domestic business enterprises. India has been securing FDI from almost 18 countries as listed in Table 1.

Table 1: Country-wise Inflows of FDI (US$ Million)

Name of the Country/Years	2015–2016	2016–2017	2017–2018	2018–2019	2019–2020 P	Mean	Rank
Singapore	12,479	6,529	9,273	14,632	12,612	11,105	1
Mauritius	7,452	13,383	13,415	6,570	7,498	9,663.6	2
Netherlands	2,330	3,234	2,677	2,519	5,295	3,211	3
Cayman Islands	440	49	1,140	863	3,496	1,197.6	7
U.S.A.	4,124	2,138	1,973	2,823	3,401	2,891.8	4
Japan	1,818	4,237	1,313	2,745	2,308	2,484.2	5
France	392	487	403	375	1,167	564.8	11
U.K	842	1,301	716	1,211	1,125	1,039	8
South Korea	241	466	293	982	777	551.8	13
Hong kong	344	134	1,044	598	678	559.6	12
Cyprus	488	282	290	161	657	375.6	14
Germany	927	845	1,095	817	443	825.4	9
Belgium	57	172	213	56	388	177.2	18
U.A.E.	961	645	408	853	323	638	10
Luxembourg	784	99	243	251	252	325.8	15
UK Virgin Islands	203	212	21	290	250	195.2	17
China	461	198	350	229	162	280	16
Others	1,725	1,905	2,498	2,768	1,796	2,138.4	6
Average	2,003.77	2,017.55	2,075.83	2,152.39	2,152.38	—	—
Rank	5	4	3	1	2	—	—

Source: Department for Promotion of Industry and Internal Trade, and Reserve Bank of India

Table 1 shows the country-wise inflow of FDI to India during the period of study with average and rank. From Table 1, it is observed that India has achieved a remarkable increase in the flow of FDI in all the five years. As per the mean, which is representative of a group of data, inflow of FDI are ranked in descending order. The reason for ranking them in descending order is from the interpretation of FDI inflows, which countries supplied more FDI to India. From Table 1, it is found that Singapore is ranked first as it has provided more FDI followed by Mauritius at the second position with a mean of 9663.6, and the third rank is achieved by Netherlands. UK Virgin Islands and Belgium got the lowest ranks of 17 and 18 with a mean of 195.2 and 177.2, respectively.

2. Sector-wise Inflows of FDI

FDI policy is an enabling policy which is uniformly applicable in the country. Government of India has put in place a liberal and transparent policy for FDI, wherein most of the sectors are open to FDI under the automatic route. The Government reviews the FDI policy and makes changes from time to time, to ensure that India remains an attractive and investor-friendly destination. Table 2 illustrates the sector-wise attraction of inflow of FDI during the study period.

Table 2: Sector-wise Inflow of FDI (US$ Million)

Name of the Country/Years	2015–2016	2016–2017	2017–2018	2018–2019	2019–2020 P	Mean	Rank
Manufacturing	8,439	11,972	7,066	7,919	8,153	8,709.8	1
Communication Services	2,638	5,876	8,809	5,365	6,838	5,905.2	2
Retail & Wholesale Trade	3,998	2,771	4,478	4,311	4,914	4,094.4	4
Financial Services	3,547	3,732	4,070	6,372	4,326	4,409.4	3
Computer Services	4,319	1,937	3,173	3,453	4,104	3,397.2	5
Business Services	3,031	2,684	3,005	2,597	3,684	3,000.2	6
Restaurants and Hotels	889	430	452	749	2,546	1,013.2	11
Transport	1,363	891	1,267	1,019	2,333	1,374.6	9
Construction	4,141	1,564	1,281	2,009	1,937	2,186.4	7
Electricity and other energy Generation, Distribution & Transmission	1,364	1,722	1,870	2,427	1,906	1,857.8	8
Real Estate Activities	112	105	405	213	564	279.8	13
Education, Research & Development	394	205	347	736	528	442	12
Miscellaneous Services	1,022	1,816	835	1,226	443	1,068.4	10
Mining	596	141	82	247	217	256.6	14
Trading	0	0	0	0	0	0	16
Others	215	470	226	102	137	230	15
Average	2,254.25	2,269.75	2,335.37	2,421.56	2,664.37	—-	—-
Rank	5	4	3	2	1	—-	—-

Source: Department for Promotion of Industry and Internal Trade, and Reserve Bank of India

Sector-wise classification of FDI is essential to understand better structure and direction of foreign investment in the country. From the Table 2, it is observed that manufacturing sector is ranked first as this sector has attracted more FDI followed by communication services at the second position with a mean of 5905.2, and the third rank achieved by financial services.

CORRELATION

Correlation analysis was carried out to find the relationship between the variables.

Table 3 shows the relationship between the variables (Country-wise FDI & Sector-wise FDI). Correlation value .897 which is significant at 0.01 levels, indicates that as the country-wise FDI increases the sector-wise FDI increase. So, the null hypothesis (H01) cannot be accepted. Hence, it is concluded that the country-wise inflow of FDI does influence the sector-wise inflow of FDP.

3. Inflow of FDI, GDP and the NNI

GDP is the standard measure of the value add, created through the production of goods and services in a country during a certain period and it also measures the income earned from that production, or the total amount spent on final goods and services (less imports). Net National Income (NNI) is defined as GDP plus net receipts of wages, salaries and property income from abroad, minus the depreciation of fixed capital assets.

The year-wise total FDI, GDP and NNI is given in Table 4.

Table 4 exhibits the total FDI inflows and the GDP along with the Net National Income registered during the study period. The FDI inflows have increased from 36.068 US$ Billion in 2015–16 to 42.629 US$ Billion in 2019–20. The increase over the period was 1.18 times. During the study period, the percentage of growth over the previous

Table 3: Correlation Analysis

Variables	Country-wise FDI	Sector-wise FDI
Country-wise FDI	1	.897**
Sector-wise FDI	.897**	1

** Correlation is significant at the 0.01 level (2-tailed)

Table 4: Year-wise Total of FDI, GDP and NNI (Rs. In US$ Billion)

Years	Total FDI	% of Growth	GDP	% of Growth	Net National Income (NNI)	% of Growth
2015–16	36.068	—	137,718.74	—	121,623.98	—
2016–17	36.317	0.69	153,916.69	11.76	136,239.37	12.02
2017–18	37.36	2.88	170,983.04	11.09	151,495.45	11.1
2018–19	38.744	3.69	189,712.37	10.95	167,892.88	10.82
2019–20p	42.629	10.03	203,398.49	7.21	179,997.54	7.21
CAGR	**3.40%**	—	**8.11%**	—	**8.16%**	—

Source: Department for Promotion of Industry and Internal Trade, and Reserve Bank of India

year lies between 0.69 per cent and 10.03 per cent. The highest growth rate has been observed (10.03%) in 2019–2020 and the lowest growth rate (0.69%) in the year 2016–17. The compound annual growth rate (CAGR) of total FDI inflow of the country was 3.40 per cent which is a welcome trend. During the study period of five years, it has been observed that for two years the growth rate was below the CAGR and for two years the growth rate was above the CAGR.

With regard to the GDP and the NNI, GDP growth has increased from 137718.74 US$ Billion and 121623.98 US$ Billion in 2015–16 to 203398.49 US$ Billion and

179997.54 in 2019–20, respectively. During the study period, the percentage of growth over the previous year lies between 7.21 per cent and 11.76 per cent &7.21 per cent and 12.02 per cent, respectively. The highest growth rate has been observed in terms of GDP (11.76%) in 2016–17 and the lowest growth rate (7.21%) in the year 2019–20. The CAGR of the country's GDP was 8.11 per cent which is a welcome trend. During the study period of five years, it has been observed that for three years the growth rate of GDP was above the CAGR, and for one year the growth rate was below the CAGR.

The highest growth rate has been observed in terms of Net National Income (12.02%) in 2016–17 and the lowest growth rate (7.21%) in the year 2019–20. The CAGR of NNI of the country was 8.16 per cent which is a welcome trend. During the study period of five years, it has been observed that for three years the growth rate was above the CAGR, and for one year the growth rate was below the CAGR.

REGRESSION ANALYSIS

Regression model was applied to test how far the country-wise FDI had impact on GDP. R^2 is the measure of proportion of the variance of dependent variable above its mean, which is explained by the independent or predictor variables (Hair et al., 1998). A higher value of R^2 represents greater explanatory power of the regression equation.

Table 5 shows a R^2 value of .821 which means that country-wise FDI is contributing to GDP by 82.1 per cent and remaining 17.9 per cent can be attributed to other factors which are not studied as they are beyond the scope of this study.

The t statistic (in Table 6) is found to be 3.709, while its p-value is less than 0.05 (.034<0.05). This indicates that with 95 per cent confidence level, the null hypothesis of $\beta=0$, there is no impact on total inflow of FDI on GDP cannot be accepted. Hence, it is concluded that the total inflow of FDI has a positive impact on GDP.

Table 5: Model Summary-impact of Country-wise FDI On GDP

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.906	.821	.761	12,925.43228

a. Predictors. (Constant) FDI

b. Dependent Variable: GDP

Table 6: Regression Coefficients

Model	Unstandardised Coefficients		Standardised Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	-170,921.681	92,413.223		-1.850	.161
FDI	8,948.838	2,412.891	.906	3.709	.034

a. Dependent Variable: GDP

Table 7 shows that the R^2 value of .818 which means that country-wise FDI is contributing to the NNI by 81.8 per cent and remaining 18.2 per cent can be attributed to other factors which are not studied as they are beyond the scope of this study.

Table 7: Model Summary-impact of Country-wise FDI on GDP

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.904[a]	.818	.757	11568.19085

a. Predictors. (Constant) FDI

b. Dependent Variable: NNI

Table 8: Regression Coefficients

Model	Unstandardised Coefficients		Standardised Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	-151,698.010	82,709.326		-1.834	.164
FDI	7,930.659	2,159.524	.904	3.672	.035

a. Dependent Variable: NNI

The t statistic (see Table 8) is found to be 3.672 and its p-value is less than 0.05 (.035<0.05). This indicates that with 95 per cent confidence level, the null hypothesis of $\beta=0$, that there is no impact of total inflow of FDI on NNI cannot be accepted. Hence, it is concluded that total inflow of FDI has positive impact on NNI.

INFLOW OF FDI AND EXPORTS

FDI plays a very dominant role in the economic growth of developing countries. With the help of the increasing trend of FDI inflows, the country's export has been constantly increasing year after year. The year-wise inflows of FDI and the value of exports are furnished in Table 9.

Table 9: Year-wise Total FDI and Export (Rs. In US$ Billions)

Years	Total FDI	% of Growth	Export	% of Growth
2015–16	36.068	—	266.35	—
2016–17	36.317	0.69	280.318	5.24
2017–18	37.36	2.88	308.97	10.22
2018–19	38.744	3.69	337.237	9.15
2019–20p	42.629	10.03	320.431	-4.98
CAGR	**3.40 %**	—	**3.77 %**	—

Source: Department for Promotion of Industry and Internal Trade, and Reserve Bank of India

Table 9 displays the total FDI inflows and the exports made by the country during the period of study. The total FDI inflows has increased from 36.068 US$ Billion in 2015–16 to 42.629 US$ Billion in 2019–20. The increase over the period was 1.18 times.

During the study period, the percentage of growth over the previous year lies between 0.69 per cent and 10.03 per cent. The highest growth rate has been observed at 10.03 per cent in the year 2019–20. The lowest growth rate has been registered at 0.69 per cent in the year 2016–17.

The CAGR of total FDI inflow was 3.40 per cent which is a welcome trend. During the study period of five years, it has been observed that for two years the growth was below the CAGR and for two years the growth rate was above the CAGR.

As far as the value of exports is concerned, it is observed from the table that the export has also increased from 266.35 US$ Billion in 2015–16 to 320.431US$ Billion in 2019–20. During the study period, the percentage of growth over the previous year lies between –4.98 per cent and 10.22 per cent. The highest growth rate has been observed 10.22 per cent in the year 2017–18. The lowest growth rate has been observed –4.98 per cent in the year 2019–20.

The CAGR of value of exports was 3.77 per cent which is a welcome trend. During the study period of five years, it has been observed that for one year the growth was below the CAGR and for three years, the growth rate was above the CAGR.

CORRELATION

Correlation analysis was carried out to find out the relationship between the variables.

Table 10 shows the relationship between the variables (Total FDI & Exports). Correlation value .681 is significant at 0.01 levels. It indicates that if the total FDI increases, the value of exports also increase. So, the null hypothesis cannot be accepted (H04). Hence, it is concluded that the total inflow of FDI influence the value of exports.

Table 10: Correlation Analysis

Variables	Total FDI	Exports
Total FDI	1	.681**
Exports	.681**	1

** Correlation is significant at the 0.01 level (2-tailed)

FINDINGS

Major findings of the study are as follows:

1) It is found from the study that India had a remarkable rising trend in the inflow of FDI but the current year 2019–20 did not attract a sizable amount of FDI when compared with the previous years.

2) The study reveals that manufacturing sector received the highest amount of FDI when compared to the other sectors.

3) It is found from statistical analysis that there has been significant relationship between the country-wise inflow of FDI and the sector-wise inflow of FDI.

4) It is found from the study that there has been a steady increase in the inflow of FDI, GDP, and NNI during the study period.

5) It is found that the trend of GDP was better because of the steady increase in the flow of FDI during the study period.

6) As the statistical analysis confirms, the total inflow of FDI has positive impact on GDP and NNI.

7) The FDI inflow of the country increases which in turn increases the value of exports. The increase of foreign exchange reserve over the study period was 1.18 times.

8) The study reveals that total inflow of FDI does influence the value of exports made by the country.

CONCLUSION

The Government has taken many fruitful initiatives in the recent years such as relaxing FDI norms across sectors such as defence, public sector oil refineries, telecom, power exchanges etc. In May 2020, the Government increased FDI in defence manufacturing under the automatic route from 49 per cent to 74 per cent. In March, 2020, Government permitted NRIs to acquire up to 100 per cent stake in Air India. In April 2020, Government amended the existing consolidated FDI policy for restricting opportunistic takeovers or acquisition of Indian companies from neighbouring nations. Thus, the Government of India's favourable policy regime and robust business environment has ensured that sizable FDI keeps flowing into the country.

SCOPE OF FURTHER RESEARCH

Even though there have been countless research which have been conducted in India analysing the performances of FDI, there still remains scope for further research in this filed. The causes, impacts and policy responses to the recent financial distress due to Covid-19 will also have a major impact in guiding the scope for future research in FDI. Some of the focal areas in this regard are enumerated here below:

a. Studies focusing on inward and outward FDI which impact the overall and sector-wise growth of economy.

b. Research may be carried out to illustrate which FDI policies need to be redesigned to attract more FDI from the less-contributing countries.

c. Empirical research on global foreign investment trends.

CONFERENCE PROCEEDINGS

International Conference of Technology and Business Management, March 28–30, 2011 on "Role of FDI in Economic Development of India: Sect oral Growth.

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"FDI is a responsibility for Indians & an opportunity for the World. My definition of FDI for the people of India is 'First Develop India."

– Narendra Modi

Focus

An Economic Analysis of Foreign Direct Investment (FDI) Inflows in Indian Economy

RITU KANG WALIA

In the present scenario, the relation between FDI and economic growth is a matter of great debate among researchers. So, the present study is an attempt to analyse various aspects of FDI Inflows in to the Indian economy. The paper will explore growth and trend of FDI inflows in India, inward direction of FDI, and the sectoral and regional distribution of FDI inflows in India. The study will also examine the relation between FDI and Indian economy's growth. The study considers the time period from 2000–01 to September 2020. To analyse growth and trend, Annual Growth Rate (AGR) and Compound Annual Growth Rate (CAGR) are computed, and for analysing the relation between FDI and economic growth, Simple Linear Regression Model is applied.

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I. INTRODUCTION

At the time when domestic financial resources are limited, each and every economy of the World has to look towards external source of finance. Foreign Direct Investment (FDI) is one of the external sources of finance and it has emerged as a leading source of foreign capital flows for many developing economies, particularly India, due to the reason that it is non-volatile and non-debt creating source of external finance. In the era of globalization, most economies of the world have opened their markets for other economies which have led to transfer of technology, capital and people. Globalization has increased the flow of FDI among economies. By transferring capital in other country, it can be most efficiently utilised by combining it with other resources. The aim of this capital transfer is to have gains for both the home economy as well as the host economy.

Emerging Market Economies (EMEs) look towards FDI as one of easy means to satisfy their financial, technical, employment generation and competitive efficiency requirements. Over the time, they also observed that substantial economic growth is unfeasible without global integration of business processes. (Ansari and Ranga, 2010) Thus, an important objective of promoting FDI in any developing country in general and India in particular has been to promote efficiency in production and to increase exports.

Despite its positive impact on developing economies, there are dichotomous views on the effect of FDI on any economy. The studies have revealed that impact of FDI totally depends upon the absorptive capacity of host economy (Haddad and Harrison, 1993). In this respect, it is important to study whether FDI is a boon or a bane for the Indian economy.

Keeping this backdrop in mind, we will analyse the

various aspects of FDI inflows in Indian economy. Section II is dedicated to literature review on the present issue. SectionIII describes the objectives and research methodology. Section IV explores economic analysis of FDI inflows in Indian economy. And conclusion of the study with policy implications is presented in Section V.

II. LITERATURE REVIEW:

FDI has long been a subject of great interest for the researchers and policy makers. One of the main reasons is the rapid growth in global FDI flows and its spill over economic growth effects. There is vast literature on the various aspects of present issue. To justify the need of the study, following literature have been reviewed:

Anusuya Y. et al., (2000) analysed the effect of liberalization of Indian economy on Foreign Direct Investment. The study covers industrial policies of FDI and factors attracting FDI in India both pre-1991 and post-1991. The study found that the industrial policies of India are favourable for attracting FDI. The investment is made mostly in infrastructure, power and coal—which are the core sectors. The study also concluded that the low cost of materials and labour, availability of market and infrastructure are other major FDI attracting factors in India.

R. Nagaraj (2003) studied the trend of FDI in India in 1990s and compares that with China. The study found that the realized amount of FDI is one third of cumulative approved amount. Over the 1980s, FDI has increased a lot, but it is still moderate compared to many rapidly growing Asian economies as well as China. Most of the approved FDI is for infrastructure sector and the realised investment is largely in manufacturing of consumer durable goods and the automotive industry.

D.N. Nayak (2004) explored the trend and pattern of FDI flow in India from Canada. It is highlighted that, while making investment plans, the Canadian firms do not give much importance to India. The main reason is the lack of information of investment opportunities in India. The study suggested that there should be regular publishing of information documents like newsletter that spotlights investment opportunities in India so that the Canadian firms are attracted towards India.

K. M. Maathai (2005) analysed the long-running association of FDI with labour productivity, gross output and export at the sectoral level in India. The study used panel co-integration (PCONT) test on the annual data from 1990–91 to 2000–01. The study found no significant co-integration among variables like FDI, gross output, export and labour productivity in principal sectors but the FDI has increased the output, productivity and export in some sectors of the economy.

Mona Kansal (2006) studied the impact of FDI on the growth and development of telecommunication sector in India. The study also highlighted the policies of government relating to FDI and telecommunication sector. The study used correlation, time-series analysis and index number to examine the causality between the two variables and concluded that in the post-liberation period, FDI led the development of telecommunication sector.

V.N. Balasubramanyam and D. Sapsford (2007) explored the levels of FDI inflows in India and China. The study found that India received one-tenth of FDI compared to China. The study also concluded that because of the structure and composition of India's manufacturing, service sectors and human capital endowments, India may not require increased FDI.

K.G. Bharathi (2008) studied the effect of FDI on Gross Domestic Product and exports in India from 1991 to 2005 by applying Simple Linear Regression model. The study concluded that a higher inflow of foreign capital has led to growth in the exports of goods and services and in economic growth.

A.S. Shiralashetti and S.S. Hugar (2009) studied the measures taken by government of India to attract FDI inflows in India in both the pre-liberalization and post-liberalization phases. The study found that the Indian economy has made remarkable progress during the pre-liberalization period in industrial, agricultural and in the tertiary sectors. During the post-liberalization period also the government has been making continuous efforts to attract foreign capital; as a result, there is increase in the inflow of foreign capital and overall progress in various sectors of the economy.

R. Sharma (2010) explored the effects of macroeconomic parameters on India and China from 1991 to 2008. The study found that FDI in India and China has grown exponentially by 526 times and 722 times, respectively. India has received less FDI than China. The main factor of FDI inflow in India is openness of economy, while foreign exchange reserves, long-term debt and exchange rates are found to be statistically significant factors for FDI inflows in China. The study also concluded that FDI has positive and significant impact on GDP of both the economies.

Ravi Aluvala (2011) analysed various aspects of FDI in Indian economy. The study found that although FDI is increasing in India rapidly, it is low by global standards. Mauritius is the largest source of FDI in India because of tax benefit. Most FDI are attracted towards electrical equipment sector. It is concentrated in the southern and western states due to administration of reform-minded leaders. The main attraction factor of FDI in the information technology sector is skilled and English-speaking workforce.

M.M. Goel & Ritu K. Walia (2013) examined the growth as well as performance of FDI in India through sector-wise, country-wise, and total FDI inflow. The study also analysed the relation between FDI and economic growth and found significant relation between the two.

A.P. Bhav (2014) studied the FDI in India from 1995 to 2010. The study applied multivariate linear regression model to find out the determinants of FDI and Chi-Square test for the regional and sectoral imbalances in distribution of FDI. The study found that FDI is getting attracted towards few regions, mainly western region, while north eastern region is receiving the least FDI. There exist sectoral imbalances also in distribution of FDI. FDI is accumulated in secondary and tertiary sectors, while the primary sector is neglected. The study also concluded that Gross Domestic Product (GDP), Current Account Balance (CAB), Foreign Exchange Reserve (FER) and WPI are statistically significant factors for FDI inflow.

Priyanka Banerji (2017) investigated the effect of Make in India programme on FDI. For analysing different determinants and parameters of FDI after Make in India programme, September 2014 to 2017 data was used. The study concluded that Make in India and FDI are positive and it is a call to potential investors from all over the world.

M.M. Goel and Ritu K. Walia (2017) analysed the determinants of FDI inflows in India. The study found that FDI inflow is highly correlated with Gross Domestic Product, Foreign Exchange Reserves, Trade Openness and Real Expected Exchange Rate, while the Inflation Rate is negatively correlated with FDI inflow during the study period.

Dr. Jonardan Koner et al., (2018) explored the impact of FDI inflows on the Services, Construction, Mining, Trading and Agricultural Sectors in India from 2007 to 2017. The study applied Fixed Effects (FE) regression model and Random Effects (RE) regression model. The results of Random Effects Model indicate that the impact of sectoral FDI is positive and FDI inflow has also positive impact on GDP.

M.M. Goel and Ritu Kang (2018) examined the relationship between FDI and economic growth of India from 1991–92 to 2016–17. The study applied unit root test, Johansen co-integration technique and Vector Error Correction Model (VECM). It was found that there is a two-way causality between FDI and economic growth. FDI has short- as well as long-run relationship with economic growth and economic growth has also short- as well as long-run impact on FDI inflows in India.

From the above literature, we can conclude that liberal government policies have positive impact of FDI inflows, while there are disparities in the distribution of FDI in different sectors and regions of India. In light of the above discussion, the present paper is an attempt to analyse FDI inflows in to the Indian Economy.

III. Objectives and Research Methodology:

The objectives of the study are as follows:

i. To analyse the growth and trend of FDI inflows in India

ii. To study inward direction of FDI inflows in India

iii. To explore sectoral distribution of FDI inflows in Indian economy

iv. To examine regional distribution of FDI inflows in India and

v. To analyse the relation between FDI and growth of Indian economy

The nature of the present study is analytical and purely based on secondary data which have been taken from various FDI factsheets published by the Department of Industry and Internal Trade (DPIIT), Government of India and various Handbook of Statistics on Indian Economy published by the Reserve Bank of India. The study considers the time period from 2000–01 to September 2020. For analysing the trend and growth of FDI inflows, the following two growth rates are used:

- Annual Growth Rate (AGR)
- Compound Annual Growth Rate (CAGR)

Annual growth rate is calculated by using the following formula:

$$AGR = (X_t - X_{t-1}/X_{t-1}) \times 100$$

Here X_t = Value of X variable in t time period

X_{t-1} = Value of X variable in t-1 time period i.e. Previous value of X

To compute Compound Annual Growth Rate, Ordinary Least Square (OLS) technique is applied by fitting the exponential function to the available data while the exponential trend equation is defined as

$$Y = AB^t$$

Where B = 1+g; g is the compound growth rate.

The logarithmic transformation of this function is as:

$$\text{Log } Y = \text{Log } A + t \text{ Log } B$$

$$\text{Or } Y^* = b_0 + b_1 t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where, $Y^* = \text{Log } Y$

$b_0 = \text{Log } A$

$b_1 = \text{Log } B$

which is a log linear function.

By applying OLS method, the values of parameters b_0 and b_1 in equation (1) are estimated. The Compound Annual Growth Rate is computed by using the following formula:

$$\text{CAGR (g \%)} = [\text{Antilog } (b_1) - 1] \times 100$$

To investigate the relationship between FDI and economic growth of India, the data on GDP at market price is used as a proxy for economic growth, while the Gross Foreign Direct Investment inflows data is taken as proxy for FDI. To investigate the relationship between these two variables, Simple Linear Regression Model is used as follows:

In the regression model, GDP is taken as dependent variable and FDI is taken as independent variable. We have used natural log transformation to determine the degree of sensitivity of the dependent variable to change in the explanatory variable. The simple linear regression model is as follows:

$$GDP_t = \alpha_0 + \alpha_1 FDI_t + U_t \qquad (2)$$

The logarithmic transformation of above model is as follows:

$$\text{In } GDP_t = \alpha_0 + \alpha_1 \text{ In } FDI_t + U_t \qquad (3)$$

However, to achieve the research objectives and for obtaining results, Statistical Package for Social Sciences (SPSS) version 16 version is used.

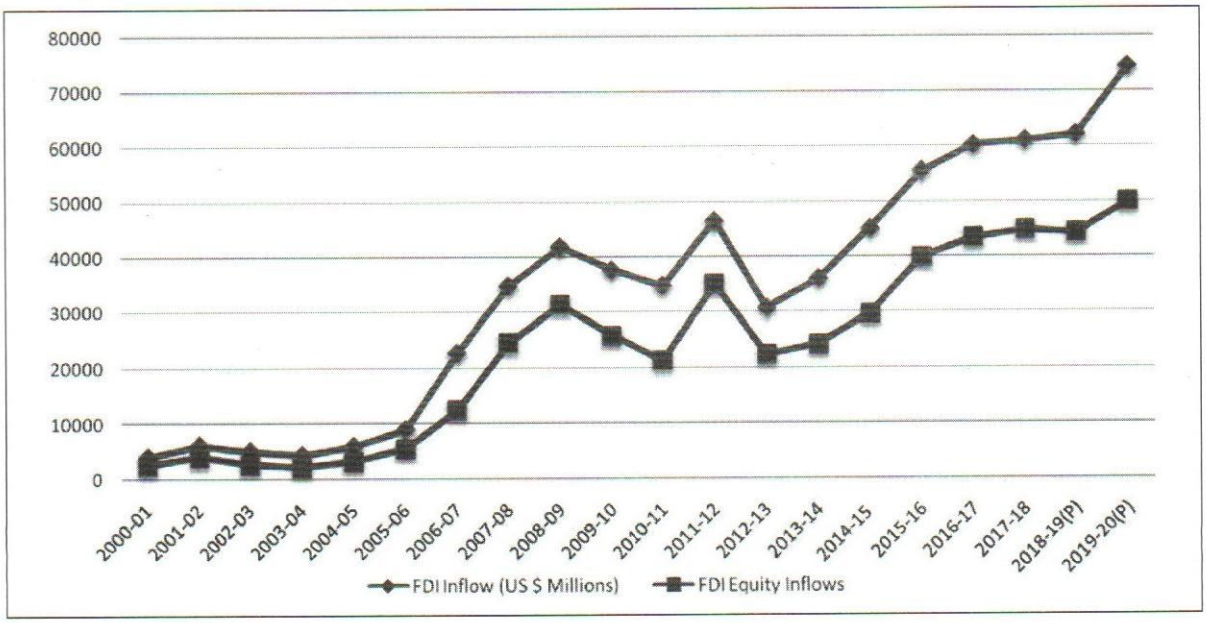
IV. ECONOMIC ANALYSIS OF FDI IN INDIAN ECONOMY:

Government of India had adopted New Economic Policy (Liberalization, Privatization and Globalization) in 1991. This is the turning point of FDI inflows in India as FDI has increased with high speed after this. Time to time, government has also removed the restriction from foreign investment and simplified the procedure for providing investment friendly environment. The main reason for attracting FDI is that it is non-debt creating foreign financial source of capital, and the other reason may be the growth miracle of the newly industrialized economies of the World. To achieve the research objectives, the section is further divided into following sub sections:

IV (A). GROWTH AND TREND OF FDI INFLOWS IN INDIA

The growth of Gross FDI inflows in India is shown in Table 1. In 2000–01, FDI inflows were US $4029 million, which increased to US $74390 million in 2019–20 i.e. 18 times. During this time period, the AGR of FDI is positive in all the years except 2002–03 and 2003–04. It has increased with highest annual growth rate of 155 per cent in 2006–07. The effect of global economic slowdown in 2008–09 can also be seen in India, as annual growth rate of FDI falls the next few years. In 2017–18, FDI inflows growth rate is lowest and one of the reasons may be repatriation of earnings, which was very low till 2008–09, but increased to 17.9 per cent of the FDI equity inflows in 2009–10 and reached 48 per cent in 2017–18. This shows that more and more capital is being taken out of the economy. From 2000–01 to September 2020, cumulative FDI inflow in India is US $721783 million. The CAGR of Gross FDI inflows in India is 16.9 per cent during the study time period.

There are three components of FDI: (1) FDI equity capital (2) reinvesting earning (3) other direct capital. Equity capital is the purchase of shares by foreign direct investors of an enterprise in another country. Equity capital consists of equity in branches, subsidiaries and associates shares (apart from non-participating and preferred shares). FDI equity is one of the main components of Gross FDI. The growth of FDI equity in Indian economy is also shown in Table 1. In 2000–01, it was US $2463 million and rose to US $49977 million in 2019–20. Its annual growth rate is positive except the years 2002–03, 2003–04, 2009–10, 2010–11, 2012–13 and 2018–19. Its annual growth rate is highest in 2006–07 i.e. 126 per cent and lowest in 2017–18 i.e. 3 per cent. From 2000–01 to September 2020, cumulative FDI equity inflow is US $500123 million and its



Source: Based on data from various FDI factsheets of DPIIT

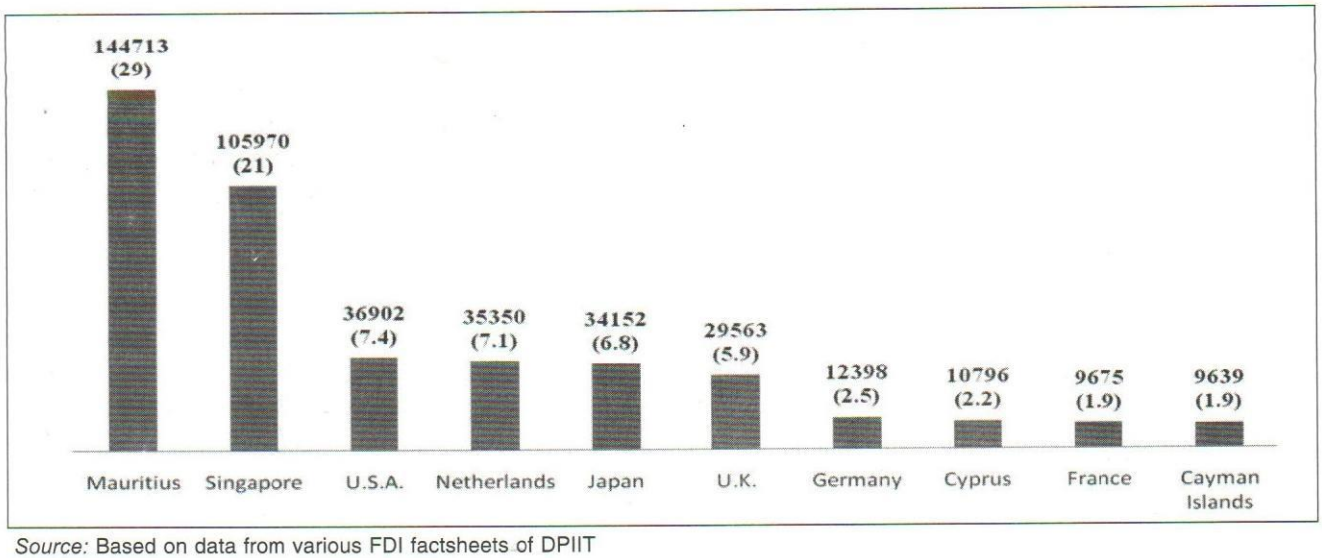
Figure: 1. Trend of Gross FDI and FDI Equity Inflows in India From 2000–01 To 2019–20

CAGR is 18.5 per cent. FDI equity inflow was 61 per cent of gross FDI inflow in 2000–01. Its share has fluctuated over the time period and was maximum in 2017–18 i.e. 74 per cent.

The trend of Gross FDI and FDI equity inflows in India is shown in Figure 1. Over the time period, Gross FDI and FDI equity have increased with fluctuation in India. High fluctuation can be observed from 2008–09 to 2013–14, which can be the effect of the global economic recession of 2008–09.

IV (B). INWARD DIRECTION OF FDI IN INDIA:

Inward direction of FDI means the contribution of different countries in FDI Inflows in India. The New Economic Policy of 1991 has widened the source of FDI into India. In 1991, Government of India had approved FDI from 26 countries. This number has increased to approximately 86 in 2000, 120 in 2008, 156 in 2018 and 166 in 2020. Although the number of countries investing in India has increased, a major share of FDI inflows is only from a few countries. Figure 2 reveals the cumulative FDI equity inflows since



Source: Based on data from various FDI factsheets of DPIIT

Figure: 2. Inward Direction of FDI Equity inflows In India From 2000–01 to Sept. 2020

2000–01 to September 2020 from the top 10 investing countries. In total FDI inflows, Mauritius is contributing 26 per cent, Singapore 21 per cent, USA 7.4 per cent, Netherlands 7.1 per cent, Japan 6.8 per cent, UK 5.9 per cent, Germany 2.5 per cent, Cyprus 2.2 per cent, France and Cayman Islands are contributing 1.9 per cent each. Collectively, these top ten countries have 82.7 per cent share in Gross FDI inflows in India. Rest 17.3 per cent of FDI in India is arriving from other 156 countries. The reason for the major share of Foreign Investment coming from Mauritius and Singapore is Double Tax Avoidance Agreement (DTAA) type of agreements done by Government of India with these economies and MNCs of other countries are using third country route to avoid taxes.

IV (C). SECTORAL DISTRIBUTION OF FDI INFLOWS IN INDIA

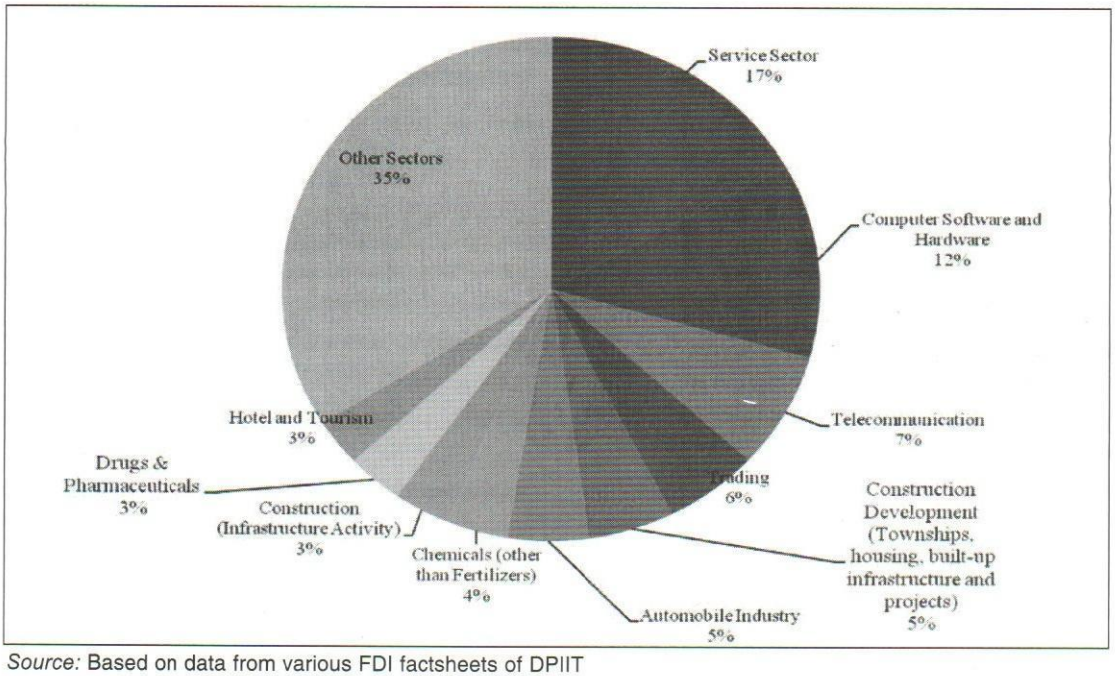
In the FDI policies, Government has given special importance to those priority sectors that helps in rapid development of the economy and helpful in employment generation. Before liberalization, FDI was mainly concentrated in the manufacturing industries. After liberalization in 1991, there has been a sharp increase in foreign investment in the services sector like telecommunications, consulting services, power generation etc. Here, the sectoral distribution of FDI inflows implies FDI inflows in different sectors of the Indian economy.

Cumulative FDI inflow distribution in different sectors of Indian economy from 2000–01 to September 2020 is shown in Figure 3. It is clear from the figure that service sector is receiving the highest share of FDI (17%) followed by computer software and hardware (12%), telecommunication (7%), trading (6%), construction development (5%), automobile (5%), chemicals (4%), construction infrastructure activities (3%), drugs & pharmaceuticals (3%) and hotel & tourism (3%). These top ten sectors are getting 65 per cent of Gross FDI, while other sectors are receiving 35 per cent of FDI.

IV (D). REGIONAL DISTRIBUTION OF INWARD FDI IN INDIA

India has 29 states and seven union territories. Different states have different resources, and diverse flora and fauna. There exists regional disparity in economic development. These disparities have also effected various policy decisions of the government. FDI inflow can be used to reduce these regional disparities in India. Here, regional distribution of FDI inflow implies states receiving FDI inflows. State-wise distribution of FDI equity inflows in India from October 2019 to September 2020 is given in Table 2, which shows the top ten states receiving highest FDI inflows during the time period.

It is clear from Table 2 that Gujarat is receiving highest FDI (35%) followed by Maharashtra (20%),



Source: Based on data from various FDI factsheets of DPIIT

Figure: 3. Sectors Attracting Highest FDI Inflows in India from 2000–01 to September 2020

Karnataka (15%), Delhi (12%), Jharkhand (5%), Tamil Nadu (4%), Haryana (3%), Telangana (3%), Uttar Pradesh (1%) and West Bengal (1%). Collectively, these states are receiving 99 per cent of India's FDI inflows. The rest one per cent goes to other states.

IV (E). FDI AND ECONOMIC GROWTH IN INDIA

There are dichotomous views on the issue whether FDI effects economic growth. To study the relationship between the two, GDP at market price is taken as the proxy of economic growth and Gross FDI inflows for FDI.

