Working Paper 385

Automation and Future of Garment Sector Jobs: A Case Study of India

Pankaj Vashisht

Nisha Rani

September 2019

INDIAN COUNCIL FOR RESEARCH ON INTERNATIONAL ECONOMIC RELATIONS

Table of Contents

List of Tables

List of Figures

Abstract

Robotics has been redefining the production process across manufacturing industries, raising serious concern about the future of jobs and the garment sector is not isolated. The recent innovations such as 'Sewbot' along with other Computer Numeric Control machines have increased the risk of technology-induced displacement of labour in the garment sector. This paper examines the technical and economic feasibility of automation in the Indian garment sector and its likely impact on jobs. Based on secondary data analysis and key informant interviews, the paper argues that though technically robotics can displace 80 per cent labour employed in the Indian garment sector, the actual displacement is going to be much lower as, owing to the economic feasibility, automation is going to be restricted to a few garment production processes only. Paper further argues that despite the automation of the certain production processes, Indian garment sector will register healthy employment growth as expansion in domestic garment demand will be more than sufficient to offset the labour-saving effect of technology.

Key Words: *Robotics, Garment, Technology*

Jel Classification: *O33, L67 J21*

Author's email*: pvashisht@icrier.res.in; nishar@gmail.com*

Disclaimer: *Opinions and recommendations in the report are exclusively of the author(s) and not of any other individual or institution including ICRIER. This report has been prepared in good faith on the basis of information available at the date of publication. All interactions and transactions with industry sponsors and their representatives have been transparent and conducted in an open, honest and independent manner as enshrined in ICRIER Memorandum of Association. ICRIER does not accept any corporate funding that comes with a mandated research area which is not in line with ICRIER's research agenda. The corporate funding of an ICRIER activity does not, in any way, imply ICRIER's endorsement of the views of the sponsoring organization or its products or policies. ICRIER does not conduct research that is focused on any specific product or service provided by the corporate sponsor.*

Automation and Future of Garment Sector Jobs: A Case Study of India

Pankaj Vashisht and Nisha Rani*

1. Introduction

Technological progress has been the key driver of economic growth in the modern history of mankind. Over the years, technological innovations have brought immense benefits. They have increased labour productivity and raised standards of living across the globe (Vashisht 2018). However, all major technological innovations, starting from the Great Industrial Revolution have also coincided with a fear of technological unemployment and a significant churning in labour markets. The current wave of information- and communication-based technological progress is no exception. The advancement in digital technology and consequent increase in automation has once again instilled the fear of mass unemployment. It has been argued that if digital innovations/robotics continues at the current pace, machines, in the near future, will be able to substitute labour in most economic activities, leading to a workless world (Rifkin 1995). Nonetheless, given the historical experience, the prediction of the technology-induced workless world seems farfetched. After all, the world has endured three waves of technological revolutions without witnessing any increase in structural unemployment. Evidence suggests that new technology eliminates few traditional jobs and reduces the demand for labour for a given level of output, nevertheless, at the same time, it also enables the creation of jobs mainly through the expansion of aggregate demand (Bassen 2018). Technological progress contributes to the expansion of demand through income as well as price channels. Since technological progress increases labour productivity, it translates into an increase in income of labour and hence higher consumption leading to higher aggregate demand for goods and services. Similarly, technology-induced increase in labour productivity reduces the unit cost of production that makes goods more affordable leading to an increase in aggregate demand (Smolny 1998). Historically, technology-induced increase in demand has been more than sufficient to offset the labour-saving impact of technology at the macro-level (Viverali 2012). Few scholars have argued that the nature of ongoing technological change is completely different from the past waves of technological change and therefore history may not repeat itself. They have highlighted the 'Great Decoupling'-the breakdown of the relationship between labour productivity and labour compensation - to argue that the self-correcting compensation mechanism that neutralized the negative impact of technology on employment in past, is not working anymore (Brynjolfsson and McAfee 2014). However, this proposition has been severely contested. Using econometric method, the hypothesis of the 'Great Decoupling' has been strongly rejected (Stansbury and Summers 2017).

* Pankaj Vashisht is a senior fellow at Indian Council for Research on International Economic Relations (ICRIER) This paper was prepared as input for Asian Development Outlook report 2018. Financial support from ADB is highly appreciated. Author is thankful to Dr. Rana Hasan, Director Asian Development Bank, Prof. Ajit Kumar Ghose, Institute of Human Development and Dr. Urvashi Aneja, OP Jindal Global University for their usefull comments and suggestions.

In the absence of any strong evidence in favour of decoupling of productivity and labour compensation, the technology-induced workless world seems far from reality. However, it does not imply that the adoption of new technology is not going to disturb the labour markets. In fact, all technological revolutions in the past have created winners and losers and technology-induced structural adjustments have been very painful for labour with certain skills. There is a consensus that the ongoing digital revolution is also set to disturb the employment structure and skill demand by fundamentally changing the way goods are produced and services are delivered. Since computers are very good at performing the routine and repetitive tasks, computer-controlled machines such as robots are expected to substitute labour engaged in these tasks sooner than later. In fact, various studies have already confirmed de-routinisation of jobs[1] in many advanced countries (Autor et al 2003, Michaels et al 2014, De la Rica and Gortaazar 2016, Hardy et al 2015, 2016). The technology induced de-routinisation of jobs is expected to intensify further, leading to a substantial displacement of labour in sectors that have high exposure to routinisation.

The garment sector has a very high exposure to routinisation. At the same time, it is also not isolated from the ongoing wave of a technological revolution. The recent innovations such as 'Sewbot' along with other Computer Numeric Control (CNC) machines have increased the potential of automation in the garment sector, which was unthinkable until a few years back. In fact, some garment manufacturers have already started investing in robotics. Tianyuan Garments, a Chinese firm, is investing US$20 million to build a fully automatic garment manufacturing facility in Little Rock, Arkansas. With fully automatic robotic production lines, Tianyuan Garments is excepting to reduce the unit labour cost of t-shirt production to just 33 cents in USA (Bain 2017). If the experiments with robotics in garment production turned out to be successful, they can have serious implications for developing countries like India, where the garment sector continues to be a major source of employment. The garment sector jobs in developing countries are particularly vulnerable to technological change owing to their high dependence on the US and European markets. With an imminent possibility of a technology-induced reversal in global offshoring, technology can harm garment sector jobs in developing Asian economics even if domestic manufacturers give a complete miss to robotics. Against this backdrop, this paper examines the likely impact of technology on employment in the Indian garment sector. Based on secondary data analysis and interaction with leading industry consultants/garment manufacturers, the paper highlights that 80 per cent of garment sector jobs are routine jobs and therefore can technically be automated. However, given the prevailing labour cost, full automation is economically not feasible. Automaton in India is expected to be restricted to a few selected garment production processes only, disturbing less than 25 per cent of existing jobs in the foreseeable future. Technology-induced reversal in offshoring is also expected to have a limited impact on garment sector jobs in India as Indian garment exports are dominated by fashion wears, a segment expected to be least affected by robotics. Paper argues that despite the adoption of labour-saving technology for certain garment production processes and some decline in the exports of basic apparels, Indian garment sector will generate a couple of million

[1] Technology induced decline in routine task content of jobs is known as de-routinisation of jobs.

additional jobs in next ten to fifteen years because the increase in domestic demand for apparels will be more than sufficient to offset the labour-saving negative impact of technology on jobs.

