NOTES & COMMENTS

AUTOMATION AND JOB LOSSES IN INDIA: AN OVERVIEW

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ABSTRACT

This paper tries to understand the issue of job losses associated with NATs in the Indian context. The current employment structure in India along with the sectoral pattern of availability of automation services seems to shield majority of workers in India from the potential job losses due to automation. Even though these findings are a source of relief, the author wishes to mention that the relief is only temporary. Future technological changes and innovations may reduce the barriers to automation and may make NATs ubiquitous in all spheres of economic activity.

Keywords: New Automation Technologies (NATs), Automation, Job losses, India

JEL Classification: J23, J24

1. Introduction

The potential role of NATs in the future transformation of labour markets worldwide is already acknowledged in literature. International Labour Office (ILO, 2017) collates various estimates on the potential effects of NATs on job losses. About 47 per cent of jobs in USA can be potentially automated. Around 56 per cent of jobs in Association of Southeast Asian Nations (ASEAN) bear this risk. World Bank (2016) predicts that 57 per cent of tasks could be automated at the global level. The same study estimated the figure for India as 69 per cent. If this happens, then it will certainly aggravate the problem of unemployment in India. In this context, this paper tries to examine the potential impact of the new automation technology on employment in India. Specifically, the paper tries to understand the issue of job losses associated with automation in India. Will majority of the workers in India be affected due to automation[1] related job losses or will they be shielded? This paper makes an effort to answer

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these research questions both by theoretically (using available literature) and empirically.

This paper is organized as follows. Section 2 presents the review of literature on potential job losses due to NATs. Section 3 analyses the current scenario of automation related job losses in India and the final section provides conclusion and policy suggestions

2. Review of Literature

Before reviewing the literature on NATs, the author wishes to give a very brief overview of the select concepts in the realm of NATs. The available literature suggests that, while the first industrial revolution of mid-1780s was powered by steam/water, the second industrial revolution of mid-1870s was powered by electricity and the third one was led by automation (computers were used to simplify tasks). The fourth industrial revolution or Industry 4.0 (I4.0) is characterized by NATs, which will synergize the digital and physical worlds through digitization of manufacturing process (AIMA-KPMG, 2018). The levers of I4.0 include Internet of Things (IOT) (which is a "seamless connected network system of embedded objects/devices, with identifiers, in which communication without any human intervention is possible using standard and interoperable communication protocols" (Government of India, 2015), Big Data (huge amount of data generated through operation of large networks), cloud computing etc. Another closely related concept is Artificial Intelligence (AI). AI is a constellation of technologies that enable machines to act with higher levels of intelligence and emulate the human capabilities of sense, comprehend and act (NITI Aayog, 2018).

A review of existing literature suggests that hardly any study is there in the Indian context as far as the impact of NATs on job losses is concerned. Hence, studies done in the case of other countries were reviewed to predict the influence of NATs on employment in the case of India.

The fear of job losses due to technological changes like automation is not new in history. Perhaps such a fear first arose during the time of Industrial revolution (ILO, 2017). Gelb and Khan (2016) mentioned about the Luddite movement which forcefully destroyed machines as an attempt to prevent job losses. But, these fears proved wrong and employment increased in the long run. A survey of available literature on the potential impact of automation seems to lead one to similar but slightly different conclusions. It is true that automation will reduce manual employment but there exist significant bottlenecks and barriers to adoption of automation in all sectors and regions of global economy.

Sirkin et al. (2015) and Gelb and Khan (2016) point out that automation is not uniformly spread in all sectors of global economy. About 75 per cent of robots in the world are used in manufacturing of electrical, electronics, computers, appliances, and transport equipments. Thus, there is a very high

chance that adoption of automation will be concentrated in few sectors of economy and job losses due to automation may not be widespread to all sectors. It may also be noted that the above mentioned sectors are already not labour intensive at the production level and job losses, if any, due to automation may not be very high.

Sirkin et al. (2015) also talk about regional dimensions of automation adoption. 80 per cent of robots in the world are deployed in 5 nations – China, Germany, Japan, South Korea and USA. Thus, currently, automation is not a worldwide phenomenon. It is regionally concentrated in the global economy. It may be noted that nations who top in adoption of NATs are mostly industrially well developed. So, spreading NATs to other regions may not be easy.