The result of Linear Regression Model is depicted in Table 3. 'R' is a measure of the correlation between the observed value and the predicted value of the criterion variable. The result shows high degree of correlation between FDI and economic growth of India because the value of R is 0.918. Here 'R^2' measures the goodness of fit of regression line and has a value of 0.842 implying 84 per cent of variation in GDP may be due to independent variable FDI. The value of 't-test' is 9.794 which is significant at 0.001 level. The value of F-statistics is also significant with value 95.919. The null hypothesis is rejected i.e. there is no relationship between FDI and GDP. In other words, alternative hypothesis is accepted. In brief, the result of linear regression equation indicates that FDI is positively related to economic growth (GDP) of India.

V. CONCLUSION AND POLICY IMPLICATIONS

In concluding remarks, it can be said that FDI inflows has increased in India but with great fluctuations during the study time period. Gross FDI inflow has increased with CAGR of 16.9 per cent while FDI equity inflow has increased to 18.5 per cent. Inward direction of FDI reveals that India is getting most of the FDI from Mauritius, Singapore, USA, Netherlands, Japan, UK, Germany, Cyprus, France and the Cayman Islands. Sectoral distribution of FDI inflows shows that services sector, computer software and hardware, and telecommunication are the top three sectors getting highest FDI. Regional distribution reveals that Gujarat, Maharashtra and Karnataka are the top three regions which are receiving most of the FDI inflows.

It is proved from the study that FDI leads to economic growth in India. Hence, there is great need to attract more and more FDI with appropriate policy measures. As it is clear from the study that services sector is getting the maximum FDI, there is a strong need to change the policy directions in such a way that India can attract FDI in all the sectors of the economy for balanced growth. Government launched 'Make in India' programme to strengthen its manufacturing sector. For achieving the government's objective, more superior technological agreements are required by giving more importance to local needs. Research and development (R&D) plays very important role; so, FDI can act as medium to enhance R&D. Indian economy is still agriculture-based economy. To solve the problem of unemployment or underemployment in India, FDI must be attracted towards the agriculture sector to make it more productive. It has been observed that FDI is concentrated in few Indian states. For balanced distribution of FDI among different states, there is need to boost infrastructure, manufacturing and services in these laggard states. And the State Government should be empowered in such a way that they can frame their own FDI policy by keeping in mind the conditions of their state. It is observed in the study that FDI in India is dominated by a few countries. To reap the spill-over effects of FDI as well as of economic growth of India, Government needs to formulate such policies that include the interest of all potential investors from other economies of the world. For this, the government needs to create more stable macroeconomic indicators and should sign more agreements with other countries so that the sources of FDI can be widened. In a nutshell, it can be said that FDI has proved as an engine of economic growth for many new industrialized counties and it can also become an engine of growth for Indian economy as well.

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"Foreign aid must be viewed as an investment, not an expense".

– Kay Granger

Table: 1 Growth of Gross FDI and FDI Equity Inflows in India from 2000-01 to Sept. 2020

Year	Gross FDI Inflows (US $ Millions)	Annual Growth (AGR) %age	FDI Equity Inflows (US $ Millions)	Annual Growth Rate (AGR) %age	%age Share of FDI Equity in Gross FDI
2000–01	4029	-	2463	-	61
2001–02	6130	52	4065	65	66
2002–03	5035	-18	2705	-33	54
2003–04	4322	-14	2188	-19	51
2004–05	6051	40	3219	47	53
2005–06	8961	48	5540	72	62
2006–07	22826	155	12492	126	55
2007–08	34843	53	24575	98	71
2008–09	41873	20	31396	28	75
2009–10	37745	10	25834	-18	68
2010–11	34847	8	21383	-17	61
2011–12	46553	34	35121	64	75
2012–13	30824	26	22423	-36	73
2013–14	36049	5	24299	8	67
2014–15	45148	25	29737	22	66
2015–16	55559	23	40001	35	72
2016–17	60220	8	43478	9	72
2017–18	60974	1	44857	3	74
2018–19(P)	62001	2	44366	-1	72
2019–20(P)	74390	20	49977	12	67
2020–21 (Up to Sept. 2020)	39929	-	30004	-	75
Cumulative from April 2000 to Sept. 2020	721783		500123		69
CAGR (%age)	**16.9**		**18.5**	-	

Source: Various FDI Factsheet of DPIIT

Table: 2 State-wise Direction of FDI Inflows in India From Oct. 2019 To Sept. 2020

State Getting Highest FDI	FDI Equity Inflows (US $ Million)	Percentage of Total FDI Inflows
Gujarat	18596	35
Maharashtra	10882	20
Karnataka	7949	15
Delhi	6635	12
Jharkhand	2644	5
Tamil Nadu	1944	4
Haryana	1408	3
Telangana	1348	3
Uttar Pradesh	468	1
West Bengal	451	1

Source: Various FDI Factsheets of DPIIT

Table: 3 Results of Linear Regression Model ($GDP_t = \alpha_0 + \alpha_1 FDI_t + U_t$)

Lag (K)	Estimated α_0	Estimated α_1	t-statistic	R	R^2	Adjusted R^2	F-statistic
Without Lag	1.906(0.180)	0.669(0.031)	9.794	0.918	0.842	0.833	95.919
Lag	(0.180)	(0.031)					

Note: * Indicates at 1% level of significance and figures in parenthesis show standard errors.

Source: Author's calculation through SPSS.16

Impact of FDI on Automobile Sector in India – An Empirical Analysis

JEENA MARIOT XAVIER AND K V RAJU

This article tries to analyse the linkages between and spillovers from foreign parent firms to foreign subsidiaries in host country's automotive industry. Conceptually, the article identifies spillovers, linkages and the effects of foreign direct investment (FDI) on domestic firms. We analyse the linkage channels of six major automobile manufacturers in India. The compound annual growth rate of FDI equity inflows is analysed using semi-log model and the average domestic input share is utilized to form linkage effect. Regressing the average sales of each firm on linkage gives the spillover effect of linkage channel on average sales of the firms. CAGR of FDI is 11.35 per cent for the period of study. Maruti Suzuki India Ltd and Honda Cars India Ltd have a significant spillover effect of linkages in the FDI on average sales of the firm. We cannot ignore the role of FDI in generating linkages, spillovers and technological transfers. Effective policy measures, FDI-friendly policy regimes, attractive incentives, pro-manufacture environment are essential in driving more FDI in automobile sector.

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1. Introduction

'Investment' is usually understood as financial contribution to the equity capital of an enterprise or purchase of shares in the enterprise. 'Foreign investment' is investment in an enterprise by a non-resident, irrespective of whether this involves new equity capital or re-investment of earnings. Foreign investment is of two kinds – (i) Foreign Direct Investment (FDI) and (ii) Foreign Portfolio Investment (FPI). It is the policy of the Government of India to attract and promote productive FDI from non-residents in activities which significantly contribute to industrialization and socio-economic development. FDI supplements the domestic capital and technology.[3]

International Monetary Fund (IMF) and Organization for Economic Cooperation and Development (OECD) defines FDI similarly as a category of cross-border investment made by a resident in one economy (the direct investor) with the objective of establishing a 'lasting interest' in an enterprise (the direct investment enterprise) that is resident in an economy other than that of the direct investor. The motivation of the direct investor is a strategic long-term relationship with the direct investment enterprise to ensure a significant degree of influence by the direct investor in the management of the direct investment enterprise. Direct investment allows the direct investor to gain access to the direct investment enterprise which it might otherwise be unable to.

The Indian auto industry became the 4th largest in the world with sales increasing 9.5 per cent year-on-year to 4.02 million units (excluding two wheelers) in 2017. India holds a strong position in the international heavy vehicles arena as it is the largest tractor manufacturer, 2nd largest bus manufacturer and 3rd largest heavy trucks manufacturer in the world. With FDI policy for automobile sector allowing 100 per cent FDI under the automatic

route, FDI equity inflows in automobile industry amounted to $17.9 bn between April 2000 and September 2017; contributing towards 5 per cent of the total FDI inflows. India was the fourth largest auto market in 2018 with sales increasing 8.3 per cent year-on-year to 3.99 million units. It was the seventh largest manufacturer of commercial vehicles in 2018. Overall domestic automobiles sales increased at 6.71 per cent CAGR between FY13–19 with 26.27 million vehicles sold in FY19.

Domestic automobile production increased at 6.96 per cent CAGR between FY13–19 with 30.92 million vehicles manufactured in the country in FY19. In FY19, year-on-year growth in domestic sales among all the categories was recorded in commercial vehicles at 17.55 per cent followed by 10.27 per cent year-on-year growth in the sale of three-wheelers.

FDI in automobile industry will bring with it technological progress, which will directly lead to economic development. Foreign direct investment in Indian automobile industry will stimulate industrialization, leading to more job opportunities[4].

As a major employment generator, GDP-contributor and FDI-earner, the automotive industry is instrumental in shaping the country's economy and hence regarded as a rising sector. India's stand on FDI has been varied and fluctuating all through the years. India's investment climate was not always conducive to attract foreign investors. But we have taken a pro-investor policy, especially in automobile industry, as it is one of the emerging industries of India. Automobile industry has become a growth driver among the manufacturing industries.

India is one of the largest producers of automobiles globally with an average annual production of about 29 million vehicles in 2017–2018, of which about 4 million were exported. India is the largest tractor manufacturer, second largest two-wheeler manufacturer, second largest bus manufacturer, fifth largest heavy truck manufacturer, sixth largest car manufacturer, and eighth largest commercial vehicle manufacturer[5]. Although Indian automobile industry hardly does anything like manufacturing, rather, we still are assemblers. Most of the foreign subsidiaries in India are placing their R&D units in India to target the rich human resource available and large market at hand. Indian customers' focus was always on the price and fuel efficiency of the car. But situations have changed; we now look for safe, less pollutant (green), well-designed cars.

As far as Indian automobile manufacturing industry is concerned, spillover happens from the parent MNC to the domestic subsidiary registered in India. Technology is transferred from the foreign parent company to the domestic subsidiary via skill development programmes arranged for the employees, through the direct transfer of components and parts of concerned vehicle, multitudes of imported raw materials, availing foreign faculty for training of workers and employees, etc.

Spillover cannot happen directly by sharing of knowledge across different plants as automobile is a highly competitive industry. While others come to know once the model is launched and what follows is imitation of design, technology, price etc., thus learning through repeated interactions with a particular parent company, and acquisition of foreign companies, or an acquisition by a foreign company changes its perspectives of growth.

All firms in the same sector face the same degree of competitive pressures posed by the presence of the foreign firm, while their ability to ultimately benefit from FDI hinges on whether they can capture positive spillovers through the linkages and demonstration channels. The ability, in turn, depends on their **absorptive capacity**—the ability to recognize, the value of new information, assimilate it, and apply it to improve production processes. By virtue of their fast growth trajectory, which may reflect high absorptive capacity and productivity, high growth firms may be better able to capture positive spillovers than local firms.

2. OBJECTIVES OF THE STUDY

- To analyse the growth of FDI in automobile industry of India.
- To understand how FDI benefit domestic firms through linkage channels.

3. RESEARCH DESIGN AND METHODS

The study is an attempt to know more about the blooming industry in India's manufacturing sector. The data pertaining to FDI was collected from the official sites of RBI and MoSPI. Data is consolidated from the fact sheet on FDI with special emphasis to sectors attracting the highest FDI equity inflows. Annualised FDI equity inflows measured in ₹ Crores is used. FDI growth in the automobile industry and share of automobile in the annual FDI equity inflows are also analysed to examine the role of FDI in the automobile industry.

The linkages channel of FDI is captured by the average share of inputs of domestic origin that foreign firms acquire in the host country. The demonstration channel is measured as the share of foreign output in total output.

For analysing the linkage channel, five firms under NIC 5 digit (29101) – passenger car segment are utilised. The linkage channels of Maruti Suzuki, Hyundai, Ford India, Honda, and Toyota are analysed. Data on these firms were collected and compiled from the CMIE (Centre for Monitoring Indian Economy) Prowess-IQ. Prowess for Interactive Querying is a powerful internet-based application for querying CMIE's database on performances of listed and unlisted companies.

Growth Analysis of FDI

We compute a simple linear regression model to find out the growth rate of total FDI equity inflows.

$$\ln Y_t = \ln Y_0 + t \ln (1+r)$$

Where $\beta_{1=} \ln Y_0$, $\beta_2 = \ln (1+r)$

$$\ln Y_t = \beta_1 + \beta_2 t + u_t$$

where 't' is the trend term which is treated as an explanatory variable and $\ln Y_t$ is nothing but ln (FDI). ln (FDI) is the natural logarithm of Total FDI equity inflows in crores which is the explained variable. We perform a simple regression analysis and estimate the model by OLS method. The slope coefficient in the model measures the constant proportional or relative changes in Y for a given absolute change in the value of the regressor.

$$\beta_{2=} \frac{\text{relative change in the regressand}}{\text{Absolute change in regressor}}$$

β_2 gives instantaneous rate of growth and not the compound rate of growth. The latter can be found by taking the antilog of the estimated β_2 and subtracting 1 from it and multiplying the difference by 100.

$$\textbf{Linkage channel} = \frac{1}{n}\sum_{i=1}^{n} input_{ic}^{dom} / input_{ic}^{tot}$$

Where $input_{ic}^{dom}$ represents the value of inputs of domestic origin used by the foreign firm, $input_{ic}^{tot}$ represents total value inputs, regardless of their origin, where subscript *i* stands for firm and *c* stands for country. The total number of foreign firms in the sector is *n* (here we use the number of passenger car manufactures in the automobile industry).

We then regress the average sales of each firm on their respective linkage effect. This is to identify the spillover effect of linkage channel on sales growth of each firm for the period of study.

Average Sales = $\beta_1 + \beta_2$ **linkages** + u_t where average sales is used as regressand and linkage channel of FDI is used as regressor.

4. SIGNIFICANCE OF THE STUDY

The study becomes relevant as Indian car manufacturing segment has attracted world renowned manufactures to India. India has become the favourite destination of many prime car manufacturers due to its population diversity, highly skewed income distribution, growing youth population and urge for new technology. Most of the Indian manufacturers are foreign subsidiaries in India, which by itself is an indication of the presence of foreign investment in India. With FDI policy for automobile sector allowing 100 per cent FDI under the automatic route, FDI equity inflows in Automobile industry amounted to $17.9 bn FDI between April 2000 and September 2017; contributing 5 per cent of the total FDI inflows. FDI in automobile industry will bring with it technological progress, which will directly lead to economic development. FDI in Indian automobile industry will stimulate industrialisation, leading to more job opportunities.

The paper particularly ponders the channels by which the benefits of FDI flow into the host country. Most of the foreign firms allow their domestic subsidiaries to use their global patents, highly skilled and trained staff of parent company are used to train the domestic employees. Thus, there are contractual linkages and demonstration effects. Let us identify these channels in few of our firms and see how they assimilate it. The paper also analyses the growth of FDI in automobile industry over a period of 12 years. In the wake of global slowdown in 2019–20, the inflow has drifted away, but the paper points out the need of such funds, technology transfers, spillovers etc. to boost one of the growth-driving industry of manufacturing sector.

5. REVIEW OF LITERATURE

Evaluation of India's FDI Policy Measures:

Gholam Syedain Khan and Papia Mitra (2014) in their work explain that the liberal policy measures towards FDI designed in the wake of structural adjustment and macroeconomic reforms in India since mid-1991 have helped attract foreign investors significantly. The amount of approved investment has grown enormously. Though the actual inflow of FDI has not picked up so fast, it has

improved and significantly strengthened the capital account of the balance of payments of the country. India is still on the lower rung of the ladder among some major FDI receiving countries of Asia. Nevertheless, only six or seven countries claim well over one half of the total FDI flows.

With the opening up of new areas for foreign investors, a huge amount of approval and actual inflow are also found in non-traditional areas such as fuel and power, services and some consumer goods. Though the automatic approval route was introduced for speedier clearance of FDI proposals, its reach and role have been marginal. The policy lacked thrust on attracting investment in sectors that offered comparative cost advantage. Well-developed and strategically located platforms in the form of Export Processing Zones (EPZs) or technology parks have not been provided for mobilising investment into these sectors. The thrust was not on export orientation due to conservative sector-specific policies. Rigid labour laws had been the other serious impediment to FDI inflows. Besides, there was a lack of transparency and clarity about micro-level procedure at the state level. To sum up, it can be said that the Indian Government has created a healthy atmosphere for FDI inflow by introducing Structural adjustment and Stabilization policy.

To quote FDI India, a foreign investment facilitator currently valued at $75 bn, the automobile industry is estimated to touch the coveted $300 bn mark by 2026. With a $135 bn revenue expectation by 2020, the automobile segment can reach $300 bn by 2026 at a CAGR (Compound Annual Growth Rate) of 15 per cent. During April 2018-January 2019, automobile production increased 9.84 per cent year-on-year to reach 26.26 million vehicle units.

Growth Analysis

Gholam Syedain Khan and Papia Mitra (2014) give a simple linear regression model to find out the growth rate of total FDI inflows. Log (FDI)t = a+ bt + u3t ..... (7) where, 't' is the trend term which is treated as an explanatory variable and log (FDI) is the logarithmic form of total FDI inflows in US dollars which is the explained variable. We perform a simple regression analysis and estimate the model by OLS method. In order to find out the growth of FDI, we multiply the estimated slope coefficient of the trend term (t) by 100.

Linkage Channel

José-Daniel Reyes (2018) explains that linkages can increase the productivity of domestic firms in at least three other ways: First, greater demand for intermediates produced by domestic suppliers can increase potential for scale economies. Second, domestic suppliers may face incentives to improve product quality and increase efficiency, owing to more stringent requirements from the foreign firms. Third, competition for other local firms for foreign consumers may also spur productivity upgrading. The analysis in this chapter focuses on the knowledge diffusion impact of linkages.

High-growth firms benefit from FDI mainly through the linkages channel. This section looks at the two channels through which FDI affects domestic enterprises, with a focus on high-growth firms. The linkages channel is characterized by direct contractual arrangements in which domestic firms become suppliers to foreign firms. The demonstration channel enables domestic firms to replicate foreign technologies or management practices either through observation or by hiring workers trained by foreign firms. Thus, stronger the presence of FDI in the sector, more the opportunities for the demonstration channel to positively affect local firms. But, while foreign firms bring technology and frontier knowledge that can improve the performance of indigenous firms, they may also increase competitive pressures in the host economy, which could hurt some local businesses. The relative magnitude of these two forces determines the ultimate effect on domestic firms. José-Daniel Reyes (2017) [6].

Following the literature, the linkages channel is captured by the average share of inputs of domestic origin that foreign firms acquire in the host country. The demonstration channel is measured as the share of foreign output in total output. These measures represent the importance of the FDI spillover channels within country-sector observations and, therefore, capture the potential for intra-industry spillover effects. The relevance of the transmission channels of FDI spillovers vary across sectors and countries. On an average, linkages are more visible in manufacturing than in services. (see Blalock and Gertler 2009; Farole and Winkler 2015).

6. PROFILE OF INDIAN AUTOMOBILE INDUSTRY UNDER STUDY

It is relevant to study the linkage effect of FDI in the passenger car segment as they occupy the largest share of market after two wheelers. Moreover, since liberalisation in 1990s, we are witnessing the onslaught of MNEs into Indian car market. We are as such interested in analysing the growth rate of FDI in automobile industry and the

Table 1: Indian automobile market and market share by segment, 2018–19

Segment	Percentage
Commercial Vehicles	4
Three wheelers	3
Passenger vehicles	13
Two-wheelers	80
Total	100

Source: Society of Indian Automobile Manufacturers (SIAM) statistics (2019)

spillover effects of linkages in FDI, specifically of five firms that fall within the passenger car manufacturers. The market share of different segments in automobile industry as per 2017–18 data is given in Table 1.

It was only in 1897 that India saw a car rolling down its streets. Hindustan Motors, Premier and Mahindra & Mahindra later ruled Indian car industry from 1960s to 1980s; and it was only when Maruti Udyog Limited entered the market in 1980s, some traces of competition evolved. Other than Maruti all other firms entered Indian automobile industry after the liberalisation implemented by the government in 1990s. Most of them entered as joint ventures. Hyundai was the only wholly-owned subsidiary. Over the years, they have changed their pattern of partnership.

We need to analyse the impacts of FDI on the foreign subsidiaries registered in India. They entered the market in different ways; the mode of entry of each firm under study is explained in Table 2. The selected firms fall under the NIC 29101(National Industries Classification-5 digit) i.e. manufacture of passenger cars. They are all foreign subsidiaries registered in India. FDI reach these subsidiaries from their multinational parent firm. Knowledge transfer is in the form of sharing of patented products, ideas and processes, also training the staff using foreign professionals, and using external expertise in the running of firm.

Table 2: Selected companies and modes of entry

Company	Mode of entry	Year
Maruti	JV with government (Maruti)	1983
Hyundai	100% subsidiary	1996
Honda	JV with Shriram	1995
Toyota	Toyota Kirloskar Motors JV with Kirloskar	1997
Ford India	JV with M & M	1996

Source: Ramachandran J. (2011), "India Entry Strategy of Auto Majors, Tejas Article, IIM Bangalore," September

FDI in Private Limited Company

A Foreign business entity can enter India via a number of alternatives, subject to general conditions mentioned in FDI Policy.

As an Indian company,

a. By setting up a wholly-owned subsidiary

b. Joint venture with an Indian entity/person

Operate as a foreign company and be registered with the Registrar of Companies, MCA

a. Opening up Liaison office: This type of office is only allowed to collect market information and liaison with the foreign company. They are not allowed to earn income from any activities.

b. Branch Offices: The scope of activities of BOs is much larger as compared to liaison offices. BOs

are allowed to generate revenue by various alternatives, such as:

I. Providing professional services

II. Providing technical support for products imported/ assembled/manufactured by the parent/holding company

c. Project Offices: Set up to execute specific projects, project offices are allowed in India if

I. The foreign entity has secured a contract in India, which will be funded via inward remittance by either a bilateral or multilateral financing agency.

II. Loan has been sanctioned by a public financial institution or bank to the Indian company contracting the project. If the above conditions are not met, the foreign investor/entity will have to make an application with RBI via its AD bank.

Partnership firms and sole proprietary concerns set up abroad are not allowed to establish branch or liaison offices in India. Branch/Liaison/Project offices have to open non-interest-bearing current accounts in RBI through AD Banks. Application for setting up offices in India has to be made in Form FNC-1 to RBI along with

a) Certificate of Incorporation or Memorandum & Articles of Association attested by Indian Embassy or Notary Public in their home country.

b) Latest Audited Balance Sheet—This form has to be submitted to the designated AD bank for further submission to the relevant department of RBI (Foreign Investment Division), Mumbai.

The Legal basis

FDI by non-resident in resident entities through transfer or issue of security to person resident outside India is a 'Capital account transaction' and the Government of India and RBI regulate this under the FEMA, 1999 and its various regulations. Keeping in view the current requirements, the Government from time to time comes up with new regulations and amendments/changes in the existing ones through order/allied rules, Press Notes, etc through the Department of Industrial Policy and Promotion (DIPP).

7. ANALYSING THE IMPACT OF FDI ON AUTOMOBILE INDUSTRY

The firms selected for the study falls under the NIC 29101(National Industries Classification-5digit) i.e. manufacturer of passenger cars. They are all foreign subsidiaries registered in India. FDI reach these subsidiaries from their multinational parent firm. Knowledge transfer is in the form of sharing of patented products, ideas and processes, also training the staff using foreign professionals and using external expertise in the running of the firm. A brief account of the firms under study is provided (see Table 3). Other than Maruti Suzuki India Ltd, all other firms entered India after 1991. Data is compiled from CMIE (Centre for Monitoring Indian Economy) Prowess IQ database.

Sector-wise FDI equity inflows:

Table 4 summarises the share of FDI received by some of the major sectors in Indian economy. Relatively high performing, consistently improving seven sectors over period of study are chosen along with automobile industry. From 2006–07 to 2010–11 we can see a continuous rise in the share of FDI in automobile sector even in the wake of global financial recession of 2008–10. But the impact of recession is found in the following years, flow of FDI to the automobile industry fell considerably from 13 per cent in 2010–11 to 5 per cent in 2011–12. Then it again rises till 2014–15 and again falls. Indian automobile industry has to ensure continuous and steady inflow of FDI equity, as this is a major source of funding. In the wake of falling inflows, our industry will certainly experience low end of the technology, innovation, patenting and R&D activities which will surely hamper the pace of growth.

Growth Analysis

A semi log model is used to calculate the CAGR. Natural log of FDI is used as regressand and trend as regressor. *The regression model thus formed is*

$\ln Y_t = \beta_1 + \beta_2 t + u_t$, Where $\ln Y_t$ is lnFDI

$\ln FDI = 3.0147 + 0.1075t + u_t$

$\beta_1 = 3.0147$ and $\beta_2 = 0.1075$

β_2 gives instantaneous rate of growth and not the compound rate of growth. The latter can be found by taking the antilog of the estimated β_2 and subtracting 1 from it and multiplying the difference by 100. The summary of results of the growth analysis is given in Table 5.

The resultant model is

$\ln FDI = 3.0147 + 0.1075t + u_t$

$CAGR = [(\text{antilog } 0.1075) - 1]*100$

Table 3: Profile of the automobile manufacturers under study

The table gives a brief account of the firms under study. Data compiled from CMIE (Centre for Monitoring Indian Economy) Prowess IQ database is given below.

	Indicators				
Company Name	**Maruti Suzuki India Ltd.**	**Hyundai Motor India Ltd.**	**Ford India Pvt. Ltd.**	**Honda Cars India Ltd.**	**Toyota. Kirloskar Motor Pvt. Ltd.**
Age group	Between 1972 and 1985	After 1991	After 1991	After 1991	After 1991
Incorporation year	1981	1996	1995	1995	1997
CIN code	L34103DL198	U29309TN19	U34103TN2000	U15114UP1995	U34101KA19
	1PLC011375	96PLC035377	PTC045537	PLC099377	97PTC022858
Industry group	Passenger vehicles	Passenger vehicles	Passenger vehicles	Passenger vehicles	Passenger vehicles
NIC Name	Manufacture of passenger cars motor vehicles n.e.c.	Manufacture of passenger cars	Manufacture of passenger cars	Manufacture of passenger cars	Manufacture of motorvehicles n.e.c.
NIC code	29101	29101	29101	29101	29109
Ownership group	**Private (Foreign)**	**Private (Foreign)**	**Private (Foreign)**	**Private (Foreign)**	**Private (Foreign)**

Source : CMIE (Centre for Monitoring Indian Economy) Prowess IQ Database-2019

Table 4: Sector-wise FDI equity inflows

	Rupees in crores					
Sector	**2006–07**	**2008–09**	**2011–12**	**2013–14**	**2015–16**	**2017–18**
Services sector	21,047	28,411	24,656	13,294	45,415	43,249
Computer software & hardware	11,786	7,329	3,804	6,896	38,351	39,670
Telecommunications	2,155	11,727	9,012	7,987	8,637	39,748
Construction development	4,424	8,792	15,236	7,508	727	3,472
Automobile industry	1,254	5,212	4,347	9,027	16,437	13,461
Chemicals (other than fertilizers)	930	3,427	18,422	4,738	9,664	8,425
Power	713	4,382	7,678	6,519	5,662	10,473
Total	42,309	69,280	83,155	55,969	124,893	158,498
Share of automobile	0.03	0.075	0.052	0.161	0.132	0.085
Percentage	3	8	5	16	13	8

Source: RBI, fact sheet on Foreign Direct Investment (FDI) with special emphasis to sectors attracting highest FDI equity inflows (from 2006 to 2018)

Table 5: Summary of results of the regression run on excel

The following table gives the summarised result of CAGR using simple regression model:

	Coefficient	Std Error	T-Statistic	Prob	R-Square	Adjusted R-Square	F-Statistic	Prob
Intercept	3.0147	0.12	25.43	0.000000				
Time	0.1075	0.02	6.67	0.0000553	0.82	0.80	44.56	0.0000553

Source: Summary of results generated from the regression run

= [1.1135-1]*100

= 0.1135*100

= 11.35 %

CAGR = 11.35 per cent

Thus the CAGR of FDI for the period 2006–07 to 2017–18 is 11.35 per cent.

Average Domestic Input Share (ADIS)

Linkage channel is measured by average domestic input share (ADIS). ADIS is the share of inputs of domestic origin that a foreign subsidiary firm uses in its raw materials in the host country. A high ADIS unveils a channel of linkage. Table 6 gives ADIS of 5 major passenger car manufacturers in India. ADIS is an indicator of linkage channel. Rising ADIS indicate that foreign subsidiaries in the host country do utilise considerable amount of domestic raw material, and is an evidence of the linkage.

The spillover effect of linkage channel of FDI on each domestic firm

The null hypothesis being tested is: the linkage channel has no significant spillover effect on average sales of the firms under study. The simple regression model is used to analyse the firm-wise spillover effect of linkages in FDI on

Table 6: Average share of inputs of domestic origin that foreign firms acquire in the host country denoted as average domestic input share-linkage channel

	Maruti	Hyundai	Ford India	Honda	Toyota
YEAR	**ADIS***	**ADIS**	**ADIS**	**ADIS**	**ADIS**
2008	0.89	0.69	0.65	0.53	0.44
2009	0.88	0.75	0.53	0.52	0.39
2010	0.87	0.78	0.65	0.57	0.33
2011	0.89	0.80	0.65	0.57	0.44
2012	0.89	0.78	0.65	0.65	0.47
2013	0.88	0.74	0.65	0.76	0.46
2014	0.91	0.77	0.59	0.88	0.52
2015	0.93	0.74	0.60	0.83	0.51
2016	0.93	0.75	0.57	0.81	0.49
2017	0.92	0.72	0.57	0.79	0.49
2018	0.93	0.72	0.57	0.77	0.50

Source: Compiled from data available in CMIE (Centre for monitoring Indian Economy) Prowess IQ Database 2019

*ADIS-average domestic input share

the average sales of the firm. Separate regression is run for each firm and

1. Tested hypothesis is rejected in the case of Maruti Suzuki, linkage channel of FDI has significant spillover effect on the average sales of the firm as the p value is significantly lower than 0.05. (The test result for Maruti Suzuki is summarized in Table 7).
2. Tested hypothesis cannot be rejected in the case of Hyundai, as the p value is not significantly lower than 0.05. The linkage channel does not have any spillover effect on the average sales of Hyundai.
3. Tested hypothesis is rejected in the case of Honda, as the p value is significantly lower than 0.05. The linkage channel does have its spillover effect on the average sales of the firm. (see Table 8).
4. Tested hypothesis cannot be rejected in the case of Ford India, as the p value is not significantly lower than 0.05. The linkage channel does not have any spillover effect on the average sales of the firm.
5. Tested hypothesis cannot be rejected in the case of Toyota, as the p value is not significantly lower than 0.05. The linkage channel does not have any spillover effect on the average sales of the firm.

Table 7: Spill over effect of linkage channel in FDI on firm's average sales

	Coefficient	Std Error	T-Statistic	Prob	R-Square	Adjusted R-Square	F-Statistic	Prob
Maruti - Average sales (Y)	-1.18094	0.296044	-3.98907	0.003162				
Maruti - Linkage channel (X)	28.18757	6.559371	4.297297	0.001999	0.672331	0.635924	18.46676	0.001999
Honda - Average sales (Y)	-0.1259	0.061832	-2.0361	0.072219				
Honda- Linkage channel (X)	6.204292	1.742092	3.561403	0.006106	0.58494	0.538822	12.68359	0.006106

Source: Computed from the regression equation run in excel

8. FINDINGS OF THE STUDY

- The CAGR of FDI for a period from 2006-07 to 2017-18 is 11.35 per cent. The growth analysis using semi-log model for regression proves that this is a significant rise.
- Maruti Suzuki India Ltd and Honda Cars India Ltd have significant spill over effect of linkages in FDI on average sales of the firm.
- FDI is certainly a growth driver of the automobile sector but the share of FDI equity inflows into automobile industry has fallen over the years. In 2017–18, the share of equity inflows was just 8 per cent of the total FDI equity inflows into various sectors.
- The highest FDI equity inflow in the referral period (2006–07 to 2017–18) was during the year 2014–15, i.e. 19 per cent.

9. CONCLUSION

The global car manufacturer's eyes are on India, as we have skilled man-power and booming market rich with youth population. But it is sad that still we find it difficult to attract considerable amount FDI in India's automobile sector. The share of FDI in automobile industry has fallen in comparison with previous years. CAGR of 11.35 per cent might be a value influenced by high FDI share in the earlier years under study, but recent trend is that of falling. The global slowdown and the recent outbreak of corona make the future bleak. The economic ramifications that the world has to face will be much severe than the current situation.

The Indian automotive sector has the potential to generate up to US$ 300 billion in annual revenue by 2026, create 65 million additional jobs and contribute over 12 per cent to India's Gross Domestic Product, as per the Automotive Mission Plan 2016–26 prepared jointly by the

Society of Indian Automobile Manufacturers (SIAM) and government. We need focused policy initiatives in the coming years to turn India into a global manufacturer. A great deal of in-house R&D has to develop, and rather than being assemblers, we need to rise as manufacturers with patenting rights.

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"Foreign investment is what keeps the whole show going."

– Patrick Barkey

A Covid-19 Combat Policy Analysis of Foreign Direct Investment Flows on Sustainability Issues

SWAPNAMOYEE PALIT AND RONISMITA MISHRA

The uncertainties meted out during crisis conditions like the COVID-19 pandemic-generated economic turmoil amplify the volatility of the financial market, of which the Foreign Direct Investment is a vital component. This necessitates unprecedented strategies and policies to grip the flow within a limit and thus prevent excessive deviation or downturn. However, the present scenario under COVID-19 for the economy in general and FDI in particular is inconclusive as the policies adopted to stabilise the market may show gradual normalisation and is surrounded with uncertainties. The focus of the present paper is to analyse the strategies and policies adopted by the government to combat the anticipated fluctuations in FDI inflows in the present scenario with an empirical forecast of the FDI flow over the future years. Though the forecast values of FDI over the next 10 years shows a mild increasing trend, showing a silver lining, its tilt towards the lower limit shows the dampened rate of growth of FDI expected on one hand; while on the other, it points to the immense potential which can be tapped with the right strategic policy incentives of the government to ensure the flow of FDI and providing a stature of resilience to it, enabling it to be towards its upper frontier.

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1. Introduction

COVID-19 has disrupted the normal functioning of various sectors affecting almost every macro-economic variable in the country in varying degrees of oscillation. The uncertainties meted out during the crisis conditions amplify the volatility of the financial market which implies wider price fluctuation and dispersion. In the financial sector, the role of Foreign Direct Investment (FDI) is unchallengingly recognised as a vital component because of its supplementing capacity to the deficient investible resources, particularly for the huge structural set up of a developing economy. Not only it enhances the physical capital of the host economy with enhanced access to new technology and management skill but is also identified as a stable constituent of the foreign capital of a nation for its current account deficit financing. This requires the need to ensure not only an increasing, but also a sustainable flow of FDI for an uninterrupted source of finance. Thus, strategic management of FDI would encompass formulation of strategy, their implementation and evaluation to monitor its contribution in accordance with the set objectives. What is the expected flow during a normal phase assumes a volatile form necessitating unprecedented strategies and policies to grip the flow within a limit and thus prevent excessive deviation. However, the present scenario under COVID-19 for the economy in general and FDI in particular is inconclusive as the policies adopted to stabilise the market may show gradual normalisation, is surrounded with uncertainties. The focus of the present paper is to analyse the strategies and policies adopted by the government to combat the anticipated fluctuations in FDI inflows in the present scenario with an empirical analysis of the FDI flow over the future years.

2. Review of Literature

Analysing the influence of sectoral caps of FDI policy reforms in India, Masharu and Nasir (2018) observed that the deregulation system in the Indian economy brings heterogeneity and economic sustainability and maximum advantages are occupied by service and retail sectors in the country. They suggested the adoption of investment-friendly measures for foreign investors to capture further investment in the country.

To avert the self-centred amalgamation in COVID-19 by economically ascendant and extensively commanding economies, India enacted revised FDI norms during the pandemic, but the real influence of this reform to safeguard third party investment through other countries needs to be contemplated over time. (Saxena, 2020)

By examining the significant influence of COVID-19, Poddar and Yadav (2020) examined the substantial causation between the circumstances of COVID-19 and the decoration of Indian economy. India is not able to achieve its expected growth rate over the last two fiscal years. The occurrence of the pandemic is overreacting the economic situation of the nation more than decay. Consequently, India will accumulate US $348 Million on its trade with the lockdown being extended.

Aneja and Ahuja (2020) try to examine the impact of pandemic on several spheres of the economy and society as well by considering tertiary, secondary and primary sectors. They found that all the sectors of the economy have been hugely influenced and the sacrifices are immoderate and at the same time the society has to sacrifice in terms of unemployment, domestic violence and mental illnesses.

FDI creates maximal job opportunities in the services sector than in any other sector in India and the main lead is taken by insurance and banking sectors supported by telecommunication sector. The findings of this study reflect that the employment generation in India during the last couple of decades is quietly discernible. India must have an obligation to provoke its administrative framework by activating its fiscal and monetary policies and require adopting positive trade environment for further FDI inclusion. (Mishra and Palit, 2020).

The FIPB (Foreign Investment Promotion Board) was abolished by the government, following which the extant FDI policy and FEMA regulations require government approval through the concerned administrative departments/ministries of mainly the 11 notified activities/ sectors, viz., defence/cases relating to FDI in small arms and mining, print media, civil aviation, broadcasting, satellites, telecom, pharmaceuticals, financial services under FDI norms, private security agencies and single-/ multi-brand/food products and trading (Foreign Investment Facilitator, 2021).

3. Methodology

This paper has used time series data on foreign investment from several secondary sources like Reserve Bank of India (RBI), UNCTAD and journals and internet sources. For data analysis it has used the ARIMA modelling technique to forecast FDI over the future 10 years. It has used the time series FDI data from the year 2000 to 2019 for the purpose. The data analysis has been done using the rstudio software, SPSS and excel. The finding of the study has been presented in the following sections. Section 4 focuses on the current Foreign investment flow status in India in 2020 with government's policy discussions, while the second part forecasts FDI over the future years to find the potential trend, which can guide appropriate strategy adaptation (section 5) followed by the policy Implications.

3.1 Foreign Investment Flow Status in India 2020

The policy framework on FDI is embodied in the Circular on Consolidated FDI policy, which are updated yearly or according to the required market scenario. The Department of Industrial Policy and Promotion (DIPP) operating under the Ministry of Commerce and Industry (MCI), announced policies on FDI through Press Releases or Press Notes that are then notified as amendments to the Foreign Exchange Management (Transfer or Issue of Security by a Person Resident Outside India) Regulations (of the year), by the RBI.

Foreign Investments can be made in the equity shares or the fully, compulsorily and mandatorily convertible debentures/preference shares of an Indian company, through the Government route (to be considered by the respective Administrative ministry and department) or the Automatic route (not requiring government approval). Foreign investments here refer to all the direct and indirect investments under the different schedules of the FEMA (Transfer or Issue of Security by a Person Resident Outside India) Regulations which includes FDI (in schedule 1), Foreign Institutional Investment (in schedule 2), Foreign Portfolio Investment (in schedule 2A), the Non-Resident Indians (schedule 3),

the FVCI (schedule 6), the LLPs (schedule 9), DRs (schedule 10) and the Investment vehicles (schedule 11). Foreign investment in sectors/activities under government approval route will be subject to government consideration where an Indian company is being established with foreign investment and is not owned/controlled/is being transferred to a foreign entity through merger or demerger, acquisition, amalgamation etc.