Rest of the paper is organized in six sections. Section 2 summarizes the data sources used in this paper. Section 3 provides an overview of the Indian garment sector and highlights its importance in the Indian economy. Section 4 documents the technological progress in the Indian garment sector over the last few years and its impact on employment. Section 5 attempts to quantify the likely impact of robotics/technology on garment sector jobs. Section 6 forecasts the expansion in domestic garment demand, while section 7 concludes the paper with recapitulations of the main findings.

2. Data Sources

The analysis in this paper is based on secondary data as well as primary research. Secondary data used in this paper has been compiled from five different sources. Statistics on garments export has been compiled from the Uncomtrade database. Data on the structure of employment has been compiled from the Employment Unemployment Surveys (EUS), conducted by the National Sample Survey Organization (NSSO). NSSO has conducted several rounds of EUS over the last two and a half decades. In this paper, we have used data from the 61st (2004-05) and 68th (2011-12) rounds only. Notably, the National Classification Occupation (NCO) used in these two rounds, is not the same. NCO 1968 was used in the 61st round (2004-05) while NCO 2004 was used in the 68th round (2011-12). In order to make the data comparable, we work out a crosswalk between NCO 1968 and NCO 2004 at the three-digit level, using the official concordance table. Unlike the employment, owing to the dualistic nature, data for other variables pertaining to the Indian garment sectors such as output, Gross Value Added (GVA) wage, is not available in one place. Given this, the data on these variables has been compiled from two different sources. Data for the formal segment of the garment sector has been drawn from the Annual Survey of Industry (ASI). ASI provides the most reliable statistics on the organized manufacturing sector in India at the five-digit level of National Industrial Classification (NIC). In this paper, we have used ASI unit-level data for selected years. Data pertaining to the informal segment has been collected from the various rounds of NSSO Enterprise Survey. We have also used the 68th round of NSSO Consumer Expenditure Survey to estimate the expenditure elasticity of garments.

Apart from the secondary data, information used in this paper has also been collected through key informant interviews. We conducted nine interviews with key informants to seek their views about the emerging garment production technologies and their likely adoption by Indian garment manufactures. Out of the nine key informants, we interviewed, two are industrial consultants. Both these constants are running consultancy firms involved in the business of advising apparel firms on competitiveness-enhancing strategies and technology-related issues. The remaining seven interviews were conducted with the managing directors/senior managers of garment firms operating in the Delhi National Capital Region (NCR). Interviews were based on the structured questionnaire and were conducted at the firm's corporate office. All seven firms, we covered, are involved in exporting. The export intensity of these firms ranges from 85 per cent to 100 per cent, while the employee strength ranges from 210 workers to 2300 workers.

Table 1: Summary of Key Informant Interviews

Category	Method	Instrument	Number of Interviews
Industrial Consultants	In-Depth Interviews	Questionnaire	2
Managing Directors / Senior Managers of Apparel Firm			7
Total			9

3. Overview of Indian Garment Sector

The garment industry in India has been going through a remarkable phase of growth and restructuring over the last fifteen years. The enormity of growth can be gauged from the fact that the number of enterprises operating in garment sector has increased from 2.8 million in 2000-01 to 5.6 million in 2014-15, while the Gross Value Added (GVA) has gone up from 1,126 billion Indian rupees to 10,071 billion Indian rupees during same time (Table 2). Notability, the most staggering growth in garment sector has been observed after 2010-11. Prior to 2010-11, the garment sector remained underperformer as it witnessed a lower rate of growth as compared to the average growth of Indian manufacturing sector. Consequently, the share of the garment sector in total manufacturing GVA declined from 4.8 per cent in 2000-01 to 2.9 per cent in 2010-11. However, the trend reversed after 2010-11. During the last four years, the garment sector has registered a much higher growth as compared to the aggregate manufacturing sector. As a result, the share of the garment sector in total manufacturing GVA has gone up very sharply from 2.9 per cent in 2010-11 to 4.3 per cent in 2014-15 (Table 2). The staggering growth in GVA has also resulted in an impressive increase in employment. In 2000-01, around 5 million people were employed in the garment sector and over the period number has increased to around 9 million, registering an annual growth rate of 5.7 per cent. Notably, the employment growth in the garment sector has remained much higher than the overall employment growth in India. Consequently, the share of the garment sector in total employment has increased significantly. In 2000-01, the garment sector has 12.5 per cent share in manufacturing employment which increased to 17.05 per cent in 2014-15. The share of the garment sector in total employment has also increased from 1.34 per cent to 1.77 per cent during 2000-01 to 2011-12 (Table 2).

Table 2: Importance of apparel Sector in Indian Economy

Year	Gross Value Added		Employment		
	Values*	Share in Manufacturing	No. in Million	Share Total Employment	Share in Manufacturing Employment
2000-01	1126	4.8	4.90	1.34	12.55
2005-06	1525	3.4	6.89	1.69	15.40
2011-12	4209	2.9	7.46	1.77	14.63
2014-15	10071	4.3	8.85	NA	17.05

Source: Compiled from NSS Enterprise Survey, Annual Survey of India and NSSO-EUS

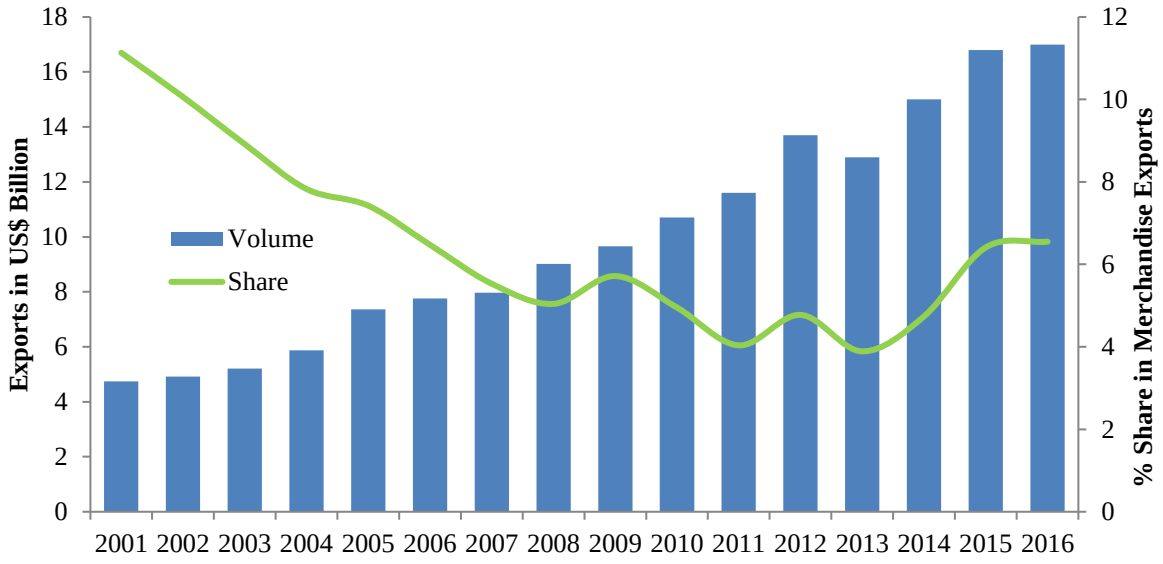
Note: * Values in Rs. Billion, NA = not available

The recent spurt of growth in the Indian garment sector has also coincided with a significant change in the structure. Traditionally, the Indian garment sector has been dominated by small

unorganized enterprises. However, the importance of the unorganized sector has consistently declined over the last fifteen years. In 2000-01, the informal enterprises had more than 67 per cent share in total GVA of garment sector that came down to around 51 per cent in 2015-16. A class size-wise analysis of garment firms suggests that the growth of the organized garment sector has primarily been driven by very large firms (Annexure 1). In 2004-05, firms with more than 200 workers had around 24 per cent share in total garment sector GVA which increased to more than 33 per cent in 2015-16.