Barriers to NATs adoption

Why is the adoption of NATs skewed regionally and sector-wise? The answer lies in the 'barriers' to automation. ILO (2017) argues that many of the estimates of potential job losses due to NATs are based on information about the progress of research on machine learning and artificial intelligence. These estimates are actually the estimates regarding the probability that, some tasks within various jobs 'could' be automated. There is no guarantee that they 'will' be automated. While the 'could' consideration is purely technical, that is, it is technically possible to automate a task; 'will' on the other hand is a socio-economic consideration. Tasks/jobs will be automated only if those are economically feasible and socially acceptable. Economic feasibility depends on capital availability and profitability. Huge amount of capital to invest in NATs may not be available in all economies (Sirkin et al., 2015). Economic profitability of the adoption of NATs depends on the relative costs of labour and NATs. These increase the gap between the technical and socio-economic considerations in underdeveloped and developing economies given the surplus labour and low wages. This also explains the regional concentration of NATs in developed economies (ILO, 2017). Arntz and Zierahn (2016) highlight the endogeneity of labour demand and wages. NATs' adoption itself reduces the labour demand and wages. This may reduce profitability of NATs' adoption in future. Thus, the main economic barrier to NATs' adoption is the relative cost of labour and NATs. But, this barrier vanishes if labour costs increase and automation costs decline.

In addition to the economic barriers to the adoption of NATs, the technical, legal, social and ethical barriers are also significant. Technical barriers to automation mainly relate to issue of 'tasks' vs. 'jobs'. ILO (2017) points out that the estimates of labour displacement due to automation are based on hours spent on automatable tasks of a job. But a job consists of several tasks and all the tasks within a job are not automatable. Workers doing jobs which have a high risk of automation also perform tasks which cannot be easily automated. Arntz and Zierahn (2016) mentioned about the tasks involving

flexibility, judgment and common sense in this context. Neglecting the differences in the nature of tasks of comparable jobs leads to over-estimation of job losses (ibid). There are differences within/across nations in the task contents of same job (Gelb and Khan, 2016). Automating a task within a job may be a purely technical consideration but whether all tasks within all jobs can be automated is a socio-economic consideration. It is not always possible to clearly define all the tasks within a job so as to decide the extent to which a job can be automated (Arntz and Zierahn, 2016). Thus, the technical possibility of automatability of tasks need not be translated to automatability of jobs and therefore job losses.

Legal, social and ethical barriers to automation are also significant. Legal barriers to automation include labour laws regarding collective bargaining, hiring/firing, policies on foreign capital/technology and interest rate policy (Sirkin et al., 2015). But legal barriers to automation may be bypassed by new technology. Gelb and Khan (2016) point to the chances of direct online communication between the employer and job seekers without collective bargaining. Social barriers include preference to human beings than machines in occupations, low levels of education, and aversion to new technologies (Arntz and Zierahn, 2016; Sirkin et al., 2015). There are also ethical barriers. Arntz and Zierahn (2016) cite the example of driverless cars and say that possibility of accidents may prevent these cars to be tested/used.

The existence of economic, technical, legal, social and ethical barriers to automation seriously limits the adoption of NATs in all sectors and regions of global economy. But, we need to acknowledge the possibility of new technological changes overcoming the aforesaid barriers to automation.

So far, we have only discussed about the job destruction effects of automation. But, the existing literature on automation also talks about job creation effects. Arntz and Zierahn (2016) argue that automation increases productivity of factors, and as a result, in the long run, factor incomes including worker income increases. Sirkin et al. (2015) argue that this is particularly true for highly skilled workers whose talent and time can be used more productively. This increases the demand for goods and services and thereby increases the demand for labour and offset the effect of job losses due to automation (Arntz and Zierahn, 2016). But this effect has another side too. The fall of income of those who bear the adverse economic effects of automation may create the opposite effect (Acemoglu and Restrepo, 2017). It seems that the relative strength of these two opposing forces determine the net effects of automation on the level of employment.

Gelb and Khan (2016) point out that the literature on automation ignores the human-machine complementarities and its potential to create new jobs. Arntz and Zierahn (2016) also hold the same view that new technology can effectively complement the tasks performed by workers. Workers can adapt to new technology and as a result either a transition from old to new jobs or

a transformation of the existing jobs will take place. Gelb and Khan (2016) opine that automation do not devastate the labour market but merely re-organizes it. Demand for highly skilled labour may increase and demand for less skilled labour may decrease. Educational system must be responsive to these changes. The actual issue is not job losses but the adjustments required in the light of technology induced changes in the job market.

