A Gendered Future of Work?

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Abstract

This paper aims to contextualise the narrative around digitalisation and automation with reference to the female labour force in India. Studies around the future of work have predicted technological disruption across industries, leading to a shift in the nature and organisation of work, as well as the substitution of certain kinds of jobs and growth of others. It then becomes exigent to study these trends in the context of the Indian female labour force, given that it has been witnessing an absolute decline over the past two decades.

The paper argues that two aspects of the structuring of the labour market will be pertinent in shaping the future of work: the gendered nature of skilling and skill classification, and occupational segregation along the lines of gender and caste. We will take the case study of the electronics manufacturing sector to flesh out these arguments further. Finally, we bring in a discussion on the platform economy, a key area of discussion under the future of work. We characterise it as both generating employment opportunities, particularly for females, due to the flexible nature of work, and retrenching traditional inequalities built into non-standard employment.

Introduction

The question on the future of work across the global North - and parts of the global South - has recently been raised with regards to technological disruption, as a result of digitisation, and more recently, automation (Leurent et al., 2018). While the former has been successively replacing routine cognitive tasks, the latter, defined as the deployment of cyber-physical systems, will enable the replacement of manual tasks previously being performed using human labour (Leurent et al., 2018). In combination, these are expected to have a twofold effect on: the "structure of employment", which includes occupational roles and nature of tasks, and "forms of work", including interpersonal relationships and organization of work (Piasna and Drahokoupil, 2017).

Building from historical evidence, the diffusion of digitising or automative technologies can be anticipated to take place differently across economic contexts, with different factors causing varied kinds of technological upgradation across the global North and South. Moreover, occupational analysis projects occupations in the latter to be at a significantly higher risk of being disrupted than the former (WTO, 2017). However, these concerns are somewhat offset by the barriers to technological adoption that exist in lower income countries such as lower wages, and a relatively higher share of non-routine manual jobs (WTO, 2017).[1] With the global North typically being early and quicker adopters of automation technologies, the differential technology levels in countries have been in fact been utilised to understand global inequality (Foster and Rosenzweig, 2010). Consequently, the labour-cost advantage that economies in the global South enjoy may be eroded, leading to what may be understood as re-shoring/back shoring - a reversal of offshoring (ILO, 2017). This may especially be the case in sectors where there has been a failure to capitalise on the labour-cost advantage by evolving supplier networks to complement assembly activities (such as in manufacturing) (Milington, 2017), or production of high-value services (such as in the services sector).

Extensive work over the past three decades has been conducted on the effects of liberalisation and globalisation on employment for the female workforce[2] in the global South. This has explored conditional empowerment and exploitation as females are increasingly employed in factories and offices, with different ways of reproducing and challenging patriarchal relations. However, the effects of reshoring and technological disruption have yet to be explored to any degree of granularity for this population, which arguably will be one of the first to face its effects. This can be seen as a consequence of industries that rely on low cost female labour being impacted first by re-shoring, such as textile and apparel and electronics manufacturing (Kucera and Tejani, 2014).

Missing women in the Indian labour market

The need for this analysis becomes exigent in a labour market such as India's, which has been experiencing a decline in female labour force participation (FLPR) steadily over the past two decades: it fell from 25.9 in 2011-12 to 23.7 percent in 2015-16 (Bhalla and Kaur, 2010). Participation also varies widely across states, ranging from 71% in Nagaland to 20% in Uttar Pradesh (Basole et al., 2018). This decline is despite growth in the GDP, lowered fertility rates, and increase in overall literacy rates over the same period - all of which are typically viewed as drivers of workforce participation. In the period following 2007, India has seen declining employment elasticity, a measure of employment growth response to GDP growth, of 0.15 per cent - attributed in large part to the withdrawal of rural women from the workforce (Polaski, 2016). To put this figure into context, the

employment elasticity was consistent at around 0.30 per cent for a period of 18 years from 1991 to 2007 (Polaski, 2015).