In line with the overall growth, the exports of the garments from India have also increased significantly. Over the last fifteen years, the volume of garment exports has increased from US$4.7 billion to US$ 17 billion[2] (Figure 1). The increase in the volume of garment sector exports has also coincided with a significant geographical diversification as the importance of the USA and European Union (EU) in Indian garment exports has declined. In 2000, with one-third share, USA was the main export market for India (Annexure 2). Though the USA has continued to be the top destination, it's share in Indian garment export has declined by more than 11 percentage points. Similarly, the importance of some leading EU countries such as of Germany, France, Italy and Switzerland in Indian garments export has also declined considerably as Indian exporters have made inroads in some Asian and African economies. Notably, the United Arab Emirates has emerged as the second-largest export market for Indian garment exports. Its share in Indian garments exports has gone up from less than 7.7 per cent in 2000 to 19.4 per cent in 2016. In the wake of ongoing efforts of reshoring in the USA and Europe, the geographical diversification of garment exports augurs really well for India.

Figure 1: Exports of Ready Made Garments from India



Source: UnComtrade

[2] Despite healthy growth, the importance of garment exports in total merchandised export basket of India has dwindled. In 2000-01, garment exports had more than 11 per cent share in total merchandise exports of India which declined to below 4 per cent in 2013 before increasing to 6.5 per cent in 2016

Owing to the rapid growth, the demand for labour in the Indian garment sector has increased substantially. The demand surge has also coincided with two significant government interventions in the labour market; (i) increase in minimum wage rate and implementation of Mahatma Gandhi Rural Employment Guarantee Act (MNREGA). The demand surge and supply-side interventions exerted upward pressure on garment sector wages. The nominal wage of production workers in the organized segment of the garment sector was around 3000 rupee in 2005-06 and it increased to more than 8000 in 2014-15, registering an annual growth rate of 11 per cent. Notably, the surge in nominal wage has occurred without any similar surge in the prices of readymade garments. The wholesale price index of the readymade garments suggests that the prices of garments in India have increased only at a modest rate of around 1.6 per cent per annum during 2005-06 to 2014-15. It implies that the real product wage in Indian garment sector has been growing at an annual rate of around 9 per cent. However, despite this phenomenal increase in real product wage, the increase in the unit labour cost of production has been rather modest. Our interaction with garment manufacturers suggests that the unit labour cost of garment production has increased from 30 rupees in 2011-12 to around 34 rupees 2016-17, registering a growth rate of 2.5 per cent per annum (Figure 2). Indian garment manufacturers have been able to absorb the spike in real product wage because the labour productivity, during this period, has witnessed almost a double-digit growth (Table 3).

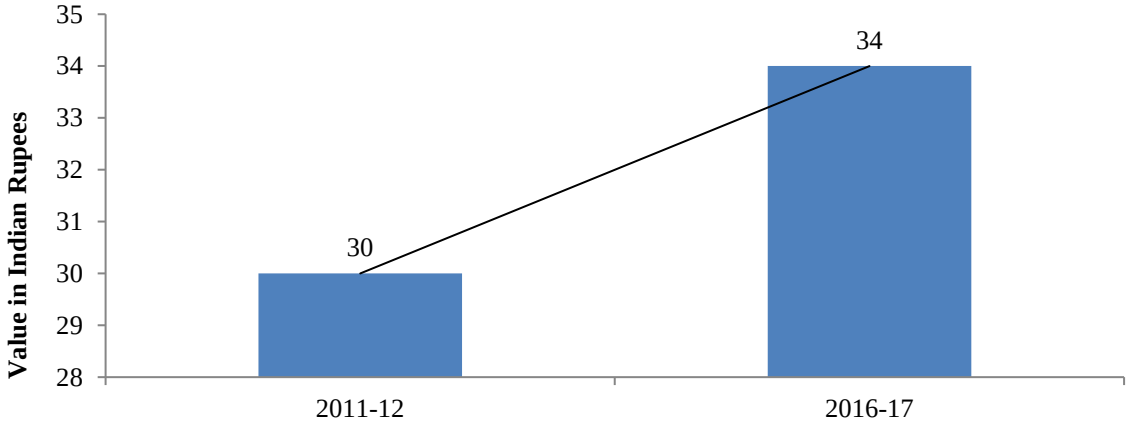
Table 3: Increasing Product Wage in Indian Garment Sector

	2005-06	2014-15	AAGR
WPI of Selected Garments	100	115.1	1.62
Average Monthly Wage of Production Workers in the Garment sector	3219	8067	11.00
Labour Productivity in the Garment Sector	5.13	9.58	9.59

Source: Authors calculation from Office of Economic Advisor and ASI data

Note: AAGR = Average Annual Growth Rate

Figure 2: Unit Labour Cost of production in the Garment Sector



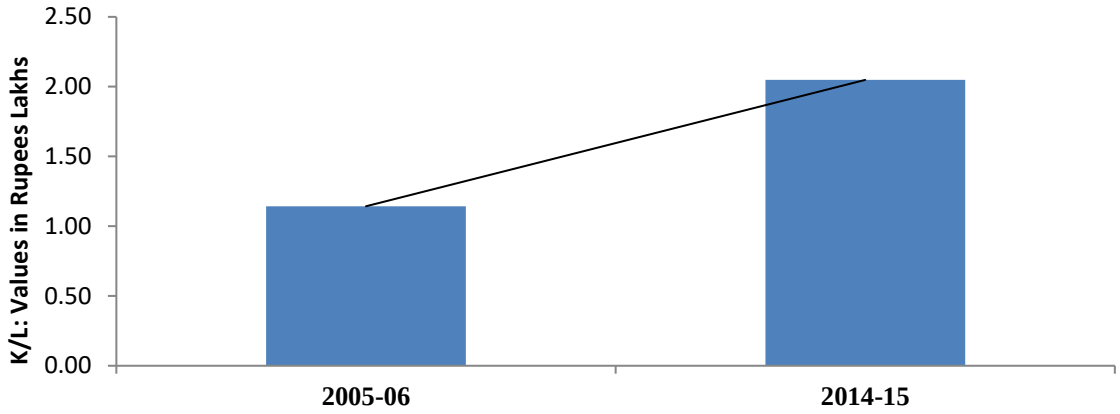
Source: Author's compilation from key informant interviews in NCR

4. Technology and Garment Sector Jobs: Experience so Far

After following the inward-looking economic policy for nearly four decades, India opened up to international trade and technology in the mid-1980s. Since then, Indian manufacturers have invested significantly in technology up-gradation to boost their competitiveness (Vashisht 2018). However, unlike other manufacturing industries, the technology up-gradation in Indian garment sector started only after 2001 when India switched to a quantitative restriction-free trade regime which opened the floodgate of garment imports from China and South-East Asian economies. The surge in imports from these internationally competitive economies out-priced the Indian garment manufacturers, forcing them to invest in better production and management technology. Consequently, Indian manufacturers started shifting production from fabricator workshops to large factories. This shift implied the introduction of the assembly lines, standardization of the production process and investment in new machinery for cutting, sewing, labelling and buttoning. In line with these changes, the capital intensity of Indian garment sector almost doubled within a decade (Figure 3). The investment in technology had a huge positive impact on labour productivity and the competitiveness of the Indian garment sector (Table 3). However, despite the huge jump in labour productivity and consequent decline in the labour required per unit of output, the garment sector did not shed any employment. In fact, Indian garment sector created more than four million additional jobs during this period of technology up-gradation (Table 2). Notably, job creation occurred both in the organized as well in the unorganized segments.