Factors that determine the extent of vulnerability of workers to automation induced job losses can be found in literature. The main factor is skill of workers. Arntz and Zierahn (2016) point out that the workers without requisite skills cannot take up the tasks that complement new technologies. Thus, low skilled workers are more threatened by automation. Workers with less education will be also threatened. Acemoglu and Restrepo (2017) argue that lowly paid workers are more affected and women are relatively less affected by automation.

The review of literature on potential impact of automation suggests that barriers to adoption of automation such as relative cost of labour, social, legal and ethical etc. may prevent the adoption of NATs. The net effect of job creation and destruction due to automation determines the actual effect on job losses. Some studies found that automation is a threat to low skilled workers but not high skilled workers.

3. Impact of Automation on Jobs

In this section, we try to analyse the potential impact of automation on job losses in India. This will be done in the following way. First, using the information of growth of wages in India and second, by looking at sectoral dimension of automation.

3.1 Growth of Wages in India

Literature on automation suggests that growth in wages is an important indicator that determines the steps towards automation. So, the author has first tried to collate the latest available information on growth of wages in India. This information is presented in Table 1.

Table 1: Annual Growth of Real Wages in India (in per cent)

Year	Real Wages
2013	5.2
2014	5.7
2015	5.4
3-Year average growth of real wages in India	5.4 per cent
Decadal average Growth rate of real wage in India (2006-2015)	60.0 per cent

Source: Global Wage Report, 2016

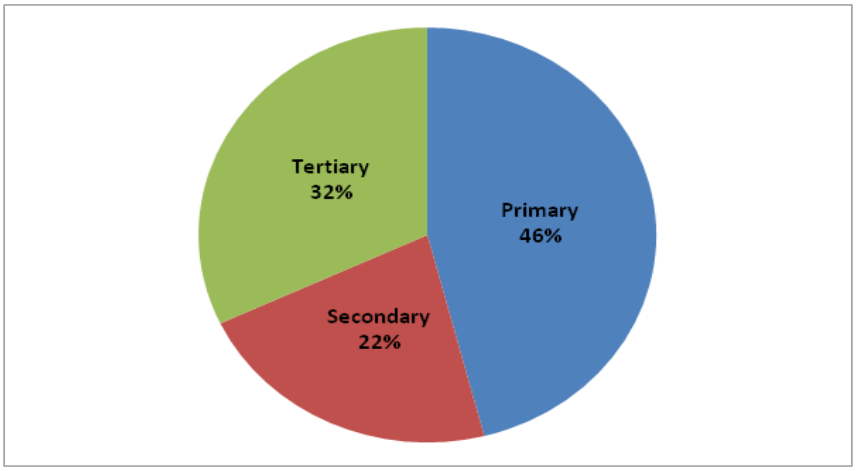
Table 1 shows that growth of real wages in India is not very much high to induce an immediate spurt in adoption of automation. However, fairly high decadal growth of wages in India may increase the pace of automation in the long run. Thus, in the short run, growth in wage rates does not seem to be sufficient to induce an immediate massive adoption of new automation technologies and resultant job losses.

3.2 Sectoral Dimension of Automation

What are the major economic sectors affected by automation in India? What is the contribution of these sectors to employment? The paper tries to make an informed guess on the present association between automation and job losses by answering these two questions.

To do that, an idea about the present sectoral share of employment in India is needed first, which has been presented in Figure 1.

Figure 1: Share of Major Economic Sectors in Employment in India (%)



Source: Economic Survey, 2016-17

Next task is to understand the major sectors of Indian economy that would be affected by automation. At present, there is no clear-cut and concrete information available in this regard. So, we have tried to understand the sectoral issues of automation through the relevant proxy information. For this, we have used the information of the 'Automation India Expo' jointly conducted by the Department of Science and Technology, Government of India and IED communications, since 2002. The website of the expo (http://www.automationindiaexpo.com/) has a list of participants who showcased their automation products and services. The author collected the information about their area of specialization from their respective websites and identified the economic sectors that might be affected due to their automation solutions/products. The contribution of these sectors to total

employment in India was assessed in a general manner to give an understanding of the present possibilities of causing job losses in India.