Interventions in the policy framework to support female participation then need to account for short to long term challenges posed by technological disruption and re-shoring. This paper will explore this question through two perspectives: the effect of automation on the female labour force globally, and historical and contemporary analyses of female labour force participation in India. The paper also utilises critiques made by feminist economists of the social organization and constitution of 'work', and the distribution of power in the workspace. Drawing on the perspective that the current phase of technological disruption does not constitute a "radical break" and must be viewed in the context of historical continuities, an analysis of effects on female workers will be undertaken.

Intersection of Gendered Skilling and Automation

The lack of females in employment is despite gender parity in secondary and primary education, which has been achieved nationally (Mehrotra, 2018). That rising education levels has not translated into increased employment can be understood through additional factors. Firstly, parity is a recent development - a 17% gap between literacy levels of males and females across age groups still exists (Census, 2011). Other factors include females opting to continue to study post secondary education to access better opportunities through higher education; and constrained employment choices due to social norms and lack of mobility.

Lack of opportunities compounded by jobless growth, mismatch in demand and supply of labour, gendered wage gaps, and poor conditions of work keep female workers out of employment despite being active job seekers. Mismatch of demand and supply of labour is also indicative of gaps in education and skilling, which have been identified globally as major challenges to equipping the labour force for technological disruption and atypical work (OECD, 2017). It then becomes relevant to contextualise skilling frameworks for female workers.

In terms of classification of workers as 'skilled' in the Indian workforce, there exists a significant gender gap, with estimates ranging from 65 to 98 percent as per the India Skills Report 2018 (Wheebox, 2018). Skill has been a difficult concept to define and measure. Beechey's conceptualisation of skill provides a useful framework to understand skill as one of: "(a) an objectively defined competency, (b) control over conception and execution and (c) socially defined occupational status" (1982). In other words, skills are not socially neutral and are both socially defined and constructed, and a socially defined occupational status may then be more or less independent of objective competencies.

This forms the basis for the creation of skill hierarchies that, in the context of the Indian labour market, are less emblematic of the skill content of the job and instead, more emblematic of biases leading to discrimination basis the *type of work* being undertaken as well as of the *category of person* possessing the skill (Srivastava, 2008). To illustrate, skill hierarchies created owing to the *type of work* is best understood by looking at how urban, industrial and non-manual work is treated as skilled work (Braverman, 1974), thus unfairly prejudicing tasks requiring a high degree of skill such as agricultural work. The latter skill hierarchy, in the Indian context, is most evident in the context of jobs requiring a high degree of skills (such as midwifery) finding a place at the bottom of the skill hierarchy owing to these jobs being traditionally practised by 'lower' castes. Furthering the argument for the above outlined social construction of skills is its ability to serve as a normative framework for understanding the state of women's jobs.

That skills are not socially neutral is also illustrated by the increasing recognition of the undervaluation of certain skills which women can currently perform at higher productivity levels than men (Mehrotra and Parida, 2017). It has been further argued that skill hierarchies - categorising jobs as 'women's jobs' and 'men's jobs' are not just reflective of the production system but also an expression of a patriarchal system linking craft identity with masculinity or femininity (Cockburn, 1986). As Wood has articulated, "Jobs are created as masculine or feminine, with their skill content continually redrawn so as to assert male exclusivity" (1987). For instance, a historical assessment of occupational segregation in the United States indicates that the entry of female workers into specific roles that were male-dominated has had a detrimental effect on the social status of that profession (Morgall and Vedel, 1985).

Mechanisms of technological change and female employment

This is particularly relevant in understanding what the future of work holds for the female labour force. As Autor et al. argue, technological change could be of two types - skill biased or routine biased change, in both of which low-skilled and/or entry level workers bear the brunt of disruption, by being involved in low skilled and/or routine and hence automable tasks (2003).