Though technology did not have any negative impact on the total jobs in the Indian garment sector, the qualitative impact of technology on labour demand has been quite significant. According to our respondents, the introduction of new technology and management practices has had two qualitative impacts on labour demand. First, it increased the demand for high skill managers and professions and second it reduced the demand for craftsman i.e. tailors and cutters in favour of machine operators. The secondary data also show a similar trend. An analysis of garment sector employment by occupation suggests that the share of high-skill managers and professional in the formal segment of the Indian garment sector has increased by more than 1.86 percentage points between 2004-05 to 2011-12, while the share of machine operators and elementary workers has gone up by more than 21.54 and 15.1 percentage points respectively. Notably, these occupations have gained at the cost of craftsmen (tailors and cutters). The share of tailors and cutters in total employment has declined by 43.91 percentage points. However, our survey suggests that technology-induced decline in demand for tailors and cutters have not pushed them out of the sector. Rather most of the affected tailors and cutters have been retrained and retained as machine operators, while some have chosen to stay as tailors and cutters and have started working with informal units, specializing in customized tailoring such as boutiques.

Figure 3: Capital Intensity in Indian Organized Garment sector



Source: Compiled from Annual Survey of Industry

Table 4: Changing Structure of Employment in Indian Garment Sector

	All States			Flexible States			Inflexible States			Neutral States		
	2004	**2011**	**Change**	**2004**	**2011**	**Change**	**2004**	**2011**	**Change**	**2004**	**2011**	**Change**
Senior Managers	0.84	2.70	1.86	0.15	3.28	3.13	0.78	0.00	-0.78	1.70	4.80	3.10
Professionals	0.70	1.06	0.36	1.78	1.28	-0.50	0.29	1.60	1.31	0.00	0.00	0.00
Technical & associate professionals	2.50	1.37	-1.13	0.77	1.98	1.21	5.65	0.00	-5.65	0.00	1.70	1.70
Clerks	0.35	3.98	3.63	0.44	1.21	0.77	0.25	12.00	11.75	0.05	0.80	0.75
Market sales workers	0.10	2.68	2.58	0.33	2.28	1.96	0.00	5.80	5.80	0.00	0.00	0.00
Craft Related Trade Workers	92.09	48.18	-43.91	92.10	55.98	-36.12	90.65	43.70	-46.95	94.12	37.2	-56.92
Plant & Machine Operators	0.18	21.72	21.54	0.16	17.48	17.32	0.29	26.20	25.91	0.00	25.4	25.4
Elementary workers	3.14	18.24	15.10	3.51	16.51	13.01	2.08	10.70	8.62	4.13	30.1	25.97

Source: Calculated from 61st and 68th rounds of NSSO-EUS

4.1 Labour Laws and Adoption of Technology

India is known for very stringent labour laws. It has been frequently argued that the stringent labour regulations especially pertaining to hiring and firing of labour have been adversely affecting the job creation in the Indian manufacturing sector by scaring off the foreign investors from the labour-intensive sectors, making them less integrated into the global value chains. Some scholars have also argued that rigid labour laws have been distorting the choice of technology. In a bid to avoid the complications associated with labour laws, Indian manufacturers have been opting for the more capital-intensive modes of production. Studies have indeed shown that the Indian manufacturing sector is using more capital-intensive technology as compared to the other countries which are at the similar level of development and have similar factor endowment (Hasan et al 2013). Exploiting the variation in labour laws across Indian states, we tried to examine the impact of labour laws on the choice of production technology by exploring the variation in the structure of garment sector employment. Following

Gupta et al (2009), we classified all Indian states into three categories; states with flexible labour laws, states with rigid labour laws and states with neutral labour laws[3].

Our analysis suggests that the structure of garment sector employment has evolved quite differently across these three categories of states since 2004 when Indian apparel manufacturers resorted to technology up-gradation. In 2004, the structure of employment was almost identical as the share of tailors and cutters in total employment was more than 90 per cent across all three categories of states while the share of machine operators was negligible (Table 4). However, over time, the structure of employment has diverged quite substantially. Notably, the inflexible and neutral states have witnessed a very sharp increase in the share of machine operators and elementary workers mostly at the cost of tailors and cutters. The share of tailors and cutters in inflexible and neutral states has declined by 47 and 57 percentage points respectively, while the share of machine operators has increased by more than 25 percentage points. In contrast, change in the employment structure among flexible states has been less pronounced. The share of tailors and cutters in the flexible states has declined by just 36 percentage points, while the share of machine operators has increased only by 17 percentage points. According to the latest available data, machine operators constitute more than a quarter of total employment in inflexible and neutral states, while their share in flexible states is just about 17 per cent. This divergence in the structure of employment across states suggests that perhaps the labour laws have been influencing the choice of technology.

5. Automation and Future of Jobs

Like most of the developing countries in Asia, the ongoing wave to digital revolution can affect employment in Indian garment sector through two channels; (1) through the adoption of robotics by domestic manufacturers, (2) through the collapse in external demand due to automation in developed countries. In the following sections, we discuss both these channels in details.

5.1 Probability of Robotics in Indian Garment Sector

In order to get a better insight into the likely impact of technology on jobs, we break down the garment production into the different processes and examine whether demonstrated technologies can perform these processes and if yes whether it is economically viable for Indian manufacturers to opt for these technologies. Our analysis suggests stitching/sewing is the most important process in garment manufacturing and tailors/sewing & other stitching machine operators account for a lion share in garment sector employment. Though the relative importance of sewing machine operators varies from firm to firm[4], our analysis suggests that this group of workers alone constitutes around 60 to 65 per cent of garment sector employment (Table 5). Notably, the sewing machine operators perform the routine task and hence their jobs can potentially be automated. In fact, the recent successful trial of 'Sewbot' has proved that

[3] This classification is based on the nature of changes in labour laws enacted by various states. For a comprehensive review of the debate on the classification of states as per labour laws please see Gupta et al (2009)

[4] Our interaction with garment manufacturers suggest that tailor/sewing and other machine operators account for roughly 65 per cent of the total workforce in a medium-size firm while the in a large firm they account for almost 50 per cent of the workforce.

robots can eliminate the role of sewing machine operators in the production process of basic apparels. Similarly, fabric spreaders & cutters, ironmasters and packers also perform the routine task and demonstrated technology can perform these activities (Table 5). These groups of workers, put together constitutes around 15 per cent of total garment sector employment. Therefore, theoretically, more than 80 per cent of current garment sector jobs in India are at risk of automation (Table 5).