India ranks 63rd out of 190 countries in 2020 with an Ease of Doing Business (EoDB) score of 71.0, which is a jump of 14 spots relative to its rank in 2019, according to the EoDB ranking of World Bank's annual report. This rank is however 32 spots below China which is at a rank of 31 with an EoDB score of 77.9. This is not only a significant improvement from its 142nd rank in 2014, but this improvement has also been recognised for India for 3 consecutive years now. Out of 10 parameters of Doing Business Indicators 2020 of EoDB, India has performed well in 7 parameters which are starting a business, getting electricity, registering properties and paying taxes, but however lesser in comparison to its significant improvement in ranking in case of dealing with construction permits, trading across borders and resolving insolvencies with near about or more than 50 per cent improvement in ranking. However, it has fallen in ranking in 3 parameters which are getting credits and protecting minority investors, while its rank performance has remained constant in case of 'Enforcing contracts', as a parameter. This naturally points to the areas which are to be focussed and targeted by the government to improve upon the country's ranking.

3.2 Government Policy Analysis to Combat COVID-19 Economic Turmoil on FDI:

The pandemic COVID-19 has proven ground-breaking accompanying the world economy, national security, and public health issues. It has had a great impact on several nations and India is no exception. As per the statistics released by the Department for Promotion of Industry and Internal Trade (DPIIT), the equity inflows of FDI in India amounted to 500.12 Billion US Dollar between April 2000 and September 2020 showing a positive result from endeavours of government to encourage EoDB by decompressing FDI norms. Inflows of FDI equity in India amounted to 30 Billion US Dollar in 2020–21 out of which computer hardware and software sector captivated major FDI inflows worth 17.55 Billion US Dollar, followed by the services sector with 2.25 Billion US Dollar, trading with 949 Million US Dollar and chemicals other than fertilizers with 437 Million US Dollar. During the same period, India obtained the maximal FDI inflows from Singapore with 8.30 Billion US Dollar supported by the US with 7.12 Billion US Dollar, Cayman Islands with 2.10 Billion US Dollar, Mauritius with 2 Billion US Dollar, the Netherlands with 1.49 Billion US Dollar and the UK with 1.35 Billion US Dollar. The Indian government has enacted several provisions to revitalize the economy under stage-1 of post unlock 1.0 for revitalising the economy. The Indian government proclaimed a unique financial measure of 120 Trillion i.e. 267 Billion US Dollar for self-sustaining India (An Atma Nirbhar Bharat). Under this economic measure to safeguard and promote indigenous industries and to establish India as a prime supply and manufacturing centre, the government has again modified FDI norms in several spheres.

The modified FDI policy is lined up with the enforcement of the Foreign Exchange Management (Non-Debt Instrument Rules) 2019 and Foreign Exchange Management (Mode of Payment and Reporting of Non-Debt Instrument Regulations), 2019 by dint of integrating required modifications containing prerequisites and adjunct guidelines on inward remittance payments. This modified FDI policy overrides entire press releases, press note circulars, and classifications released by DPIIT on 15th October 2020. These drives revised FDI policy simple assessment to comprehend the FDI framework. The major changes reflected by modified FDI policy, 2020, in comparison with Consolidated FDI policy, 2017 are:

Enforcement of the Non-Debt Instrument Rules (NDI Rules)

The Federal Government put forward NDI norms in replacement of the Foreign Exchange Management Transfer and Issue of Security by a person resident outside India Regulation, 2017 and Foreign Exchange Management Acquisition and Transfer of Immovable Property in India Regulation, 2018. This modification creates a transfer in rule creation power in FDI to the central administration, and consequently the NDI Rules were enacted in July 2020 and the monopoly power is given to RBI to examine the application for investment in India that were not explicitly approved under FEMA,1999 rules and regulations.

Incorporation of Press Note-3, 2020 (PN-3, 2020)

The modified FDI norms embed the essential restraints enforced by Press Note-3, 2020 regarding FDI from resident of neighbourhood nations including China, sharing their

land boundaries with India. According to PN-3, 2020, the existence of a nation that shares land boundaries with India or the actual beneficiary of investment into India is located in or emerge as a resident of any such nation can be able to invest in India only through the Government Route. A transmit of dominion in FDI agreements which brings gain to any nation and shares their land boundaries with India will also require government permission and countries like Bangladesh, Pakistan, China, Bhutan, Afghanistan, Nepal, and Myanmar are included in it. Those investors who are not included under modified FDI policy need to notify RBI subsequently after a transaction instead of wondering for pre-consent from the respective governmental authorities.

The previous FDI norm was restricted to permitting merely Pakistan and Bangladesh for investment through government mode, whereas the modified FDI norm has now included Chinese investment under the government route. A subsection is added by the Indian government to impede the flowing of funds through other economies.

Modifications to sector-specific ceiling:

i. Defence—In defence manufacturing, FDI permits have risen from 49 per cent to 74 per cent through the automatic route, and various sectoral cap conditions are reformed.

ii. Contract Manufacturing—In this sector, the essential assortment is emanated to comprise contract manufacturing in the manufacturing sector through an automatic route.

iii. Single Brand Retailing—In this sector, 100 per cent FDI equity is permitted through an automatic route. Furthermore, various sectorial conditions are made by encompassing regional provenance norms.

iv. E-Commerce—Various prohibitions are enforced on E-Commerce emporiums' existence or group of industries merchandising their **products in different platform from doing business on Internet portal.**

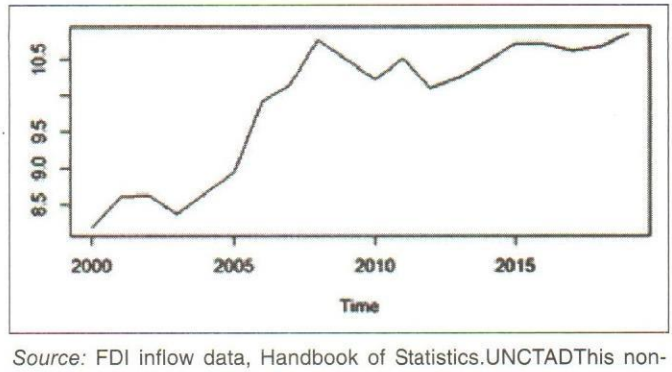
v. Digital media—Under digital media, DPIIT has **permitted 26 % of FDI equity in different section that include streaming and uploading current affairs and news with the help of digital media under Government approval.** ***Pre-condition of Foreign Currency Transfer (FC-TRS)***

Acknowledgement:

Distinctly, the modified norms also maintain the precondition of FC-TRS acknowledgment before the entrance of shares in the targeted industry's book. For this purpose, the stakeholders of Indian industries require to check that the FC-TRS filings are ended and approved in an accelerated form so that the detail of the purchaser can be maintained in the company's book without any delay.

5. FDI Forecast Through ARIMA

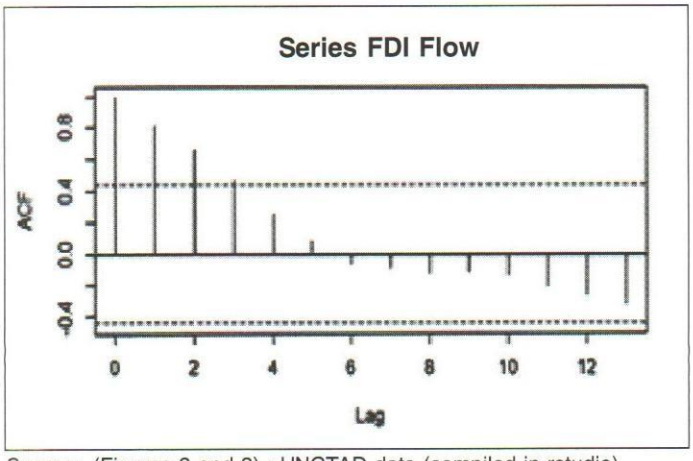
This section forecasts the FDI inflows over the next 10 years, that is from 2020 to 2030, to find the effect of the pandemic on it. For this purpose it has used secondary data on FDI inflow of the United Nation Conference on Trade and Development (UNCTAD) available in its Handbook of Statistics. It has used the ARIMA technique for forecast using the rstudio software. As the present values of FDI are dependent on its past values, as are the features of time series variables, this Autoregressive Integrated Moving Average (ARIMA) model was found to be suitable. Also, it is the technique identified by SPSS as appropriate for the given data. It has taken the time series data from 2000 to 2019, over a 20 years' time period. The reason for choosing this time period is firstly to capture the significant impact of New Economic Reforms 1991, adopted by India. With this lag period, (1991–2000), the impact of this reforms is assumed to have unfolded better, relative to the immediate connecting years with lesser lags. Secondly, the impact of the Global Economic crisis of 2008 on foreign capital flows

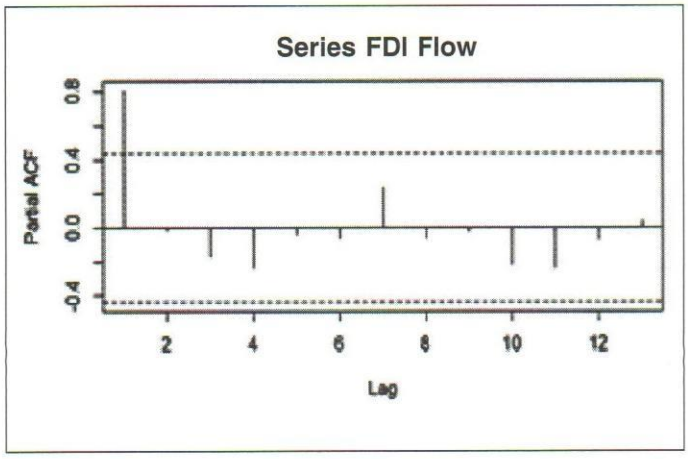


Source: FDI inflow data, Handbook of Statistics.UNCTADThis non-stationary feature is further supported by the Autocorrelation function in Figure 2 which shows significant autocorrelation among the variables till the 4th lag period depicted the spikes crossing over the blue demarcation border line. The Partial autocorrelation test (see Figure 3) shows a significant correlation only for the first lag period in a positive direction.

Figure 1: Non-Stationary FDI data (2000–2019)

in India could be accounted for. The forecasting requires the data to be stationary and so it was plotted to see the variation. As the time series data are by nature non-stationary, the log transformed values of the FDI inflows are used to reduce the heteroscedasticity issue. Figure 1 depicts the non-stationarity of the FDI data. A dip can be also marked in the FDI data in 2008–09 which was the year of global economic crisis after which the data shows a fall and lower trend.





Source: (Figures 2 and 3) : UNCTAD data (compiled in rstudio)

Figure 2: ACF of FDI Flow

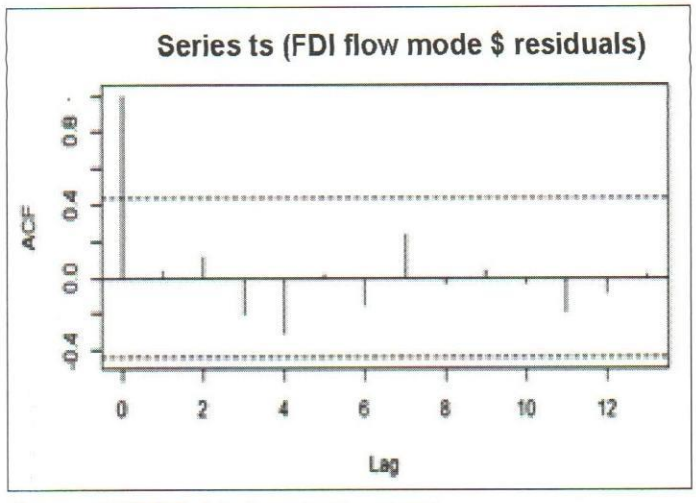
Figure 3: PACF of FDI Flow

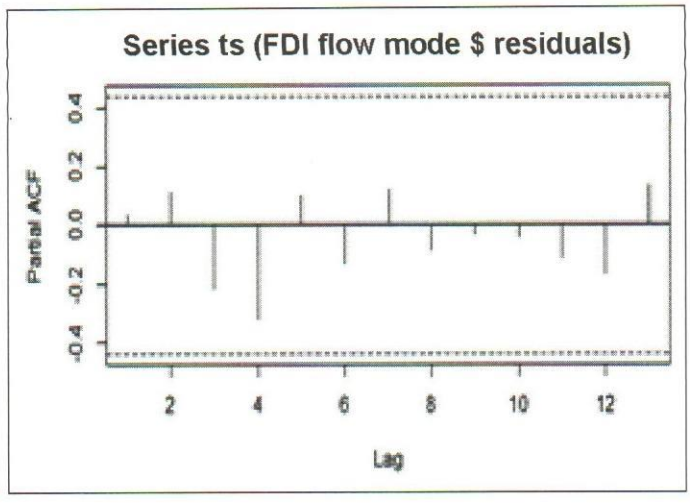
The Augmented Dickey-Fuller Test results shows the following values:

Dickey-Fuller = -1.9407, Lag order = 2, p-value = 0.595. As the p-value is greater than 0.05, we accept the null hypothesis which is that the FDI data here is highly non-stationary. Hence, the data was converted to stationary time series using the auto.arima option in rstudio. Out of the several ARIMA models verified by the software, the best identified is ARIMA (0,1,0) with drift, which was selected as it has the lowest AIC value that forms the basis of selection of the model. This means that the data becomes stationary after the first order differencing. Thus, the identified ARIMA model with drift can be written as "$Y_t = c + Y_{t-2} + e_t$. Given the estimated values for the model, it can be represented as $\Delta \log Y_t = 0.1392 + \log Y_{t-2} + e_t$.

(s.e. 0.0743)

[sigma^2 estimated as 0.1108: log likelihood=-5.55, AIC=15.1 AICc=15.85 BIC=16.99]





Source : UNCTAD data (compiled in rstudio)

Figure 4: ACF of the Stationary FDI Flows **Figure 5: PACF of the Stationary FDI Flows**

Table 1: FDI Forecast Values with Upper and Lower Limits at 95% Confidence Interval

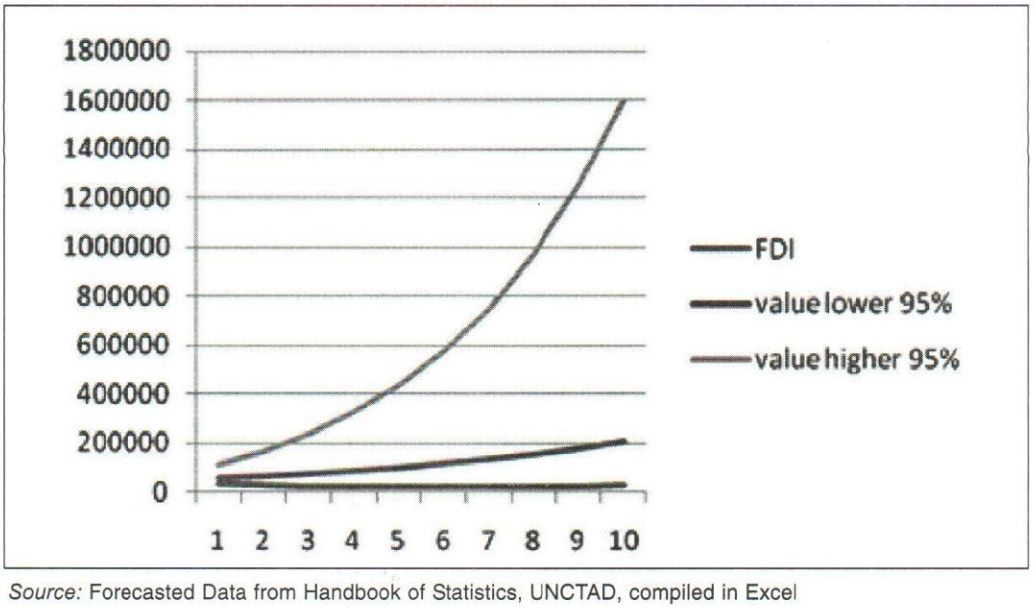
Year	Forecast	Lower CI at 95%	Higher CI at 95%	FDI actual values	Lower CI at 95% (actual values)	Higher CI at 95% (actual values)
2020	10.97001	10.31752	11.62250	58039.12	30225.77	111445.9
2021	11.10924	10.18648	12.03201	66708.53	26513.88	167839.3
2022	11.24848	10.11833	12.37862	76673.68	24767.33	237360.8
2023	11.38771	10.08273	12.69269	88126.56	23901.22	324932.9
2024	11.52694	10.06793	12.98596	101290.2	23550.12	435658.3
2025	11.66618	10.06790	13.26445	116421.3	23549.41	575546.1
2026	11.80541	10.07908	13.53174	133811.3	23814.14	751883.7
2027	11.94464	10.09912	13.79017	153799	24296.14	973584.8
2028	12.08387	10.12640	14.04135	176772.2	24967.99	1251551
2029	12.22311	10.15975	14.28647	203179	25814.63	1599159

Source : Compiled UNCTAD database in rstudio

Table 2: Box-Ljung test to Test Model Validity!!

X-squared = 4.0368,	df = 5	p-value = 0.5441
X-squared = 6.8353	df = 10	p-value = 0.7409
X-squared = 9.399	df = 15	p-value = 0.8557

Source: Compiled in rstudio



Source: Forecasted Data from Handbook of Statistics, UNCTAD, compiled in Excel

Figure 6: Plot of FDI Forecast with Its Lower and Upper Confidence Interval at 95%

The predicted ARIMA (0,1,0) model was used to predict the FDI values over the years as shown in Table 1 with both the upper and lower confidence interval limit at 95 per cent. It shows an increasing trend but with slow average rate of growth.

The validity of this model was further tested with the Box-Ljung test to find if any autocorrelation still exists, in which case the p-value will be less than 0.05 for a given lag period. As is observed in Table 2, the p-value of the Box-Ljung test at different lag periods is found to be greater than 0.05, thus supporting the hypothesis that there is no autocorrelation among the autoregressive FDI variables and hence the forecast can be acceptable.

Plotting the forecast values of the FDI over the next 10 years shows a mild increasing trend (see Figure 6). Though this is a silver lining, but as can be observed, the trend is tilted more towards the lower limit. On the positive side the upper limit shows the immense potential which can be tapped with the right strategic policy incentives to ensure the flow of FDI and provide a stature of resilience to it.

6. Policy Implications:

1. The government has to not only improve upon the parameters where the country has performed poorly in terms of establishing itself as an investment hub for foreign investors which are getting credit, protecting minority investors and enforcing contracts, but it also has to focus on starting a business, getting electricity, registering properties and in paying taxes. It has shown improvement in these categories but yet its ranks are poor and thus displays hidden potential to tap upon these areas, ensuring a better performance for the country as a whole in foreign investment sector.
2. It has to strengthen its economic measures to safeguard and promote indigenous industries and to establish India as a prime supply and manufacturing centre with appropriate flexibility in the FDI norms; this will help in managing several uncertainties generated by the likely economic volatility in vital macro-economic variables such as exchange rate, inflation, and trading partners' changing foreign sector policies, to highlight some prime ones.
3. Though the forecast values of the FDI over the next 10 years shows a mild increasing trend, showing a silver lining, its tilt towards the lower limit shows an immense potential which can be tapped with the right strategic policy incentives to ensure the flow of FDI and providing a stature of resilience to it.
4. Timely amendments to the FDI policy to guard against the impending threat of an "opportunistic" take over of Indian firms by some economic rival nation's firms is the need of the hour. As such it has made mandatory the union government's approvals in case of any direct or indirect change of ownership in case of Indian companies taken over by a foreign entity. Such FDI policy moves—in case of Chinese companies' takeover of some Indian entities—in the current pandemic situation is an apt move and needs to be made stringent.

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"An investment in knowledge pays the best interest."

– Benjamin Franklin

Feature

Estimation and Decomposition of Productivity Growth of the Organized Manufacturing Industries of Transport Equipments in India: An Interstate Analysis

PRASANTA KUMAR ROY

The study applies stochastic frontier approach to estimate and decompose the sources of total factor productivity growth (TFPG) of the 2-digit manufacturing industries of transport equipments in fifteen major industrialised states in India, as well as in All-India. The periods cover 1981–82 to 2010–11, engulfing the pre-reform (1981–82 to 1990–91) and post-reform periods (1991–92 to 2010–11), and also during two different decades of the post-reform period, i.e., 1991–92 to 2000–01 and 2001–02 to 2010–11. The components of TFPG are technological progress (TP), technical efficiency change (TEC), economic scale change (SC) and allocation efficiency change (AEC). According to the estimated results, technological progress (TP) is the major contributing factor to the TFPG of the organised manufacturing industries of transport equipments in India and in its fifteen major industrialised states during the period 1981–82 to 2010–11. Further, TFPG of the 2-digit manufacturing industries of transport equipments have increased during the post-reform period (1991–92 to 2010–11) and the increase is mainly accounted for by the increase in TP too for the same period.

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1. Introduction

The transport manufacturing industry is one of the key segments of the global manufacturing industry. This industry manufactures vehicles that are used for transporting goods and people. Production of various vehicle components is included in this industry. Transport equipment manufacturing includes the manufacture of aircraft and other aerospace equipment, railroad equipment, motor vehicles and auto parts, motorcycles and bicycles, as well as the building, repairing and breaking of ships. A key economic driver for a developing country like India is transportation equipment manufacturing. The transport equipment manufacturing sector is, therefore, central to economic development, specifically as it provides the means for transporting both individuals and goods. Demand for transport equipments has risen rigorously as the volume of goods transported and the distance travelled by passengers have expanded greatly during the last few years. Further, the rise in demand for transport equipments enhances productivity growth of the same during recent years. It remains, therefore, useful to study productivity growth and different components of this industry during the last few decades.

By productivity here, we mean total factor productivity (TFP). TFP is the portion of output not explained by the amount of inputs used in production. TFP growth can be calculated in a number of ways. The two most common approaches used in Indian manufacturing are 'growth accounting' and 'econometric estimation'. Growth accounting measure estimates the TFP growth by subtracting the weighted input growth from the output growth. The growth accounting approach assumes that producers are price takers in both output as well as input markets, so that output prices are equal to the marginal costs of production, and factors are paid their respective

marginal products. The approach also assumes technology to be of constant returns to scale. When it is difficult to satisfy these assumptions, a direct econometric estimation of production function is usually undertaken, which, however, has its own limitations. The problems such as multicolinearity, autocorrelation and the need for large sample associated with the econometric estimation procedure may often present serious challenge to the correct estimation of the parameters of production function [Trivedi et al., (2000)]. In order to avoid these problems, the present study makes use of stochastic production frontier approach for estimation and decomposition of productivity growth.

The stochastic frontier model was originally and independently proposed by Aigner, Lovell and Schmidt [Aigner et al., 1977] and Meeusen and van den Broeck [Meeusen & van den Broeck 1977]. The original specification involved a production function specified for cross-section data which had an error term with two components, one to account for random effects and another to account for technical efficiency. Many studies on frontier production function are based on cross-section data. The studies such as Pitt and Lee, 1981; Battese and Coelli, 1988; Battese and Coelli, 1992 and several other authors have conducted numerous studies for estimating technical inefficiencies in production. Battese and Coelli's (1992) study on paddy farmers in India proposed a time varying model for the technical efficiency effects in the stochastic frontier production for panel data, where the technical efficiency error term was assumed to be an exponential function of time which involved only one unknown parameter. More recently, studies by Kumbhakar, Ghosh and McGuckin (1991), Reifschneider and Stevenson (1991), Huang and Liu (1994) and Battese and Coelli (1995) have adopted a single-stage approach in which explanatory variables are incorporated directly into the inefficiency error component. In this approach, either the mean or the variance of the inefficiency error component is assumed to be a function of the explanatory variables.

The stochastic frontier model has been intensively used to estimate and decompose TFP growth at the firm, industry, state, and even at the national levels. Although a vast number of empirical applications have contributed to identify the sources of TFP growth by focusing on its decompositions, representative studies are Nishimizu and Page (1982), Kumbhakar (1990), Fecher and Perelman (1992), Domazlicky and Weber (1998), to mention only a few. Some studies have extended their analysis to deal with issues such as scale effects and allocative efficiency effects. By applying a flexible stochastic translog function, Kumbhakar and Lovell (2000), Kim and Han (2001) and Sharma et al., (2007) decompose TFP growth into four components: technological progress (TP), changes in technical efficiency (TEC), changes in allocation efficiency (AEC) and economic scale effects (SC). The present study makes the use of stochastic production frontier approach (SFA) for estimation and decomposition of productivity growth of the organised manufacturing industries of transport equipments. A stochastic frontier model is used as it has the ability to gain information on the specified production technology and technical inefficiency component. This information is used to estimate and decompose the sources of TFP growth of the same into four components: TP, TEC, SC, and AEC. We selected this industry to measure various sources of TFP growth as the relevant data is available and is more accurate than other industries of the sector.

In the present study, we estimate and decompose TFPG of the organised manufacturing industries of transport equipments in India and in its fifteen major industrialised states, namely, Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal, assuming that the manufacturing industries of the afore-mentioned states are not able to fully utilize the existing resources and technology because of various non-price and organisational factors that may lead to inevitable technical inefficiencies in production. Using a balanced panel data in the above mentioned states in India and also in All-India over the earlier declared period, we have estimated and decomposed TFPG of the same into four components as mentioned earlier. This decomposition of TFPG of the 2-digit manufacturing industries of transport equipments has also been made for the pre- and post-reform periods, and also for different decades in order to examine the trend and variations in the TFPG and its different components of the same, during these sub-periods. To the best of our knowledge, none of the existing studies have decomposed TFPG of the organised manufacturing industries of transport equipments in India at the inter-state level in such a manner.

The rest of the paper is organised as follows. The next section (section 2) outlines the stochastic frontier production function and the methodology that involves estimation and decomposition of TFPG. The econometric

specifications of the stochastic frontier production function and the time-varying technical inefficiency function have also been analysed in this section. Data sources and the measurement of variables are presented in section 3. Section 4 presents the empirical results, hypothesis tests and the estimation and decomposition results. The final section contains concluding remarks.

2 The stochastic frontier production function and the methodology that involves estimation and decomposition of TFPG

Stochastic frontier model, which was pioneered by Aigner, Lovell and Schmidt (1977) and Meeusen Van den Broeck (1977) and was developed by Pitt and Lee (1981), Schmidt and Sickles (1984), Kumbhakar (1990) and Battese and Coelli (1992) to allow for panel data regression estimation show technical efficiency and technological progress vary over time and across different production units. In this section, we discuss the methodology used in our study for estimating stochastic production frontier and the decomposition of TFPG and provide justification for use of these methods. We start with a standard stochastic frontier model that can be estimated using panel data. The model is written as:

$$y_{it}=f(x_{it}, \beta, t) \exp(v_{it}-u_{it}) \quad (1)$$

where y_{it} represents the output of the i-th production unit (i=1... N) at time 't' (t=1... T); f (.) denotes the production frontier of the i-th production unit at time't'; x_{it} is the input vector used by the i-th production unit at time't'; β is the vector of technology parameter; 't' is the time trend serving as a proxy for technological change; v_{it}s are symmetric random error terms independently and identically distributed with mean zero, and variance σ^2_v is used to capture random variation in output due to external shocks like weather, strikes, lock-outs etc. u_{it}'s are non-negative random variables associated with technical inefficiency of production which are assumed to be independently distributed, such that u_{it}'s are obtained by truncation at zero of the normal distribution with mean ì and variance σ^2_u.

Taking logs of equation (1) and totally differentiating it with respect to time, give the growth rates of output at time't' for the i-th production unit as shown below:

$$\dot{Y}_{it}=d\ln f(x_{it},\beta,t)/dt-du_{it}/dt=\partial \ln f(x_{it},\beta,t)/\partial t+\sum_j \partial \ln f(x_{it},\beta,t) /\partial x_{jt}.dx_{jt}/dt-du_{it}/dt \quad (2)$$

The first and second terms on the right-hand side of equation (2) measure the change in frontier output caused by technological progress (TP) and change in input use, respectively. From the formula of output elasticity of input 'j', $\varepsilon_j=\partial \ln f(x_{it},\beta,t)/\partial \ln x_{jt,}$ the second term can be expressed as $\sum_{jt}$ where a dot over a variable indicates its rate of change. Thus, equation (2) can be written as

$$\dot{Y}_{it}=TP_{it}+\sum_j \varepsilon_j \dot{x}_{jt}-du_{it}/dt \quad (3)$$

So that overall productivity change is not only affected by TP and changes in input use, but also by changes in technical inefficiency. TP will be positive if it shifts the production frontier upward and it will be negative if the exogenous technological change shifts the production frontier downward. On the other hand, the negative value of du_{it}/dt indicates improvements in TE, while positive du_{it}/dt indicates deterioration in TE over time and $-du_{it}/dt$ can be interpreted as the rate at which an inefficient producer catches up with the production frontier.

To examine the effect of TP and change in efficiency on TFPG, let us express TFPG as output growth unexplained by input growth:

$$T\dot{F}P_{it}=Y_{it}-\sum_j S_j \dot{x}_{jt} \quad (4)$$

where S_j denotes the observed expenditure share of input 'j'.

By substituting equation (3) into equation (4), we get

$$T\dot{F}P_{it}=TP_{it}-du_{it}/dt+\sum_j(\varepsilon_j-S_j)\dot{x}_{jt}=TP_{it}-du_{it}/dt+(\varepsilon-1)\sum_j \lambda_j \dot{x}_{jt}+\sum_j(\lambda_j-S_j)\dot{x}_{jt} \quad (5)$$

where $\varepsilon_j=\sum_j(\varepsilon_j$ denotes the measurement of returns to scale (RTS) and $\lambda_j=/\sum_j \varepsilon_j/\varepsilon$. The last component in equation (5) measures inefficiency in resource allocation resulting from the deviation of input prices from the value of their marginal products. Thus, in equation (5), TFP growth is decomposed into, i) TP that measures the shift in production frontier over time; ii) technical efficiency change ($-du_{it}/dt$) that measures the shift in production towards the known production frontier; iii) effect of scale change $[(\varepsilon-1)\sum_j \lambda_j \dot{x}_{jt}]$ which shows the amount of benefit a production unit can derive from economies of scale through access to a larger market; and iv) the allocative efficiency change denoted by $(\sum_j(\lambda_j-S_j)\dot{x}_{jt}$ captures the impact of deviations of inputs' normalised output elasticities from their expenditure shares [Kumbhakar and Lovell (2000)].

2.1 Econometric Model Specification

For the empirical analysis, a translog production frontier is specified with the two inputs labour (L) and capital (K) in the following form:

$$Lny_{it}=\beta_0+\beta_L lnL_{it}+\beta_K lnK_{it}+\beta_t t+1/2\beta_{LL}L_{it}^2+1/2\beta_{KK}K_{it}^2+1/2\beta_{tt}t^2+\beta_{LK}lnL_{it}lnK_{it}+\beta_{Lt}L_{it}t+\beta_{Kt}K_{it}t+v_{it}-u_{it} \quad (7)$$

Where y_{it}, L_{it} and K_{it} are respectively output, labour input, and capital input for the organised manufacturing industry in 'i'th industry group at time't'. The distribution of technical inefficiency effects, u_{it}, is considered to be non-negative truncation of the normal distribution $N(\mu,\sigma^2_u)$, following Battese & Coelli (1992). It takes the form:

$$u_{it}=\eta_t u_i=u_i exp(-\eta [t-T]),\ i=1,\ldots,N;\ t=1,\ldots,T \quad (8)$$

Here, the unknown parameter η represents the rate of change in technical inefficiency, and the non-negative random variable, u_i, is a measure of the technical inefficiency effect for the i-th production unit in the last year of the data set. That is, the technical inefficiency effects in earlier periods are a deterministic exponential function of the inefficiency effects for the corresponding forms in the final period, (i.e., $u_{it}=u_i$) given that data for the i-th production unit are available in period T. So the organised manufacturing industries of transport equipments with a positive η are likely to improve its level of efficiency over time and vice-versa. A value of $\eta=0$ implies no time effect.

Setting $\eta=0$ we will get time-invariant model as set out in Battese, Coelli and Colby (1989). Furthermore, restricting the formulation to a full balanced panel data gives the production function assumed in Battese and Coelli (1988). The additional restriction of $\mu=0$ reduces the model to model one in Pitt and Lee (1981). We may add a fourth restriction of T=1 to return to the original cross-sectional, half-normal formulation of Aigner, Lovell and Schmidt (1977). Finally if all these restrictions except $\mu=0$ is imposed, the model suggested by Stevenson (1980) results.

Since the estimates of technical efficiency are sensitive to the choice of distributional assumption, we consider truncated normal for general specifications for one-sided error u_{it}, and a half-normal distribution can be tested by Likelihood Ratio (LR) test.

Given the estimates of the parameters in equation (7) and (8), the technical efficiency level of unit 'i' at time 't' (TE_{it}), defined as the ratio of the actual output to the potential output, determined by the production frontier, can be written as

$$TE_{it}=exp(-u_{it}) \quad (9)$$

and TEC is the change in TE, and the rate of technological progress (TP_{it}) is defined by

$$TP_{it}=\partial lnf(x_{it},\beta,t)/\partial t=\beta t+\beta_{tt}t+\beta_{Lt}lnL_{it}+\beta_{kt}lnK_{it} \quad (10)$$

where βt and β_{tt} are 'Hicksian' parameters and β_{Lt} and β_{kt} are 'factor augmented' parameters. It is noted that when technological progress is non-neutral, the change in TP may be varied for different input vectors. To avoid such problems, Coelli, Prasada Rao and Battese (1998) suggest that the geometric mean between the adjacent periods be used to estimate the TP component. The geometric mean between time't' and t+1 is defined as

$$TP_{it}=[1+\partial lnf(x_{it},\beta,t)/\partial t]*[1+\partial lnf(x_{it+1},\beta,t+1)/\partial t+1]^{1/2}-1 \quad (11)$$

The TE_{it} and TP_{it} both are varying over time and across the production units.

The associated output elasticities of input labour and capital can be defined as

$$\varepsilon_L=\partial lnf(x_{it},\beta,t)/\partial lnL_{it}=\beta_L+\beta_{LL}lnL_{it}+\beta_{LK}lnK_{it}+\beta_{Lt}t \quad (12)$$

$$\varepsilon_K=\partial lnf(x_{it},\beta,t)/\partial lnK_{it}=\beta_K+\beta_{KL}lnL_{it}+\beta_{KK}lnK_{it}+\beta_{Kt}t \quad (13)$$

The above equations show the percentage change in output with respect to one percent change in input. They are used to estimate the aggregate returns to scale ($\in$). The scale elasticity of output, i.e. the change in output with respect to change in scale, is given by the formula:

$$\in=\varepsilon_{L+}\varepsilon_K \quad (14)$$

If scale elasticity exceeds unity, then the technology exhibits increasing returns to scale (IRS); if it is equal to one, the technology obeys constant returns to scale (CRS), and if it is less than unity, the technology shows decreasing returns to scale (DRS).

3 Data and Variables

3.1 Data Sources

The study is based on panel data collected from the various issues of Annual Survey of Industries (ASI), Central Statistical Organisation (CSO), Ministry of Statistics and Program Implementation, Government of India, New Delhi, for the period from 1981–82 to 2010–11. The EPW database has also been utilised to obtain data for the period 1981–82 to 2010–11 to perform our study. To arrive

at the measures of output and inputs in real terms, suitable deflators for the variables were constructed. In order to obtain the data at constant prices, all the required series were deflated with relevant price indices with a base of 1980/81=100. In cases where the exact deflators were not available, the best suitable proxies for the industry concerned were picked up from the WPI series. Series on real gross value added for each industry was obtained by deflating the nominal figures by the WPI of the industry concerned. Implicit price deflator, used to deflate the series on capital stock at current prices, is constructed by taking data from the National Accounts Statistics (NAS).

3.2 Variables used

The variables used in this exercise are output, labour and capital inputs. To make the values of output and capital inputs comparable over time, across industries, and states, suitable deflators have been used. The definition of the variables and the deflators used are as given below. The discussion also highlights various issues involved while selecting these variables.

3.3 Output

In our study, we have taken gross value added as the index of output. Gross output is not taken directly as the index of output, in order to avoid the possibility of double counting. However, it may appear that net value added might have been a better measure of output index, but since the depreciation figures are not reliable as the entrepreneurs often provide us with inflated figures in order to avoid tax-laws, we have preferred gross value added as a measure of output to net value added. Data regarding gross value added are collected from various issues of Annual Survey of Industries, while the data regarding the price level are collected form National Accounts Statistics published by CSO.

If value-added is used as a measure of output, nominal value-added needs to be converted into real value-added. This conversion can be done with either single deflation (SD) or double deflation (DD) method. In case of single deflation, nominal value-added is deflated by the output price index, i.e., both nominal output and nominal material inputs are deflated by the output price index. Whereas in case of double deflation, gross value added is deflated by the manufacturing price index and the material inputs by the weighted index of the material input prices. Here we could not use DD method for three reasons: a) ASI data consists of large number of multi-product firms; b) value added as a proportion of output is low in the formal sector which leads to GVA becoming negative for several industries with DD method for cases where the input price deflator is higher than the output price deflator (CSO, 2007: 127); and c) the non-availability of industry specific input deflators. Hence, we used SD method.

3.4 Labour

In this study, total number of persons engaged is taken as the measure of labour input. As workers, working proprietors and supervisory/managerial staff/ technicians etc. can affect productivity; number of persons engaged is preferred to number of workers. For recent issues, it is reported in the ASI under the head 'persons engaged', for earlier issues, it is reported as 'number of employees'. This relates to all persons engaged by the factory for wages or not, in work directly connected or indirectly with the manufacturing process and includes administrative, technical and clerical staff as also labour used in the production of capital assets for the factory's own use. Implicit in such a measure is the assumption that workers and other than workers are perfect substitutes. This may not be a proper assumption to work with when the objective of the study is to compare productivity growth across industries, and management is one of the vitally important factors in explaining inter-industry differentials. Total emoluments divided by total number of persons engaged in production is considered as price of labour input in the study.

3.5 Capital

The measurement of capital is the most complex of all input measurements. Actually, there is no universally accepted method for the measurement of capital and, as a result, several methods have been applied to estimate capital stock in several studies. In many studies, capital is treated as a stock concept and is, therefore, measured by the book value of fixed capital assets. Some studies have used the perpetual inventory accumulation method (PIAM) to construct capital stock series from annual investment data. Goldsmith (1951) was the first to introduce PIAM.

However, it is essential to point out that each of these measures have certain limitations. For example, the book value method has the following three limitations:

1) The use of 'lumpy' capital data underestimates or overestimates the amount of capital expenditure.

2) The book value may not truly represent the physical stock of machinery and equipment used in the production.

3) It does not address the question of capacity utilisation.

Perpetual inventory method also does not address the question of capacity utilisation.

Despite its limitation, several studies on Indian manufacturing (e.g. Ahluwalia, 1991, Balakrishnan and Pushpangadan, 1994, Trivedi et al., 2000, Goldar, 2004 etc.) used PIAM to obtain the series of capital stock. In this study, we too have used PIAM to obtain the fixed capital stock series. The steps in the construction of fixed capital series are as follows:

1) Implicit deflator for gross fixed capital formation for registered manufacturing is derived from the data on gross fixed capital formation in registered manufacturing at current and constant prices as given in National Accounts Statistics (NAS). The deflator series is constructed for the period 1981–82 to 2010–11. The base is shifted to 1980–81 in order to make it consistent with the wholesale price index (WPI) used to estimate real value added.

2) From ASI data, gross investment in fixed capital in registered manufacturing is computed for each year by subtracting book value of fixed assets in the previous year from that in the current year and adding to that figure the reported depreciation in fixed assets in the current year. To obtain real gross investment, the nominal figures have been deflated using the implicit deflator for fixed investment mentioned above.