In their work on the effects of automation on labour in the European Union, Piasna and Drahokoupil find, based on ISCO occupation classification of workers in the EU, that non-manual jobs cohere to Autor et al.'s (2013) theory of technological change (2017). In the context of the Indian labour force, this would imply that low skilled jobs such as those in the manufacturing industry would be at greater risk than those in services. This approach, however, can be challenged in the context of low income economies given the availability of cheap labour and consequent lack of cost efficiency in introducing automative technologies. This has been found historically as well - a key factor in the mechanization of certain manual tasks during the Green Revolution was the easy availability of locally manufactured and cheap technology (Prahladachar, 1982).

The second theory of job loss through automation is that of "ICT-based polarisation", which argues that faster growth in ICT will propel a shift from middle-skilled to high-skilled workers, especially in ICT intensive industries, with so-called 'low-skill workers' remaining largely unaffected (Michaels et al., 2013). This is attributed to the nature of tasks, wherein cognitive routine tasks are likelier to be replaced than non-routine cognitive tasks, and non-routine manual tasks remain unaffected. This would mean that routine cognitive tasks such as those dominated by females in the IT-BPO sector would be at a higher risk than non-routine manual tasks in other sectors, such as healthcare, security, and domestic work. Going by the "ICT-based polarisation" theory, the concentration of female workers in the informal sector in India puts them at a lower risk than males in the short term, but will harm female workers in the long-term as higher returns and job growth gets concentrated in jobs with ICT-based tasks with lower female representation.

Accordingly, Sorger et al. (2017) find that digitisation is less likely to substitute jobs with overrepresentation by female workers, primarily as a result of women being concentrated in low-skilled non-routine manual jobs (Sorgner et al., 2017). However, they will be disadvantaged in the long run, as occupations and industries witnessing growth will be high-skilled non-routine cognitive tasks that are complemented by digital tools, wherein females are significantly underrepresented in the Indian context (Sorgner et al., 2017).

This will be further exacerbated by the barriers to access digital information, tools, and skills for females globally (Kunt, 2017), leading to "Involuntary skills-based exclusion" that hurts sections of

the population that are unable to participate in social life using ICTs (Walton et al., 2013). The gender gap in India in the number of internet users grew from 11% in 2013 to 12% in 2016, taking the total number of female internet users in India to 29% (ITU, 2016). There also exists a further 36% gender gap in mobile phone usage, as a result of a combination of socioeconomic barriers, educational and literacy gaps; constraining social skills norms and lack of autonomy, technical skills, and/or confidence levels among female users (Scott, 2018). The implication of this is constrained access to digitally accessible economic opportunities, critical information, and social networks.

The skill-based approach to measuring the effects of automation on the female workforce is even more relevant in the context of a society such as India's, with social norms that rigidly regulate the kinds of tasks performed by females. Following the Green Revolution, for instance, Agostino finds evidence of social norms, as opposed to inadequate skill sets amongst female workers, creating barriers for entry for females into high productivity *jobs* - especially those witnessing high growth following technological disruption (Agostino, 2016). He also identifies social norms as the primary barrier for females to perform profitable *tasks* within agriculture, such as harvesting and sowing.

Gendered valuations of skilling can also be found in the time devaluation of female workers, which is reflected in the average wage gap of 34 percent and pervasive inequality across sectors (ILO, 2018). This has largely been attributed to cultural factors that lead to discrimination in workplaces, rather than gaps in productivity. Feminist economists have pointed out that the sexual division of labour in the household and workplace is contingent on this devaluation of the time and labour of female workers (Parr, 1988). The extent of this devaluation in India is reflected in the high percentage (62.43%) of invisiblised and unacknowledged females in the working age group primarily involved in unpaid domestic tasks (NSSO, 2011-12). In the context of the future of work, it should be noted that technological change has historically narrowed the gender wage gap in the global North, but is unlikely to so in the global South due to a range of factors such as limited investment in human capital, weaker state capacity in enforcing regulation on equal and/or living wage, and the influence of conservative social norms (Black and Spitz-Oener, 2007).