The availability of technology and adoption of technology are two different things. Despite, the availability of technology, manufacturers may or may not opt for it due to various reasons including the cost-effectiveness. Our interaction with the garment manufacturers shows that they do not have any plan to go for robotics in the near future because they don't see it as cost-effective. Installing a robotic assembly line for sewing which replaces around 15-16 workers, if we factor in the increase in productivity, need an investment of more than US$1 million. So a medium-size firm with 100 tailors needs an investment of US$8 to 9 million to adopt the robotic process. However, even with this investment, labour unit cost of production is not expected to decline below the prevailing unit labour cost of production in India. Despite some recent increase, the unit labour cost of producing a shirt in India has remained around 34 rupees. Even with Sewbot, the average unit labour cost of production is expected to remain higher than this. Therefore, it does not make any sense for Indian garment manufacturers to switch to fully automatic robotic production lines. However, the cost is not the only consideration. According to a leading garment manufacturer, Indian garment manufacturers will not be able to switch to cutting-edge technology such as robotics over next 5 years even if the technology is made available to them free of cost because the skilled manpower required to operate the robotic production line is completely missing in India. Apart from this, he also highlighted the poor quality of electricity supply and slow internet along with a complete absence of post-installation service network for robots as other impediments to automation in the Indian garment sector in next five year.

Predicting anything about the adoption of robotics in the sewing process beyond the next five years is very difficult as technology can change at a very rapid rate. Therefore respondents were cautious to talk about the likely impact of technology on jobs in the next 10 to 15 years. However, they feel that the chances of Indian manufacturers going for robotics in sewing are very low even in next 10 to 15 years until and unless the improvement in robotics reduces the expected unit labour cost of production very significantly, which seems unlikely. They feel that if the expected unit labour cost of production with robotics remains unchanged i.e. around 40 to 50 rupees; Indian garment manufacturers, despite an increase in nominal wage rate, will not go for automatic sewing arm (Sewbot) as they still have scope to increase labour productivity by investing in incremental technology up-gradation.

Though the use of robotic for sewing and even packing looks very unlikely over the next 15 years, the requirement of tailor/sewing & other machine operators along with packers is still expected to decline as more and more firms are expected to invest in incremental technological up-gradation. According to our respondents, for a given level of output, the requirement of tailors/ sewing & other machine operators will decline by 8 to 10 per cent in next 5 years, while

the decline will be in the range of 15 to 20 per cent over the next 10 to 15 years. Similarly, investment in semiautomatic packing machine is expected to reduce the requirement of packers between 25 to 30 per cent over the next 5 years and 35 to 40 per cent in next 10 to 15 years for current level output.

Unlike sewing and packaging, fabric spreading & cutting is expected to witness a lot of automation in the coming years. At present, most of the Indian garment manufacturers, even with more than 2000 workers, have been using manual spreading and cutting methods. These methods result in low productivity and high waste. Therefore, manufacturers in the organized sector are planning to invest in computer-controlled automatic spreaders and cutters. According to our respondents, unlike Sewbot, the Computer Numeric Controlled (CNC) spreaders and cutters are well tested and are becoming cost-effective for most of the medium and large firms. The use of CNC spreader and cutters is expected to eliminate between 40 to 50 per cent of spreading and cutting jobs in the next 5 years. The expected job loss of spreaders and cutters could be around 70 to 75 per cent in the next 10 to 15 years. Similarly, the finishing segment is also expected to witness automation in a big way, especially over the next 15 years. It is anticipated that the use of automatic knitwear finisher will reduce the requirement of ironmasters between 20 to 25 per cent in the next 5 years and between 45 to 50 per cent over the next 15 years.

Table 5: Probability of Automation in Indian Garment Sector

Jobs in the Garment Sector	Share in Employment	Nature of Task Performed	Education	New Technology	Probability of Automation	
					Next 5 years	10 to 15 years
Managers & professional	2.5	Cognitive	College	None	NA	NA
Clerks	1.5	Routine Cognitive	Senior Secondary	None	NA	NA
Fabric Spreaders and Cutters	8	Routine	Primary and Below	CNC Spreaders & Cutters	High	High
Tailors / Sewing Machine Operators	65	Routine	Primary and Below	Sewbot	Nil	Very Low
Iron Masters	5	Routine	Primary and Below	Automatic Knitwear Finisher (Ironing Robot)	Low	High
Quality controllers	8	Cognitive	High School	None	Nil	Nil
Packers	2	Routine	Primary and Below	Folding Robots	Nil	Very Low
Other Support Staff	8	Manual Physical	Primary and Below	None	NA	NA

Source: Author's Compilation based on the Key Informants Interviews in Delhi NCR

In a nutshell, though, technically, 80 per cent of garment sector jobs are at the risk, technology, at best is expected to affect 15 – 25 garment sectors jobs in next one and a half decades. The technology-induced reduction in jobs is going to be small because automation is expected to be restricted to few segments such as spreading, cutting and finishing only. The automation in these segments will reduce the demand for semiskilled workers in favour of high skill CNC machine operators.

5.2 Jobs and External Demand

India is one of the largest exporters of readymade garments in the world. Like many other developing countries, India too has benefited considerably from the production outsourcing by the USA and European firms. At present, Indian garment manufacturers have been supplying garments to leading global brands such as Gap Inc., JCPenny Co. Inc., Ivy Co. etc. India, like other developing countries, has been able to gain in the international market due to low labour cost. According to our key informants, at present, the unit labour cost of producing a cotton shirt in the USA is around 7 dollar while the unit labour cost of producing the same shirt in India is around 50 cent, while in Bangladesh it is only 22 cents. However, with the inventions such as Sewbot, this difference in unit labour cost is expected to decline. It is anticipated that the use of robotic will reduce the unit labour cost of producing a cotton shirt in the USA and Europe to around 40 to 50 cents. In such a case, developing countries can lose the competitive edge that could potentially result in the reversal of global outsourcing and offshoring in a big way. Given the fact that India is exporting garments of worth US$ 17 billion, the technology-induced reversal in global outsourcing can hurt employment in India. However, owing to the strong and still growing domestic demand, India's dependence on export has been much smaller as compared to other Asian economies. The size of the Indian domestic apparel market was estimated to be around US 59 billion in 2015, while its exports were around 17 billion (FICCI 2016). It means, unlike other Asian economies such as Bangladesh, Indian garment manufacturers have the potential to mitigate the automation induced collapse in external demand by switching to the domestic market. However, Indian garment exports are confident that they are not going to witness any significant decline in exports at least in the next 5 years. Their confidence is base on the fact that the majority of Indian garment exports are consists of high-end fashion wears, a segment expected to be least affected by robotics. According to a Delhi NCR based exporter "Indian workers have some special skills in their hands and machine will never be able to replace those skills". There is a concern that India may suffer some decline in exports of basic apparels to automation in the west or to competition from countries such as Bangladesh, Sri Lanka and Pakistan in the next ten to fifteen years. However, they feel that the decline in export of basic apparels will not affect their scale of production because the increase in domestic demand will be more than sufficient to compensate for the anticipated decline in exports demand.

6. Demand-Pull: The Counterbalancing Force

The World has witnessed three major waves of technological revolutions in the past and all these waves have reduced the amount of labour required to produce a given level of output.