3) To construct capital stock series for the manufacturing industries, ASI data for 1980–81 have been considered as the benchmark year of capital stock. The capital stock series for the manufacturing industries, then, in the subsequent years has been arrived at by adding the real investment figures to the stock of capital of the previous year.

Let B_t and B_{t-1} denote the book value of fixed capital in the year t and t-1 respectively, D_t the reported depreciation in the year t and P_t is the implicit deflator for fixed capital in the year t. The real gross investment in the year t, denoted by I_t, may be obtained as-

$$I_t = (B_t - B_{t-1} + D_t)/ P_t$$

The relationship between gross fixed capital in the year t, denoted by K_t, the benchmark capital stock, K_o and the rate of obsolescence for each year at a uniform rate of 'δ', is given by the equation-

$$K_t = K_{t-1} - \delta K_{t-1} + I_t$$

Let us assume that the rate of obsolescence for each year at a uniform rate is 5% as found in TSL and Unel study. Then the capital stock series can be written as-

$$K_1 = K_o - 0.05K_o + I_1$$

$$K_2 = K_1 - 0.05K_1 + I_2, \text{ and so on.}$$

Gross fixed capital stock at constant (1993–94) price is taken as a measure of capital input. The base of this series has then been shifted arithmetically to 1981–82. This was to retain the consistency of a single base year for all the price indices. ASI provides data on fixed capital stock at historical cost. It consists of land, buildings, plant and machinery, capital work in progress, furniture, fixtures and office. Rental price of capital equals the ratio of interest paid, while capital invested (Jorgenson and Griliches, 1967) is assumed to be price of capital in our study.

4. Empirical Results, Hypothesis Tests and the Estimation and Decomposition results

4.1 Empirical Results

The estimation of parameters in the stochastic frontier model given by equations (9) and (10) are carried out by maximum-likelihood (ML) method, using the programme FRONTIER 4.1 (Coelli, 1996). Instead of directly estimating σ^2_v and σ^2_u, FRONTIER 4.1 seeks to estimate $y=\sigma^2_u/\sigma^2$ and $\sigma^2=\sigma^2_u+\sigma^2_v$, the results of which are presented in Table 1. These are associated with the variances of the stochastic term in the production function, v_{it} and the inefficiency error term u_{it}. The parameter σ must lie between zero and unity. If the hypothesis $\gamma=0$ is accepted, this would mean that y^2_u is zero and thus the inefficiency error term, u_{it} should be removed from the model, leaving a specification with parameters that can be consistently estimated by OLS. Conversely, if the value of y is unity, we have the full-frontier model, where the stochastic term is not present in the model.

The maximum likelihood estimates for the translog stochastic frontier production function are reported in Table 1. Almost all the estimated coefficients of the translog stochastic frontier production function are found to be

Table 1: Parameter Estimates of the Stochastic Production Frontier and Technical Inefficiency Model in the 2-Digit Manufacturing Industries of Transport Equipments

Variables	Parameters	Coefficients
Constant	β_0	-6.46***(0.94)
lnL	β_L	2.66**(0.32)
lnK	β_K	-0.79***(0.21)
t	β_t	0.105***(0.024)
lnL^2	β_{LL}	-0.139***(0.034)
lnK^2	β_{KK}	-0.013(0.018)
t^2	β_{tt}	-0.0002(0.0003)
lnL*lnK	β_{LK}	0.12***(0.048)
lnL*t	β_{Lt}	-1.19***(0.005)
lnK*t	β_{Kt}	0.013***(0.004)
Sigma squared	σ^2	0.22***(0.045)
Gamma	γ	0.19(0.16)
Mu	μ	0.13(0.21)
Eta	η	0.024**(0.013)
Log-Likelihood		-293.10

Standard errors are mentioned in the parenthesis

***,** & * denote statistical significance at the 1%, 5% and 10% levels, respectively

Source: Authors' own calculation

statistically significant at the conventional levels. However, as under translog specification there may exist high level of multi-collinearity due to the interaction and squared terms, certain estimated coefficients were found to be statistically insignificant.

In Table 1, it is also found that the estimated value of gamma (γ) is as low as 0.19 which implies that the organised manufacturing industries of transport equipments are operating at only 19% of their potential output determined by the frontier technology. Further, statistical test suggests that the estimated value of $\tilde{a}$ is statistically insignificant. This implies that technical inefficiency may remain absent in the organised manufacturing industries of transport equipments.

4.2 Hypothesis Test

Various tests of hypotheses of the parameters in the frontier production function can be performed using the generalised likelihood ratio-test statistic, defined by

$$\lambda = -2\,[\ell(H_0) - \ell(H_1)]$$

where $-\ell(H_0)$ is the log-likelihood value of a restricted frontier model, as specified by a null hypothesis, H_0; and $-\ell(H_1)$ is the log-likelihood value of the general frontier model under the alternative hypothesis, H_1. This test statistic has approximately a chi-square distribution (or a mixed chi-square) with degrees of freedom equal to the difference between the parameters involved in the null and alternative hypotheses. If the inefficiency effects are absent from the equation, as specified by the null hypothesis H_0: y=0, then the statistic λ is approximately distributed according to a mixed chi-square distribution. Table 2

presents the test results of various null-hypotheses as shown below:

The first likelihood test is conducted to test the null hypothesis that the technology in the organised manufacturing industries of transport equipments is a Cobb-Douglas (H_0: $\beta_{LL}=\beta_{KK}=\beta_{LK}=\beta_{tt}=\beta_{Lt}=\beta_{Kt}=0$), is rejected. This is shown in Table 2 where a likelihood ratio of the value 50.74 indicates the rejection of null hypothesis at both 5% and 1% level of significance. Thus, Cobb-Douglas production function is not an adequate specification for the organised manufacturing industries of transport equipments, given the assumption of the translog stochastic frontier production model, implying that the translog production better describes the technology of the said manufacturing industries.

The second null hypothesis, that there is no technological change over time (H_0: $\beta_t=\beta_{tt}=\beta_{Lt}=\beta_{Kt}=0$) is also strongly rejected. The value of the test statistic as shown in Table 2 is 67.64 which is significantly larger than the critical value of respectively 9.49% and 13.28 at 5% and 1% probability level. This indicates the existence of technological change over time in the manufacturing industries of transport equipments, given the specified production model.

The third null-hypothesis is that the technological change is Hicks neutral (H_0: $\beta_{Lt}=\beta_{Kt}=0$). The value of the test statistic in this case becomes 12.42 which is greater than the critical value of 5.99 and 9.21 respectively at 5% and 1% probability level. This indicates that the translog parameterisation of the stochastic frontier model does not allow for Hicks neutral technological change in the organised manufacturing industries of transport equipments.

Table 2: Tests of Hypothesis for Parameters of the Distribution of Technical Inefficiency Effects and Appropriateness of the Functional Form of 2-Digit Manufacturing Industries of Transport Equipments

	Log- Likelihood value		Test statistics	Critical value		Decision
Null hypothesis	**$L(H_1)$**	**$L(H_0)$**	**λ= -2[$L(H_0)$-$L(H_1)$]**	**At 1% level**	**At 5% level**	**Reject H_0/ Accept H_0**
Cobb-Douglas production specification H_0: $\beta_{LL}=\beta_{KK}=\beta_{LK}=\beta_{tt}=\beta_{Lt}=\beta_{Kt}=0$	-293.10	-318.47	50.74	16.81	12.59	Reject H_0
No technological change H_0: $\beta_t=\beta_{tt}=\beta_{Lt}=\beta_{Kt}=0$	-293.10	-326.92	67.64	13.28	9.49	Reject H_0
Neutral technological change H_0: $\beta_{Lt}=\beta_{Kt}=0$	-293.10	-299.31	12.42	9.21	5.99	Reject H_0
No technical inefficiency H_0: $\gamma=\mu=\eta=0$	-293.10	-294.83	3.46	11.34	7.81	Accept H_0
Half-normal distribution of technical inefficiency H_0: $\mu=0$	-293.10	-293.19	0.18	6.63	3.84	Accept H_0
Time invariant technical inefficiency H_0: $\eta=0$	-293.10	-294.58	2.96	6.63	3.84	Accept H_0

Source: Authors' own calculation

Fourth, null-hypothesis that technical inefficiency effects are absent ($H_0=\gamma=\mu=\eta=0$) is accepted. This implies that the traditional production function is an adequate representation for the organised manufacturing industries of transport equipments.

The fifth null-hypothesis, specifying that technical inefficiency effects have half-normal distribution (H_0: $\mu=0$) against truncated normal distribution, is also accepted both at 5% and at 1% level of significance.

The sixth null-hypothesis, that technical inefficiency is time-invariant (H_0: η=0) is accepted both at 5% as well as at 1% level of significance. This implies that technical inefficiency in the organised manufacturing industries of transport equipments is time-invariant in nature as statistical tests suggest.

4.3 Estimation and Decomposition results

Based on the translog stochastic frontier production function estimates presented in Table 1, we derive the following measures: the output elasticity with respect to factor inputs (e_L & e_K), returns to scale ($e= e_{L+} e_K$), rate of technological progress (TP), scale effect (SC), and the rate of allocation efficiency effects (AEC). These measures are then used to derive the sources of TFPG. Because the translog specification is used, the performance of these measures vary depending on states and years. The sources of TFPG are technological progress (TP), scale effect (SC), and allocation efficiency effects (AEC). Technical efficiency effect (TEC) does not exist as statistical tests suggest. For the three sources of TFPG, Table 3a to Table 3p in the Appendix show that the major contributor to the TFPG is TP. On an average, TP accounts for more than 80 per cent of TFPG of the manufacture of transport equipments in most of the industrialised states in India and All-India during the entire study period as well as during both the pre-and the post-reform periods.

So far as the estimates of TFPG are concerned, it is found that TFPG in almost all the states in India, including that in All-India, have increased during the post-reform period and the increase in TFPG of these industries is mainly accounted for by the increase in TP of the same during that period. The contribution of SC to TFPG of the same is, however, found to be negligible or even negative in many states during the aforementioned study periods. Whereas the contribution of TEC to the same is found to be absent and/or they are found to be time invariant in nature during the whole study period as well as during both the pre- and post-reform periods as statistical tests (Table 2) suggest. Further, so far as the AEC is concerned, it is found that its contribution to TFPG of the said industries is also very negligible or sometimes negative too in many states. So, it is clear from Table 3a to Table 3p that TFP growth rates in the manufacturing industries of transport equipments in almost all the states in India as well as those in All-India have increased during the post-reform period and the increase in TFPG of the aforesaid industries during the post-reform period is mainly accounted for by the increase in TP of the same during that period.

It is found from Table 3a to Table 3p that Karnataka (5.19%) and Kerala (5.12%) are the only two states among the 15 major industrialised states in India and in All-India (5.95%) that have achieved more than 5 percent annual average growth rates of TFPG during the entire study period (1981–82 to 2010–11). A total of five out of these 15 states have achieved average annual growth rate of TFPG of the same in the range of 5 per cent to 4 per cent; three states have achieved average annual growth rate of TFPG in the range of 4 per cent to 3 per cent; four states have experienced average annual growth rates of TFPG in the range of 1 per cent to 3 per cent. One state, namely Odisha, has achieved negative growth rate of TFPG -1.82 percent during the study period. So far as the shares in the average annual growth rates of TFPG of the three sources of TFPG are concerned, TP is found to have the maximum share in all the states under study and in India as a whole during this period. The share of the other sources of TFPG, namely, SC and AEC, is very insignificant (negative in many states including All-India); whereas, in the case of TEC its share has remained absent in all the states including All-India, as suggested by statistical tests of hypothesis (Table 2). So what we see is that the average annual growth rate of TFPG of the manufacturing industries of transport equipments in India and in its 15 major industrialised states during 1981–82 to 2010–11 is accounted for by only one factor-the rate of technological progress (TP). The SCs and AECs are very negligible in most of the states under study and their effects have been negative too in many cases, and TECs remain absent as statistical tests (Table 2) suggest.

A comparison of the performance of TFPG of the 2-digit manufacturing industries of transport equipments and the share of the three sources of TFPG during the pre- and post-reform periods shows that only five states have achieved higher growth rates of TFPG (more than 5%) during the post-reform period (Table 3a to Table 3p in the Appendix). As in the case of the entire study period (1981–82 to 2010–11), during the pre-and post-reform periods, the share of technological progress has been greater than the shares of the scale effects (SC) and allocation efficiency effects (AEC) where the effect technical efficiency (TEC) has remained unchanged and/or it has no effect at all as statistical tests suggest. It is only in case of All-India AEC exceeds TP both in the pre- and post-reform periods and SC exceeds TP in Assam only during the post-reform period.

A further division of the post-reform period into two sub-periods of 1991–92 to 2000–01 and 2001–02 to 2010–11 is made to estimate the relative contribution of the sources of TFPG of the said industries during these two sub-periods of a decade each (Table 3a to Table 3p in the Appendix). From Table 3a to Table 3p in the Appendix we see that 5 states and India as a whole have registered higher growth rates of TFP (more than 5%) during the first half of the post-reform period while 4 states registered higher growth rates of TFP (more than 5%) during the second half of the post-reform period. However, in the second decade of the post-reform period, the contribution of TP has been higher in most of the states under study. The contributions of SCs and AECs have been very negligible or even negative in most of the states under study in both the decades after reforms, while TECs remain unchanged and/or it has no contribution at all as suggested by statistical tests of hypotheses.

5. Conclusion

The paper estimates and decomposes the sources of TFPG in the 2-digit manufacturing industries of transport equipments in India and in its fifteen major industrialised states during the period from 1981–82 to 2010–11, during the entire period, pre-reform period (1981–82 to 1990–91), post-reform period (1991–92 to 2010–11) and during two different decades of the post-reform period (1990–91 to 2000–01 and 2001–02 to 2010–11) using stochastic frontier approach. The methodology involves estimation and decomposition of the sources of TFPG into four components, i.e., technological progress (TP), technical efficiency effect (TEC), economic scale effect (SC) and allocation efficiency effect (AEC).

The main findings of the estimation and decomposition analysis show that during the periods under study, TP has been the major driving force of productivity growth in the 2-digit manufacturing industries of transport equipments in India and in its fifteen major industrialised states. Further, TP of the organised manufacturing industries of transport equipments in India and in its major industrialised states as mentioned in our study has increased during the post-reform period and the increase in TFPG of the aforesaid industries during that period is mainly responsible for the increase in TP of the same during the same period of time. The technical efficiency effects of the organised manufacturing industries of the same is, however, found to be time-invariant in nature i.e., over-time changes in technical efficiency are not statistically significant. With respect to SC and AEC, their contribution to TFPG in the organised manufacturing industries of transport equipments has been very low or even negative. The change in allocation efficiency component shows that resources allocation in India and in most of its states under study have deteriorated during the post-reform period. This implies that deregulation and delicensing of the economy in the post-reform period has increased the price distortion measured by the gap between price and marginal cost of the organised manufacturing industries of transport equipments in India and in almost all of its major industrialised states. Further, poor contributions of scale effects suggest that per unit cost of production of the organised manufacturing industries of the same have increased.

Although the findings show that technological progress is the major source of TFPG of the 2-digit manufacturing industries of transport equipments in India and in its fifteen major industrialised states, further study is needed to understand what drives the productivity growth of the manufacturing industries of transport equipments at the more disaggregated level. Further, resources should be allocated economically in order to reduce the gap between price and marginal cost of production of these industries. Finally, scale should be increased not by increasing networks but by building more factories in order to reduce average cost of production.

Table 3a: Average Annual Rates of TP, SC, AEC and TFPG of the Manufacture of Transport Equipments (37) in Andhra Pradesh

Study Period	TP	SC	AEC	TFPG
Entire Study Period (1981–82 to 2010–11)	3.07	-0.20	-0.92	1.95
Pre-reform Period (1981–82 to 1990–91)	3.03	-0.12	-1.09	1.82
Post-reform Period (1991–92 to 2010–11)	3.09	-0.23	-0.83	2.03
Post-reform Period: Decade 1 (1991–92 to 2000–01)	3.13	-0.48	-1.90	0.75
Post-reform Period: Decade 2 (2001–02 to 2010–11)	3.04	0.01	0.24	3.29

Appendix

Table 3b: Average Annual Rates of TP, SC, AEC and TFPG of the Manufacture of Transport Equipments (37) in Assam

Study Period	TP	SC	AEC	TFPG
Entire Study Period (1981–82 to 2010–11)	2.91	2.76	-1.25	4.42
Pre-reform Period (1981–82 to 1990–91)	1.81	-4.50	-1.34	-4.03
Post-reform Period (1991–92 to 2010–11)	3.46	6.39	-1.20	8.65
Post-reform Period: Decade 1 (1991–92 to 2000–01)	3.17	13.48	-2.17	14.48
Post-reform Period: Decade 2 (2001–02 to 2010–11)	3.75	-0.70	-0.24	2.81

Table 3c: Average Annual Rates of TP, SC, AEC and TFPG of the Manufacture of Transport Equipments (37) in Bihar

Study Period	TP	SC	AEC	TFPG
Entire Study Period (1981–82 to 2010–11)	3.96	0.05	0.94	4.95
Pre-reform Period (1981–82 to 1990–91)	3.87	-0.24	-1.48	2.15
Post-reform Period (1991–92 to 2010–11)	4.00	0.20	2.15	6.35
Post-reform Period: Decade 1 (1991–92 to 2000–01)	3.40	-0.41	1.77	4.76
Post-reform Period: Decade 2 (2001–02 to 2010–11)	4.61	0.81	2.53	7.95

Table 3d: Average Annual Rates of TP, SC, AEC and TFPG of the Manufacture of Transport Equipments (37) in Gujarat

Study Period	TP	SC	AEC	TFPG
Entire Study Period (1981–82 to 2010–11)	3.36	0.49	0.90	4.75
Pre-reform Period (1981–82 to 1990–91)	2.79	0.04	0.40	3.23
Post-reform Period (1991–92 to 2010–11)	3.65	0.71	1.15	5.51
Post-reform Period: Decade 1 (1991–92 to 2000–01)	2.77	-0.46	0.76	3.07
Post-reform Period: Decade 2 (2001–02 to 2010–11)	4.53	1.88	1.53	7.94

Table 3e: Average Annual Rates of TP, SC, AEC and TFPG of the Manufacture of Transport Equipments (37) in Haryana

Study Period	TP	SC	AEC	TFPG
Entire Study Period (1981–82 to 2010–11)	3.88	0.80	-0.74	3.94
Pre-reform Period (1981–82 to 1990–91)	3.64	1.18	-2.60	2.22
Post-reform Period (1991–92 to 2010–11)	4.00	0.61	0.19	4.80
Post-reform Period: Decade 1 (1991–92 to 2000–01)	4.23	1.20	0.35	5.78
Post-reform Period: Decade 2 (2001–02 to 2010–11)	3.78	0.02	0.04	3.84

Table 3e: Average Annual Rates of TP, SC, AEC and TFPG of the Manufacture of Transport Equipments (37) in Haryana

Study Period	TP	SC	AEC	TFPG
Entire Study Period (1981–82 to 2010–11)	3.88	0.80	-0.74	3.94
Pre-reform Period (1981–82 to 1990–91)	3.64	1.18	-2.60	2.22
Post-reform Period (1991–92 to 2010–11)	4.00	0.61	0.19	4.80
Post-reform Period: Decade 1 (1991–92 to 2000–01)	4.23	1.20	0.35	5.78
Post-reform Period: Decade 2 (2001–02 to 2010–11)	3.78	0.02	0.04	3.84

Table 3f: Average Annual Rates of TP, SC, AEC and TFPG of the Manufacture of Transport Equipments (37) in Karnataka

Study Period	TP	SC	AEC	TFPG
Entire Study Period (1981–82 to 2010–11)	3.56	0.43	1.20	5.19
Pre-reform Period (1981–82 to 1990–91)	3.10	0.60	1.19	4.89
Post-reform Period (1991–92 to 2010–11)	3.79	0.34	1.20	5.33
Post-reform Period: Decade 1 (1991–92 to 2000–01)	3.54	0.11	1.61	5.26
Post-reform Period: Decade 2 (2001–02 to 2010–11)	4.04	0.58	0.80	5.42

Table 3g: Average Annual Rates of TP, SC, AEC and TFPG of the Manufacture of Transport Equipments (37) in Kerala

Study Period	TP	SC	AEC	TFPG
Entire Study Period (1981–82 to 2010–11)	4.79	-0.44	0.77	5.12
Pre-reform Period (1981–82 to 1990–91)	5.77	-0.88	2.73	7.62
Post-reform Period (1991–92 to 2010–11)	4.29	-0.22	-0.22	3.85
Post-reform Period: Decade 1 (1991–92 to 2000–01)	4.69	-0.54	-0.96	3.19
Post-reform Period: Decade 2 (2001–02 to 2010–11)	3.90	0.11	0.52	4.53

Table 3h: Average Annual Rates of TP, SC, AEC and TFPG of the Manufacture of Transport Equipments (37) in Madhya Pradesh

Study Period	TP	SC	AEC	TFPG
Entire Study Period (1981–82 to 2010–11)	3.93	0.49	-1.28	3.14
Pre-reform Period (1981–82 to 1990–91)	3.44	0.71	-1.65	2.50
Post-reform Period (1991–92 to 2010–11)	4.17	0.37	-1.09	3.45
Post-reform Period: Decade 1 (1991–92 to 2000–01)	4.43	0.22	-2.37	2.28
Post-reform Period: Decade 2 (2001–02 to 2010–11)	3.92	0.52	0.19	4.63

Table 3i: Average Annual Rates of TP, SC, AEC and TFPG of the Manufacture of Transport Equipments (37) in Maharashtra

Study Period	TP	SC	AEC	TFPG
Entire Study Period (1981–82 to 2010–11)	3.43	0.01	1.37	4.81
Pre-reform Period (1981–82 to 1990–91)	2.92	-0.07	2.03	4.88
Post-reform Period (1991–92 to 2010–11)	3.68	0.05	1.04	4.77
Post-reform Period: Decade 1 (1991–92 to 2000–01)	3.73	0.16	1.44	5.33
Post-reform Period: Decade 2 (2001–02 to 2010–11)	3.64	-0.07	0.64	4.21

Table 3j: Average Annual Rates of TP, SC, AEC and TFPG of the Manufacture of Transport Equipments (37) in Odisha

Study Period	TP	SC	AEC	TFPG
Entire Study Period (1981–82 to 2010–11)	5.09	-2.26	-4.65	-1.82
Pre-reform Period (1981–82 to 1990–91)	3.45	-0.46	-4.07	-1.08
Post-reform Period (1991–92 to 2010–11)	5.91	-3.15	-4.94	-2.18
Post-reform Period: Decade 1 (1991–92 to 2000–01)	5.39	-4.68	-5.56	-4.85
Post-reform Period: Decade 2 (2001–02 to 2010–11)	6.43	-1.62	-4.32	0.49

Table 3k: Average Annual Rates of TP, SC, AEC and TFPG of the Manufacture of Transport Equipments (37) in Punjab

Study Period	TP	SC	AEC	TFPG
Entire Study Period (1981–82 to 2010–11)	2.32	-0.01	1.17	3.48
Pre-reform Period (1981–82 to 1990–91)	1.99	-0.06	0.60	2.53
Post-reform Period (1991–92 to 2010–11)	2.49	0.01	1.45	3.95
Post-reform Period: Decade 1 (1991–92 to 2000–01)	2.52	0.21	1.17	3.90
Post-reform Period: Decade 2 (2001–02 to 2010–11)	2.45	-0.18	1.74	4.01

Table 3l: Average Annual Rates of TP, SC, AEC and TFPG of the Manufacture of Transport Equipments (37) in Rajasthan

Study Period	TP	SC	AEC	TFPG
Entire Study Period (1981–82 to 2010–11)	3.73	-0.32	-1.91	1.50
Pre-reform Period (1981–82 to 1990–91)	2.44	-1.00	-2.31	-0.87
Post-reform Period (1991–92 to 2010–11)	4.37	0.02	-1.71	2.68
Post-reform Period: Decade 1 (1991–92 to 2000–01)	3.68	-2.17	-1.88	-0.37
Post-reform Period: Decade 2 (2001–02 to 2010–11)	5.06	2.21	-1.54	5.73

Table 3m: Average Annual Rates of TP, SC, AEC and TFPG of the Manufacture of Transport Equipments (37) in Tamil Nadu

Study Period	TP	SC	AEC	TFPG
Entire Study Period (1981–82 to 2010–11)	2.88	0.09	1.30	4.27
Pre-reform Period (1981–82 to 1990–91)	2.08	-0.13	0.75	2.70
Post-reform Period (1991–92 to 2010–11)	3.29	0.20	1.57	5.06
Post-reform Period: Decade 1 (1991–92 to 2000–01)	2.93	0.33	2.13	5.39
Post-reform Period: Decade 2 (2001–02 to 2010–11)	3.65	0.07	1.00	4.72

TTable 3n: Average Annual Rates of TP, SC, AEC and TFPG of the Manufacture of Transport Equipments (37) in Uttar Pradesh

Study Period	TP	SC	AEC	TFPG
Entire Study Period (1981–82 to 2010–11)	3.48	0.27	-1.34	2.41
Pre-reform Period (1981–82 to 1990–91)	3.16	-0.06	3.41	6.51
Post-reform Period (1991–92 to 2010–11)	3.65	0.43	-3.71	0.37
Post-reform Period: Decade 1 (1991–92 to 2000–01)	3.67	0.07	-7.70	-3.96
Post-reform Period: Decade 2 (2001–02 to 2010–11)	3.62	0.79	0.29	4.70

Table 3o: Average Annual Rates of TP, SC, AEC and TFPG of the Manufacture of Transport Equipments (37) in West Bengal

Study Period	TP	SC	AEC	TFPG
Entire Study Period(1981–82 to 2010–11)	1.62	0.10	0.18	1.90
Pre-reform Period (1981–82 to 1990–91)	0.94	0.42	0.66	2.02
Post-reform Period (1991–92 to 2010–11)	1.97	-0.06	-0.07	1.84
Post-reform Period: Decade 1 (1991–92 to 2000–01)	1.45	-0.07	-1.68	-0.30
Post-reform Period: Decade 2 (2001–02 to 2010–11)	2.48	-0.04	1.54	3.98

Table 3p: Average Annual Rates of TP, SC, AEC and TFPG of the Manufacture of Transport Equipments (37) in India

Study Period	TP	SC	AEC	TFPG
Entire Study Period (1981–82 to 2010–11)	1.92	-1.16	5.19	5.95
Pre-reform Period (1981–82 to 1990–91)	1.36	-1.05	7.55	7.86
Post-reform Period (1991–92 to 2010–11)	2.21	-1.22	4.00	4.99
Post-reform Period: Decade 1 (1991–92 to 2000–01)	1.99	-1.12	6.19	7.06
Post-reform Period: Decade 2 (2001–02 to 2010–11)	2.42	-1.32	1.82	2.92

Source: Author's own calculation

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"Productivity is the deliberate, strategic investment of your time, talent, intelligence, energy, resources, and opportunities in a manner calculated to move you measurably closer to meaningful goals".

– Dan S Kennedy

Feature

Balancing Employee Skill with Technology Adoption in Indian Context

MOHIT KUMAR KOLAY

A snapshot study has been done in this paper to examine the compatibility between employee skill and technology adopted by 100 organisations in India, taking top 10 from each of the 10 sectors. Technology level is assessed by the conventional measure of net block and employee related cost is considered as the surrogate measure of employee skill. Organisational performance is analysed for the full sample and sector-wise, taking two sets of input parameters, i) net block versus employee related cost, and ii) tech-intensity versus employee skill-intensity. Correlation analysis is done to examine organisational performance for the full sample and sector-wise data. It is found that the employee related cost is below 8 per cent of net block, and employee skill-intensity is just 4 per cent compared to overall tech-intensity of 52 per cent. Correlation gives significant results for the full sample, and six out of 10 sector data. The study indicates that there is much more scope to upgrade employee skill to match with the level of technology adoption to improve their performances.

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Introduction

With rapid developments in technology (such as artificial intelligence, 3D printing, nanobots, genetics, biotechnology, and other robotics areas), the world is on the verge of the "Fourth Industrial Revolution," as predicted by the World Economic Forum, 2019. But as research reports go, automation will throw out millions of people from their jobs (Wisskirchen, 2018; World Economic Forum, 2019). According to World Bank data, the percentage of jobs that will be replaced by automation is 69 per cent in India, while it is 77 per cent in China and 85 per cent in Ethiopia. The market for software technologies is growing 20 per cent per year and is likely to reach US$ 5 billion by 2024 (Market Watch, Oct. 5, 2018). Such an accelerated adoption of automation is creating intense demand for technical skills that do not widely exist in today's workforce. Many observers argued that during the 1980s, in spite of the massive investment boom in IT capital for the past 15 years, the US companies poured billions of dollars in IT, but they were not getting their money's worth. Questions were also raised on the unimpressive productivity growth from the impressive investment done by newly industrialising countries in East Asia (Eggleston, 1997). The answers to such questions must be lying on the effectiveness of companies' human resource, at what rate the employees are learning and digesting the technology and realising their full potentials over time. Today, in the midst of rapid technological advances, we are faced with the relentless acceleration of artificial intelligence, cognitive technologies, and automation, but the paradox of today is that, while we live in a world of amazing technology, it is the human potential as the only self-perpetuating and ever-evolving productivity factor that enables us to assimilate technology. In fact, 85 per cent of employees around the world are not engaged or are

actively disengaged from their jobs. More than 40 per cent of the workforce in the US now works on a contingent basis and more than two-thirds of millennial and Generation Z workers work side hustles to help make ends meet (Pofeldt, 2015). People are working more hours, and problems of financial and mental stress seem to be at a peak. Some experts attribute the high suicide rate among young men in Japan to an increase in precariously designed short-term employment contracts (Wingfield-Hayes, 2015). Deloitte Survey, 2018, reports that millennials are unprepared for the implementation of Industry 4.0. Employees would have an easier time finding a new job with a new employer than within their current organisation (Deloitte survey, 2019). In fact, more than 25 per cent of the US labour force changes jobs each year (Mutikani, 2018). Research now shows that the number one reason people quit their jobs is the inability to learn and grow (Bersin, 2018). Employers really need to focus on cultivating relationships with workers, and understand each individual's needs and aspirations, not just giving them rewards. This shift from rewards to relationships is critical to creating and embedding a workforce experience that alone will place organisations in an enviable position towards attracting and retaining the high-talent workers of tomorrow. When parts of jobs are automated by machines, the work that remains for employees is generally more interpretive and service-oriented, involving problem-solving, data interpretation, customer service, teamwork and collaboration. Now, new jobs for the employees are evolving to require new combinations of human skills and capabilities. This creates the need for organisations to redesign jobs along with their businesses and work processes to keep pace with technological developments. But many employers believe that large numbers of our college graduates are missing skills in complex thinking, collaboration, teamwork, and communication. The National Employability Report of India for Engineers 2019 says that the employability of Indian engineers continues to be very low with over 80 per cent of them unemployable for any job in the knowledge economy. In the midst of tens of thousands of management graduates churned out by the 5500 business schools in India, only 7 per cent turn out to be employable, ASSOCHAM, 2016 reports. In fact, we need much greater collaboration between academia and business to close the skills gap (Workday-Bloomberg, 2018). As automation becomes more prevalent in the workplace, technology has not only invaded the workplace, but is transforming individuals' identities at work. We need to enable human work to be reengineered in terms of problem-solving and the ability to create new knowledge, making humans as unique and different from the robots (Evans-Greenwood, et al., 2017). There is the need to constantly rejuvenate organisations for enduring strategic advantage mandates an out-and-out adoption of the learn-unlearn-relearn model. What is important in this context is the organisational culture symbolized by flexibility, agility, steadfastness and tactfulness (Tabassum, 2008). Despite a pervasive corporate focus on digital transformation, majority of corporate leaders believe that they need to rethink their workforce experience to improve productivity. As per Deloitte survey, 2019, only 6 per cent of respondents said that their organisations were very ready, suggesting that organisations are now beginning to understand the scale and the massive implications for job design, reskilling, and work reinvention involved in integrating people and automation more extensively across the workforce. With rapid technological changes, as IT teams have moved from sequential design-develop-test-operate models to new agile team-based connected process, we need new approaches to integrate learning and work, as the two constantly connected sides of each and every job. In a world where technology is changing jobs along with the accelerating rate of skills obsolescence and again when people are living longer lives (Deloitte Insights, 2018) with more diverse careers, organisations have not only an opportunity, but a responsibility to reinvent learning and reskilling through new approaches creating diverse portfolios of learning and work experiences to support people during their working lives, instead of making them obsolete still faster. The challenge may be nothing less than to integrate ongoing learning into the flow of life.

Today, the use of mobiles, internet, laptops, and computers have become a part and parcel of our daily life with which we were averse when it started. In fact, the present COVID-19 era has made a real boost to the Digital India programme; and people are gradually switching over from cash to cash-less digital economy. Likewise, automation and robotics applications are on their way to improve productivity of the organisational human resource across all sectors of our economy. Today when all the economies in the world are dominated by the contribution of knowledge workers with hardly 20.4 per cent of organisational assets being tangible **(as on July 15, 2019, Global Intangible Finance Tracker),** it all depends on organisations, how they facilitate their employees to learn and continue to work with the new

technology to meet the challenges of future work instead of making them jobless. Naturally, questions arise, are we spending enough to keep our people up-to-date in tune with technological advances for their need-based learning and development, utilisation, and retention Are we nurturing the relationships with them so that using the technology base, they continue to add value and enable the organisations to reach the top, or on the contrary, are we overfocussed on automation and technological investments as screwdriver technology, trying to maximise short-term financial targets (Bersin, 2018) at the cost of liquidating the organisational human resource?

The present paper attempts to examine how far the skill level of employees matches with the technology adoption to influence organisational performance of top-ranked companies in India.

The present study

The level of investments in technology and its growth will depend on the specific sector of production or service, and then within a specific sector, it will again depend on the scale of target operation and how it is likely to balance automation with manual from cost-value calculus point of view specific, to the target level of operation. But once the level of technology has been decided and acquired, the most important issue centres on the actual skill level available on jobs from its employees, whether it is in tune with the requirement of the technology adopted or not. It depends on the skill-set of existing employees and that of the new recruits, to what extent opportunities are being provided to enable employees learn on-the-job through training and development, to what extent right jobs have been assigned to the right employees through job allocation, job rotation, and job enrichment to facilitate on-the-job learning and employee development, to what extent care, rewards, and relationships are being built with employees to continue to harness their best potentials on-the-job. The basic question arises that to what extent the employee skills are upgraded and cared for, in tune with the level of technology adoption or on the contrary, to what extent they are made obsolete and jobless overtime. This raises the question in our mind on how we can assess the level of available skill set as the outcome of all these employee related strategies for their recruitment, learning, development, utilisation and retention towards balancing with the level of technology adoption in pursuit of sustained organisational productivity improvement.

Investment in technology is recorded and published in the annual accounts, but the extent of care for employees and investments made in them by way of training and development are treated as revenue expenditure in the income statement along with the periodic cost of their services. Here, we can fall back on the economic theory of wages in the free-market economy. Employees today are freely changing their jobs for still higher salary and growth, and bargain for their best possible worth from new employers. When job change has become the order of the day for employees in pursuit of still better growth and development, and when employers too are leaving no stone unturned to attract the best possible talents from the market, can we not use the actual employee related cost as their value in equilibrium, and can be considered as the surrogate measure of the overall skill set available from its employees (Kolay & Sahu, 1995; Lev & Schwartz, 1971). Based on this rationale, the present paper compares the level of technology deployed by an organisation with the corresponding employee related cost to assess the extent of their compatibility. The level of technology deployed is measured here by the net block in the plant and infrastructures as available in the published annual accounts. The employee related cost, hereafter termed as the HR cost, is also directly available in the published annual accounts. The net block as percent of net sales will reflect the tech-intensity, whereas the HR cost as percent of sales will reflect employee skill-intensity. The compatibility between the two input parameters, the level of technology deployed and the employee available skill set will be reflected by, i) net block versus HR cost, and ii) tech-intensity versus employee skill-intensity.

The extent of compatibility between the two input parameters, the technology and the employee skill set, will result in organisational performance which has been reflected here by four parameters, viz., net sales, net profit, net worth, and the market capitalisation. Such a proposed measurement framework of organisational performance as the result of balancing technology with the employee skill set is presented in Figure 1.

An attempt will be made here to assess the extent of compatibility between the two input parameters, the level of technology deployed and the HR cost, and its corresponding impact on the organisational output performance parameters through correlation matrix between the input and the output parameters.

Here, a 100 listed companies have been chosen, the top 10 (based on the market capitalisation) from each

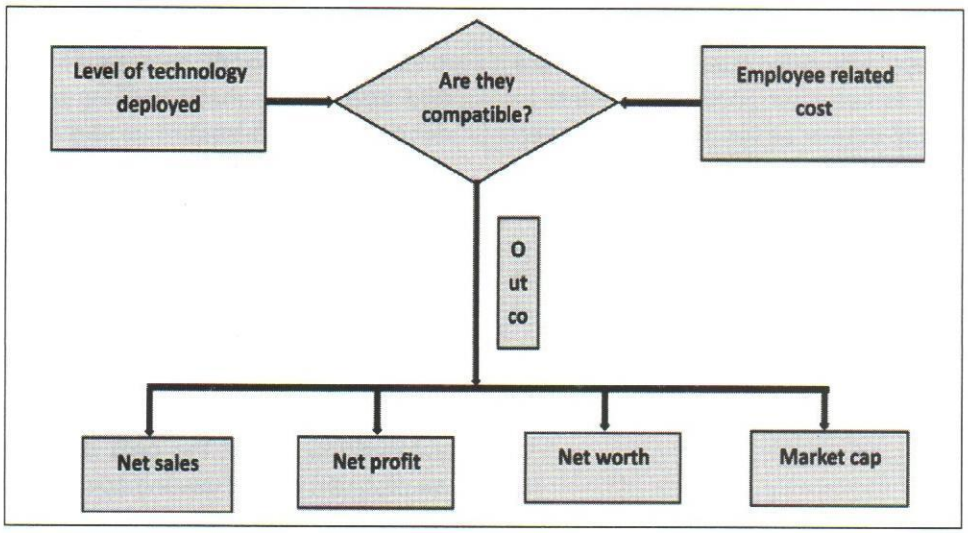


Figure 1: Balancing technology with employee related cost for organizational performance

of the 10 chosen sectors based on the latest figures available (2019 annual accounts) from the Bombay Stock Exchange-BSE (Money Control Report). All 10 sectors have been chosen from the production group of companies, leaving aside the service sector. The knowledge-based IT and internet companies, no doubt, top the list of market value-rich giants, but in these cases, intangible assets dominate, and they report even less than 10 per cent of intangible value. In the midst of such unreported facts and figures of intangible assets, the companies in the service sector have been kept outside the scope of the present study. The list of 10 selected production sectors are shown in Table 1.

Table 1: Selected production sectors

Code	Sectors
1. AU	Automobiles
2. BR	Breweries and Distilleries
3. EN	Engineering – Industrial Equipment
4. FZ	Fertilizers
5. HP	Household and Personal Products
6. IS	Iron and Steel
7. PH	Pharmaceuticals and Drugs
8. PW	Power Generation and Distribution
9. RP	Refineries and Petrochemicals
10. TX	Textiles and Apparels

Analysis of results

Sector-wise analysis

Analysis of sector-wise overall performance data (as presented in Table 2A) reflects that the investment in technology is dominated by the RP sector constituting 44 per cent of total technology deployed by all the 10 sectors. In fact the three sectors, RP, PW, and IS account for 88 per cent of total technology deployed. The HR cost of all 10 sectors together has been just 8 per cent of net block. Here too the RP sector dominates, and constitutes 25 per cent of total HR cost of all 10 sectors together. The tech-intensity varies very widely from as high as 214 per cent for the PW sector to a low of 14 per cent for the EN sector, with an overall average of 52 per cent for all 10 sectors together. The employee skill-intensity varies from 17 for the EN sector to just 2 per cent for the RP sector, with an overall average of 4 per cent.