The gendering of skills is closely linked to occupational segregation, at least from evidence that has emerged from literature looking at advanced industrial economies (Estevez-Abe, 2005). The central claim therein is that general skills are more gender-neutral than firm-specific skills that discriminate against women. Deriving from Becker's analysis, firm-specific skills are those that are acquired through on the job training, are valued by the current employer and consequently, lack portability owing to the difficulty of assessment of such skills by outside employers (Becker, 1964). General skills, on the other hand, are effective in their portability as they are certified in an objectively recognizable form (such as diplomas) for outside employers. The underlying rationale is that not only are skill categorisations gendered and segmented, but their acquisition is too. Similarly, it is argued that vocational centres, such as Industrial Training Institutes in the Indian context, promote acquisition of skills that further "gender-typed" occupational choices (Charles, et al., 2001).

Intersectional Occupational Segregation and the Future of Work

Caste and geographical occupational segregation

As indicated by the Employment - Unemployment Survey in 2011-12, the FLPR is higher for workers

from SC, ST and OBC groups than Hindu females from upper castes, although the share of employment of female workers from higher socioeconomic backgrounds is higher in regular salaried jobs. Poor rates of participation among higher caste groups, despite the marginal increase over the years in regular salaried employment, is a result of two factors broadly: historical upper-caste patriarchal cultures that construe income generated by the female as subsidiary to male-generated income, and barriers to employment for females in specific kinds of jobs and tasks (Chakravarti, 1993). Concurrently, FLPR in lower caste households has been found to be driven by distress than choice, and is then concentrated in low paid contractual jobs in the informal sector (Abraham, 2009). It should also be noted that these figures are captured by national censuses and surveys, which have been critiqued for being unable to capture and classify female labour accurately.

36 percent of females of working age are employed in rural India, while urban areas see a participation rate of only 21 percent (Andres et al., 2017). 135 of 148 million working women are concentrated in the informal sector and within that, in household industries and seasonal and temporary employment (Mehrotra, 2018). Disaggregating this data further shows a stark class divide - upper class females have greater access to regular salaried jobs in the formal sector, whereas lower class females are concentrated in the self-employed or casual labour categories (Srivastava and Srivastava, 2009).

Gendered occupational segregation

Job growth in India has been concentrated in sectors employing males in urban areas, while sectors, especially labour-intensive ones, that historically employ females have seen a gradual decline in job growth (Srivastava and Srivastava, 2009). Capital intensive growth and an atypical structural transformation of the Indian economy as a consequence of premature deindustrialisation has further constrained occupational choices for female workers (Mehrotra and Parida, 2017).

In the 2011-12 period, the distribution of female workers in each sector was: 11% in agriculture, 29% in manufacturing industrial work, 5% in non-manufacturing industrial work, and 55% in services. Female workers have moved out of agriculture primarily into services, within which a majority were traditionally female dominated industries such as education, retail trade, domestic work, and other services like hair dressing. Occupational segregation in manufacturing has implied that female workers are employed mainly in apparel, electronics, textiles, and tobacco products industries.

Gendered occupational segregation, both vertical and horizontal, will be key factors in determining the impact of Industry 4.0 on the female labour force. Vertical segregation is understood to mean the lack of female representation in jobs typically construed as high-status such as managerial roles (Estevez-Abe, 2005). Horizontal segregation, on the other hand, refers to gendered differentiation found cross-sectorally - for instance, manufacturing and craft jobs see female underrepresentation while service sector jobs see relative female overrepresentation (Estevez-Abe, 2005).