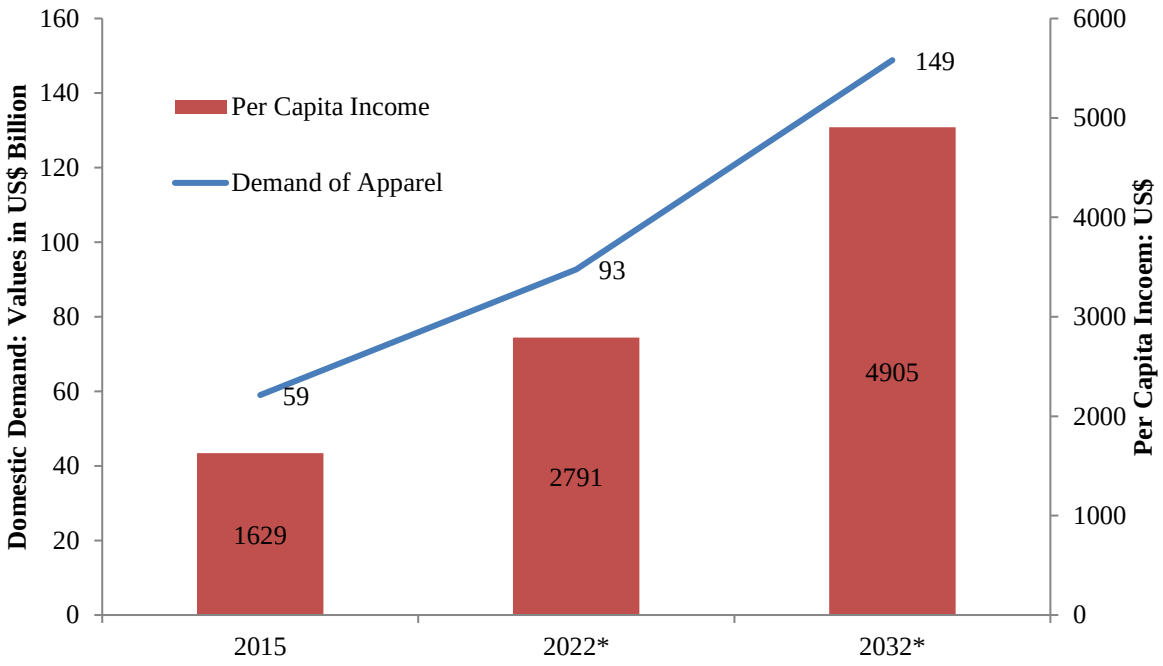
Despite this, the world has not witnessed an increase in structural unemployment. Historical experiences show that technological progress stimulates demand for goods and services through various channels that, in the long run, counterbalance the negative impact of technology on jobs. Given this, there is a consensus that technology does not affect the employment negatively at least at the macro level. However, literature provides conflicting views about the impact of technology on employment at the micro or sectoral level. Macro models dealing with the issue of de-industrialization or structural transition shows that technology does influence the distribution of employment. One strand of this literature suggests that the sectoral difference between rates of technological progress drives the structural transition of employment in an economy - employment declines in sectors that witness a relatively faster rate of technological progress. Another strand of macro literature relies on the differences in income elasticity to explain the shift in employment structure. According to these models, technological progress leads to high-income growth that stimulates aggregate consumption. However, sectors that have high-income elasticity of demand benefits more from general income growth vis-a-vis sectors with low-income elasticity of demand. Both these explanation implies that sectors like the readymade garment that has a low-income elasticity of demand will shed employment if it witnesses a productivity surge due to the adoption of robotics.

Nonetheless, models of structural transition are clearly at odds with the observed pattern of employment in various industries. Bessen (2018) shows that over the last century, various manufacturing industries in the USA witnessed an inverted U shape pattern of employment growth. During the initial decades, automation and consequent productivity surge in various USA industries were accompanied by robust growth in employment. It was only after several decades when these industries started shading employment. Propounding a model with hierarchical preferences, Bessen (2018) show that the inverted U shape pattern of employment growth was driven by the changing elasticity of demand. According to his model, initially, pent-up consumer needs ensure that technology-induced reduction in price invokes a very elastic demand response. Consequently, an increase in product demand outweighs the decline in labour required per unit of output, leading to an increase in employment. However, over the period demand becomes satiated and therefore any further technology-induced decline in product prices generates a modest increase in demand that fails to offset the labour-saving impact. In other words, Bessen (2018) shows that product demand plays an important role in shaping the impact of technology on employment at the sectoral level and demand effect is determined both by income and price effects. He shows that though income effect is important, it is the price effect which shapes the demand response during the era of technology up-gradation. In other words, technology-induced price effect can invoke a very elastic demand response even for products which have traditionally been classified as necessary products - having inelastic demand.

India is one of the most populous and poverty-ridden countries in the world. Despite impressive economic growth over the last two decades, it continues to be a low-income country with more than 62 million people living in extreme poverty. Against this backdrop, it is impossible to believe that that demand for garments has satiated in India. A cross-country comparison of apparel demand also corroborates this. In 2015, domestic demand for apparels

in India was just US$59 billion. In contrast, it was US$93 billion in Japan, US$237 billion in China and US$315 billion in the USA (FICCI 2016). These statistics suggest that there is huge pent-up consumer demand for apparels in India. Therefore, garments demand is set to boom as India moves up on the economic ladder. In 2015, the per capita income in India was just around US$ 1600 which is expected to increase to US$2800 in 2022 and further to US$4900 in 2032. In order to estimate the future size of domestic demand for the garments in India, we estimated the income elasticity[5] of expenditure on the garment, using the NSSO's 68th round of household consumption expenditure survey. Our results show that income elasticity of expenditure on the garment is around 0.79 (Annexure 3). We use this elasticity to project the future demand for apparels in India. Our calculation suggests that the size of domestic garment demand is expected to increase from US$ 59 billion to US$ 93 billion in 2022 and further to US$ 149 billion in 2032 (figure 4). In other words, the income effect alone is expected to increase the domestic demand for apparels in India by more than 2.5 folds in the next fifteen years. This surge in domestic demand will be more than sufficient to offset the foreseeable direct negative impact of technology on garment sector employment in India.