Based on the above level of two facets of technology and HR combination, the performance of different sectors is presented in Tables 2A and 2B. Table 2A shows that the RP sector dominates in each component of organisational performance with percent share of sales as 61, and the consequent profit as 36, net worth as 41 and market cap as 39.

As presented in Table 2B, the profitability on sales varies sector-wise from 17 to 4 per cent with an overall profitability of 7 per cent of all 10 sectors together. The return on equity varies from 47 to 8 per cent with an average return on equity of 12 per cent for all 10 sectors together. As expected, the market to book ratio has been the highest

Table 2A: Sector-wise overall performance of top 10 companies (total in ₹ Crores)

Sector	Net block	HR cost	Net sales	Net profit	Net worth	Market cap
1. AU	60369	14549	249169	17219	170585	160135
2. BR	5414	1302	20838	1603	9144	76058
3. EN	8369	10228	61039	4454	52811	61721
4. FZ	26405	3274	73472	10968	38436	43013
5. HP	12774	3910	70962	12237	26314	784510
6. IS	231856	17493	266325	25923	206167	131395
7. PH	36530	12208	83730	12411	127593	493307
8. PW	376785	13767	175882	29950	262818	264576
9. RP	614180	26652	1604356	67260	639729	1319021
10. TX	13999	3900	38410	3883	19518	52234
Total	1386681	107283	2644183	185908	1553115	3385970

(*Source*: moneycontrol.com/stocks/marketinfo/marketcap/bse/index.html)

Table 2B: Sector-wise performance of top 10 companies

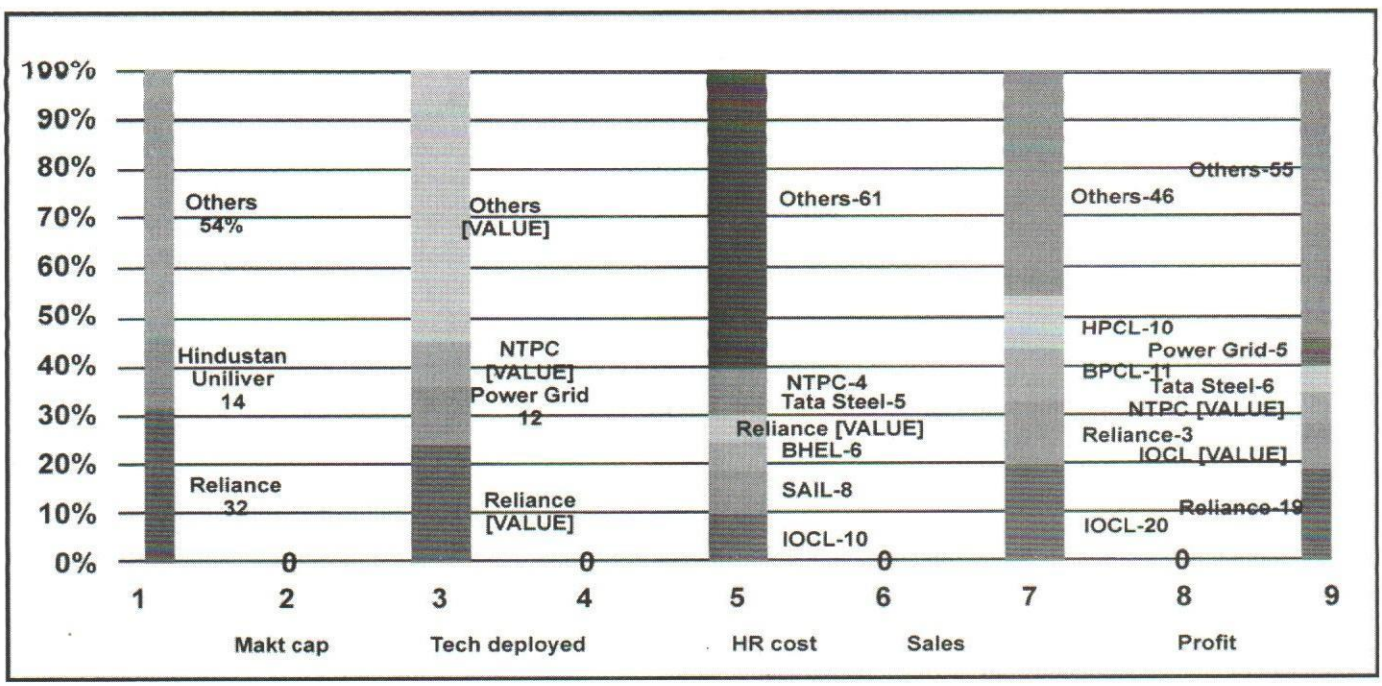
Sector (NP/Sales)	Profitability (NB/Sales)	Tech-intensity (HR cost / sales)	Skill-intensity ROE (NP/NW)	ROE (NP/NW)	Market cap/ Book ratio
1. AU	6.91	24.23	5.84	10.09	0.94
2. BR	7.69	25.98	6.25	17.53	8.32
3. EN	7.30	13.71	16.76	8.43	1.17
4. FZ	14.93	35.94	4.46	28.54	1.12
5. HP	17.24	18.00	5.51	46.50	29.81
6. IS	9.73	87.06	6.57	12.57	0.64
7. PH	14.82	43.63	14.58	9.73	3.87
8. PW	17.03	214.23	7.83	11.40	1.01
9. RP	4.19	38.28	1.66	10.51	2.06
10. TX	10.11	36.45	10.15	19.89	2.68
Overall	7.03	52.44	4.06	11.97	2.18

(Source: moneycontrol.com/stocks/marketinfo/marketcap/bse/index.html)

at 29.8 for the HP sector, the lowest at 0.6 for the IS sector with an average being 2.2 for all 10 sectors together.

Performance of dominating companies

The analysis of all 100 companies from 10 production sectors clearly establishes the domination by only a few renowned companies in certain sectors on both the input factors of technology and the HR, and the output side of selected performance parameters as reflected in Figure 2. It shows that only two companies, one in the RP sector (Reliance Industries Ltd.) and the other from the HP sector (Hindustan Unilever Ltd.) constitute 46 per cent of the total market capitalisation of all 100 companies under study. On the technology deployment area, three companies, the same one from the RP sector (Reliance Industries Ltd.) and two from the PW sector (Power Grid Corporation of India Ltd. and National Thermal Power Corporation Ltd) dominate with 45 per cent of total investments in net block. Even on the HR's cost front, only six companies, two in the RP sector (Indian Oil Corporation Ltd. and Reliance Industries Ltd.), two from the IS sector (Steel Authority of India Ltd. and Tata Steel Ltd.), one from the EN sector (Bharat Heavy Electricals Ltd.), and one from the PW sector (National Thermal Power Corporation Ltd.) account for 39 per cent of total HR cost. The same domination persists on organisational performance side too. The sales figure is dominated by four companies, all from the RP sector with 54 per cent share of total sales of all the 100 companies. On resultant profits earned, only five companies, two in the RP sector, two in the PW sector, and one from the IS sector account for 45 per cent of total net profit earned by all 100 companies, as shown in Figure 2.



(*Source:* moneycontrol.com/stocks/marketinfo/marketcap/bse/index.html)

Figure 2: Percent holding of input and output parmeters

Compatibility of technological intensity with employee skill-intensity

The level of technological intensity of the top 10 and the bottom 10 amongst the chosen 100 companies is presented in Table 3. This shows that the technological intensity varies from as high as 480 per cent for Power Grid Corporation of India Ltd in the PW sector to as low as 3 per cent for Abbott India Ltd in the PH sector, with an average of 52 per cent for all 100 companies. As expected, the PW sector dominates, eight out of top 10 are from the PW sector. However, the bottom 10 are more or less evenly distributed.

The level of employee skill-intensity of the top and the bottom 10 is presented in Table 4. It shows that the employee skill-intensity varies from a maximum of 50 per cent for HMT Ltd. in the AU sector to a minimum of 0.7 per cent for Mangalore Refinery Ltd. in the RP sector,

Table 3: Technological intensity-Top and bottom 10 companies

Companies ranked in terms of technological intensity (Net block/ net sales percent)			
Top 10		Bottom 10	
Company	Percent	Company	Percent
PW-Power Grid Corpn. India Ltd.	480.26	PH-Abbott India Ltd.	2.85
PW-NHPC Ltd.	292.27	BR-Ravi Kumar Distilleries Ltd.	4.61
PW-SIVN Ltd.	289.34	HP-Bajaj Consumer Care Ltd.	5.28
PW-CESC Ltd.	190.04	HP-Procter & Gamble Ltd.	7.94
BR-Jagatjit Industries Ltd.	178.13	FZ-Southern Petrochemicals Ltd.	8.79
PW-NLC India Ltd.	163.50	EN-Bharat Heavy Electricals Ltd.	9.78
PH-Torrent Pharma Ltd.	160.06	TX-Page Industries Ltd.	10.55
PW-Torrent Power Ltd.	139.10	IS-KIOCL	10.55
PW-Tata Power Co. Ltd.	128.86	TX-Bombay Dyeing Ltd.	11.92
PW-JSW Energy Ltd.	120.30	EN-Kirloskar Oil Engines Ltd.	12.45

(*Source:* moneycontrol.com/stocks/marketinfo/marketcap/bse/index.html)

Table 4: Employee skill-intensity-Top and bottom 10 companies

Companies ranked in terms of employee skill-intensity (HR cost/ net sales percent)			
Top 10		Bottom 10	
Company	Percent	Company	Percent
AU-HMT Ltd.	50.00	RP- Mangalore Refinery Ltd.	0.69
PW-NLC India Ltd.	41.48	RP- Hindustan Petroleum Corpn. Ltd.	1.07
BR-Jagatjit Industries Ltd.	30.80	RP- Chennai Petroleum Ltd.	1.24
TX- RITES Ltd.	24.58	FZ- Chambal Fertilizer & Chem. Ltd.	1.28
EN- Bharat Earth Movers Ltd.	23.04	RP- Bharat Petroleum Corpn. Ltd.	1.30
PW- NHPC Ltd.	20.89	IS- Apollo Tubes Ltd.	1.35
EN- Bharat Heavy Electricals Ltd.	20.63	RP- Reliance Industries Ltd.	1.81
EN- Forbes Gokak Ltd.	19.82	IS- JSW Steel Ltd.	1.82
PH- Dr. Reddy's Labs Ltd.	18.18	FZ- Deepak Fertilizers & Petro. Ltd.	1.91
PH- Torrent Pharma Ltd.	17.60	RP- Indian Oil Corporation Ltd.	2.10

(*Source:* moneycontrol.com/stocks/marketinfo/marketcap/bse/index.html)

Table 5: Profitability-Top and bottom 10 companies

Companies ranked in terms of profitability (Net profit/ net sales percent)			
Top 10		Bottom 10	
Company	Percent	Company	Percent
FZ-Tata Chemicals Ltd.	234.25	BR-Jagatjit Industries Ltd.	-29.46
AU-HMT Ltd.	85.00	IS-Jindal Steel & Power Ltd.	-0.95
PW-Indian Energy Exchange Ltd.	69.26	RP-Chennai Petroleum Ltd.	-0.52
PW-SIVN Ltd.	51.36	FZ-Deepak Fertilizer & Petro. Ltd.	0.25
IS-NMDC Ltd.	37.37	RP-Mangalore Refinery & Petro. Ltd	0.53
PW-NHPC Ltd.	32.24	RP-Bharat Petroleum Corpn. Ltd.	0.94
PW-Power Grid Corpn. India Ltd.	29.13	FZ-Mangalore Chemicals & Fert Ltd	1.07
TX-Bombay Dyeing & Manu. Ltd.	27.77	AU-SML ISUZU Ltd.	1.42
PH-Divis Labs Ltd.	27.32	BR-Piccadilly Agro Industries Ltd.	1.62
HP-Bajaj Consumer Care Ltd.	24.86	EN-Bharat Earth Movers Ltd.	1.84

(*Source:* moneycontrol.com/stocks/marketinfo/marketcap/bse/index.html)

with an average of 4 per cent for all 100 companies together. It is evident that the overall employee skill-intensity is just 8 per cent of tech-intensity (4% compared to 52%).

Performance analysis of all 100 companies

The profitability performance of the top and bottom 10 companies shows a very wide variation as reflected in Table 5. The profitability of top 10 companies varies as high as 234 per cent for Tata Chemicals in the FZ sector to a reasonable figure of 25 per cent for Bajaj Consumer Care in the HP sector. Amongst the bottom 10, three companies (each from a different sector) are in the red. Here too there is a wide variation; as low as minus 29 per cent for Jagatjit Industries in the BR sector to a very nominal of plus 1 per cent for Mangalore Refinery in the RP sector. Here, all the 100 companies belong to the top 10 of each of 10 sectors, but still the profitability level varies between the two extremes from a plus 234 per cent to a minus 29 per cent with an average profitability of just 7 per cent.

The return on equity of the chosen 100 companies also shows a very wide variation as seen in Table 6. The return on equity of top 10 in the list varies as high as 665 per cent for Bombay Dyeing in TX sector to a figure of 33 per cent for Gillette India in the HP sector. Amongst the bottom 10 in the list, it varies from a negative of 72 per cent to a quite low figure of just 3 per cent for Tata Motors in the AU sector. On the whole, the return on equity varies between the two extremes from 665 per cent to a minus of 72 per cent with an average return on equity of just 12 per cent.

The market to book ratio also shows a very wide variation from as high as 64 for Hindustan Unilever in the HP sector to as low as 0.10 for HMT in the AU sector (shown in Table 7) with an average of 2.2 for all 100 companies together. As expected, the HP sector with six out of 10 companies dominates the list of top 10, but even amongst them, the market to book ratio of Godrej Consumer is 80 per cent lower compared to Hindustan Unilever who is heading the list of the top 10. Amongst the bottom 10 also, there is a very wide variation with the market to book ratio of the lowest rank holder HMT (0.10) being 76 per cent lower than Maharashtra Seamless (0.41) at the end of the list. The bottom 10 is dominated by two sectors, the AU and the IS comprising six out of 10 companies.

The above analysis clearly demonstrates that the three capital intensive sectors—RP, PW, and IS—indeed represent

Table 6: Return on equity-Top and bottom 10 companies

Companies ranked in terms of return on equity (Net profit/net worth percent)			
Top 10		**Bottom 10**	
Company	**Percent**	**Company**	**Percent**
TX-Bombay Dyeing & Manu. Ltd.	664.86	BR-Jagatjit Industries Ltd.	-71.75
HP-Hindustan Unilever Ltd.	88.26	RP-Chennai Petroleum Ltd.	-5.52
FZ-Tata Chemicals Ltd.	57.99	IS-Jindal Steel & Power Ltd.	-0.81
HP-Colgate Palmolive India Ltd.	56.39	FZ-Deepak Fertilizer & Petro. Ltd.	0.50
TX-Page Industries Ltd.	50.84	PW-Tata Power Company Ltd.	1.04
PW-Indian Energy Exchange Ltd.	48.11	PH-Sun Pharma Industries Ltd.	1.97
HP-Bajaj Consumer Care Ltd.	46.60	IS-Jai Corporation Ltd.	2.13
HP-Procter & Gamble Hyg. Ltd.	46.10	EN-Bharat Earth Movers Ltd.	2.93
FZ-Chambal Fertilizers Ltd.	37.80	RP-Mangalore Refinery & Petro Ltd.	3.09
HP-Gillette India Ltd.	32.50	AU-Tata Motors Ltd.	3.36

(*Source:* moneycontrol.com/stocks/marketinfo/marketcap/bse/index.html)

*significant at 5% level; ** significant at 1% level

Table 7: Market to book ratio-Top and bottom 10 companies

Companies ranked in terms of market to book ratio (market cap/ net worth)			
Top 10		**Bottom 10**	
Company	**Percent**	**Company**	**Percent**
HP-Hindustan Unilever Ltd.	64.24	AU-HMT Ltd.	0.10
HP-Procter & Gamble Hyg. Ltd.	35.91	AU-Maruti Suzuki Ltd.	0.12
TX-Page Industries.	28.38	FZ-Gujrat State Fertilizers Ltd.	0.27
HP-Colgate Palmolive India Ltd.	25.56	RP-Chennai Petroleum Ltd.	0.28
HP-Dabur India Ltd.	20.99	IS-Jindal Steel & Power Ltd.	0.30
HP-Gillette India Ltd.	20.88	EN-Bharat Heavy Electricals Ltd.	0.31
PH-Abbott India Ltd.	17.47	IS-Steel Authority of India Ltd.	0.32
BR-United Spirits Ltd.	13.78	BR-Ravi Kumar Distilleries Ltd.	0.32
PW-Indian Energy Exchange Ltd.	13.73	AU-Escorts Ltd.	0.32
HP-Godrej Consumer Products Ltd.	13.48	IS-Maharashtra Seamless Ltd.	0.41

(*Source:* moneycontrol.com/stocks/marketinfo/marketcap/bse/index.html)

Table 8: Correlation results amongst the input and output parameters

	HR cost	Net sales	Net profit	Market cap
For 100 companies				
Net block	0.609**	0.687**	0.919**	0.760**
HR cost		0.752**	0.640**	0.351**
1. Au-Automobiles				
Net block	0.968**	0.962**	0.698*	0.367
HR cost		0.978**	0.780**	0.493
2. BR-Breweries and Distilleries				
Net block	0.952**	0.922**	0.914**	0.877**
HR cost		0.986**	0.976**	0.968**
3. EN- Engineering- Industrial Equipment				
Net block	0.918**	0.951**	0.868**	0.668*
HR cost		0.993**	0.643*	0.348
4. FZ-Fertilizers				
Net block	0.364	0.653*	0.159	0.140
HR cost		0.616	-0.061	0.188
5. HP-Household and Personal Products				
Net block	0.967**	0.958**	0.959**	0.952**
HR cost		0.983**	0.985**	0.983**
6. IS-Iron and Steel				
Net block	0.771**	0.941**	0.665*	0.656*
HR cost		0.742*	0.429	0.336
7. PH-Pharmaceuticals and Drugs				
Net block	0.580	0.463	0.154	0.415
HR cost		0.906**	0.553	0.337
8. PW-Power Generation and Distribution				
Net block	0.616	0.782**	0.962**	0.973**
HR cost		0.829**	0.752*	0.699**
9. RP-Refineries and Petrochemicals				
Net block	0.646*	0.649*	0.978**	0.960**
HR cost		0.961**	0.715*	0.411
10. TX-Textiles and Apparels				
Net block	0.612	0.735*	-0.047	-0.261
HR cost		0.311	-0.318	0.277

(*Source:* moneycontrol.com/stocks/marketinfo/marketcap/bse/index.html)
*significant at 5% level; ** significant at 1% level

very high investments in technology. As expected, PW and IS also dominate in tech-intensity; however, PH sector comes up at the third position and pushes the RP sector to the fourth. On HR total cost front, the same three sectors—RP, IS and PW—dominate. As compared to overall tech-intensity of 52 per cent, the overall employee skill-intensity has been much lower at 4 per cent. Here, three other sectors dominate—EN, PH, and TX. Again, on the output front, the HP sector tops the list in all three performance indicators, viz., the profitability, the return on equity and the market to book ratio, where outside market factors may be more important rather than the level of technology deployed vis-à-vis the employee skill. In fact, the profitability of the RP sector has been the lowest even though the level of technology deployed has been the highest. The return on equity of the EN sector is the lowest, though it dominates the employee skill-intensity. Likewise, the PW sector dominates both in the level of technology deployed and the HR cost, but its market to book ratio has been the second lowest, thus raising questions on compatibility between the two facets—the technology deployed and the employee skill—towards organisational performance.

Correlation analysis between input and output parameters

As questions arise on compatibility between the level of technology deployed and the available employee skill, correlation analysis has been done to examine it further and the resultant impact of the same on the organisational performance. The correlation matrix has been worked out amongst the two input and three output parameters using data for all the 100 companies together, as well as amongst 10 companies in each of the 10 sectors, and the results are presented in Table 8.

The correlation matrix for the two input and three output parameters for the full sample of 100 companies show significant results at 1 per cent level. However, the correlation coefficient between the technology deployed (in terms of net block) and the employee skill level (in terms of HR cost) is just moderate (0.61). Regarding the influence on the output parameters, only the correlation between technology and net profit is strong with a correlation coefficient of 0.92.

Within sector-wise data, the correlations between the technology deployed and the employee skill are significant for six out of 10 sectors (1% level for five and 5% level for one). The correlation results between the two input and three output parameters are significant only for 65 per cent combinations (47 per cent at 1% level and 18 per cent at 5% level). The relationship between the technology deployed and the employee skill is strong (correlation coefficient>0.9) only for four out of 10 sectors. The impact on output parameters is strong (measured by coefficient>0.9) in 37 per cent combinations (22 out of 60).

The above correlation results clearly demonstrate that there is much scope to enhance the employee skill set to match the level of tech advances to influence organisational performance in terms of the three output parameters.

Conclusions

The snapshot study conducted here with 100 companies, the top 10 from each of the 10 production sectors clearly establishes that they need to give much more attention to learning and development of their employees to match with the growing needs of technological developments in the organisation. However, the results need to be reaffirmed with data over a number of years. Instead of making the existing employees redundant, organisations need to move towards becoming learning centres at workplace, allowing the employees to innovate still newer ways to harness the best out of the technological advances. Instead of expensing employees against their services, organisations need to feel much more for their employees and create more and more HR as assets to balance with the growing needs of technological advances. Appreciating the nature of organisational HR is indeed essential to balance with the growing needs of technological advances and that will only enable the companies to excel and continue to remain at the top. Much more research is needed in this area to monitor the appreciating or depreciating nature of organisational HR in tune with technological advances, and to take appropriate strategic moves to manage the HR as an asset for sustained profitability and growth of our organisations.

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"Education is not only a ladder of opportunity, but it is also an investment in our future."

–Ed Markey

Feature

Investigating Determinants of Declining Participation of Women in Uttar Pradesh Rural: An Inter-District Analysis

NOMITA P. KUMAR AND KAVITA BALIYAN

The paper presents trends in growth of workforce and changes in its structure using census data from the last several decades in Uttar Pradesh. It is an attempt to highlight the relative performance in the present decade as compared to the 1980s and 1990s, for which we have comparable data. Precisely, the objectives are to examine trends, patterns and factors propelling / discouraging women to participate in workforce in rural Uttar Pradesh and is understood with the help of social and religious factors, land rights, agricultural income and education. The study highlights that women employment in rural Uttar Pradesh has been continuously declining, possibly, for the following reasons: firstly, women participation in the labour market is driven due to distress conditions; secondly, they find working conditions either unsafe or unsuitable due to increase in crimes against women in recent times; and thirdly, social norms restrict their entry into the job market (Bhattacharya and Goyal, 2017). Studies suggest that by improving their access to land and productive resources, providing them decent work opportunities and prioritising their education and skills training will collectively lead to the improvement of women's socioeconomic status (Bhattacharya and Goyal, 2017) along with empowering them.

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1. Introduction

Academicians noted that the proportion of women in total population who either have a job or are actively seeking for one – has been steadily falling since the 43rd round of the National Sample Survey, only to register an increase during the period 1999–2000 to 2004–05, before falling again in 2011–12. The female labour force participation rate (FLFPR) in India fell in 2011–12 from 31.2 per cent to yet again a spectacular plunge of 23.3 per cent in 2017–18 (EPW, 2019). Further it is documented that rural FLFPR declined by more than 11 per centage points in 2017–18. Abraham (2009) and Himanshu (2011) argued that a greater proportion of women took to employment on their own farms to make up for the losses in household incomes in agriculture due to agrarian crisis after the economic reforms. Some of these results have been counter-intuitive and have garnered much controversy around the issue of women employment. Although there has been a decline in the labour force participation rates for rural men, the rate of decline was much sharper for rural women. This is quite baffling in a nation with huge demographic dividend of working-age population. Scholars have analysed and probed this trend of low and declining female labour force participation and have attributed it to education and income effects (Rangarajan et al., 2011; Abraham, 2013).

In the present context, a plethora of studies have focused on the declining income growth in agriculture sector and the stagnation of employment with declining FLFPR. Due to agrarian distress, men move out of agriculture sector (distress migration) leaving behind women to manage fields either as helpers or managers – is it feminisation of agriculture or feminisation of distress? Itishree et al., (2017) have stated that though feminisation has been taking place due to the complexity of dwindling land holdings; depleting natural resources (soils and

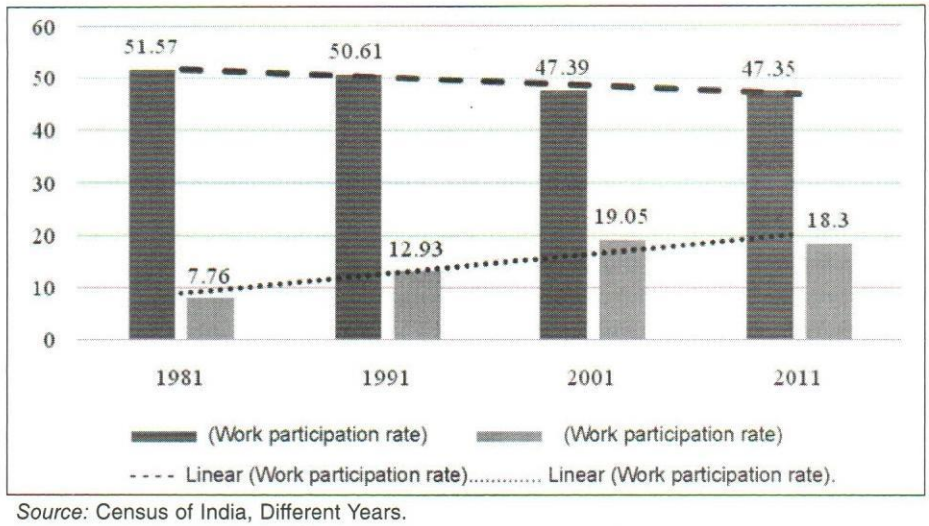
water); inaccessibility to agricultural inputs; distortion in market incentives for choice of crop and technology; alarming labour shortages and increasing mechanisation also contribute. The story differs in Uttar Pradesh as Census 2011 very pertinently exemplifies the waning female participation rates in rural economy. The paper looks at the trends in employment of women in Uttar Pradesh from 1971 to 2011 using data from different census rounds. Given the controversial results from NSSO's employment and unemployment surveys, we rely on the Census outcomes.

Census 2011 ropes in newer angle to the ongoing discourse on the precarious drop in the growth of employment and resulting into a better scenario when compared to NSSO's estimation of workforce. The rhetoric is about a fast slackening in the rate of growth of female workforce during 2001–2011. Amazingly, workforce participation rates have not plunged downward, if not increased, as the workforce growth rate is not less than the growth of population. On the other hand, incremental ratios of workforce, that too of males, is being reduced to mere marginal workers while the females who were concentrated as marginal workers has registered a slight decline too. Further, distribution of the workforce by occupation shows that workers in the category of cultivators are declining and this decrease in agriculture sector is compensated by increase in the category of agricultural labourers. Rates of growth of workforce is more in non-agricultural sector as compared with growth of workforce in the agriculture sector. In non-agricultural sector, the growth of female workers is higher when compared with the growth of male counterparts.

The present paper is an attempt to analyse the trends in workforce growth and changes therein in its structure in Uttar Pradesh preceding several decades of Census 2011. We have tried to put forth the transformation in workforce over the period using Census rounds as this is the only source which compiles district-wise information. Though NSSO provides much recent data, district-wise employment data is not provided and hence the paper relies on Census rounds. The paper highlights that rural female employment in Uttar Pradesh has been continuously experiencing precarious drop perhaps due to the following reasons: firstly, women are understood to opt to work under distress conditions; secondly, the recent scenario in the labour market turns out to be unsafe and hence unsuitable; and thirdly, social norms govern their entry into the job market (Bhattacharya and Goyal, 2017). Studies suggest that increasing access to land and productive resources, providing decent work opportunities, and prioritising education and skills training to the prospective workers will help women to improve their socioeconomic status (Bhattacharya and Goyal, 2017).

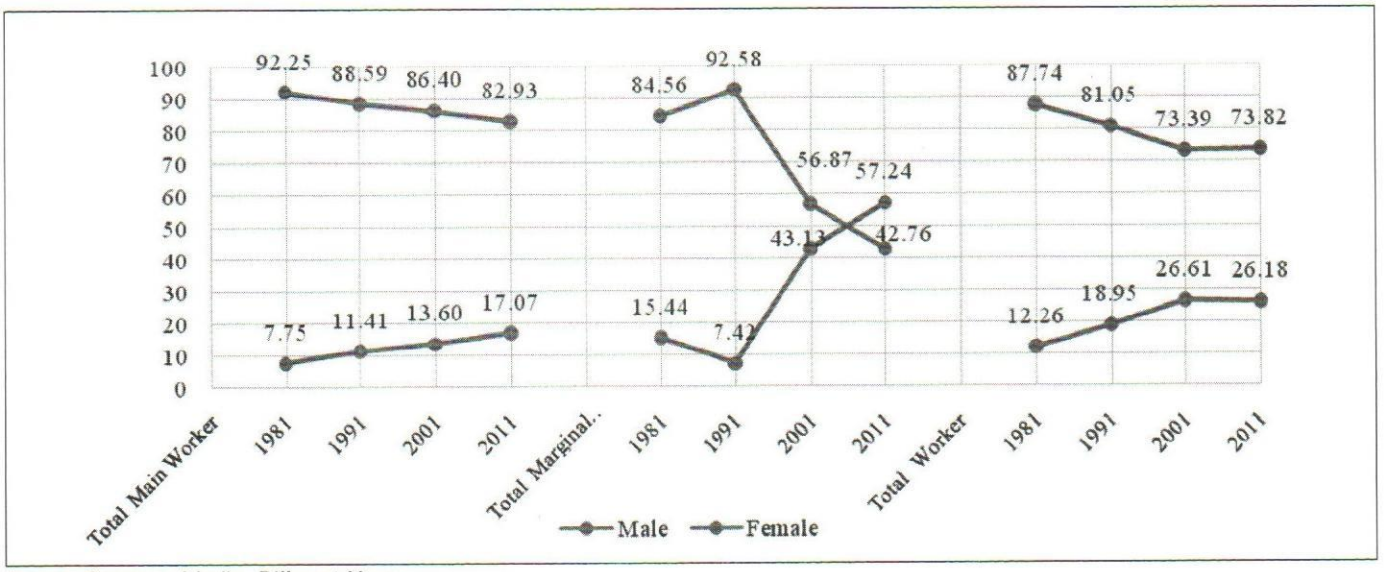
2. Female WPR in Rural Uttar Pradesh

The work participation rates (WPR) is defined as the share of working population to total population. In rural Uttar Pradesh, WPR is 32.94 per cent in 1991, with 33.93 per cent in 2001 and 33.45 per cent in 2011. The WPR for males stood at 50.61 per cent in 1991, 47.39 per cent in 2001 and 47.35 per cent in 2011 for rural areas of the states and WPR of females was 12.93 per cent in 1991, 19.05 per cent in 2001 and declined to 18.3 per cent in 2011 as can be seen in Figure 2. Because of definitional



Source: Census of India, Different Years.

Figure 1: Work Participation Rates in Rural Uttar Pradesh - 1981-2011



Source: Census of India, Different Years.

Figure 2: Gendered Share of Toral Rural Workforce in Uttar Pradesh

change controversy, we see that females WPR for the years 1971 and 1981 are a bit lower but it can be gauged from it that the female WPR has always remained lower than male WPR. Figure 1 highlights the share of males and females in the total rural workforce. The share of the female workers is lower i.e. 18.10 per cent, as compared with male workforce of 59.18 per cent in 1961 (Figure 1). The female WPR declined, for 2001 and 2011, from 19.05 per cent to 18.3 per cent.

Figure 2 charts gendered share of total workforce as main and marginal workers in rural Uttar Pradesh. The share of female marginal workers has registered a tremendous decline as compared to the increase of males in this category. Surprisingly, female marginal workers' (42.76%) share in total rural workers always remained high, except in 2011, when it went below the male marginal workers share (57.24%).

The recent Census data of 2011 puts forth an interesting picture that the overall rate of growth in main workforce is 3.39 per cent during 2001 and 2011 in rural areas, and it is worth mentioning that it is higher because of growth in the category of agricultural labourers though cultivators declined by -1.78 per cent. Further, the rate of growth of workforce in the present situation is lower as compared to the previous census rounds of 1980s and 1990s – where acute deceleration is found. Another striking feature is that both the rate of growth of the workforce along with rate of growth of population have decelerated between 2001 and 2011 Censuses. However, the rate of growth in workforce has always been higher than that of population growth which implies increase in work participation rates.

3. Sectoral Distribution & Growth of Female Workers in Rural Uttar Pradesh

The industrial classification of the workforce in rural sector shows that the share of male and female workers highlights that, in rural areas, the females are dominating the primary sector as compared to male workers in every census year. But surprisingly, it is found to be lesser than the share of male workers in primary sector in 2011—thus registering a decline compared to the past rounds of census.

Another angle to the discourse is that the male workers' share in the secondary and tertiary sectors is found to be higher than that of the females' share. The latest Census (2011) shows that 74.88 per cent of male workers and 67.15 per cent of female workers in rural areas are absorbed by the agricultural sector. Sectoral distribution shows that 10.07 per cent and 15.01 per cent of male workers were involved as workers in both the secondary and tertiary sectors, respectively. The proportions for female workers are 7.3 per cent and 25.55 per cent, respectively. The past several decades faced the advent of major transformation in economy as the workers in the primary sector (both males and females) have registered a declining trend, while on the other hand, the share of workers in secondary and tertiary sectors have shown upward trends. Such changes in the rural female workforce participation is noted by Desai (2018) especially in the secondary sector which can be attributed

Table 1: Percentage Distribution of Total Workers by Sector of Work in Rural Areas of Uttar Pradesh

	Rural Females			Rural Males		
Census Years	Primary Sector	Secondary Sector	Tertiary Sector	Primary Sector	Secondary Sector	Tertiary Sector
1981	88.85	6.67	4.49	86.9	5.92	7.14
1991	90.98	4.81	3.21	84.81	5.37	9.77
2001	81.68	10.41	7.86	77.4	10.44	12.09
2011	67.15	7.3	25.55	74.88	10.07	15.01
Growth Rates (CAGR in %)						
1981–91	0.26	-3.57	-3.66	-0.27	-1.08	3.55
1991–2001	-1.19	8.96	10.46	-1.01	7.67	2.40
2001–11	-2.15	-3.87	13.99	-0.37	-0.40	2.43

Source: Census of India, different years

to the launch of MGNREGA, which directs to absorb one-third of the beneficiaries from the women's category (Desai, 2018). But despite these work opportunities being made available to the rural workforce, the WPR of women in non-farm occupations (secondary and tertiary sectors) is lower compared to men, and yet registering declining trends which needs proper investigation by the scholars and policy formulators (see Table 1).

The distribution of workers in Uttar Pradesh shows that the share of female workers as cultivators and agricultural labourers is more. The census data shows that the share of female—main and marginal cultivators both—have registered a downward slump, whereas the share of agricultural labourers is showing an increasing trend. Our analysis shows that though the female workforce participation is declining, the observed shifts within agriculture sector is more pronounced towards marginal agricultural labourers than marginal cultivators (see Table 2).

Table 2: Distribution of Female Workers in Rural Uttar Pradesh (%) as Cultivators and Agricultural Labourers

	Cultivators (Main)			Agricultural Labourers (Main)		
Year	Person	Male	Female	Person	Male	Female
1981	68.03	70.35	40.36	18.61	16.13	48.14
1991	62.79	65.07	45.07	22.17	19.18	45.43
2001	58.03	59.30	49.96	18.16	16.90	26.18
2011	45.03	47.82	31.49	27.12	25.91	32.98
Growth (CAGR %)						
1981–91	1.64	1.20	8.37	4.56	4.06	6.37
1991–2001	-1.16	-1.59	2.84	-2.48	-1.95	-4.37
2001–11	-1.99	-2.02	-1.78	5.39	5.22	6.08

Years	Cultivators (Marginal)			Agricultural Labourers (Marginal)		
	Person	Male	Female	Person	Male	Female
1981	3.78	0.71	24.23	1.97	0.23	13.62
1991	58.83	60.16	58.71	33.86	26.73	34.47
2001	27.20	19.64	32.93	54.14	57.24	51.79
2011	18.46	16.42	21.18	53.33	54.59	51.63
Growth (CAGR %)						
1981–91	8.45	-0.41	9.74	9.68	3.29	10.27
1991–2001	6.77	24.15	3.39	22.56	53.01	15.36
2001–11	-0.79	4.78	-4.45	3.40	6.32	0.31

Source: Census of India, different years

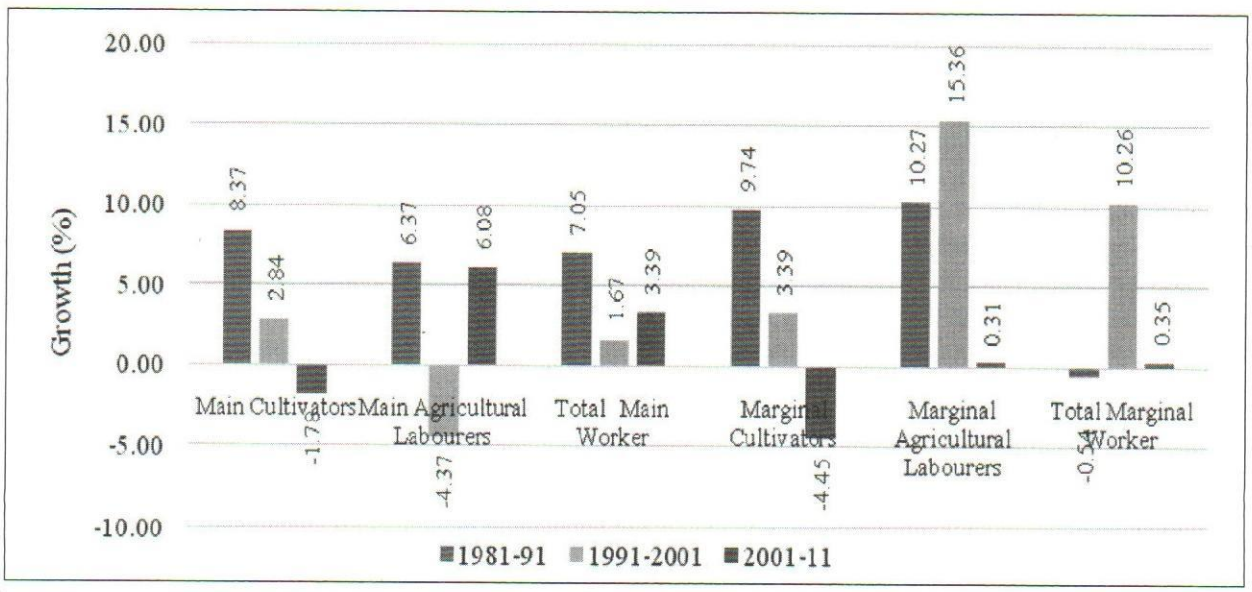


Figure 3: Growth of Female Marginal Workers vis-ā-vis Female Main Workers by Broad category in Rural Uttar Pradesh - 1981-2011

Figure 3 shows the growth of female marginal workers compared to female main workers by broad categories in rural Uttar Pradesh between 1981–91, 1991–2001 and 2001–2011. We find that female main cultivators declined whereas female agricultural labourers have declined in the recent 2001–2011 decade. Female marginal workers as cultivators also declined in 2001–2011, but overall female marginal workers registered an increase of 0.35 per cent. Total main female workers increased in 2001–2011 by 3.39 per cent in rural Uttar Pradesh.