There are several theories that seek to explain gendered occupational segregation, each providing unique insights. The mainstream labour economics view establishes causal relations between lower education levels levels among women and gendered occupational segregation (Becker, 1981). Another view that models employer behaviour argues for economic rationality in recruitment determinations that rely on the assumption of the greater likelihood of women quitting their jobs (Augner and Cain, 1977). Rejecting these economic theories are cultural theories favoured by both sociologists and feminist economists. They draw attention to cultural norms about gender roles and the process of socialisation as determinants of managerial practices and women's career choices (Conway et al., 1996). The argument here is that social norms further prevent women from taking up

blue-collar and manufacturing occupations also play a central role in determining occupational choices, especially in economies undergoing industrialisation (Lansky et al., 2017).

A more contemporary theoretical framework assimilating several facets of the above mentioned theories is a hybrid developed by Charles and Grusky (2004). Arguing that sex-segregation has several facets, they seek to address issues of horizontal and vertical segregation independently. They go on to identify the two causal factors as gender egalitarianism and post-industrialism. They argue that high levels of gender egalitarianism serve as an antidote to vertical segregation, but it is post-industrialism (i.e. the expansion of the services sector) that further exacerbates the horizontal segregation of women into non-manual job roles. This becomes particularly relevant in anticipating the challenges that will be faced by the Indian economy witnessing a ballooning of its services sector.

Implications for the future of work

A 2016 report by the World Economic Forum assesses the future of jobs in nine industries by interviewing senior management of the ten largest global companies in each industry (WEF, 2016). The report, with one of the regional focus areas being India, concludes that automation will cause losses in industries that have successfully employed and retained women, such as manufacturing and office administration, and create jobs in STEM-based industries, that have historically been incompetent at retaining female workers. Secretarial work, which contributes heavily to female middle class income in both emerging and developed economies, in particular is poised to be affected by Industry 4.0. Lack of growth in the short term has been predicted in occupations that typically employ a larger percentage of females, such as secretarial and human resource management in the textile, logistics, retail, and financial services sectors in India (Chapman et al., 2018). Occupations in which job growth will be concentrated, including customer relations and sales, have historically witnessed a lower concentration of females in the same sectors.

Men and women globally are predicted to bear the brunt of job loss equally in terms of absolute numbers, which implies a widening gender gap since females will be bearing a disproportionate level of job loss through disruption owing to a pre-existing lower percentage of FLPR (WEF, 2017). Unequal vertical distribution of power across the workforce has also been traced across industries globally (Fenwick and West LLP, 2015), implying a centering of decision-making and planning power in the workspace, even as other, ancillary tasks get decentralised across different work spaces through remote work. Occupational segregation then becomes a critical variable to assess the future of work across industries.

The Female Workforce and Electronics Manufacturing

The electronics manufacturing industry in India can be used to contextualise the impact of Industry 4.0. The sector was chosen for two reasons: its contribution to the GDP, which stands at 1.2%, and the relatively high concentration of females in electronics manufacturing within the larger manufacturing sector (Basole et al., 2018). The entry of multinational corporations in the global South following liberalisation has been associated with providing access to new employment opportunities for women (Kelkar et al., 2002). This has had positive effects on overall household income, decision-making power in the household, and spatial mobility (Caraway, 2007). However, the employment that “low-skilled” workers are engaged in is characterised by poor work conditions, low wages, and precarity (Standing, 2011). One such industry that grew post-liberalisation in India was

electronics manufacturing, catering largely to a rising domestic market. The sector has been critiqued for substandard working conditions, none of which adhere to any of the conditions laid out under the ILO's "decent work framework", which includes "opportunity for work, work security, fairness of income, social protection, and freedom of association" (ILO, 2013).

Electronics manufacturing, like other manufacturing sectors, has had a historical preference towards "fresh green labour" (Chhachhi, 1999), showing a decline in the participation of married women and increase in single (never married, widows, or deserted) women over the past two decades. This is due to both supply and demand factors resulting from pressure of care duties in married females (Mazumdar and Neetha, 2011). In terms of caste, female workers in the electronics manufacturing industry have been found to be largely belonging to lower strata (ST, 46%), while males mostly belong to upper strata (56%) (NSSO, 2014). Lower caste females are then less likely to benefit from job growth following technological upgradation.