Figure 4: Projected Domestic Demand for Apparels in India



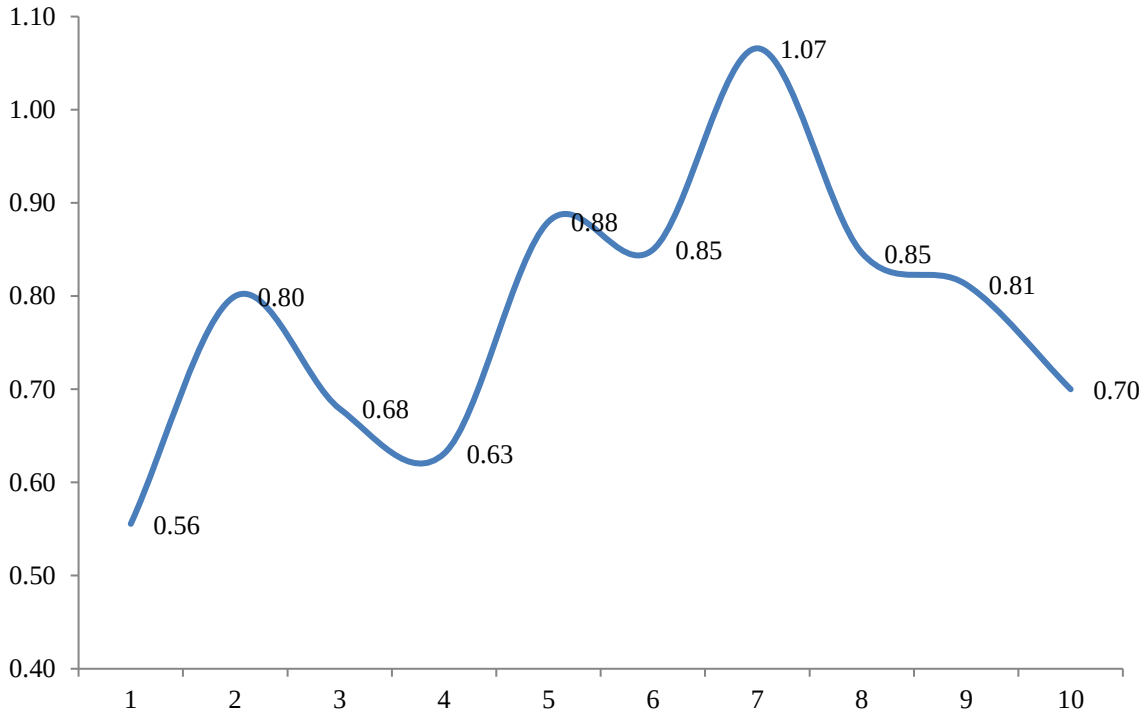
Source: Author's projection based on expenditure elasticity of garments

Our estimates further suggest that expenditure elasticity on garments varies quite substantially across different income groups. Expenditure elasticity increases as we move from the lowest income deciles to the next income deciles (Figure 5). It declines after the second income deciles and peaks again for seventh income decile. Notably, the income elasticity declines sharply for the top income decile. This roughly inverted U shape pattern of income group-wise expenditure elasticity of apparels show that that poor people are more

[5] For methodology see Deaton and Case (1988)

responsive to the income changes. At the same time, the expenditure elasticity of apparels is considerably high for urban consumers as compared to the rural population (Annexure 3). Since India is set to witness population transition from low income to high-income deciles and from rural to the urban areas, differences in expenditure elasticity imply that income effect driven increase in apparels demand can be even stronger. Moreover, if the adoption of technology results in a lower price of apparels, the increase in apparels demand can be much higher. Therefore, given the expected demand push, the Indian garment sector is expected to create a couple of million additional jobs in the next fifteen years despite some negative impact of labour-saving technology up-gradation.

Figure 5: Expenditure Elasticity of Garments by Income Deciles



Source: Author's calculation using NSS Household Consumption Expenditure Survey 2011-12

7. Conclusion

Robotics has been redefining the production process across manufacturing industries, raising serious concern about the future of manufacturing jobs. The garment sector is also not isolated from the ongoing wave of the digital revolution. The recent innovations such as 'Sewbot' along with other CNC machines have increased the potential of automation in the garment sector, which was unthinkable until a few years back. In fact, few garment manufacturers have already started experimenting with robotics in garment production. If the experiments with robotics turned out to be successful, they can have serious implications for developing countries like India where the garment sector continues to be one of the largest employers. Against this backdrop, this paper examined the likely impact of technology on garment sector jobs in India. Based on secondary data analysis and key informant interviews, the paper highlighted that around 80 per cent of jobs in the Indian garment sector are routine

jobs and therefore can, technically, be automated. However, given the prevailing unit labour cost of production, complete automation is economically not viable for Indian garment manufacturers. Specifically, Indian manufacturers are not expected to go for automation in the sewing and packaging processes in the near future. Technology at best is expected to disturb only 15 to 25 per cent of existing jobs in the foreseeable future as automation is expected to be restricted to fabric spreading & cutting and finishing processes only. We also examine the indirect impact of technology on garment sector jobs through a technology-induced reduction in exports. We found that even the adoption of robotics in western countries is not going to have any major impact on garment sector jobs because the majority of Indian garment exports to western countries are consists of high end-fashion wears, a segment expected to be least affected by robotics. Finally, forecasting the domestic garment demand, we argue that despite the adoption of labour-saving technology for certain garment production processes along with some reduction in exports of basic apparels, Indian garment sector will not shed jobs. In fact, garment sector will create a couple of million additional jobs in next ten to fifteen years as domestic demand for apparels is set to zoom which will be more than sufficient to offset the labour-saving impact of technology.

References

Autor D., Levy F., Murnane R. (2003): "The Skill Content of Recent Technological Change: An Empirical Exploration", ***Quarterly Journal of Economics*** 118 (4): 1279-1333.

Bain, M. (2017), "Rise of the Sewbots", *QUARTZ*, 30 August. Available at https://qz.com/1064679/a-new-t-shirt-sewing-robot-can-make-as-many-shirts-per-hour-as-17-factory-workers/

Bessen J. (2018): "Automation and Jobs: When Technology Boosts Employment" **Law and Economics Paper No. 17-09**: Boston University School of Law: Boston

Brynjolfsson, Erik, and Andrew McAfee (2014). "**The second machine age: Work, progress, and prosperity in a time of brilliant technologies**". WW Norton & Company

De la Rica S., Gortazar L. (2016): "Differences in Job De-Routinization in OECD Countries: Evidence from PIAAC", ***IZA Discussion Paper No. 9736.***

Deaton and Anne Case. 1988. Analysis of Household Expenditures; **World Bank LSMS working paper 28**. Washington, D.C. USA.

FICCI (2016): "Global Shifts in Textile Industry and India's Position", **FICCI Knowledge Paper**: Mumbai: India

Gupta P., Hasan R., Kumar U. (2009): "Big Reforms But Small Payoff: Explaining the Weak Record of Growth in Indian Manufacturing" In Bery S., Bosworth B. and Panagariya A. (eds), ***India Policy Volume 5***. Delhi:

Hardy W., Keister R., Lewandowski, P. (2015): "Do entrants take it all? The evolution of task content of jobs in Poland", **IBS Working Paper 10/2015**.

Hardy W., Keister R., Lewandowski, P. (2016): "Technology or Upskilling: Trend in the Task Composition of Jobs in Central and Eastern Europe", **HKUST IEMS Working Paper No. 2016-40.**

Hasan R, Devashish M. and A. Sundram (2013), "The Determinants of Capital Intensity in Indian Manufacturing", ***Indian Growth and Development Review***, Vol. 6, (2):212-241.

Michaels G, Natraj A. and J. V. Reenen (2014), "Has ICT Polarized Skill Demand? Evidence from Eleven Countries over 25 years", *Review of Economics and Statistics,* Vol.99, No. 1, pp. 60-77.

PWC. 2015. The World in 2050: Will the Shift in Global Economic Power Continue? PWC Report, PWC UK Available at https://www.pwc.com/gx/en/issues/the-economy/assets/world-in-2050-february-2015.pdf

Rifkin, J. (1995), "***The End of Work - The Decline of the Global Labour Force and the Dawn of the Post-Market Era***", Tarcher/Putnam, New York, 1995.

Stansbury A. M. and Lawrence H. Summers (2017): 'Productivity and Pay: Is the Link Broken', **NBER Working Paper No. 24165**, NBER Cambridge, USA

Vashisht P. (2018): "Destruction or Polarization: Estimating the Impact of Technology on Manufacturing Jobs in India", ***The Indian Journal of Labour Economics***, Vol. 61 (2): 227-250.