3.1 Anatomy of Inter-District Distribution of Workforce in Uttar Pradesh

Previous sections have focused on inter-temporal changes in work participation rates of female in rural Uttar Pradesh. As the study is based on Census data, we have attempted comparisons only for 1981, 1991, 2001 and 2011 as the data, though available for earlier period, changes in the definition in worker makes comparison overtime difficult for 1961 and 1971 with the later periods. To capture and

Table 3: Regional Disparity in FWPR and Coefficient of Equality in U.P. (Rural/Urban)

Disparity in Female Work Participation								
Indicators	Rural				Urban			
	2011	2001	1991	1981	2011	2001	1991	1981
Mean	25.76	7.08	7.28	4.83	16.96	4.5	3.99	3.37
SD	7.15	3.83	5.66	4.16	3.86	1.71	2.02	2.14
CV	27.75	54.12	77.8	86.21	22.73	37.97	50.64	63.53
	Disparity in Coefficient of Equality							
Indicators	Rural				Urban			
	2011	2001	1991	1981	2011	2001	1991	1981
Mean	53.95	28.06	22.77	15.75	35.76	19.5	20.63	12.05
SD	14.40	11.92	15.56	12.59	8.02	6.45	41.31	6.56
CV	26.69	42.48	68.31	79.95	22.42	33.07	200.21	54.45

Source: For 1981, 1991 and 2001—data from Kumar, 2007; while recent 2011 data is from Census of India 2011

understand the regional dimensions, these broad state level scenario fail to deliver to policy formulators. The readings on regional economics do mention about variation in female participation rates, district by district and region to region (Kumar, 2007). Thus, it is pertinent to investigate and understand the situation at the district levels of Uttar Pradesh and highlight the emerging regional issues.

An exploration of regional disparity in Female work participation rates (FWPR) at the district level is highlighted in Table 3. The table shows district-wise FWPR which is low and still continuously declining over the three decades under consideration. The table also reflects on sharp variation over the districts in Uttar Pradesh and shows coefficient of equality at district level. Disparity envisioned in the table is very remarkable. The disparity captured by Coefficient of Variation is seen declining from 1981 (86.21%) to 1991 (77.8%), 2001 (54.12%) and in 2011 it reduced to 27.75 per cent in rural Uttar Pradesh and a similar scenario is visible in urban UP also, moving from 63.53 per cent in 1981 to 50.64 per cent in 1991 and finally to 22.73 per cent in 2011. Uttar Pradesh experienced a rising average participation rate amongst its districts where the average work participation rates are seen to increase from 1981 to 2011 both in rural and urban areas. It is noted that the disparity in FWPR has declined from 1981 to 2011 both in rural and urban Uttar Pradesh. Coefficient of variations too, in the rural areas, have registered a decline from 86.21 per cent in 1981 to 77.80 per cent in 1991 and further plummeted to 27.75 per cent. Urban participation rates hovered around 3.37 per cent in 1981 and increased to 16.96 per cent in 2011 with a coefficient of variation of 63.53 per cent in 1981 and plunging down to 22.73 per cent in 2011, thus indicating declining disparity levels (see Table 3).

Table 3 further shows disparity in coefficient of equality for females and is an important and reliable indicator for showing their real employment status in society, because it considers the relative proportions of females in population and employment (Saxena, 1990). This coefficient of equality with respect to female employment should be 100. The district-wise coefficient of equality exhibits a similar inconsistent pattern of FWPR. The coefficient of equality varies widely from 26.15 for Saharanpur to 82.40 for Sonbhadra in rural areas, and 18.99 in Shrawasti and 61.22 in Mau for the year 2011. It is apparent from the table that there are less inter-district variations in the coefficient of equality as compared to FWPR. In 22 out of 71 districts the coefficient is below 40, whereas in 11 districts it ranges between 40 per cent and 50 per cent, while in the remaining 38 districts it is above 50 per cent but below 77.76 per cent. This shows that in a large number of the districts the real employment

Table 4: Compound Annual Growth Rate (CAGR) of Female Workers in Rural Uttar Pradesh during 2001–2011

Range of CAGR	Agricultural labours	Household industries worker	Other workers
Negative	Muzaffarnagar, Baghpat, Gorakhpur, Faizabad, Shrawasti, Kushinagar, Deoria, Bulandshahr, Sant Kabir Nagar, Mau, Ambedkar Nagar, Ballia (12)	Varanasi, Saharanpur, Auraiya, Kannauj, Bijnor, Sant Ravidas Nagar (Bhadohi), Hardoi, Bulandshahr (8)	Bulandshahr, Moradabad, Mathura (3)
Low (0.01 to 3.00)	Meerut, Rae Bareli, Lucknow, Hamirpur, Azamgarh, Etah, Mathura, Jalaun, Chandauli, Siddharthnagar, Mahoba, Balrampur, Basti, Mahrajganj, Pratapgarh, Allahabad, Bareilly, Auraiya, Kannauj, Banda, Mirzapur, Varanasi, Sultanpur, Gautam Buddha Nagar, Kanpur Nagar, Unnao, Bara Banki, Aligarh, Saharanpur, Kaushambi (30)	Muzaffarnagar, Banda, Moradabad, Etah, Jaunpur, Allahabad, Meerut, Mau, Kaushambi, Firozabad, Sultanpur, Jyotiba Phule Nagar, Mathura, Aligarh, Unnao, Farrukhabad, Lalitpur, Kanpur Nagar (18)	Meerut, Muzaffarnagar (2)
Moderate (3.01 to 6.00)	Ghazipur, Bijnor, Fatehpur, Sant Ravidas Nagar (Bhadohi), Lalitpur, Kanpur Dehat, Chitrakoot, Jaunpur, Ghaziabad, Bahraich, Moradabad, Jhansi, Mahamaya Nagar (Hathras), Gonda, Kheri, Sonbhadra, Budaun, Sitapur (18)	Faizabad, Mahamaya Nagar (Hathras), Ghazipur, Basti, Lucknow, Azamgarh, Kanpur Dehat, Bara Banki, Ghaziabad, Pratapgarh, Uttar Pradesh, Sant Kabir Nagar, Chitrakoot, Shahjahanpur, Rae Bareli, Sitapur, Pilibhit, Chandauli, Ambedkar Nagar (18)	Ghaziabad, Auraiya, Aligarh, Baghpat, Saharanpur, Kanpur Nagar, Gautam Buddha Nagar, Mahamaya Nagar (Hathras), Chitrakoot (9)
High (6.01 & Above)	Hardoi, Firozabad, Pilibhit, Shahjahanpur, Agra, Jyotiba Phule Nagar, Rampur, Farrukhabad, Etawah, Mainpuri (10)	Kheri, Mirzapur, Baghpat, Budaun, Jalaun, Agra, Gorakhpur, Jhansi, Kushinagar, Etawah, Shrawasti, Ballia, Deoria, Fatehpur, Gautam Buddha Nagar, Hamirpur, Balrampur, Rampur, Mahrajganj, Siddharthnagar, Sonbhadra, Mahoba, Bahraich, Bareilly, Mainpuri, Gonda (26)	Bareilly, Agra, Etah, Budaun, Varanasi, Lalitpur, Faizabad, Banda, Kannauj, Lucknow, Hamirpur, Bijnor, Basti, Fatehpur, Firozabad, Kanpur Dehat, Hardoi, Jyotiba Phule Nagar, Jalaun, Shrawasti, Kheri, Sultanpur, Bara Banki, Azamgarh, Jhansi, Chandauli, Jaunpur, Sant Ravidas Nagar (Bhadohi), Allahabad, Unnao, Ghazipur, Mau, Rae Bareli, Siddharthnagar, Ambedkar Nagar, Rampur, Mirzapur, Pratapgarh, Gorakhpur, Mahoba, Sant Kabir Nagar, Mainpuri, Sitapur, Deoria, Pilibhit, Kaushambi, Balrampur, Farrukhabad, Sonbhadra, Shahjahanpur, Mahrajganj, Etawah, Ballia, Kushinagar, Bahraich, Gonda (57)

Source: Census of India, 2001 & 2011

status of the rural females is at a very low level. The coefficient of variation is 26.69 per cent in rural areas of Uttar Pradesh and much less in urban areas, i.e. 22.42 per cent for the year 2011 which declined from 42.48 (rural) and 33.07 (urban) per cent in 2001. The coefficient of variation for FWPR is higher (27.75%) than that of coefficient of equality for rural females, and it implies that the former depicts more blatant inter-district variations than the latter.

For making the analysis more revealing, the districts of Uttar Pradesh were clubbed together into low FWPR (below 5%), medium FWPR (5% to 10%) and high FWPR (above 10%) categories for rural and urban areas separately. To make the study comparative over the decades 1991–01 and 1981–1991, the depiction of category was carried out for both the decades i.e. 1991 and 2001. Western districts (e.g., Saharanpur, Muzaffarnagar, Bijnor, Moradabad, Rampur, Shahjahanpur, Meerut, Baghpat, Pilibhit, Mainpuri, Agra, Rampur, Badaun, Etah, and Farrukhabad) which are economically more developed, show very low female work participation rate. Low female work participation seems to be largely due to cultural factors. The Tables 4 and 5 are self-explanatory. The inter-district analysis reveals that female participation in economic activity is not uniform and variation is enormous at the district level.

Table 5: Compound Annual Growth Rate (CAGR) of Cultivators in Rural Uttar Pradesh during 2001–2011 (Female)

Range of CAGR	Cultivators
Moderate (3.01 to 6.00)	Etawah, Agra, Firozabad, Rampur, Pilibhit, Shahjahanpur, Farrukhabad, Mainpuri, Budaun (9)
Low (0.65 to 3.00)	Sitapur, Ballia, Hardoi (3)
Negative (-0.01 to -3.00)	Jyotiba Phule Nagar, Kheri, Bara Banki, Unnao, Gautam Buddha Nagar, Sant Ravidas Nagar (Bhadohi), Bahraich, Lucknow, Allahabad, Ghazipur, Gonda, Lalitpur, Ghaziabad, Bijnor, Varanasi, Jaunpur, Sonbhadra, Saharanpur, Kaushambi, Mahamaya Nagar (Hathras), Fatehpur, Sultanpur, Jhansi, Aligarh, Kanpur Dehat, Mirzapur, Chitrakoot, Etah, Chandauli, Siddharthnagar, Meerut, Jalaun, Kannauj, Banda (34)
Deeply Negative (-3.01 & Above)	Azamgarh, Pratapgarh, Deoria, Mahoba, Gorakhpur, Ambedkar Nagar, Kushinagar, Basti, Kanpur Nagar, Mau, Rae Bareli, Bareilly, Hamirpur, Auraiya, Moradabad, Mahrajganj, Faizabad, Sant Kabir Nagar, Balrampur, Mathura, Baghpat, Bulandshahr , Shrawasti, Muzaffarnagar (24)

Source: Census of India, 2001 & 2011

4. Education and Workforce Participation Rates

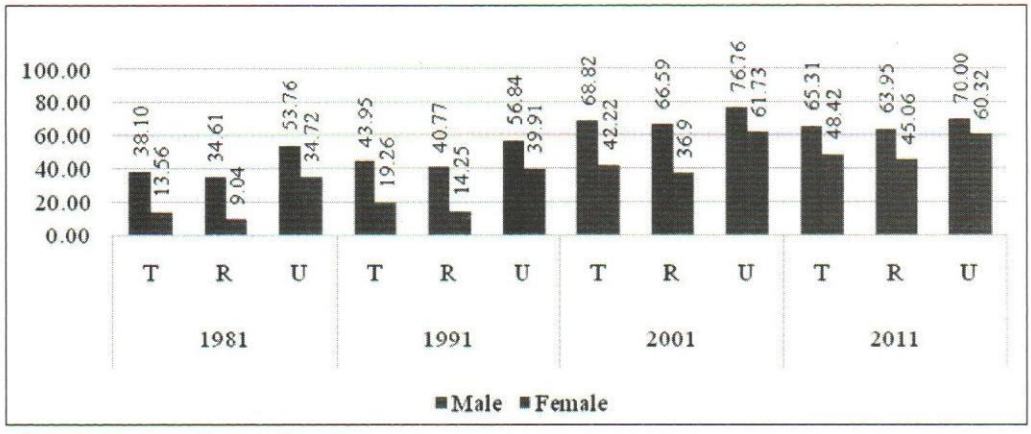
Recent literature talk about females being engaged in large numbers in different levels of education. Decline in female absorption as workers in the agricultural and allied sectors, increased mechanisation in agriculture and rise in household income all combine to influence the precarious drop in females as workers. However, non-agricultural sector is confronted with dearth of decent, remunerative and productive employment and has perhaps led to a slowing down in female employment. Part of this deceleration in labour force participation could be attributed to larger number of young people, particularly women, opting to and staying on in educational institutions (Mehrotra et al., 2014).

It is interesting to note that the literacy rates for rural females has increased to 45.06 per cent in 2011 Census from 36.9 per cent in 2001 and 14.25 per cent in 1991 Census (Figure 4).

Thus, a declining gender-gap in rural literacy over the years could be observed, meaning thereby that the female literacy rates have improved more compared to male literacy in rural areas (Figure 5).

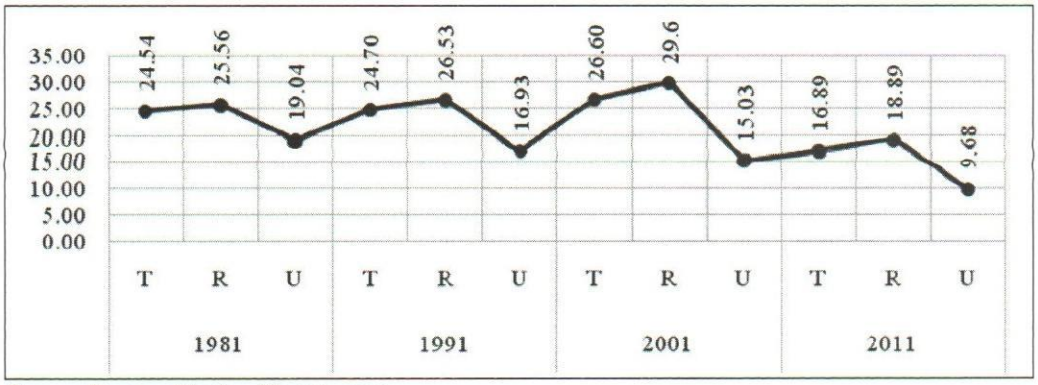
Figure 6 shows changes in Female WPR at different educational levels in rural agricultural and non-agricultural activities between 2001 and 2011. We find that education has percolated into the rural sector of Uttar Pradesh as females working in agriculture activities are seen to acquire education and also non-agriculture activities find educated females as workers in Uttar Pradesh.

Rising educational enrollments do not explain the decline in women's employment (Desai, Deshmukh and Chouhan, 2018). It was understood that increase in enrolment would definitely explain the decline in women's work participation as the younger lot would prefer to



Source: Census of India, different years.

Figure 4: Literacy Rates in Uttar Pradesh - 1981-2011



Source: Census of India, different years

Figure 5: Gender Gap in Literacy over the years - 1981-2011

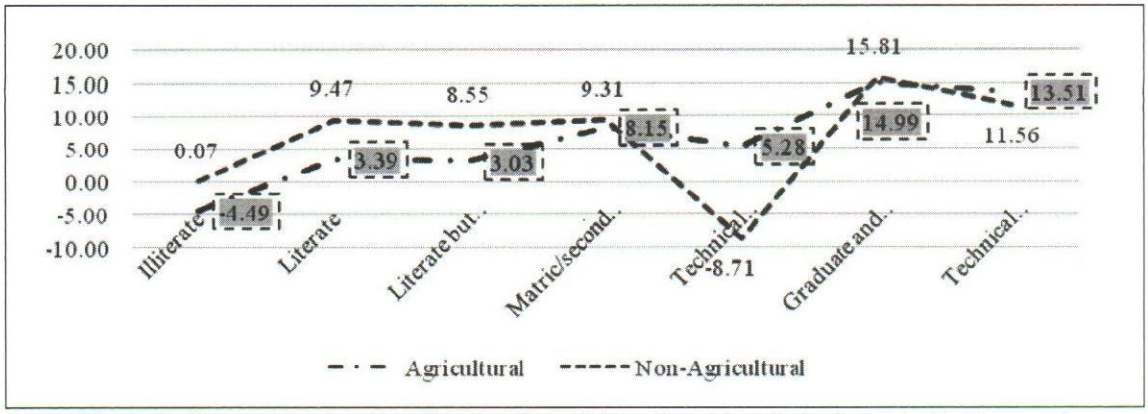
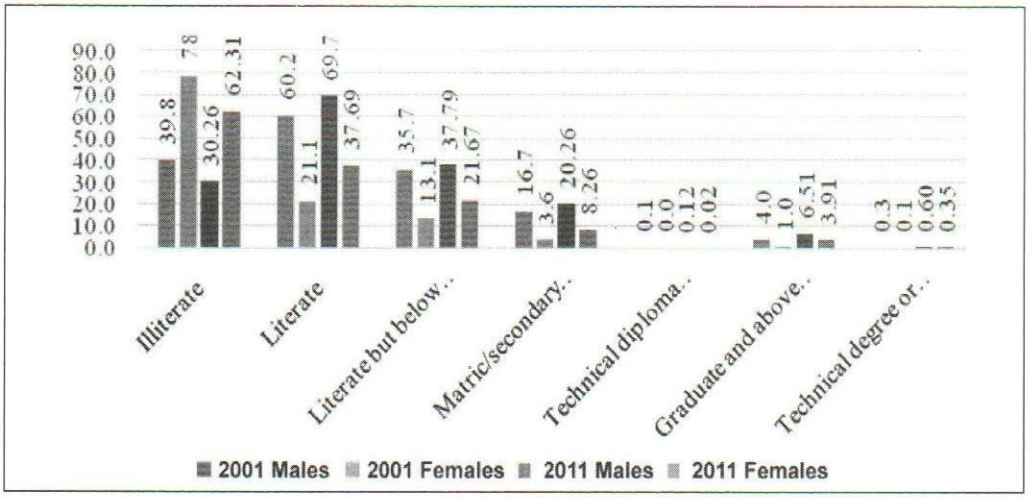


Figure 6: Changes in Female WPR at Different Educational Levels in Rural Agricultural and Non-Agricultural Activities Between - 2001 and 2011 - UP

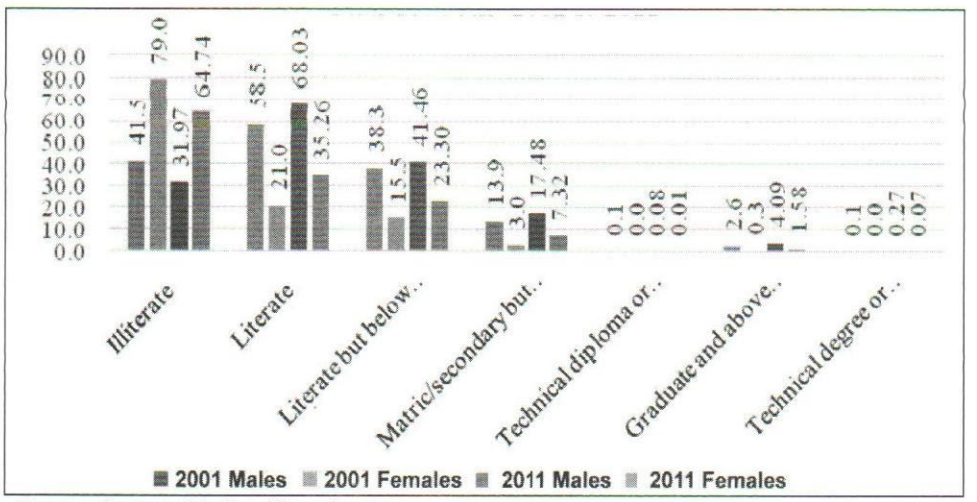
continue in school instead of joining the workforce, or, we may say that after getting educated, women are not willing to do farm jobs or they move to non-agricultural / marginal workers category (Kumar and Baliyan, 2019). It is observed that literacy amongst rural marginal workers has also increased as we find 7.32 per cent females at the secondary level (Figure 8).

It is pertinent to state that the recent decline in WPRs of females could be due to their increasing participation in education, which could be understood to be a welcome



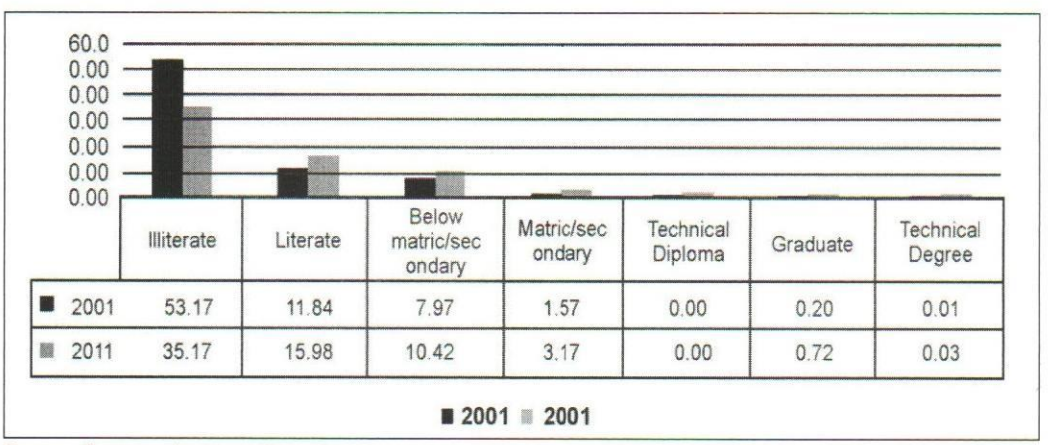
Source: Census of India, different years

Figure 7: Percentage of Literate Rural Main Workers in Uttar Pradesh - 2001 and 2011



Source: Census of India, different years

Figure 8: Percentage of Literate Rural Marginal Workers in Uttar Pradesh- 2001 & 2011



	Illiterate	Literate	Below matric/secondary	Matric/secondary	Technical Diploma	Graduate	Technical Degree
2001	53.17	11.84	7.97	1.57	0.00	0.20	0.01
2011	35.17	15.98	10.42	3.17	0.00	0.72	0.03

Source: Census of India, different years

Figure 9: Percentage of Rural Women Participating in the Agricultural Workforce by Education in UP

sign. Studies indicate that this still does not explain the complete scenario about the declining female labour force participation rates which has been significantly greater in rural areas of Uttar Pradesh. Figure 9 brings out the per centage of rural women participation in agricultural workforce by educational levels in Uttar Pradesh. Literate agricultural workers have increased from 11.84 per cent in 2001 to 15.98 per cent in 2011 but illiterates have declined from 53.17 per cent in 2001 to 35.17 per cent in 2011.

5. Factors Impacting Rural Female Workforce Participation

With the help of census data at the district-level, we have tried to look into the plausible factors that could impinge upon the female worker's participation in agriculture sector in rural Uttar Pradesh. A set of socio-economic and agricultural variables were collated for all the districts. For the period 2001–2011, a panel data set was formulated by considering district-wise (70) variables such as Log of Net District domestic product, per capita income, per cent rapes (crimes) to total rapes in UP, child women ratio, average size of land holdings, area under food grain, gross value of agricultural produce, per cent SC population, per cent Hindus, per cent Muslims, female literacy rates, cropping intensity, electricity consumption in agriculture, electric pump sets, availability of gross area sown per tractor, per cent NDDP from agriculture, per cent NDDP in non-agriculture, number of small scale industries per lakh population and total length of pucca road. Review of literature helped in selection of variables and its availability at district-level. Data sets for 70 districts of Uttar Pradesh were collected from the statistical abstracts of Uttar Pradesh and Department of Agriculture, respectively. The correlation coefficients among the explanatory variables have been assessed and the variance inflation factor is estimated to be 1.20, thus showing absence of multicollinearity in the data set.

Investigating factors that determine women's participation in agriculture as a dependent variable and hence separate models were formulated. Taking district level data into the panel data, pooled (OLS) and Panel (fixed effect) regression models were formulated for analysis. Following is the equation for the regression model:

$$Y_{it} = \alpha + \beta iX_{it} + \delta t\, T_{it} + u_{it} \ldots where,$$

Y_{it} is the dependent variable (rural female worker participation in agriculture)

X_{it} incorporates all the independent variables, as given earlier

T_{it} is related to time variable, fixed effect to capture time invariant.

In this section, we seek to examine the determinants of inter-district variations in the shares of female participation rates in Uttar Pradesh. The first step here is to test whether pooling of data is necessary or not. The null hypothesis of probability test is OLS model verses the alternative one (fixed effects). The table 6 shows that in the fixed effects model the probability is 0.000, rejecting the null hypothesis of the all the district effect intercepts equal to zero. Thus, the probability test confirms the presence of district-specific effects.

Although pooled (OLS) model is preferable for the present analysis, we have also used fixed effects model because within mean showed much variation in different variables across the districts (see Table 6). Hence, we have estimated both pooled and fixed effects equation to observe the effects of socio-economic as well as proximate variables on FLFPR in agriculture and non-agriculture, to compare the value of the regression coefficients. Table 6 depicts the results based on both models.

Table 6 (in which pooled analysis is given) shows the result of regression of the socio-economic model. All the regressions have high R-square values. The R-square value is higher in the case of pooled (0.359) than in the fixed effects (0.261). Evaluating results, we find that socio-cultural variables determine female participation in agriculture. Among the six listed variables, the presence of Schedule Caste population is the most insignificant and positively associated to female participation in agriculture, thus substantiating our underpinning on the issue. Among women, caste and religion make real difference to workforce participation rates as we find significant and positive association in both pooled models, but not much in fixed effect mode implying that social norms and religious conservatism play a role in women participating in labour force. Crimes against women deter women from participating in the agriculture sector is proven, as this variable is significant and negatively associated; female literacy—as thought—hampers their participation in agricultural activities and hence the coefficient is significant and negatively associated with women in agriculture (FWAPR). The presence of children restricts female, in participation in agriculture. These results very distinctly bring out the importance of

Table 6: Regression model : Social and demographic indicators determining women's participation in agriculture in Uttar Pradesh

Variables	Pooled OLS			Fixed Effects Model (OLS)		
Y1	**Coef.**	**t**	**P>t**	**Coef.**	**t**	**P>t**
Hindu	3.501	3.810	0.000	1.284	0.384	0.880
Muslim	3.296	3.520	0.001	1.900	0.218	1.240
CWR	-0.002	-0.180	0.857	-0.014	0.002	0.002
Girls in HS	0.024	0.040	0.971	-0.572	0.116	0.116
Crimes Rate	-2.779	-3.590	0.000	-0.078	0.816	0.816
Sc	0.105	0.820	0.413	0.050	0.515	0.515
_cons	-321.058	-3.540	0.001	-112.181	0.442	0.442
R-squared	**0.359**			**0.261**		
Prob > F	**0.000**			**0.003**		

Source: Kumar and Baliyan, 2019

Table 7: Women in Agriculture-Economic factors

Variables	Pooled OLS			Fixed Effects Model (OLS)		
	Coef.	**t**	**P>t**	**Coef.**	**t**	**t P>t**
Log (NDDP)	-6.304	-3.890	0.000	0.386	0.470	0.638
Pump sets	-2.694	-3.340	0.001	0.138	0.360	0.717
Fertilizers (kg.)	-0.032	-3.190	0.002	0.000	0.060	0.956
Average size of holdings	-10.157	-4.530	0.000	-3.297	-1.420	0.160
Cropping intensity	-0.163	-3.530	0.001	-0.011	-0.400	0.693
% share of agriculture in NDDP	-0.256	-2.860	0.005	-0.007	-0.100	0.918
Roads length per lakh population	0.088	3.470	0.001	0.004	0.290	0.771
Per capita prod_food grains	-0.011	-1.310	0.192	0.026	0.250	0.800
% share of non-Agri in NDDP	0.125	1.680	0.095	0.003	0.410	0.687
Prob > F	**0.000**			**0.009**	**0.280**	**0.781**
R-squared	**0.437**			**0.150**		
_cons	119.533	7.180	0.000	18.724	1.770	0.082

Source: Kumar and Baliyan, 2019

demographic and socio-cultural factors in determining participation of females in the economy of Uttar Pradesh to the extent of 43.7 per cent.

In our proximate determinants model, the value of R-square of the OLS regression (pooled) is 0.437 (see Table 7). Lower R-square have been found in the case of fixed effects models i.e. 0.150. This result confirms the fact that the explanatory variables in the model account for significant variations across districts. P-value is 0.000, proving that these explanatory variables influence the women in agriculture of the districts. In this model log of NDDP, index of mechanisation (fertilizer and pump sets), size of land holding, cropping intensity, road length, and per cent of agricultural income in NDDP have emerged as significant (at 1% level) predictors of women participation in agriculture across the districts.

6. Conclusion

Conclusions drawn from this paper are that women's WPR in the rural areas in Uttar Pradesh has been declining. The women workers' share in agriculture is higher as compared to men, but still is plunging and gradually transforming into non-agricultural activities. Women's participation is low in non-agricultural sector (both secondary and tertiary sectors). Besides, the earlier trend of feminisation of agricultural workforce with abundance of low-skilled women is not a scenario that one can foresee. Mostly rural women are engaged in manufacturing and construction activities and the possibility of women trading into better paid formal, professional, scientific and technical jobs is bleak.

Women's participation from social groups i.e. SC/ST is higher because of their marginalised status, and their deplorable conditions pushed them to earn a living and also absence of social norms/ taboos in their community encourage them to participate and seek livelihood. Districts with higher SC/ST population usually report better female WPR. Usually, majority of women do not have ownership rights over land resources and hence the control over resources is inversely related to land size, which means that women's control over land decreases as the land holding size increases. This inverse relationship can be due to social and cultural factors that are responsible for less control of women, especially relatively better-off women, on land resources (Bhattacharya and Goyal, 2017).

Even though female literacy rates are showing a rising trend over the years, it is not resulting in higher rates of workforce participation. There is no doubt of the possibility of women educated and with specialised skill have better chances of joining/tending to work in better-paid non-agricultural activities—hence decline in rural female participation rates could be perceived in rural Uttar Pradesh.

The female WPR in rural areas is declining, no doubt, possibly because rural women are pushed to work due to agrarian distress, or perhaps because of unsafe or unsuitable work conditions, or due to restrictions laid by social norms hence withdrawing from the labour market. All the three conditions raise grave concern regarding women's participation. Access to land and control over its operation in rural areas determine women's autonomy. Thus, in rural areas, besides employment, women's access to land and productive resources is critically required to improve their social and economic status, while empowering them in the society. The primary focus should be to create conducive opportunities for job creation and enabling to join the workforce. Further, the need of the hour is to prioritise education and skilling for women. Labour market should generate jobs to create work-life balance, providing maternity protection along with flexible working conditions. To fulfill the goal of increasing female workforce participation by providing decent work opportunities with the ultimate goal of conferring empowerment for the second half of the population.

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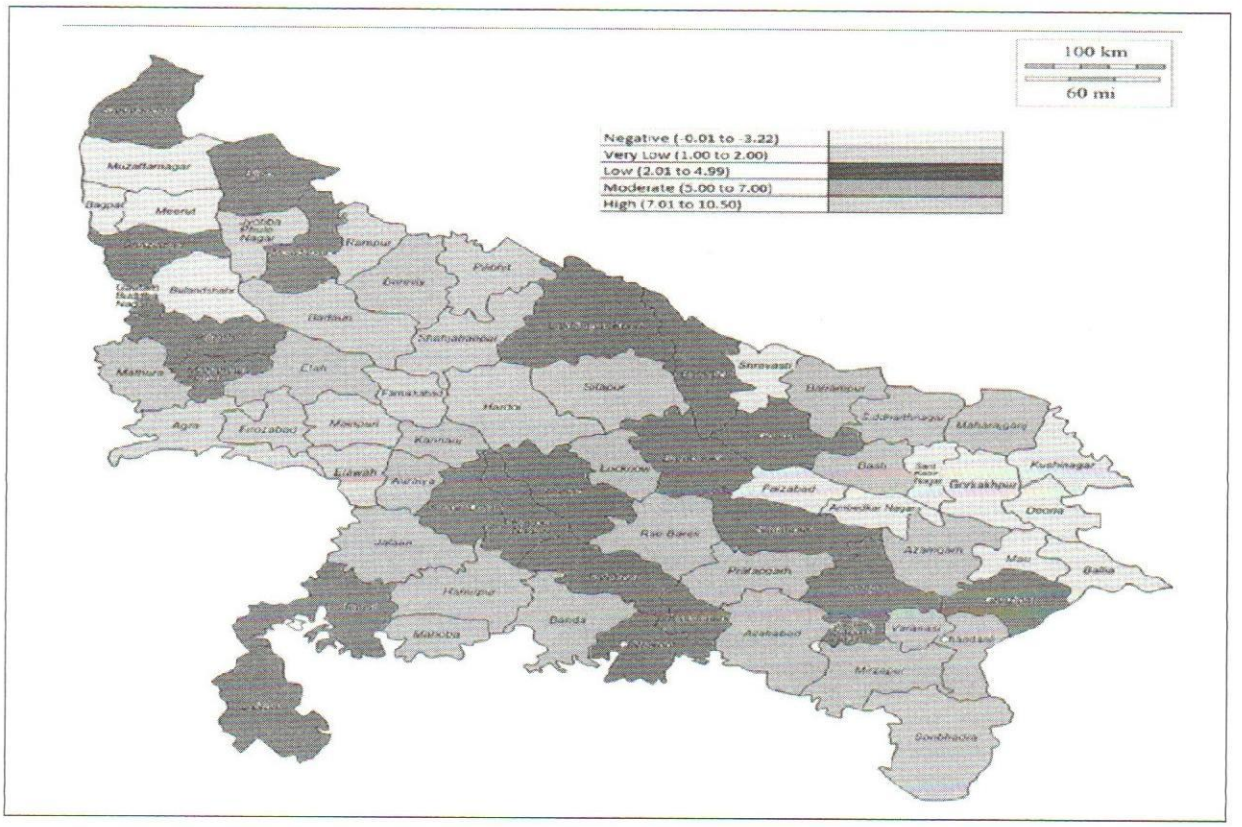
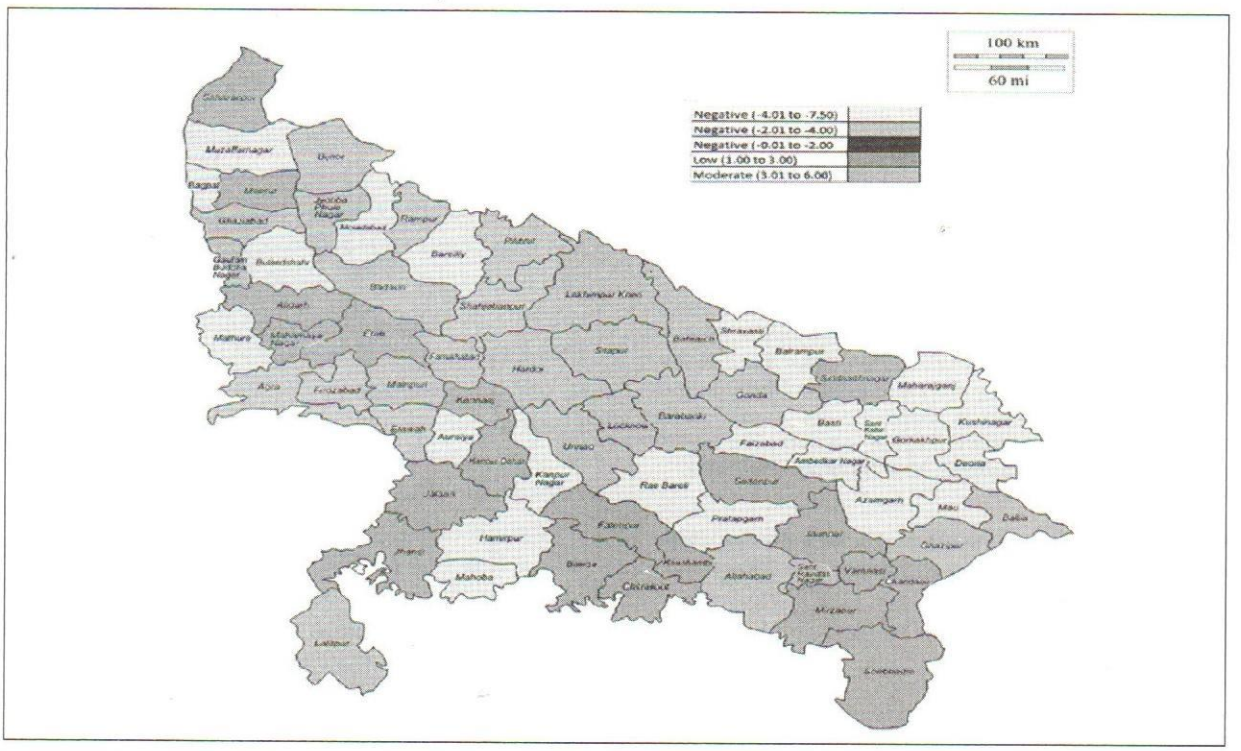
Sustainable development is a path way to the future we want for all. It offers a framework to generate economic growth, achieve social justice, Exercise environmental stewardship and strengthen governance.

– Ban ki Moon

Annexure 1: Growth (CAGR) of Agricultural Labourers in Uttar Pradesh between 2001–2011



Annexure 2: Growth (CAGR) of Cultivators in Uttar Pradesh Between 2001–2011



Empirical Evidences of Tribal Women Participation in Local Economy

ARCHANA SINHA

Tribal women are the worst sufferers as most large-scale industries are displacing them from their lands and denying them access and control over natural resources. Tribal women who have been dependent on traditional land, forests and water-based occupations. Thereby it has led to the reduction in the social and economic status of women, especially indigenous women, as a result of forced transition from land-based traditional systems to contemporary economies. In India, women perform 2.6 times more unpaid care and domestic work than men. While families, societies and economies depend on this work, for women, it leads to lower earnings and less time to engage in non-work activities. In addition to equal distribution of economic resources, which is not only a right but also accelerates development in multiple areas, there needs to be a fair balance of responsibility for unpaid care work between men and women (Gender Equality, Goal 5 SDG). The working conditions of women workers are deteriorating and there are no legal protections for women to demand for their rights and duties. They also bear disproportion responsibility for unpaid work and are undervalued for their work, like, household activities where she is not considered as part of labour force and is an invisible labour. The work participation rate and occupational composition among them, and prevailing sex disparity in different economic pursuits certainly reveal their economic status and the system of social organization in it. This study is an attempt to understand the perceptions, responses and actions, and the determinants of actions in the society as well as the lives of the tribal women in the context of existing gender relations in general and among tribal societies in particular in the preview of constitutional amendment. The rooted patriarchal structure in the society manifests among tribal societies. Further, the study attempts to understand how the women place themselves in the constricted situations and deal with home and social responsibilities and what the outcomes of the processes were. In light of this, the present study was undertaken under the premises of Indian Social Institute, to study the participation of tribal women in local economy: "Case Studies in Jharkhand and Assam" in the year 2020, with perspectives from tribal women. The author acknowledges Indian Social Institute, New Delhi, for the same.

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Introduction

There are no visible or explicit accounts of gender discrimination in tribal communities both at the familial and societal level, which can be justified as almost equal sex ratio, equal work participation ratio, etc. Among tribal societies, tribal women occupy a significant place in both economic and non-economic activities, as in their own world, they have freedom and self-expression (Maharatna: 1998; Bhasin: 2007; Chatterjee: 2014). However, the status of tribal women are not the same in all places, and their status vary from one tribal group to another and one social structure to another (Hutton: 1921; Kakati: 2012b, 2013a; Chatterjee: 2014). Generally, tribal women have enjoyed greater freedom and higher status than other women, but not equal to tribal man. Among tribal communities, though women had a comparatively higher social position and respect in society, they are still missing in governance and in other fields of life.