Before proceeding further, it is essential to acknowledge the limitations of this information. As stated earlier, participants' list in the automation expo is only a proxy and do not give us a full picture on the extent of automation in India. All firms who deal with automation solutions need not turn up in an expo. Information given in websites about the activities of a firm may not be clear and accurate. The limited technical knowledge of the author may also influence his idea regarding the nature and extent of automation/job losses in different sectors. The mere presence of a firm that offers automation solutions for a particular sector do not necessarily implies job loss. Literature review already pointed out that the decision to adopt new automation technologies is determined by economic and non-economic considerations. Despite these limitations, ignoring the information provided by the automation expo website do not seem to be prudent as the author could not find a more comprehensive information source (on automation adoption in India) in public domain.

If lists of participants of all expos since the inception of Automation India Expo would have been available, then a multi-period time series analysis could be done. But, unfortunately the website of the expo only provides the lists of participants for 2018. Besides this lists and the information on total number of stalls in the expo (which is not available on a continuous basis), no other time series information regarding the dimensions of automation adoption in different sectors of India is available in public domain. So, the author was able to perform only a very rudimentary time series analysis and statistical testing using 20017 and 2018 data. This data covers information about the area of specialization of the 360 firms who participated in the expo in 2017 and 397 firms who participated in the expo in 2018. These data are summarized in Table 2.

Table 2: Area of Specialization of Automation Sector in India (in per cent)

Products/Services offered by firms	2017	2018
Industrial Equipment	71.00	69.78
Robotics (non-industrial)	1.94	2.26
ICT	6.67	3.02
Electrical equipment	4.17	3.27
Others	4.17	1.75
Other Services	3.89	7.80
Printing	2.78	3.52
Imaging	1.67	1.26
Home Automation	1.39	0.50

(contd.)

(Table 2 contd.)

Communications	0.83	0.76
Touch Technology	0.83	0.50
Energy	0.56	1.00
Internet of Things	0.56	2.02
Agriculture	0.00	0.25
Loading/Unloading Solutions	0.00	0.25
Laboratary Equipment	0.00	0.75
Automatic Doors	0.00	0.25
Driverless Vehicles	0.00	0.25

Source: Computed by author using the data available from http://www.automationindiaexpo.com/

From Table 2 it is clear that most of the firms specialize in the provision of industrial equipment. The data show that maximum percentages of firms specialize in the area of industrial equipment (71 per cent in 2017 and 69.78 per cent in 2018). For an in-depth analysis of the area of specialization, we have done further disaggregated analysis of industrial equipment which is reported in Table 3.

Table 3: Area of Specialization within Industrial Equipment (in per cent)

Products/Services offered	2017	2018
Miscellaneous Industrial Machinery	25.98	27.24
Censors	16.54	8.31
Controlling	14.96	14.86
Measurement	14.17	9.31
Testing	4.72	0.76
Monitoring	4.33	1.26
Packaging - Coding	2.76	0.50
Connectors	2.36	1.00
Industrial robots	2.36	1.01
Safety equipment	3.94	1.01
Pneumatics	1.57	2.51
Power systems	1.57	1.76
Coating	0.79	0.00
Displays	0.79	0.25
PCB	0.79	0.00
Tubes	0.79	0.00
Conveyer Belts	0.39	0.00
Transmission	0.39	0.00

Source: same as Table 2

The above table shows that maximum percentages of firms in industrial equipments are specializing in the area of censure, controlling, measurement etc. Moreover, it points to the conclusion that the area of specialization of automation sector in India is changing over the time. For example, the number of firms providing IOT related services increased by 4 times. The number of firms providing automation solutions to tertiary sector as a whole has increased by 2 times. At the same time, there is a decline in the number of firms catering to sectors/tasks like packaging, coding, industrial robotics etc. Do the available data show any significant difference in the sector/task-wise availability of automation solutions in India during 2017 and 2018? This question is answered by conducting a paired sample t-test. The Null hypothesis is of no significant difference in this regard. The P value of the test statistic was 0.50 at 5 per cent confidence level. So, the null hypothesis cannot be rejected and there is no significant difference in the number of firms providing automation solutions for different sectors/tasks during 2017 and 2018. This finding is further corroborated by the fact that the number of firms in 2017 and 2018 were highly correlated. Correlation coefficient was 0.879 and significance of this correlation was 1 per cent level. These findings suggest that the scenario emerging from the analysis of the available data on availability of automation solutions have not changed during 2017 and 2018.