Vivarelli M. (2012), "Innovation Employment and Skills in Advanced and Developing Countries: A Survey of Literature*", IZA Discussion Paper 6291*, Institute for the Studies of Labour (IZA).

Annexure

Annexure 1: Size Class Distribution in Indian garment Sector

	% share in Number of Firms			% share in Gross Value Added			% Share in Employment		
	2004-05	**2014-15**	**Change**	**2004-05**	**2014-15**	**Change**	**2004-05**	**2014-15**	**Change**
Own account enterprise	88.148	90.738	2.590	33.291	28.902	-4.389	65.684	65.113	-0.571
Establishments	11.749	9.147	-2.602	31.998	22.444	-9.554	25.951	23.720	-2.231
1 to 5	0.004	0.007	0.003	0.054	0.129	0.075	0.007	0.011	0.004
6 to 9	0.004	0.006	0.002	0.110	0.229	0.119	0.018	0.028	0.010
10 to 19	0.013	0.013	0.000	0.449	0.661	0.211	0.109	0.115	0.006
20 to 49	0.024	0.025	0.000	2.499	3.885	1.386	0.450	0.487	0.037
50 to 99	0.017	0.019	0.002	3.506	4.164	0.658	0.660	0.807	0.147
100 to 200	0.012	0.015	0.003	3.638	6.263	2.625	0.903	1.130	0.227
Above 200	0.029	0.031	0.002	24.453	33.323	8.869	6.217	8.588	2.372
	100.000	100.000	0.000	100.000	100.000	0.000	100.000	100.000	0.000

Source: Compiled from NSS enterprise survey and Annual Survey of India

Annexure 2: Destination of Indian garments exports

	1991	**2000**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
United States	26.8	33.7	24.6	21.8	22.2	22.2	21.3	21.8	22.3
Germany	15.7	7.3	9.7	10.1	8.0	8.3	8.0	6.8	6.8
United Kingdom	10.7	7.7	11.5	11.2	11.7	11.3	11.5	10.8	10.3
France	6.6	6.3	6.2	6.4	5.3	5.3	5.3	4.5	4.6
United Arab Emirates	4.3	9.8	8.8	8.7	10.1	10.7	13.4	19.1	19.4
Japan	4.1	2.0	1.3	1.6	1.9	1.6	1.4	1.2	1.2
Italy	3.8	3.6	4.4	4.4	3.6	3.7	3.3	2.7	2.6
Netherlands	3.4	2.6	3.6	4.0	3.6	3.2	2.8	2.3	2.3
Canada	3.1	3.8	2.0	1.9	1.7	1.7	1.5	1.5	1.4
Switzerland	2.2	1.0	0.3	0.4	0.4	0.4	0.3	0.4	0.3
Spain	1.5	2.1	5.3	5.0	5.0	4.8	4.8	4.9	5.4
Others	17.9	20.1	22.4	24.6	26.4	26.9	26.4	24.2	23.5

Source: Author's compilation from UNCOMTRADE database

Annexure 3: Expenditure elasticity of Various Products Groups

	Rural	**Urban**	**All India**
Food	0.833	0.692	0.755
Non Food	0.716	0.705	0.693
Garment	0.708	0.786	0.797
Services	1.525	1.420	1.563
Durables	2.042	1.889	1.796

Source: Author's calculation using NSS Household Consumption Expenditure Survey 2011-12

LATEST ICRIER'S WORKING PAPERS

NO.	TITLE	AUTHOR	YEAR
384	INDIA-BHUTAN ECONOMIC RELATIONS	NISHA TANEJA SAMRIDHI BIMAL TAHER NADEEM RIYA ROY	AUGUST 2019
383	LINKING FARMERS TO FUTURES MARKET IN INDIA	TIRTHA CHATTERJEE RAGHAV RAGHUNATHAN ASHOK GULATI	AUGUST 2019
382	CLIMATE CHANGE & TECHNOLOGY TRANSFER – BARRIERS, TECHNOLOGIES AND MECHANISMS	AMRITA GOLDAR SHUBHAM SHARMA VIRAJ SAWANT SAJAL JAIN	JULY 2019
381	STRENGTHENING INDIA-NEPAL ECONOMIC RELATIONS	NISHA TANEJA SHRAVANI PRAKASH SAMRIDHI BIMAL SAKSHI GARG RIYA ROY	JULY 2019
380	A STUDY OF THE FINANCIAL HEALTH OF THE TELECOM SECTOR	RAJAT KATHURIA MANSI KEDIA RICHA SEKHANI	JUNE 2019
379	TOTALISATION/PORTABILITY OF SOCIAL SECURITY BENEFITS: IMPERATIVES FOR GLOBAL ACTION	ANWARUL HODA DURGESH K. RAI	JUNE 2019
378	INDIA-MYANMAR BORDER TRADE	NISHA TANEJA TIN HTOO NAING SANJANA JOSHI THIYAM BHARAT SINGH SAMRIDHI BIMAL SAKSHI GARG RIYA ROY MANALI SHARMA	JUNE 2019
377	THE ROLE AND CHANGING PARADIGM OF INDIA'S ASSISTANCE TO NEPAL: CASE OF THE EDUCATION SECTOR	TANU M. GOYAL	JUNE 2019
376	WHAT EXPLAINS INDIA'S POOR PERFORMANCE IN GARMENTS EXPORTS: EVIDENCE FROM FIVE CLUSTERS?	SAON RAY	MAY 2019
375	INCLUSIVE GROWTH IN INDIA - LEARNING FROM BEST PRACTICES OF SELECTED COUNTRIES	SURESH CHAND AGGARWAL DIVYA SATIJA SHUHEB KHAN	MAY 2019

About ICRIER

ICRIER, one of India's leading think tanks, was established in August 1981 as a not-for-profit research organisation to provide a strong economic basis for policy making. Under the current Chairperson, Dr. Isher Judge Ahluwalia, ICRIER has continued and reinforced the pursuit of its original vision and in the process significantly expanded the scope of its research activities.

ICRIER is ably supported by a Board of Governors, which includes leading policy makers, academicians, opinion makers and well-known representatives of the corporate world.

ICRIER's success lies in the quality of its human capital. Led by Dr. Rajat Kathuria, Director & Chief Executive, ICRIER's research team consists of highly qualified professors, senior fellows, fellows, research associates and assistants and consultants.

ICRIER conducts thematic research in the following eight thrust areas:

1. Macroeconomic Management, Financial Liberalisation and Regulation

2. Global Competitiveness of the Indian Economy – Agriculture, Manufacturing and Services

3. Challenges and Opportunities of Urbanisation

4. Climate Change and Sustainable Development

5. Physical and Social Infrastructure including Telecom, Transport, Energy and Health

6. Skill Development, Entrepreneurship and Jobs

7. Asian Economic Integration with focus on South Asia

8. Multilateral Trade Negotiations and FTAs

International conferences, seminars, public policy workshops, public lectures and publications form an integral part of ICRIER's outreach activities. ICRIER maintains a wide network of resource persons from India and abroad. It strives to attract well-qualified researchers, provides them a stimulating and scholarly work environment and encourages researchers to work in teams. ICRIER's research is widely cited by both academia and the popular press, and has over the years provided critical inputs for policy making.