India's Female Labour Force Participation (FLFP) rate has remained visibly low and the International Labour Organisation (ILO) ranks India's FLFP rate at 121 out of 131 countries in 2013, one of the lowest in the world. India had the lowest FLFP rate in South Asia. In India, women workers do not construct their roles in positive ways and their identity at workplace affects gender relations. Majority of work is socially constructed, be it the household work, construction or agricultural work. As tribal communities all over India have been subjected to various forms of deprivation and alienation, there is an unprecedented marginalisation of tribal women workers over the years and it has further resulted in large unemployment and underemployment. Majority of tribal women labour constitute in agriculture and other allied sectors and has increased in the recent years. Apart from agricultural activities, she contributes to ploughing, collecting minor forest produce such as leaves, gums, fruits, water, seeds,

herbal plants and other materials used for domestic purposes. Her labour contribution in mines, mineral collection and other industrial operations stand no less than her counterpart, the tribal men of working class. The major contribution of tribal women labour is found in the construction industry for activities such as brick-lifting, soil mixing and other menial work. Particularly for all these activities tribal women are preferred by the contractors as their bargaining capacity for justified wages remain minimal or more often absent.

As of 2013, 49.1 per cent of the world's working women were in vulnerable employment, often unprotected by labour legislation, compared to 46.9 per cent of men. Women were far more likely than men to be in vulnerable employment in East Asia (50.3% versus 42.3%), South-East Asia and the Pacific (63.1% versus 56%), South Asia (80.9% versus 74.4%), North Africa (54.7% versus 30.2%), the Middle East (33.2% versus 23.7%) and Sub-Saharan Africa (nearly 85.5% versus 70.5%).

In 2011–12, less than 20 per cent of the total workers in non-agricultural sectors were women, according to Indian statistics department. Manipur, Tripura, Tamil Nadu and Kerala have the highest percentage share of women in wage- employment in non-agricultural sector. India is one of the few countries where the rate of participation of women in the workforce has drastically declined in the last decade. It fell from 33.7 per cent in 1991 to 27 per cent in 2012, according to UN gender statistics.

Purpose, Aim and Universe

Though there are a number of studies to show that women work for longer hours and contribute more than men in terms of total labour energy spent by the household members on account of deeply entrenched social customs, taboos and prejudices, women's work continues to be invisible. In the present state of affairs, this paper aims to study the status quo of women and their contribution to labour markets and their awareness to the labour laws, and their rights types of work pertaining to family livelihood, domestic help, construction work, manufacturing industries, where a tribal woman locates them, and their role in the contemporary society, and how these works are impacting the socio-economic status of women. In the traditional societies which lack market system, the business of everyday living is usually carried on gender division of labour. In the proposed study, it intends to study the division of labour mainly between herding, agriculture, construction and other allied industries. In all other tasks concerned with life in the village, such as crafts, house building, watermills and work on boundary walls, there is division between men's work and women's work. Research objectives include analysis of work participation of tribal women, understanding the changing role of tribal women in connection with the socio, cultural and economic status and to suggest policy measures for empowerment from the perspective of scheduled tribe women.

Qualitative data was collated from 50 tribal women workers from Jharkhand engaged in formal and informal economy. Tribal women respondents were selected by using purposive sampling method. The selection of the women respondents of the study of a particular field is multifaceted. The census 2011 data provided the base for understanding different aspects of demographic composition at the district-level core areas in Jharkhand (Khunti district and Ranchi district).

Table: 1 Criteria for District Selection in Jharkhand

District	Total Population	Total ST popn	Total ST Rural popn	Rural ST Rural Women popn	ST Rural % Literates	ST Rural % workers
Khunti	531,885	389,626 (73.25%)	371,469 (95.33%)	186,559 (50.22%)	77,223 (41.39%)	90,855 (48.70%)
Ranchi	2,914,253	1,042,016 (35.75%)	789838 (75.79%)	394,120 (49.89%)	176,702 (44.83%)	168,725 (42.81%)
Jharkhand	32,988,134	8,645,043 (26.20%)	7,868,150 (91.01%)	3,939,827 (50.07%)	1,434,150 (36.40%)	1,718,504 (43.61%)

Source: Census of India Year-2011, Government of India.

Table: 1 lays down the criteria for the selection of two districts (Khunti district and Ranchi district) in Jharkhand state. The total population of Khunti is 531,885. The population of Scheduled Tribes is 73.25 per cent of the total population, at 389,626. 95.33 per cent of the total ST population (371,469) lives in rural areas, out of which 186,559 or 50.22 per cent are women. The number of rural women literates are 77,223 (41.39%); while the number of women workers are 90,855, which is 48.70 per cent of the total population of rural ST women.

The total population of Ranchi is 2,914,253.The population of Scheduled Tribes is 35.75 per cent of the total population, at 1,042,016. Out of the total ST population, 75.79 per cent (789,838) lives in rural areas, of which 394,120 or 49.89 per cent are women. The number of rural women literates are 176,702 (44.83%); while the number of women workers are 168,725, which is 42.81 per cent of the total population of rural ST women.

The total population of Jharkhand is 32,988,134. The population of Scheduled Tribes is 26.20 per cent of the total population, at 8,645,043. Out of the total ST population, 91.01 per cent (7,868,150) lives in rural areas, of which 3,939,827 or 50.07 per cent are women. The number of rural women literates are 1,434,150 (36.40%); while the number of women workers are 1,718,504, which is 43.61 per cent of the total population of rural ST women.

In Jharkhand state, the 50 women from 4 villages of both Khunti district (Doengar village and Marcha village) and Ranchi district (Persatari village and Tanger village) were selected as study sample – with the dominant tribes in Khunti district being Munda tribe, while it is the Oraon tribe in Ranchi district. The prime reason for selecting these villages being that, these were tribal-dominated and the marginal women workers in all the villages are significantly higher than men. Women entered the market for wage labour after the industrial revolution, creating employment opportunities for women, but these women occupied secondary workplace in the labour work force, their significance was considered marginal and constituted the reserved labour force. They entered the labour market only when the economic necessities forced them to supplement the meagre family earnings. The study of tribal women's work participation and occupation pattern is vital towards understanding the socio-economic functioning of a region.

Table: 2 describes the different fields of work in which people of different tribes are involved. In case of the Munda tribe, 100 per cent of the women surveyed were involved in household work, 96 per cent of them having their own land to work on, 84.6 per cent of them involved in animal-husbandry and 69.2 per cent in agricultural labour. Cent per cent of the women of the Oraon tribe were involved in household work, 87.5 per cent of them in their own agricultural land, the percentage of women involved in animal-husbandry and that doing agricultural labour are 79.2 per cent each. When women of all the above mentioned tribes are taken into account, all of them are involved in household work, while only 74 per cent of them are involved in agriculture labour.

There are still huge inequalities in the labour markets in some regions, with women systematically denied equal access to jobs. The unequal division of unpaid care and domestic work, and discrimination in public office, all remain huge barriers. Affording women equal rights to economic resources such as land and property are vital targets of sustainable development goals. However, there are still

Table 2: Tribe-Wise Work Engagements of Women in Study Area

	Work Engagements (Number and Percentage)				
Tribe	**Household Works**	**Own Agriculture**	**Animal Husbandry**	**Agriculture Labour**	**Total**
Munda	26 100%	25 96.2%	22 84.6%	18 69.2%	26
Oraon	24 100%	21 87.5%	19 79.2%	19 79.2%	24
Total	50 100%	46 92%	41 82%	37 74%	50

Source: Field Research Sample Data 2019-2020, Indian Social Institute, New Delhi.

enormous barriers between policy and practice and the conversion of policies into reality. The National Policy for Empowerment of Women (2001) commits to address all forms of violence against women including physical, mental and that arising from customs and traditions. Various programmes and policies have been initiated by the state to enhance empowerment of women. Inadequate planning and implementation gave rise to more gender disparities. It is expected that this research paper will influence policy makers to device steps towards empowerment of tribal women, since research outcomes will be shared both nationally and internationally.

Struggles of Tribal Women

Ranchi District

Oraon Tribe

Women belonging to the Oraon Tribe of Ranchi district, Jharkhand, are mostly engaged in agriculture and related works like helping husbands in subsistence farming, carrying produce to the market to sell it and similar works. Few women have taken up animal rearing as their profession. Women complain of water scarcity in the village. Since all their work depends on water, their work gets hampered and income gets affected. The village lacks in proper roadways. The roads are so bad that they find it difficult to go to the market and sell their produce. Not just that it is difficult for them, but they also complain that they hardly get any opportunities to work because of the bad roads.

Women complain about the lack of support mechanisms in the village. Few say their village is so far off that nothing reaches their village. MGNREGA is known to everyone and, while on one hand, few do not have job cards, on the other hand, the ones who have job cards either find no opportunities to take up or that the payment is erratic. One needs to have a bank account to get paid after working in MGNREGA, but few do not have bank accounts, hence, chose not to work through the scheme. Not just in this scheme, but workers of every scheme and labourers in general repent about the lack of fixed salaries, untimely payments and under payment. Women have no money to realise their dreams of establishing businesses, tailoring units, study further or educate themselves and their children. These small yet significant dreams are being left unattended.

The village has no Anganwadi according to few, but there is an Anganwadi sahayika. There is only one school in the village. Many children though do not study in the school and younger children who are at an age of going to Anganwadi go to this one school available for lunch. This makes it difficult to maintain a count and shows the lack of responsibility of the government. There is no hospital in the village and patients need to be transferred to hospitals in far off places through the damaged roads.

Women who are the only bread winners in the family find it difficult to handle the work and the house. These women are usually the ones with a sick husband or husband that resorts to drinking instead of supporting family. Few women complain that it gets difficult to work and take care of the children. Since most women's parents were illiterate and unaware, women were not provided with education. These women are aware and want to provide children with good education, but lack resources to earn enough money.

Women complain that village heads and tribal leaders are not helpful at all. Few are indeed working but most of them are cheaters who do not work at all. With no responsible leader, the village is not governed properly and as informed earlier, lacks support mechanisms, and even if there are support mechanisms, they are not efficient.

Khunti District

Munda Tribe

Women belonging to the Munda tribe of Khunti district, Jharkhand, faced struggles. These women living in the rural area of the district complain of lack of financial assistance. It is found that there are no agencies and no proper government facilities to support these women financially. Women here work as wage labourers, agriculture workers and take up animal husbandry to satisfy their family needs. Most women help their husbands in subsistence farming. They complain that animal husbandry is very difficult to manage but there is no other source of income for them.

Though government schemes like Indira Awaas function in the village, it is neither efficient nor the money provided through this is sufficient. The wage given to the workers is very less to run a family. Even MGNREGA does not provide wages corresponding to the work done. Programmes like Ajivika operate in the village but this is also not sufficient. Women need to be supported and more training units need to be set up, so as to improve the skills of these women which could help them earn income.

The village's major issue is water scarcity throughout the year. The villagers suggest that solar pumping would help the situation of water, but the government has taken no measures to resolve it. The water scarcity disturbs the farming and also makes animal husbandry difficult. There is neither proper transportation nor good quality road system. The roads get muddy during the rainy season which makes it even more problematic. Not just water and roads but food is also an issue. Parents are not earning enough to provide their children with healthy food, hence, depend on the Anganwadi but the Anganwadi workers complain that food is not supplied in a timely manner. Parents are so deprived that they can neither provide their children with basic requirements nor education. Poverty is very much prevalent in this village and women face many struggles.

Suggestions to enhance awareness and progress Implementation of women's labour rights as laid down in national legislation

i. **Awareness about labour rights**

In Munda tribe of Jharkhand, women were found to be aware that if they have an MGNREGA card they are entitled for a job. Some of them have a job card but still do not want to take up those jobs because the wage rate is very less. Some have the card but have not got any work. In Oraon tribe also, some women did not have awareness about their labour rights.

ii. **Safeguarding interest of workers**

Some women from Munda tribe perceived the importance of safeguarding the interest of the workers; some had no idea about it; while in one case it was also revealed that it is not important. Most women from Oraon tribe perceived the importance of safeguarding the interest of workers.

iii. **Need for awareness programmes so as to be informed about labour laws and rights**

Women of Munda tribe had mixed opinions on this aspect. Few desired training and few do not, while few others desired training but not for themselves. Most women stated that awareness programmes and trainings are much needed for themselves and also for their communities, while one other respondent woman stated there is no requirement for training. Thus, there were mixed opinions on the question of requirement of training and awareness programmes. All the Oraon women agreed that they needed awareness and training programmes on the facilities provided by the government as the leaders are helpful. They might also need trainings on various skills that would help earn some income.

Conclusions and Policy Implications

Change is visible in the status of women towards one of greater equality with men, and in their role towards greater participation in local economy and other social and economic activities because of legal changes made through constitutional amendments, government schemes and policies. However, the elements and pace of such changes cannot be said to be the same across all tribal communities and states. Further, gender relations are context specific which varies depending upon the socio-cultural and economic settings. Thus, the qualitative study helped to understand the gender relations in the context of work, and to further knowledge creation. It is necessary to understand the participation of tribal woman as their effective participation is an important indicator of their empowerment that would lead to social transformation.

i. **Migration and wage work:**

The decision to migrate in case of wage employees was mainly taken by the women. However, the decision to migrate could also be influenced by factors such as role of the state, age, educational level, and work opportunities. They migrated in search of livelihoods. They worked as wage workers. A considerable number of households of those villages were dependent on wage employment for survival. However, some of them were also involved in other sources of livelihood such as agriculture, animal husbandry, business and service. Wage employment was an important source of livelihood for the villages, but it was mostly seasonal activities for those families who were engaged in other activities too, especially agriculture. According to the nature of sources of employment, wage employment at these villages can be divided into two types, viz., government works and private works. Government works included works undertaken by different employment generation programmes like MGNREGS, where wage rates for both men and women were equal. Work that they generally do through MGNREGS were construction of roads, repairing of village roads, etc.

ii. **Economic institutions and social division:**

A number of economic groups like SHGs can point out to economic life of the villagers of selected

villages. Objectives of these groups were to fulfil the credit needs of the women in a collective way. With the formation of these economic groups, dependency of the villagers declined on other agencies or money lenders, etc. and SHGs replaced the need for them. During field study, different women SHGs were identified. The woman members of the SHGs regularly met and took small loans. Thus, woman members purely owned and managed this economic institution. Though the members were the direct beneficiaries, the group provided economic guarantee to them. In some cases, from the version of the informant, it was observed that gender played an important role in the issue of participation and non-participation of women members in the SHGs. Moreover, many other women informants also reported this in group discussions that although they wanted to be members of the SHGs, their husbands did not allow them to do so. Hence, whatever the reason of non-participation, it can be believed that the control of men over the decision of women which actually restricted and barred a section of women to take part in such economic institutions.

iii. Poverty outcome:

Although the village women have been involved in different activities, still their economic condition was not so well, as was visible in different aspects of their lives. The implication of extreme poverty compelled the villages to adjust with any kind of discrimination or malpractices without questioning them. One such prominent example of such implication of malpractice was observed in MGNREGA scheme where the village women reported to have job cards but were not provided with any workdays, and so no payment of wages. After enquiring about the reason that forbade them to raise their voice against the malpractice, the respondent women stated that they were not much worried about this as they have some work through agriculture, SHGs, and weaving. The poor economic condition of these villages was reflected in their housing condition. The smallholdings constructed by them were very simple having no fencing to demarcate the boundary with the neighbour. Most of the villagers had kutcha houses made of locally available materials such as bamboo, straw and mud, and constructed their houses on elevated plinths. Thatch was used for roofing. Walls were made of bamboos, mud and reeds. Some families had constructed separate sheds for domestic animals. Thus, they lived in an unhealthy condition. On the other hand, only a few families could manage to construct pucca houses in Jharkhand. Although the government had sanctioned a number of houses to the families living below the poverty line (BPL) under the Indira Awaas Yojana (IAY now known as Pradhan Mantri Awaas Yojana), not all the households availed this scheme. Further, the impact of poverty was also visible on the health condition of the villagers, especially among the women. The health condition of older women was poorer mainly because of poor services of Primary Health Centres (PHCs) situated near the villages. However, from observation, it could be inferred that the reason associated with the poor health condition of these women was their workload.

iv. Village in technological transition:

Most tribal women in selected villages were involved in agriculture but there was a considerable section too that was involved in other sources of livelihood such as wage and SHGs. State had also intervened in the rural areas with its different development projects on education, health, livelihood, basic amenities and social security in these villages. Introduction of these projects had empowered a group of women who were earlier denied this right. Like this, the social security programmes and other basic amenities had not only provided security but also helped the weaker section to lead a dignified life. Introduction of modern technology had tremendous impact over the village economy. Villagers used different modern implements such as power tiller, and harvesting machines. People used tractors for ploughing and machines for threshing paddy. They used different machines, their labour was reducing, and life became fast. However, it had some social consequences too which had been seen in the form of social transformation. Many of their social systems and economic institutions had disappeared, as with capital investment technologies, now no more labour-intensive technologies were required. Thus, with change in production relations, there has been some decline of social interactions.

v. Tribal women in work force:

Participation of men in domestic chores was very negligible. Moreover, as the domestic chores were

unrecognised, there was negligible chance of combined resistance by the women to those kinds of division of work. (Rowbotham: 1973/1981). Broadly, the work of women were of two types. One type was the work which confined to domestic arena and which can be termed as familial performance. The second type of work can be termed as community performances related to societal level work. Familial performance further had two forms, that is, domestic chores, which a woman generally did within the house premises and non-domestic works. Domestic chores included works such as cleaning, fetching water, preparing food, caring for children and elders, caring for the animals, collecting firewood, weaving, etc. Non-domestic works included works like attending religious ceremonies at village, wage labour, etc. for which a woman needed to go outside her house. Community performances were generally undertaken by few sections of women who were socially motivated, or the family and the society allowed them to choose. These included different forms of work such as attending different institutions, meeting, etc. which were undertaken only by those section of women who were members of different social or economic institutions such as village panchayats, SHGs, etc. The impact of division of works between men and women can be seen in the form of deprivation of women from the economically productive resources, which further led to exploitation of women. The women's works were not economically unproductive, but the society considered these works as economically unproductive. Therefore, unpaid domestic chores were exclusively assigned to women. On the other hand, by keeping the economically productive works with them, men at the village maintained economic dependency of women on men.

Although the above description of work division between men and women at these villages seemed to be simple and based on social norms, it was one of the important process of distribution of power between men and women at field. Thus, sexual division of labour is a social structure to the extent that this allocation becomes a constraint on further practice (Connell: 1987).

Wage rate of women was not equal to rate paid to men. By doing this, they were actually not allowing the women to carry out other activities, while men had exclusive rights over them. For example, use of technology in agriculture replaced women's control over some of the traditional domains such as harvesting of paddy. Therefore, mechanisation of different activities, basically agriculture, displaced the women's control over production as men assumed control over machines. Men at these villages now controlled the works which were earlier done by women. Thus, the construction of sexual division of labour is not just a matter of allocation of work to people, but it also involves the design of the work (ibid). Social norms were being constructed to control the labour of women or to prevent them from controlling the economic resources.

vi. Impact of Gram Panchayat on women:

During the field study, Gram Panchayats were managing schemes such as MGNREGS and IAY. The MGNREGA which was introduced with an objective to enhance the livelihoods, security of rural poor by providing at least one hundred days of guaranteed wage employment to able bodies of each household in a financial year (Shah: 2012). This had made mandatory the provision of participation of women in the programme, and hence fixed a certain amount of resources to be handed over to women. However, analysis of MGNREGS works showed that the level of participation of women in this programme was far below the mandatory provision. Even the participation of both sexes was lower than the mandatory percentage. Interestingly, it was not even half of the total work force of these villages.

Now, question may arise as to why—in spite of equal wage rates and a huge labour force—was the participation in MGNREGS low in these villages. Further, it can also be found that if we count one labourer irrespective of sexes, representing one household whose primary livelihood was wage labour, then also the percentage of people involved with the MGNREGS was less in comparison to the total households involved with wage labour. Then, one may ask why people were not getting involved with MGNREGS. The foremost reason for this low participation in MGNREGS was late payment to the labourers as revealed by FGD and through interview with women informants. It was informed that they were paid late. Even the guidelines of the act urged to pay the wages on weekly basis and not beyond a fortnight in any case, but they did not receive their wages in time, and payments were delayed; in fact, in some cases these were delayed for more than six

months. No doubt it is very difficult for a wage labourer to continue to work if they were not paid regularly. This resulted in low participation of wage labourers and was less attractive for them. In such conditions, how would a wage labourer accept work with late payment when their main livelihood was wage. People, due to late payment, preferred to work in other places where they were paid regularly even though they were paid less wage, no matter whatever the wage rate, they got it on daily basis. Some earlier studies (Khera and Nayak: 2009; Abraham: 2010; Kakati and Behera: 2014) reveal the same. Further, the delayed payment also led to low participation of women in MGNREGS as 'delays in wage payment make things particularly difficult for single woman who cannot afford to wait for work and wages as they are sole earners in the family' (Khera and Nayak: 2009).

Yet, there were some who preferred to work in MGNREGS because of the nature of this scheme. This scheme has the provision of wage employment in the village premises or in a short radius of house of the labourers. Few informants shared that they worked in MGNREGS only because they got wage employment under MGNREGS inside the village. It was revealed that the panchayats employed contractors to carry out the different works of MGNREGA. To finish the work quickly, the contractors used machines and other technologies. In such situations, the status of tribal women was worse than that of men as they did not have decision making power and their jobs could be easily appropriated by other male members of their family. Along with low participation of people in general, and women in specific in MGNREGS, people were less aware about MGNREGA. They did not know the different provisions of this act such as unemployment allowances, procedural formalities of making complaints against the non-payments or late payments of wage, etc. Thus, all these affected the participation of women in this programme. This scheme and this agency have at least tried to generate the concept of equality among the people providing them with equal wage and equal participation. However, there is a need for creating awareness among the women regarding the programme and sensitizing them about the programme. Further, Gram Panchayats can play an important role in leading this as it is the lowest level institution of decision-making and has its roots in society.

Munda Tribe:

Women belonging to Munda tribe of Khunti district, Jharkhand had mixed set of conclusions. Very few women enjoy their job and are passionate about it. Few women work under the government and influence people about hygiene and other concerns. Women complain about not having permanent jobs and fixed salary. They do not get paid timely. Women lack in communication and have not received education. Most women face poverty here; they should be made aware about poverty and ways to deal with it to overcome. One educated woman could find a job outside of the village but was scared to leave the village. Other women spoiled her interview as she reached the location drunk.

The village has bad transport facilities and roadways. The village faces water scarcity throughout the year. The villagers hope that they have water irrigation facilities throughout the year which would help them earn better. Job opportunities should be made available to the villagers. Though MNREGA is available, most work in the programme is now mechanised and also the wages are not fair and timely. Government facilities like ration should be provided and Anganwadi food supply should be made regular. Children should be provided with basic requirements and education. Though schemes are available, they are not implemented properly. Women suggest that they need to be supported in order to fulfil their dreams like starting a small business or study further. Training should be provided in various fields in order to improve women's skills and enable them a path to earning income.

Oraon Tribe:

Women associated to the Oraon tribe of Ranchi district, Jharkhand, mostly engage in farming and poultry. The women are poverty stricken and have no means to come out of it. They work very hard to meet the family needs, but they fail to do so. Income is very less and irregular. Wages paid are less and dissatisfying. The village has many problems regarding water, bad road conditions, no proper medical facilities and very bad support systems. There is only one primary school in the village. They hardly have any opportunities. MNREGA is available but is not sufficient to fulfil all their needs. Ration is available, but the quantities are reduced without prior intimation. The women are poor in communication and hence do not ask for their rights and needs. Women hope to get support to establish businesses that would help them earn. They hope to get training in various fields like tailoring that would generate some income and would provide a means to support their families.

Therefore, it can be concluded that Munda and Oraon in Jharkhand have no defined methods of assigning task explicitly to men and women. Both are equally responsible for the execution of tasks in the house and outside it. They have equal contribution in the income of the family. Therefore it was observed that in both the tribes, women were stereotyped to perform all the household tasks that are 'meant' to be done by them. Men of the given tribes in Jharkhand are solely responsible for ploughing in the field. Despite continuously contributing to the economic growth of the region and importantly in a sustainable way, we see the difficulties faced by them are often ignored by the mainstream society. The growing inequalities— social, economic, political—between the women working in rural and tribal areas, and the women working in urban and non-tribal areas cannot be taken for granted. The problems such as deforestation, lack of infrastructural development, irregular pay, etc have a greater impact on the tribal communities than they have on others. The need of the hour is to look beyond MGNREGA and other schemes which provide very marginal help, and rather look for long-term solutions that would reduce the inequalities and be useful for the usually neglected communities. Therefore we conclude that a patriarchal society exists in the tribes of Jharkhand where more preference is given to the male members of the family. There still exists a huge gap between the male's and female's equal rights.

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"Productivity is never an accident. It is always the result of a commitment to excellence, intelligent planning, and focused effort."

–Paul J. Meyer

Feature

Literature Review on Quality Concepts in Industrial Systems using QFD (Quality Function Deployment) – Survey and Extensions

P. SIVASANKARAN

In this paper, the importance of quality concepts in product development is studied by reviewing several papers from various reputed journals. In order to improve the quality of product design, QFD (Quality Function Deployment) is used as a tool that studies the various parameters of product design such as aesthetic appeal, cost, service life, maintenance, etc. In QFD, the analysis is carried out to improve the quality of the product design based on customer's evaluation. The use of QFD helps the product development management team to take decisions about the product quality by studying and improving its characteristics. In every organization, there will be a cross functional team, which comprises of Design, Safety, Quality and Maintenance. With the help of the cross functional team member's suggestions, it will be possible to improve the safety, design and aesthetic appeal of a product. Hence, in this paper, an attempt has been made to study and review various characteristics of product design and development, namely QFD model and also report several case studies in different domains of industrial applications.

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1. Introduction

QFD (Quality Function Deployment) is a customer-focussed tool which helps to strive hard for excellence in product quality by translating the customer needs into specific requirements of the product design such as good look of the product in terms of aesthetics, cost, service life and maintenance. QFD is used to tackle customer-oriented problems related to product services and measuring satisfaction through quality enrichment of product design by improving its technical features such as geometries, dimensions etc. Chan and Wu [1] defined QFD as "the set of procedures or system of guidelines used to satisfy the request of customer needs in terms of efficient product design and production process". Generally, QFD comprises of 4 phases. First phase is said to be House of Quality (HOQ), which is said to be the most important segment in deploying QFD process. In this phase, after finding out the customer needs and technical characteristics, the relationship between Customer Needs (CN) and Technical Characteristics (TC) of the product design are determined by finding the weights. In the second phase, TCs of product design are converted into specific personal needs of customers. The critical aspects of the product design are considered in the third phase, which the last stage specific production requirements of the product design. Majority of data of "QFD processes and activities" are used in simple natural language. For example, customer expectations from products are expressed using phrases such as "easy to handle", "flexible", "safe" and "endurance", which are to be evaluated. Use of FQFD (Fuzzy Quality Function Deployment) with other techniques improves its efficiency and effectiveness. In 1969, Yoji Akao introduced the concept of QFD. He aimed to take advantage of the power of QFD in its product design stage such that service quality metrics are obtained

from product design characteristics. Later, many researchers contributed several methods to enhance the power of QFD. The design goal is achieved through quality control, which is an important activity in the product design stage. Quality control ensures that the design quality conforms to product specifications. QFD is the productive methodology for recognizing the customer's perception and connecting them into technical requirements.

QFD manages various heterogeneous team members like marketing team, design engineering team and manufacturing team who work together in uplifting the product's quality.

2. LITERATURE REVIEW

This section gives a comprehensive review of literature of QFD, which is an important tool to rank technical descriptors of a product based on customers' requirements.

The taxonomy of the literature review of QFD process is as presented in Figure 1.

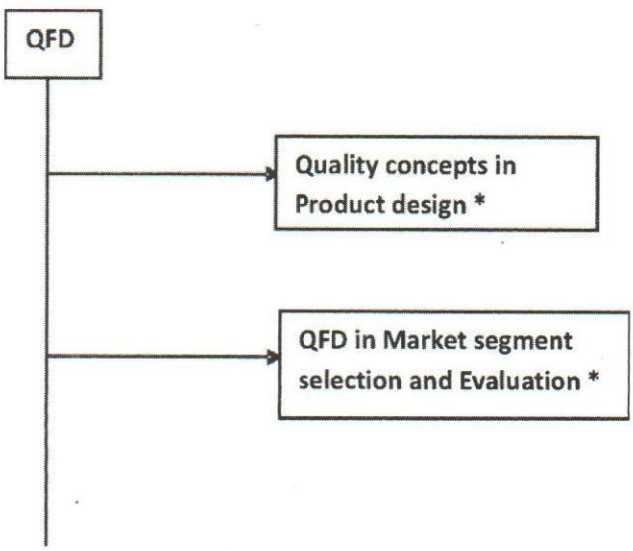

Figure 1: Taxonomy of QFD process

*2.1 QFD in Product Design Concepts

*2.2. QFD in Market segment selection and Evaluation

*2.1 QFD in Product Design Concepts :

Abdolshah [1] carried out a survey in two main classifications. First one tells about a proposed model to develop FQFD (Fuzzy Quality Function Deployment). The second one was focused on new applications of FQFD models. Most of the research work focused on quantitative methods of QFD that is House of Quality (Phase) 1 oriented towards multi-criteria decision-making methods in product development.

Puglieri [2] carried out survey based on the environmental aspects or eco-design of product development process by aid of various techniques, tools and procedural methods, but in other literature works many authors do not focus on environmental aspects of product quality. This paper has three broad categories: 1. Determining eco-design and operational aspects of product development process. 2. Assessing and selecting the QFD based product which is focused on environmental friendliness. 3. Analysing the research perspective of product development process and eco-design. So, the review was carried out based on the eco-design of the product development and its operational criteria using QFD techniques.

Chan and Wu [3] carried out various literature review on QFD for about 650 publications through various sources from reputed journals. They performed different reviewing processes about QFD and its importance in various fields of engineering, viz. product development, quality management, customer needs analysis, product design and product planning. These are the key areas where QFD can be applied to enhance the quality of products and services.

Gonzalez et al., [4] analysed the design furniture used in schools in developing countries based on Costa Rica as base point. They designed a "Dynamic Process Model for QFD". This model facilitates the team for taking decisions which are efficient and effective after considering the customers' requirements. This approach ensures product safety and service features using a simplified form of QFD.

Gandara, Muri and Purba [5] carried out a research to come out with right design for improved services of formaldehyde products, as per the requirements of customers using QFD. In this study, an effective questionnaire was designed to capture data on customer satisfaction from respondents in a field survey.

Neira-Rodado et al., [6] developed "a novel integration of AHP (Analytical Hierarchy Model) and QFD (Quality Function Deployment)". They translated the customer requirements into technical descriptors and further ranked them in their order of importance from high to low. In reality, many of the customer requirements possess vagueness, which is resolved using fuzzy. This computes the impact of each requirement. Then the design alternatives were generated using the weights of the requirements through

AHP. The independencies among the alternatives have been evaluated through DEMATEL. It is followed by the selection of the best design using QFD.

Rogers and Salustri [7] introduced pattern languages for product design to gather information and convey them to others who have limited knowledge.

Shih and Chen [8] applied QFD for the conceptual design of a future mobile or portable healthcare device. They coupled with Analytical Network Process (ANP) and Theory of Inventive Problem Solving (TRIZ). The results of the combined approach help to characterize priorities of the product of concern.

Cherif et al., [9] formulated an imprecise goal programming model to optimize the optimum target levels of engineering characteristics of QFDs such that the customer satisfaction is maximised, subject to resource limitation and market competition.

Yang et al., [10] proposed a hybrid method, which uses the theory of inventive problem solving coupled with KANSEI to evaluate QFD processes for developing new product design in its initial phase. This research uses numerical rating scale based on questionnaire, factor analysis and AHP at the first instance.

Next, a correlation matrix and interrelationship matrix of Quality Function Deployment are used to establish critical innovation points. This results with many alternative designs suitable for inventive principles, design rulers and crucial design zones. At the end, Kansei evaluation framework of the best design alternative is discussed. This method is used to design innovative car seat design.

Ionica and Leba [11] tried to integrate new product development process with QFD. They increased the robustness of the product design through the voice of the customers. The results of QFD focused determining the requirements, which are useful for design phase and product development phase.

Falk and Schmitt [12] emphasized the fact that the product must have quality and value for money, instead of having only the attractive features. They directed their study by giving importance to determination of customer requirements and integrating them to the technical descriptors in the process of new product development.

Sivasamy et al., [13] carried out a survey to capture the characteristics of different QFD models. As everybody knows that the objective of any QFD is to translate the customer requirements into technical descriptors, they identified different features of QFD studies carried out in the past and compared the computational complexities of them. The complexity of QFD is reduced using Total Quality Function Deployment (TQFD) technique.

Moldovan [14] used QFD coupled with knowledge management to determine customer requirements of a product to rank the technical descriptors of a product, for a new product manufactured by a mineral water company.

Mrugalska and Tytyk [15] carried out a review and recommended advanced technology to extend the use of the product in varied connotations. This study has been oriented to improve the reliability and safety of the product by considering the aspect of uncertainties, which will prevail in reality.

Luu et al., [16] concentrated on emotional and psychological needs of customers along with functional needs of the customer of a product of interest. Such consideration would definitely improve the success of the product in the market in terms of overcoming competition and improving the market share of the product. This design involves interaction with people, product and environment. They applied this approach to a baby bicycle design and found that it had greater positive impact for the product in the market.

2.2. QFD in Market segment selection and Evaluation:

Luu Quoc Dat, Thinh Thi Phuong, Hsing-Pei Kao, Shuo-Yan Chou and Pham Van Nghia [16]

In this research, authors have done some analysis on market segment evaluation and selection of target markets. In today's scenario, these are the two critical activities for all companies. In order to evaluate and choose appropriate market segments, several decision-making attributes must be considered in the process of evaluation. In this paper, focus is on new integrated Fuzzy Quality Function Deployment (FQFD) to aid the market segment selection. The proposed approach of research using QFD must have the ability to understand the features of Market (Whats), in order to fit the company's strength (Hows).

The computational method is illustrated by means of case study. Finally, this research compares the proposed approach with Fuzzy QFD approach, demonstrating the advantages of proposed approach.

Chih-Hsuan Wang, Jiun-Nan Chen [17] In this research, it was observed from the fact that, in growing

fast global marketing environment launching new products in the customer market segments is said to be challenge. Also, many firms now try to launch the products within a shorter lead time. In this study, a Fuzzy MCDM (Multi-criteria decision-making) based QFDs which integrates Fuzzy Delphi, Fuzzy DEMATEL (Decision Making Trial and Evaluation Laboratory) with LIP (Linear Integer Programming) was used to support an enterprise with more product mix in a collaborative way. In this research, Fuzzy Delphi was used to collect marketing information or data from various customers. Fuzzy DEMATEL was used to solve the priorities of technical attributes in a market-oriented manner, while LIP was used to enhance the maximum capability of product as per a vendor's budget constraints.

Ze-Ling Wang, Jian-Xin You and Hu-Chen Liu [18] Quality Function Deployment (QFD) is a widely used quality system tool for converting customer requirements (CRs) into engineering design requirements (DRs) of products or services. The classical QFD analysis has been criticised based on the limitation such as relationship, between customer requirements and engineering design requirements. The assessment of customer requirement weights and the prioritization of design requirements are studied using QUALIFLEX (Qualitative Flexible Multiple Criteria Method) approach for tackling QFD problems with weight information. Finally, an analysis of market segment selection problem is conducted to demonstrate and validate the proposed QFD approach.

K.G. Durga Prasad, K. Venkata Subbaiah, K. Narayana Rao and C.V.R.S. Sastry [19] In this research, authors have studied the importance of customer preferences using market segmentation by forming a basis for House of Quality matrix. In conventional QFD approach, as per hierarchy structure of consumer needs is formulated through various assignments of weights for customer needs. The priority weightage ratings of customer needs may be different for various needs. In this paper, a case study is presented to illustrate domestic refrigerator working and functions using QFD as a proposed methodology to establish the different preferences of customer needs in detail.

Züleyhan Baran and Mehmet Selami Yıldz [20] The main aim of this paper is to consider the requests made by the various customers for products in order to maximize the customer loyalty as well as retention by applying modern management tool like QFD methodology (Quality Function Deployment). In this paper, QFD methodology is used to assess the quality of fast-food industries with the aim of giving quality services within short lead time.

Mohammad Hassan Pourhasomi, Alireza Arshadi Khamseh and Yaser Ghorbanzad [21] In this research, the authors have addressed various competing pressures faced by service sectors around the world. Quality plays an important role in banking industry and customer service satisfaction is considered as the most important goal in the field. The proposed study aims to integrate the two approaches of Quality Function Deployment (QFD) and Kano's Model through implementation of AHP (Analytical Hierarchy Process). In this research, the authors attempted to identify the different priorities of customer's requirements in a banking industry. The result proves that the consumer preferences are different before and after applying KANO'S model in the planning matrix of QFD.

Andreas C. Georgiou, Katerina Gotzamani, Andreas Andronikidis and George. N. Paltayian [22].

The proposed research uses QFD in order to assess and transform the customer's needs into required achievable goals for enhancing the capacity requirements. Specifically, this study aims to focus on selection criteria "wants" of banks in Greece. Customer "wants" are related to key product market segments to formulate the house of quality matrix. A specific questionnaire was designed based on the list of selection criteria that was drawn from past surveys and nearly 549 questionnaires were administered to customers of major bank Thessaloniki, Greece.

Sheng Teng Huang, Yoshida Shigeru [23] In this research, authors have strongly focused on the national policy guidelines for logistics industries as published by Japan comprehensive logistics policy 2012, plans to efficiently integrate transportation mode and establish complete global logistics network to meet the ever-increasing demands for advance logistics infrastructure. As observed from the survey, nearly 70 per cent of the firms in Japan and 40 per cent of the firms in U.S. prefer to outsource their major logistics distribution channels. The main objective of this paper aims to improve the service quality of fourth party logistics service provider and applies QFD to explore the key performance of quality improvement. Customer retention through achieved satisfaction is said to be a major task in logistics industry. QFD is one of the unique features by cross correlation analysis between customer requirements and technical measures.

Ibo van de Poel [24] It is noted from the survey, that QFD is a famous and widely used tool in the product development industry. QFD tries to focus on setting objectives for improving product characteristics by following better marketing research. In this research the main aim is to focus on fundamental aspects of QFD and its limitations which are applied by taking practical applications like customer market segmentation. In this research, the major deviation observed is the impossibility of converting individual into customer demands as overall in total measures.

Andreas Helferich, Georg Herzwurm and Sixten Schockert [25] In this paper, strong focus is made on understanding the competitive business atmosphere with respect to today's scenario, where it is evident that companies must be able to offer products as per the consumer's requirements. Software product lines must have the ability or potential to support industries by offering large variety of products of various types. But even offering a large range of varieties does not influence the increase in profits. The role of product portfolio management is the enhancement of product portfolio that optimally satisfies the consumer needs, while at the same time it limits the number of products offered. In this paper, QFD is used to demonstrate the product portfolio planning thus offering potential benefits.