Are 'they' shielded?

Review of literature on automation mentioned about the barriers to adoption of automation and job creation effects of automation. Social and ethical barriers to automation cannot be quantified easily. Technical barriers to automation in India can be understood only by an in-depth survey at firm level. The author has not come across any recent changes in labour laws that are associated with automation. But media reports suggest that Government of India is contemplating some changes in factory Act like increasing the threshold limit for coverage of factories under the Factories Act, 1948 (The Hindu, February 14, 2017). It needs to be seen whether these moves will reduce the legal barriers to automation. Even though job creation effects of automation in India can be ascertained only after a detailed primary survey, information from automation expo suggests that the existence of 397 companies who provide automation products and services is likely to generate some jobs. But quantifying the extent of job creation is difficult as it needs more information about their origin (weather they are new companies or new departments of the existing companies) and characteristics. Such an attempt has not been made by the author owing to paucity of data.

A World Bank study mentioned in literature review estimated that automation has the possibilities to cut up to 69 per cent of jobs in India. But the review indicated that these studies only have mere predictions which may not become reality. An attempt is made in this paper to understand the current reality in India using Tables 2 and 3. Table 2 shows that majority of

firms (71 per cent in 2017 and 69.78 per cent in 2018) which offer automation solutions specialize in provision of industrial equipment. This is in line with the international experience of concentration of automation to few sectors (see Sirkin et al., 2015 and Geld and Khan, 2016 in literature review). Table 3 shows the disaggregated picture of specialization of these 71 per cent firms. The author lacks the technical knowledge to comment if the products of these firms are labour displacing or not. *But even if they are,* they will have significant effect only on the 22 per cent of workers in India. This will be clear from Figure 1 and Table 2. Majority of automation companies (71 per cent) concentrate on industrial needs. But at present, only 22 per cent of India's workforce is employed in this sector. So, the World Bank prediction of a cut in 69 per cent of jobs in India is not a cause of worry for us, as the present progress of automation in India is not in tandem with this worrisome estimate. Within this 22 per cent of workers a large majority is employed in MSME (Micro Small and Medium Enterprises) but only one company was found (among the 360 companies which participated in automation expo-2017) that offered automation solution to MSME sector. This further reduces the vulnerability of automation to Indian workers as only a fraction within this 22 per cent may be affected. Majority of workers in India are now employed in agriculture (46 per cent) and services (32 per cent). Only one company was found (among the 397 companies which participated in automation expo-2018) to offer automation services in agriculture/primary sector and Table 2 shows that only 10.56 per cent of companies in 2017 and 10.82 per cent companies in 2018 offer automation solutions to services sector. Thus, current information on the availability of automation solutions suggests that their availability is comparatively low in the two sectors that generate the highest quantum of employment in India and is the highest in a sector that generates the lowest quantum of employment in India. Thus, the current employment structure in India along with the sectoral pattern of availability of automation services seems to shield the majority of workers in India from job losses due to automation. Thus, available data indicate that majority of workers in India will be shielded from job losses due to automation. This broad trend has not changed during 2017 and 2018.

This paper attempts to contextualize the findings of this study in the light of recent developments that took place in the Indian employment scenario. Abraham (2017), using latest data on employment in India estimated that the total employment in India declined by about 0.4 per cent per annum. Most of the decline in employment came from unorganized sector. Highest decline in employment took place in primary sector and the decline in agricultural employment caused the same. Secondary employment, especially manufacturing employment also declined. Employment declined in almost all sectors except a few sub-sectors of the services sector. Lack of growth in the employment generating sectors of economy is the reason behind this.

These recent trends in employment scenario seem to indirectly support the arguments of this paper. A decline/stagnation of employment is there in almost all sectors/sub-sectors of the Indian economy and this phenomenon is not confined to any one sector such as manufacturing which has more prevalence of NATs. Thus, NATs are not responsible for the current stagnation/decline of employment in India. Decline in employment in primary sector (especially agricultural sector) and unorganized sector are the main drivers of the overall reduction in employment in India. This study proves that these sectors show the low automation prevalence. Lack of sectoral/ sub-sectoral growth is the main reason behind the fall/stagnation in employment. So, even the decline in secondary/manufacturing sector (where the study shows comparatively higher NATs prevalence) is due to this reason and not due to the advent of NATs; at least for the time being. Thus, NATs are yet to emerge as a significant factor causing a massive decline in employment generation in India.