Dinmukhamed Kelesbayev, Kuatbek Kalykulov, Yermek Yertayev, Altynay Turlybekova and Akhmet Kamalov [26] In this paper, the importance of quality improvements in technical education universities are considered as primary objective of the research. However, it is considered that raising the quality of education at par with international level is a big challenge to all technical universities in today's economic world. In this study, QFD is used as a systematic method for improving the quality of education with respect to the country's demographical culture. This study is about the demand of course students from universities and reveals the quality of education services at best satisfactory level.

Sung Chun Choi [27] In this paper, focus is on product platform design; and development is a process that involves different stakeholders, both internal and external, within and away from organisation. Although there are numerous methods in product design platform such as generation, selection and optimisation have been proposed and executed through various case studies presented in this paper. In this paper, water purifier product platform options were generated and assessed for their effects on value chain such as organisation structure, product line configuration, economic effect and preferences of various stakeholders.

Xiaosong Zheng, Petri Pulli [28] In this research, QFD used for improving customers' requirements in mobile services application. Conventionally, QFD is used in product manufacturing lines. In this paper, QFD is used in mobile service industry, a highly challenging industry, in information security systems. In this research, case study is carried out to conduct mobile e-learning services for university professors and students using QFD methodology.

Evrim Kabukcu [29] In this paper, the author addressed the quality concepts of fashion industry using QFD. Fashion industry is said to be increasing in popularity in today's conditions due to the rapid cycles of products, sustainable products and processes in term of creativity and innovative approaches are desired. In this study, QFD house of quality was designed with QFD approach. In this juncture, experts from fashion industries evaluated the brands of products using QFD method. Thus, technical descriptions and social aspects of products are analysed and collected together.

Liang-Hsuan Chen and Cheng-Nien Chen [30] In this research, authors used to focus target market segment based on customer specification or needs using QFD. In this paper, mathematical model is proposed to find the level of target market segments. From this numerical model, overall customer satisfaction level is measured and evaluated.

A.I.A. Costa, M. Dekkar and W.M.F Jongen [31] This paper presents a detailed literature review about the applications for food industry with the aid of QFD tool. This review is extended with various methodologies involved in the practice of food industry. The benefits, applications and challenges in using QFD are discussed.

Summary of Review

From the above review it is noted that several authors have contributed their ideas to improve the quality concepts in product design using QFD tool along with various additional techniques like DEMATEL, AHP and KANSEI MODEL etc., to evaluate certain parameters.

Conclusion

In this paper, the brief reviews are focused on modern management tools and techniques to improve the accuracy

of product design like QFD or House of Quality. QFD tries to merge both consumer requirements and product's technical characteristics, based on which the relative weights are assigned accordingly. Determining the correlation between two factors and measuring the variation out of any two factors, say cost and maintenance of the product. Likewise, several factors are measured whose relative weights are tabulated in the House of Quality Matrix. Also, in another section in the literature, a study is carried out on market segmentation and selection of customer preferences using QFD in specific areas like consumer behaviour, product target markets, product performance, customer loyalty in fast food restaurants, banking industry, QFD in logistics, product portfolio management etc.

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Excellence is a continuous process and not an accident."

–A. P. J. Abdul Kalam

Feature

Problems Faced by Physically Challenged Students in Accessing and Utilizing the Library Resources and Services of College Students in India

M. MURUGAN AND R. JEYSHANKAR

This study explores the personal and institutional issues confronted by physically challenged UG and PG college students of India in accessing and utilising the library resources and services. The data was collected from 27 randomly selected colleges. Census method was employed to select the respondents. A well-structured questionnaire was employed to collect the required data. 129 respondents participated in the study. The study reveals that: The most prominent personal issues faced by the respondents in accessing the library, its resources and services include lack of ICT skills, difficulty to reach the library, lack of internet skills, lack of computer skills and difficulty to get required information by themselves. The institutional issues most agreed by the respondents include insufficient space, materials and equipment, no disability-friendly furniture, inadequacy of recent publications and current journals and lack of guidance about use of library resources and services. Nature of disability, studying district and gender do not, but studying course and studying department do have an impact on the institutional problems faced by the respondents.

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1. INTRODUCTION

Libraries are service organisations that collect, organise, store, preserve and disseminate information to all its eligible patrons. A public library is open to all the citizens. An academic library is open to all the incumbents of the parent body-school, college or university. In terms of a true democracy, a library is supposed to serve all its patrons without any discrimination. No colour, creed, caste, community, race, language, physical ability, educational qualification, wealth etc., should have an impact on the equitable provision of library resources and services. As Michell (1996) rightly pointed out, "the ideal library service is one which each individual, regardless of their degree of disability, has access to the materials and information at the time they are required, in a format that can be used, in the quantities that are needed, and where the needs of the user are understood by the staff. In a nutshell, the resources and services of a library must be accessible to all irrespective of their level of ability or disability".

This is very true when it comes to the library services for physically disabled users. The user community may consist of different kinds of physically challenged users. Some of them may be physically challenged. They have mobility problems. Some of them move around with the help of crutches or sticks or wheelchairs. Some of the users may be hearing impaired, visual impaired and speech impaired. Some of the users may be suffering from some mental disorders or slow learning abilities. It is the duty of every library that has physically/mentally challenged users, to serve such patrons at par with normal library users. Uzohue and Yaya (2016) remarked that provision of library and information services to the disabled is very important to every society. Ezeani et al., (2017) too supported this motion with his statement "The role of library in ensuring

inclusive access to information and services is crucial".

2. NEED AND SIGNIFICANCE OF THE STUDY

Libraries are social institutions that preserve and promote culture, science and civilisations. Libraries have been evolving from clay tablets-based store houses to computer tablets-based service organisations. The kind of materials they acquire, the methods they follow to organise these materials, the way they strive to reach their users, the kind of services they undertake, the nature and expectations of their clientele and the social environment in which they operate etc...all have been changing over a period of time.

People say library is the best example for the implementation of 'true democracy'. Because it is a place where all kinds of readers are permitted to avail the library services irrespective of their caste, creed, colour, community, religion, nativity, educational background, economic status and such other discriminating elements. The library resources and services are meant for the entire community, in case of public/community libraries.

This is so true in the case of academic libraries also. But in the academic libraries, it serves only a limited set of well-defined group of users- students, research scholars and faculty members of the parent body. In case of arts and science college libraries, the clientele comprises of undergraduate and post graduate students, M.Phil. scholars, Ph.D scholars, faculty members and non-teaching staff of that particular college. Majority of the users in any arts and science college are UG and PG students.

The college library is expected to be an inclusive library – an organisation capable of serving all kinds of students – first year students, last year students, students with interest to read for pleasure, for life and for academics, etc. Most importantly the library should provide an all-encompassing environment. Both normal students and physically challenged/differently-abled students are to be served by the college libraries.

Though the number of physically challenged/ differently-abled students may be less in number, it is the moral responsibility of any college library to serve this small set of users. The differently-abled users may be either physically challenged (they have mobility problems) or visual/hearing impaired students. Both these groups of users have different set of expectations from their libraries. The physically challenged users need the same kind of resources that are required by other normal users. But they need more physical provisions in the library that help them have easy mobility within the library or they need special kind of arrangement of resources so as to enable them to reach the resources without any issue. But in the case of visual/hearing impaired students, they need entirely different set of resources and resource accessing tools than both normal students and physically challenged students. As they are not able to read normal library resources, they need required information in different format, or they need different assistive tools to access the normally available resources.

It is important for the college or library authorities to conduct periodical evaluation studies and collect feedback from their clientele about their infrastructure facilities, resources, services and physical provisions. This will help them understand the pulse of the differently-abled users, their expectations, their comments on the existing resources and services, their level of satisfaction with library and library staff and the problems they counter in using the library. It is also pertinent to understand the information needs of the differently-abled students and various information channels used by them to quench their thirst for information. So, such user studies/evaluation studies/ feedback surveys are very important for any library to reshape, refresh and rejuvenate its physical infrastructure amenities, its resources, its services, its ICT tools and technologies to transform them to meet the information requirements of differently-abled students and prove that the college libraries are inclusive libraries.

3. LITERATURE REVIEW

Different studies examined the problems faced by the physically challenged users in reaching, accessing and using the library, its resources and services. Some studies focused on select issues, while others investigated all possible issues encountered by them. The problem of inadequate materials is reported by Khasseh et al., (2020); Ayiah (2007); Atinmo (2002); Lawal-Solarin (2012); Adetoro (2012); Said (2017); Lucky and Achebe (2013); Kwak and Bae (2009) and Ekwelem (2013). The problem of lack of provisions was revealed by Ponera (2015); Lawal-Solarin (2013); Okoli (2010); Iyoro (2004) and Cassner et al., (2011). The unavailability of skilled libraries was reported by Ochoggia (2003) and Bodaghi et al., (2014).

The problem of lack of skilled librarians to help/render services to physically challenged users was noted by Ochoggia (2003) and Bodaghi et al., (2014). There is a problem of lack of accessibility according to Carter (2004);

Chataika (2010) and Lawal-Solarin (2012). Researchers like Alqaryouti (2010); Ekwelem (2013); Bhardwaj (2018); Ayiah (2017) raised the issue of lack of assistive tools and adaptive technologies in the libraries. There is also a problem of lack of knowledge/awareness/training for the physically challenged users as disclosed by Quarless (2016) and Fatima & Kumari (2017). The problem of inadequate library services was reported by Abdelrahman (2016); Wambua (1995); Ayiah (2007) and Kumar and Sanaman (2015). Financial constraint was the major problem as reported by Harris and Oppenheim (2003); Majinge (2014); Shunmugan (2002); Bodaghi et al., (2016); Hopkins (2000); McDonald (2000); Wei et al., (2012); Murugan & Jeyshankar (2019) and Khasseh et al., (2020).

The libraries do not have sophistically devised services for the differently-abled users. This problem was supported by Abdelrahman (2016), Wambua (1995), Ayiah (2007) and Kumar and Sanaman (2015). A good number of studies explored different kinds of problems faced by the differently-abled students. Adetoro, N. (2014) assessed the provision of information materials in alternative format, in terms of its availability, access and level of use by the visually impaired in public libraries in southwestern Nigeria. 166 visually impaired persons that were personally interviewed, and the observations made, were analysed. The study found that the needed materials were inadequate and, e-resources were not available, Braille is the most utilized format while audio materials and large prints were seldom used.

Sambo et al., (2016), confirmed that problems confronting information needs of the physically challenged include furniture in the library are not good for relaxing (100%), lack of infrastructural facility (82%), lack of information materials (76%), lack of architectural design (73%), staff attitude is discouraging (67%), library environment is not accommodating (61%), and others (41%). Kumar & Sanaman (2013) surveyed preference and use of electronic information and resources by blind/visually impaired users in the leading National Capital Region (NCR) libraries of India. The study found that 'complexity of content available on the net' is found as the major challenge faced during Internet use by blind users and 'Audio books on CDs/DVDs and DAISY books' are the most preferred electronic resources among the majority of blind/visually impaired users. Baskaran, Babu & Gopalakrishnan (2013) studied human behaviour of the Library and Information Science (LIS) students in India. In the survey, three aspects comprising student behaviour have been analysed such as work environment, natural environment, and social environment and discussed about complacent, patient, easy-going, and relaxed. Finally the authors suggested that LIS students need to possess certain qualities and behaviours to work in different environments.

The most common constraints faced by disabled student users was cost of buying and equipping electronic resources (93%), followed by "most university libraries are still unaware of the needs of the disabled student users (91%)" followed by "most electronic resources are designed for normal users" (73%). The finding also showed that the respondents did view the high development cost and the small market in assistive technology as a constraint (70%) (Ekwelem, 2013).

The major problems that hindered wheelchair user's information needs include inadequate entrance (100%), lack of architectural design (95%), inadequate orientation/ lack of chairs with sturdy armrests (74%), inability to retrieve books/social discrimination (72%), poor concentration/inadequate facilities (67%), staff attitude is discouraging/inadequate relevant materials (51%) and 7 per cent others (Sambo et al., 2018).

Problems faced by the Physically Challenged Persons are: lack of appropriate furniture in the library for this class of users, library staff's attitude towards the Physically Challenged Persons is horrible and lack of appropriate orientation programme to the group (Idhalama, 2019). 72 per cent respondents said they lack braille books, 88 per cent lack well-equipped library, 76 per cent lack of building facilities, 88 per cent lack of standby library staff to assist, 84 per cent lack of special attention to the blind, 80 per cent lack of automatic doors for the visually impaired, 92 per cent lack of lifts for multi-storied buildings and lack of walkway free of obstacles. 88 per cent and 76 per cent lack walking sticks and government attention respectively (Onifade & Babarinde, 2020).

4. METHODOLOGY

The researcher has adopted descriptive research design for the present work. The researcher has used survey method of research. The UG and PG students of arts and science colleges located in Dindigul, Madurai and Sivagangai districts of Tamil Nadu state, India, form the population of the present study. Out of 79 arts and science colleges functioning in these three districts, 27 (one-third) colleges were selected. 5 colleges from Dindigul, 7 colleges

from Sivagangai District and 15 colleges from Madurai were randomly selected by the researcher from among the list of colleges where some sort of physically challenged UG/ PG students are pursuing their higher education. The researcher has followed census method for distributing questionnaires to the available physically challenged users at the time of his visit.

A structured questionnaire was used to collect data. The questions were set to be simple, mostly having yes or no type of dichotomous questions. Only very few questions had 5-point Likert scale statements. The researcher has personally visited all the seven colleges of Sivagangai district, distributed the questionnaire copies to the students directly and collected the data, as he resides in Sivagangai district. Out of 15 colleges drawn from Madurai district, the researcher has visited 10 colleges personally, distributed the questionnaires and collected the data. He has mailed the questionnaires to the remaining five colleges. Since Dindigul district is a bit far, he had mailed the questionnaires to all the five colleges there and collected data with the help of libraries working over there.

5. OBJECTIVES

The present research work was conducted with the following objectives:

- To examine the personal issues faced by the respondents in accessing the library, its resources and services and
- To examine the institutional issues faced by the respondents in accessing the library, its resources and services.

6. HYPOTHESES

- There is no significant difference between gender, course, department and district of the respondents and the personal issues faced in accessing and using the library, its resources and services and
- There is no significant difference between gender, course, department and district of the respondents and the institutional issues faced in accessing and using the library, its resources and services.

7. DATA ANALYSIS

Table 1 shows that out of 129 respondents who are physically challenged, 65.1 per cent are male and 34.9 per cent of female; 68.2 per cent are undergraduates and 31.8 per cent are postgraduates; 45.7 per cent are from social science courses, 44.2 per cent are from language studies and 10.1 per cent are from science courses; 49.6 per cent belong to Madurai district, while 24 per cent belong to Sivagangai district and 26.4 per cent belong to Dindigul district. Thus, most of the physically challenged respondents are male, undergraduates, from social science courses and belong to Madurai District.

Table1: Socio-Demographic information about the respondents

Variable	Levels	Count	%
Gender	Male	84	65.1
	Female	45	34.9
Course	UG	88	68.2
	PG	41	31.8
Department	Science	13	10.1
	Social Science	59	45.7
	Language	57	44.2
District	Dindigul	34	26.4
	Madurai	64	49.6
	Sivagangai	31	24.0

Table 2 shows the personal issues faced by the respondents in accessing the college library, its resources and services. More than 60 per cent of Physically Challenged students lack ICT skills (78, 60.5%) and face difficulty in reaching the library (90, 69.8%). More than half of the OC students agreed that they lack time (75, 58.1%), they have difficulty to get required information by themselves (74, 57.4%), they lack computer skills (74, 57.4%), they lack internet skills (71, 55%) and they lack skills to use adaptive and assistive technologies (74, 57.4%). One-third of them agreed that they are teased by friends (47, 36.4%) and they have difficulties in locating the needed materials (46, 35.7%).

More than 60 per cent of them are neutral with such personal issues as teasing by friends (78, 60.5%), difficulty to move around the library (85, 65.9%) and difficulty in locating the needed materials (78, 60.5%). Slightly more than one-third of them are neutral to issues like lack of

Table 2: Personal issues in accessing and using the library, its resources and services

Personal Issues	SA	Agree	Neutral	Disagree	SD
Lack of ICT skills	10 (7.8%)	78 (60.5%)	36 (27.9%)	5 (3.9%)	0 (0.0%)
Difficulties in locating the needed materials	0 (0.0%)	46(35.7%)	78(60.5%)	5(3.9%)	0 (0.0%)
Lack of time	0 (0.0%)	75 (58.1%)	48 (37.2%)	6 (4.7%)	0 (0.0%)
Difficulty to reach the library	0 (0.0%)	90 (69.8%)	34 (26.4%)	5 (3.9%)	0 (0.0%)
Difficulty to move around the library	4 (3.1%)	32 (24.8%)	85 (65.9%)	8 (6.2%)	0 (0.0%)
Difficulty to get required information by oneself	2 (1.6%)	74 (57.4%)	49 (38.0%)	4 (3.1%)	0 (0.0%)
Lack of computer skills	2 (1.6%)	74 (57.4%)	51 (39.5%)	2 (1.6%)	0 (0.0%)
Lack of internet skills	3 (2.3%)	71 (55.0%)	53 (41.1%)	2 (1.6%)	0 (0.0%)
Lack of skills to use adaptive and assistive technologies	1 (0.8%)	74 (57.4%)	49 (38.0%)	5 (3.9%)	0 (0.0%)
Teasing by friends	2 (1.6%)	47 (36.4%)	78 (60.5%)	2 (1.6%)	0 (0.0%)

Note. SA = Strongly Agree; SD = Strongly Disagree

skills to use adaptive and assistive technologies (49, 38%), lack of computer skills (51, 39.5%), difficulty to get required information by themselves (49, 38%) and lack of time (48, 37.2%). 1 to 6 per cent of the respondents disagree with the personal issues faced in accessing the library, its resources and services.

Table 3 shows that lack of ICT skills (WAM of 3.72) and difficulty to reach the library (WAM of 3.65) are the

Table 3: Personal issues: Mean values one sample KS test of normality (Testing of hypothesis one: independent variables *Vs.* personal issues)

Personal Issues	Mean	One Sample KS Test	
		Test Statistic	Sig. (2 tailed)
Lack of ICT skills	3.72	.346	.000
Difficulties in locating the needed materials	3.31	.364	.000
Lack of time	3.53	.367	.000
Difficulty to reach the library	3.65	.429	.000
Difficulty to move around the library	3.24	.378	.000
Difficulty to get required information by myself	3.57	.357	.000
Lack of computer skills	3.58	.360	.000
Lack of internet skills	3.58	.343	.000
Lack of skills to use adaptive and assistive technologies	3.55	.360	.000
Teasing by friends	3.37	.376	.000

most serious issues faced by the respondents; while difficulty to move around the library (WAM of 3.24) is the least serious among the personal issues. The p value of one sample K Test is 0.000 in case of all the 10 personal issues. The data is not normally distributed. Hence, parametric tests cannot be conducted on individual issues.

Table 4 shows that there is no significant difference between gender and studying district of the respondents and all the 10 personal issues, as p value is more than the significant level of 0.05 in all the cases. There is a significant difference between course of study of the respondents and their level of agreement with one issue namely 'difficulty to move around the library' (p = .040). There is a significant difference between studying department of the respondents and three personal issues namely, difficulties in locating the needed materials (p=.048), difficulty to move around the library (p=.009) and lack of skills to use adaptive and assistive technologies (p=.039).

The Table 5 shows the gender and course of the respondents *Vs.* personal issues: Independent sample t test tested.

Gender: The mean value of male is slightly higher than that of female respondents. The assumption of equal variance is met as the p value of Levene's test is more than 0.05 (.782). The null hypothesis of no significant difference is accepted as the p value of t test is more than 0.05 (t=.543, df=127, p=.588).

Course: The mean value of PG students is slightly higher than that of UG students. The assumption of equal variance is met as the p value of Levene's test is more

Table 4. Independent Variables *Vs.* Personal Issues: Mann Whitney U Test and Kruskal Wallis H Test

Personal Issues	Mann Whitney		Kruskal Wallis	
	Gender	Course	Department	District
Lack of ICT skills	.656	.055	.185	.224
Difficulties in locating the needed materials	.320	.597	**.048**	.600
Lack of time	.212	.282	.182	.544
Difficulty to reach the library	.856	.726	.191	.320
Difficulty to move around the library	.161	**.040**	**.009**	.183
Difficulty to get required information by myself	.838	.785	.207	.268
Lack of computer skills	.468	.528	.149	.735
Lack of internet skills	.591	.563	.069	.565
Lack of skills to use adaptive and assistive technologies	.315	.340	**.039**	.656
Teasing by friends	.452	.878	.315	.593

Table 5: Gender and course of the respondents *Vs.* Personal Issues: Independent Samples t test

Variable	Mean	Levene's Test	Equal Variance	t Test	Result
Gender	Male = 35.261 Female =34.955	F = .077 Sig. = .782	Assumed	t = .543 df=127 p=.588	H_o is accepted
Course	UG =34.852 PG = 35.804	F = 3.849 Sig. = .052	Assumed	t = 1.664 df=127 p=.098	H_o is accepted

Table 6: Studying department and district of the respondents *Vs.* personal issues: One Way ANOVA / Welch Test

Variable	Mean	Levene Statistic	Homogeneity Variance	Welch Test	Result
Department	Science = 31.692 Social Science = 35.542 Language = 35.543	F = 23.885 Sig. = .000	Assumed violated	Statistic = 2.756 Df 1= 2 Df 2 = 29.077 Sig. = .080	H_o is not accepted
Variable	**Mean**	**Levene Statistic**	**Homogeneity Variance**	**One way ANOVA**	**Result**
District	Dindigul =35.470 Madurai = 34.84 Sivagangai = 35.451	F = 2.600 Sig. = .077	Not Violated	Sum of Squares Between Groups = 12.314 With Groups = 1176.586	H_o is accepted

Table 7: Institutional issues faced by the respondents in accessing library, its resources and services

Institutional Issues	SA	Agree	Neutral	Disagree	SD
Inadequacy of recent publications and current journals	3 (2.3%)	74 (57.4%)	52 (40.3%)	0 (0.0%)	0 (0.0%)
Insufficient space, material and equipment	58 (45.0%)	28 (21.7%)	38 (29.5%)	5 (3.9%)	0 (0.0%)
Lack of guidance about use of library resources and services	0 (0.0%)	85 (65.9%)	38 (29.5%)	6 (4.7%)	0 (0.0%)
Availability of old, damaged, mutilated books and journals	1 (0.8%)	49 (38.0%)	79 (61.2%)	0 (0.0%)	0 (0.0%)
Lack of architectural design	1 (0.8%)	42 (32.6%)	82 (63.6%)	4 (3.1%)	0 (0.0%)
Lack of orientation programme	3 (2.3%)	48 (37.2%)	77 (59.7%)	1 (0.8%)	0 (0.0%)
Lack of infrastructural facility	3 (2.3%)	48 (37.2%)	77 (59.7%)	1 (0.8%)	0 (0.0%)
Library environment is not conducive	2 (1.6%)	46 (35.7%)	76 (58.9%)	5 (3.9%)	0 (0.0%)
Staff attitude is discouraging	1 (0.8%)	75 (58.1%)	50 (38.8%)	3 (2.3%)	0 (0.0%)
Non-availability of required information resources to suit my disability	3 (2.3%)	50 (38.8%)	69 (53.5%)	7 (5.4%)	0 (0.0%)
Services are not tailor-made to assist me	4 (3.1%)	62 (48.1%)	54 (41.9%)	8 (6.2%)	1 (0.8%)
Library arrangement is not disability-friendly	2 (1.6%)	75 (58.1%)	47 (36.4%)	5 (3.9%)	0 (0.0%)
Lack of training programme	0 (0.0%)	45 (34.9%)	76 (58.9%)	8 (6.2%)	0 (0.0%)
Non-availability of adaptive and assistive technologies	2 (1.6%)	75 (58.1%)	50 (38.8%)	2 (1.6%)	0 (0.0%)
No disability-friendly furniture	3 (2.3%)	92 (71.3%)	28 (21.7%)	6 (4.7%)	0 (0.0%)
Non-availability of required software	3 (2.3%)	45 (34.9%)	74 (57.4%)	7 (5.4%)	0 (0.0%)

The only issue which is strongly agreed by a good number of PC students is 'insufficient space, material and equipment' (58, 45%).

than 0.05 (.052). The null hypothesis of no significant difference is accepted as the p value of t test is more than 0.05 (t=.1.664, df=127, p=.098).

Department: The mean value of social science and language students is more than that of science students. The assumption of homogeneity of variance is violated as the p value of Levene's test is less than 0.05. So, instead of one-way ANOVA, Welch Test was conducted. The null hypothesis of no significant difference is accepted as the p value of Welch Test is more than 0.05 (.080).

District: The mean value of Dindigul and Sivagangai students is slightly higher than that of Madurai students. The assumption of homogeneity of variance is met, as the p value of Levene's test is more than 0.05. So, one way ANOVA Test was conducted. The null hypothesis of no significant difference is accepted as the p value of One-way ANOVA test is more than 0.05 (F=.659, p=.519).

A sizeable number of PC students agreed that there is no disability-friendly furniture (92, 71.3%) and there is a lack of guidance about use of library resources and services (85, 65.9%). More than half of the PC students agreed with the existence of such institutional issues as inadequacy of recent publications and current journals (74, 57.4%), staff attitude is discouraging (75, 58.1%), library arrangement is not disability-friendly (75, 58.1%) and non-availability of adaptive and assistive technologies (75, 58.1%). Slightly less than half of them (62, 48.1%) agreed that there are no services tailor-made to assist them in the college library.

30-40 per cent of PC students agreed that old, damaged, mutilated books and journals are available (49, 38%),

Table 8. Institutional issues: Mean values and one sample KS Test of normality (Testing of Hypothesis Two: Independent Variables Vs. Institutional Issues)

Personal Issues	Mean	One Sample KS Test	
		Test Statistic	Sig. (2 tailed)
Inadequacy of recent publications and current journals	3.620	.359	.000
Insufficient space, material and equipment	4.077	.284	.000
Lack of guidance about use of library resources and services	3.612	.408	.000
Availability of old, damaged, mutilated books and journals	3.395	.395	.000
Lack of architectural design	3.310	.383	.000
Lack of orientation programme	3.410	.376	.000
Lack of infrastructural facility	3.410	.376	.000
Library environment is not conducive	3.348	.354	.000
Staff attitude is discouraging	3.573	.368	.000
Non-availability of required information resources to suit my disability	3.379	.317	.000
Services are not tailor made to assist me	3.465	.290	.000
Library arrangement is not disability-friendly	3.573	.360	.000
Lack of training programme	3.286	.342	.000
Non-availability of adaptive and assistive technologies	3.596	.364	.000
No-disability-friendly furniture	3.713	.423	.000
Non-availability of required softwares	3.341	.337	.000

there is no architectural design (42, 32.6%), there is a lack of orientation programme (48, 37.2%), there is a lack of infrastructural facility (48, 37.2%), library environment is not conducive (46, 35.7%), non-availability of required information resources to suit my disability (50, 38.8%), there is a lack of training programme (45, 34.9%) and non-availability of required software (45, 34.9%).

More than 60 per cent of them are neutral with two issues namely availability of old, damaged, mutilated books and journals (79, 61.2 %) and lack of architectural design (82, 63.6%). More than half of the respondents are neutral in respect of few institutional issues like lack of orientation programme (77, 59.7%), lack of infrastructural facility (77, 59.7%), library environment is not conducive (76, 58.9%), non-availability of required information resources to suit my disability (69, 53.5%), lack of training programme (76, 58.9%) and non-availability of required software (74, 57.4%). 6.2 per cent of the OC students disagree with two institutional issues namely, services are not tailor made to assist me and lack of training programme.

Table 8 reveals that 'insufficient space, material and equipment' (WAM of 4.07) is the most serious institutional issue faced by the respondents while lack of training programme (WAM of 3.28) is the least serious issue among them. But a score of 3.0+ out of 5 indicates that all these are the institutional issues faced by the respondents mostly. One sample KS Test shows that the data is not normally distributed as the p value is less than 0.05 in all the 16 cases. Hence, parametric tests cannot be conducted on these individual institutional issues.

There is a significant difference between gender and course of study of the respondents and the problem of

Table 9. Independent variables *Vs*. Institutional issues: Mann Whitney U Test and Kruskal Wallis H Test

Personal Issues	Mann Whitney U Test		Kruskal Wallis H Test	
	Gender	Course	Department	District
Inadequacy of recent publications and current journals	.161	.424	.627	.770
Insufficient space, material and equipment	.344	.122	**.001**	.313
Lack of guidance about use of library resources and services	.458	.901	**.007**	.192
Availability of old, damaged, mutilated books and journals	.201	.995	.445	.763
Lack of architectural design	**.017**	**.042**	.156	.211
Lack of orientation programme	.220	.998	.895	.795
Lack of infrastructural facility	.425	.268	**.016**	.683
Library environment is not conducive	.377	.489	**.014**	.859
Staff attitude is discouraging	.268	.452	.205	.749
Non-availability of required information resources to suit my disability	.461	.159	**.010**	.455
Services are not tailor-made to assist me	'.302	.354	**.002**	.164
Library arrangement is not disability friendly	.335	.522	.054	.431
Lack of training programme	.185	.385	**.026**	.773
Non-availability of adaptive and assistive technologies	.152	.269	.173	.821
No disability-friendly furniture	.955	.404	.115	.537
Non-availability of required software	.474	.764	**.022**	.468

'lack of architectural design'. There is a significant difference between studying departments of the respondents and the problem of insufficient space, material and equipment; lack of guidance; lack of infrastructural facility; non-conducive library environment; non-availability of required resources; non-availability of tailor-made services; lack of training programme and non-availability of required softwares. In all these cases, the p value is less than 0.05.

Table 10. Institutional issues Vs. Gender and course of study of the respondents: Independent Samples t test

Variable	Mean	Levene's Test	Equal Variance	t Test	Result
Gender	Male = 56.321 Female = 55.733	F = .044 Sig. = .951	Assumed	t = .758 df =127 p =.450	H_o is accepted
Course	UG = 55.568 PG = 57.292	F = 5.495 Sig. = .021	Not Assumed	t = 2.208 df =124.967 p =.029	H_o is rejected
95% CI may range between - 54.684 and 2.90216					

There is no significant difference in all other cases, as the p value is more than 0.05.

Gender: The mean score of male students is slightly higher than that of female students. The assumption of equality of variance is assumed. t test shows that the null hypothesis is accepted as the p value is more than 0.05 (t=.758, df =127, p=.450).

Course: The mean score of PG students is slightly higher than that of UG students. The assumption of equality of variance is violated. t test shows that the null hypothesis is rejected and the alternative hypothesis is accepted as the p value is less than 0.05 (t=2.208, df =124.96, p=.029). The population mean may vary between -.54684 and -2.90216.

Table 11. Institutional issues *Vs.* Studying department and district of the respondents: Welch Test and One-Way ANOVA Test

Variable	Mean	Levene Statistic	Homogeneity Variance	Welch Test	Result
Department	Science = 49.923 Social Science = 56.339 Language = 57.298	F = 26.131 Sig. = .000	Assumption violated	Statistic = 7.144 Df1= 2 Df2 = 28.975 Sig. = .003	H_o is rejected
Variable	**Mean**	**Levene Statistic**	**Homogeneity Variance**	**One way ANOVA**	**Result**
District	Dindigul =56.029 Madurai = 55.609 Sivagangai = 57.116	F = 2.528 Sig. = .084	Not Violated	Sum of Squares Between Groups = 57.115 With Groups =2192.140	F = 1.641 Sig.= .198 H_o is accepted

Department: The mean score of science students is less than that of social science and language students. The assumption of homogeneity of variance is violated as the p value of Levene's test is less than 0.05. So, Welch test was conducted, and it shows that null hypothesis is rejected, and the alternative hypothesis is accepted as the p value is less than 0.05.

District: There is a slight variation in the mean score of Dindigul, Madurai and Sivagangai students. The assumption of homogeneity of variance is met as the p value of Levene's test is more than 0.05. So, One Way ANOVA test was conducted, and it shows that null hypothesis is accepted as the p value is more than 0.05 (F=1.641, p=.198).

The result of Games-Howell Post Hoc Test of Multiple Comparisons (as the assumption of equality of variance is violated) shows that:

a) There is a significant difference between science and social science students and there is a significant

Table 12. Games-Howell Post Hoc test of multiple Comparisons: Institutional issues *Vs.* Studying department and district of the respondents

(I) Department		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Science	Social Science	-6.41591*	2.14058	**.026**	-12.0565	-.7753
	Language	-7.37517*	2.10744	**.011**	-12.9718	-1.7785
Social Science	Science	6.41591*	2.14058	**.026**	.7753	12.0565
	Language	-.95926	.54186	.185	-2.2497	.3311
Language	Science	7.37517*	2.10744	**.011**	1.7785	12.9718
	Social Science	.95926	.54186	.185	-.3311	2.2497

difference between science and language students. These two pairs caused the difference.

b) There is no significant difference between social science and language students. This pair does not have any influence.

8. DISCUSSIONS AND CONCLUSION

More than half of the respondents agreed that they do not have required Information Communication Technology skills, computer skills, internet skills and skills to use adaptive and assistive tools and technologies. The best way is to train them on the use of such tools and technologies. Hands-on training programmes, workshops, seminars, short-term training classes, lectures, practical sessions, one-to-one assistance hours etc., may be organised or conducted by the colleges either by themselves or jointly with other libraries every year. One library may organise such programmes for visually impaired users, another library may do so for hearing impaired users, so on and so forth. Videos on how to make use of various adaptive and assistive tools (software and hardware components) may be prepared either at college level or district level and circulated among the physically challenged users or made available in the college websites. Half of the respondents stated that they are not able to get the required information by themselves. It means that some sort of supporting services are to be set right to assist the physically challenged users to obtain necessary information from the library. The help of Nation Physically Challenged al Service Scheme and National Cadet Corps students and student volunteers may be sought to address the issue. One-third of the respondents felt that they are teased by their friends. Disability-sensitisation should be insisted in the campus. The students should be taught to be polite, gentle and helpful towards physically challenged students in the counselling programmes, career guidance sessions, orientation programmes, fresher's meet etc., being organized either by library or by various departments. Such disturbing students may be spotted and guided suitably. Slightly more than 60 per cent of the respondents expressed that they have difficulties in reaching the library. The libraries may either improve their physical infrastructure provisions (wide paths, ramps, wheelchairs, non-slippery floors, parking slots etc.) to enable the physically challenged users reach the library at ease or they may take the information resources to the desktops of physically challenged Users through online mechanisms or they may make the accessible formats of information resources made available in their respective departments.

Insufficient space is a major problem in the arts and science college libraries. Some of the libraries are single hall libraries or libraries with two rooms. How can we expect them to provide sufficient service to the Physically Challenged Users? So, the University Grant Commission may prescribe a norm for minimum functional space for a library in an arts and science college. Even the state government may decide upon such a standard. Sufficient space is to be allotted for the central library in every college building layout plan. Two-third of the respondents complained of non-availability of disability-friendly furniture.

The library should provide for a minimum number of disability-friendly furniture. At least one wheelchair, two or three chairs with armrest and adjustable size, one or two computer tables of adjustable heights, one low shelf etc., may be made available in each library. When budget for the college furniture is planned, a small percentage may be allocated towards disabled-friendly furniture. Half of the respondents raised the issue of non-availability of adequate recent publications and current journals in accessible format. This is a serious concern. The library may not be able to purchase all the resources in accessible format. But what can be done is that they should have sufficient assistive tools (software and hardware) to convert / amend the existing resources to some formats that can be used by physically challenged users. The open access e-resources which are available in accessible formats may be compiled and given to them. For example, Arxive.org gives thousands of electronic resources in accessible format. Project Gutenberg gives thousands of e-books in accessible format. The availability and use of such free and open access accessible e-resources may be brought to the attention of the physically challenged users. More than half of the respondents stated that there is a lack of guidance about the use of library resources and services. The library should conduct orientation programmes in the beginning of every year exclusively for the physically challenged users. Use education programmes may be organized for the second and third year UG and second year PG students. The physically challenged users should be given enough awareness about various information resources available and various information services provided in the libraries, what are the rules and regulations to make use of all these resources and services, what are the special provisions and facilities that library offers to physically challenged users during these orientation/ user education programmes. A handout/manual on the use of library resources and services may be prepared and circulated among the physically challenged users. The manual may be posted in the college website. Guided tour may be arranged for the physically challenged userss to show them what the library has for them. Library video tours may be hosted in the library website/blog. More than half of the respondents opined that library staff attitude is discouraging. It is a really hurting news. The library staff should be smiling and welcoming. They should extend necessary personal help to the physically challenged users on their online/offline visits and enquiries. They should display a friendly and helpful attitude towards the physically challenged users. The library staff may be given orientation on how to serve the physically challenged users in libraries. More than half of the respondents complained of the non-availability of adaptive and assistive technologies. Depending on the nature of disability of the library users, the library should plan to procure both software and hardware components to help the physically challenged users be able to use the library, its resources and services in an effective manner. Open source softwares, if available, may be employed by the library for screen reading, text enlargement, screen magnification, braille conversion, voice recognition etc.

Personal issues: Lack of Information Communication Technology skills, difficulty in reaching the library, lack of time, difficulty to get required information by themselves, lack of computer skills, lack of internet skills and lack of skills to use assistive technologies are the personal problems faced by the respondents. The problem of lack of knowledge to use technologies is also reported by Williams (2016) and Quarless (2016). The respondents expressed, in Cassner et al.,'s study (2011), that they could not retrieve library materials from the shelves.

Institutional Issues: Insufficient space, material and equipment, lack of disability-friendly furniture, lack of guidance on the use of library, inadequacy of recent publications and current journals, discouraging staff attitude, lack of disability-friendly library arrangement and non-availability of adaptive and assistive technologies are the institutional issues expressed by respondents. This is in line with the findings of Ponera (2015) and Lawal-Solarin (2013) who reported that libraries lack adjustable shelves, chairs and do not have shelves that are user friendly to users on wheel chairs; Cassner et al., (2011) reported that one university library had plastic chairs and tables for library users; Idhalama (2019) reported that there is a lack of appropriate furniture in the library for this class of users and Sambo et al., (2016) confirmed that furniture in the library are not good for relaxing (100%). This is corroborating with the findings of Sambo et al., (2016) who confirmed that staff attitude is discouraging (67%); Patil Rohit and Kumbar (2020) said that library personnel are not helpful (58.14%) and Idhalama (2019) reported that library staff's attitude towards the PCPs is horrible. This finding is supported by Fatima and Kumari (2017) who reported that majority of the users did not receive any

awareness training program and 67.5 per cent respondents face difficulties because of lack of training, and Idhalama (2019) reported that there is a lack of appropriate orientation programme to the group. This is in line with the findings of Patil Rohit and Kumbar (2020) who found that the respondents encountered the problem of lack of assistive technologies with access to computers.

The present research work may be extended / modified / adopted by the future LIS researchers like information needs and use of library resources by the differently-abled PG students and research scholars of universities in India and other countries. The study explored the problems faced by the physically challenged students in accessing and using library, its resources and services. In the light of findings of the study, the researcher suggests the following: A national level content creation body may be established to convert the existing information resources into accessible formats; an exclusive consortium may be formed for the libraries which need information resources in accessible formats; union catalogue of information resources (books, journals, conference proceedings, handbooks, manuals, theses and dissertations, question banks etc.) which are available in accessible formats in various educational and research institutions may be prepared and the universities may establish an exclusive accessible-learning resource centre with maximum number of resources, software, hardware components and services designed for the physically challenged users, and extend the same to the library users of affiliated colleges. Let the libraries become inclusive to cater the information needs of all and satisfy S.R. Ranganathan's Second Law of Library Science "Every *Reader His/Her Book"* and fifth law of Library Science *"Library is a growing Organism".*

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"Quality is never an accident. It is always the result of intelligent effort."

–John Ruskin

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