The decision to limit the methodology/scope of this study to an exploratory one prevents an in-depth study of the problem. But since the study suggests that job losses associated to NATs is not an imminently serious problem, an in-depth study of factors/processes involved in NATs (using some other research methods) is not required right now. Thus, the results justify the use of methodology adopted by the researcher. Before concluding the study, the author would like to comment briefly on the policy initiatives/ responses pertaining to NATs in India. The revised draft policy on IOT, prepared by the Department of Electronics and Information Technology (DeitY), Government of India (2015) focused on setting up of model projects like IOT enabled smart cities. It also emphasised capacity building, human resource development (HRD), governance and standardization regarding IOT. Research, innovation and development in this field need to be encouraged by providing incentives and incubation. NITI Aayog's (2018) discussion paper on national strategy for AI identified the focus areas and key challenges for reaping the benefits of AI in India. It had touched upon the importance of research, skilling, ethics, privacy, security aspects and steps to accelerate AI adoption in India. National Productivity Council's theme paper (2018) on Industry 4.0 (I4.0) identified the lack of clear vision, digital infrastructure, data security and standardization as among the key challenges to successful adoption of I4.0 in India. For India, to benefit from I4.0, the 'Make in India' initiative of the government is needed to adopt techniques/principles of I4.0.

This study does not intend to critically evaluate and examine all NATs related policies. Rather, it has focused on a particular issue of potential job losses due to NATs. As found from the analysis, NATs did not cause immediate loss of jobs in India. But its impact on job losses in the future cannot be ruled out due to lack of holistic approaches in skilling and re-skilling of workforce. To prevent it to happen in future, there is a need for proper strategy to protect the workers. Though re-skilling of workers is important in this regard,

this alone may not be sufficient. All workers need not be re-skilled due to a variety of factors like old age, habit, values, customs etc. None of the Indian policy documents in the realm of NATs has touched these aspects. They only aim at maximizing the gains from NATs. Strategies to minimize the social losses (like job losses) due to NATs should also find a place for discussion. Suggestions given by ILO (2018) are very relevant here. It emphasizes labour protection strategies (for example, ensuring minimum working conditions to workers) and redistribution strategies (for example, taxing NAT adopters to fund support programmes for workers who became jobless due to NATs). There may be practical difficulties in adoption of these strategies. But given the comparative labour abundance of the Indian economy, the spirit of ILO approach needs to be incorporated in the Indian policy documents pertaining to NATs. The author feels that NATs related policy documents are still in infancy in India. At present, only a few policy documents pertaining to specific domains of NATs are out in public domain. Let us hope that these will pave the way for a more comprehensive policy on NATs.

4. Summary and Conclusions

This paper was an attempt to understand the issue of job losses associated with New Automation Technologies (NATs) in the Indian context. Theoretical review of the research topic highlighted barriers to automation and job creation effects of automation. Barriers seem to be significant in the Indian context. India is (predictively) categorized as a slow adopter of automation and growth of wages in India do not seem to be very high to induce immediate adoption of NATs and therefore immediate job losses need not be expected. Most of the firms that provide automation solutions specialize on Industrial Equipment. This study could find only one firm specializing on agriculture/ primary sector automation and number of firms specializing on tertiary sector automation is comparatively lower. Availability of automation solutions is less in two sectors that generate highest quantum of employment and it is the highest in a sector that currently generates the lowest quantum of employment in India. Thus, the current employment structure in India along with the sectoral pattern of availability of automation services seems to shield majority of workers in India from the potential job losses due to automation. Even though these findings are a source of relief, the author wishes to mention that the relief is only temporary. Future technological changes and innovations may reduce the barriers to automation and may make NATs ubiquitous in all spheres of economic activity. Therefore, more efforts to understand the dynamics of employment and technological changes, and programmes that enable workers to be responsive to future technological changes is the need of the hour.

Note

1. NATs and automation are used synonymously in this paper.

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