This demographic composition is relevant to understand the "ideal workforce" demanded by electronics manufacturing, which has low levels of care burdens (therefore requiring less leave), and willingness to take on contract-based work at low wages. Regimes of constant surveillance and supervision by male managers are posited as constraining the autonomy of workers.

Female workers also have very little presence in trade unions, even though it's been found to be positively related with higher wages and decent work conditions (Mehta and Shree, 2017). This is particularly relevant for female workers, as collective representation has been seen to equate to more bargaining power for females. This is primarily due to undervaluation and vulnerability of female workers causing them to be less likely to bargain for pay on an individual basis than males (Ghosh, 2012). This reflects a flexible and underpaid workforce with very little access to collective bargaining, leaving them with lesser tools to effectively deal with precarity and technological disruption in the short or long term.

Vertical occupational distribution in electronics manufacturing has been heavily skewed in favour of males, with over three times men than women in occupations at the top of the tier, and over two times in mid-level occupations (NSSO, 2015). 44.3% of female workers in the sector are concentrated in "unskilled" or "semi-skilled" jobs, largely at the entry level (NSSO, 2015). Top five roles for female workers are blacksmiths and toolmakers, assemblers, precision workers, painters and building cleaners, and manufacturing labourers (Shree, 2015). However, the manufacturing sector as a whole is expected to adopt automative technologies in specific tasks, such as painting and manual assembly, some of which are dominated by female workers in electronics manufacturing, putting them at risk of substitution.

Women are hired in repetitive manual labour, which requires high levels of accuracy, dexterity, and concentration. These are tasks female workers are perceived as "biologically" embodying, ignoring the investment in socialisation - or "hidden training" - at the household (Shree, 2015). The sexual division of labour in the factory can thus be seen as an extension of the household. These skills are implicitly taken into account by managers during the hiring process, but not recognised, accredited, or compensated (Chhachhi, 1999). This also contributes to the undervaluation of such labour, underscoring the ideological and political gendering of skill classification. In fact, in a fieldwork-based study across factories in North India, Chhacchi finds skill level to correlate with neither education nor experience, with workers ranging from highly educated to illiterate distributed across the spectrum of skill (Chhachhi, 1999). Barriers to gaining higher classifications for female workers have been underscored by the concentration of females in "low skilled" work despite having higher levels of qualifications.

Since the impact of digitalisation or automation on the female labour force is difficult to measure, researchers have attempted to identify the gender gap in the intensity of complex and repetitive tasks and "on-the-job learning" (Piasna and Drahokoupil, 2017). A number of tasks pointed out above, including assembly and painting, are being automated across industries, putting females in "low and mid" skill level categories at risk of being pushed further down the classification, or stagnating at low levels despite years of experience or education. This can be understood through historical trends, which indicate that as the valuation of technical skills in fresh entrants increases, extant skills are at risk of being downgraded and devalued (Chhachhi, 1999).

These trends are relevant to contexualise the future of work in electronics manufacturing, given the lack of data from the ground regarding the automation or adoption of disruptive technology in the industry. They will be briefly assessed in the services sector - specifically in the 'platform economy' in India, which holds a centerstage in discussions around the future of work.

'Platform Economy': The Promised Land?

Online digital labour platforms have ushered in a future of work that is a product of technological advances. While still reflecting traditional work arrangements in non-standard work, these roles are mediated through digital tools. This has also been identified as a potential avenue for increasing female participation, given the opportunities afforded to females through flexible work (Kathuria et al., 2017). As an economy undergoing structural change from agriculture to services, platform-based growth has been touted as providing immense potential for employment in the services. The narrative around easing female participation through remote and platform-based work is built on economic inclusion of females through greater flexibility to balance care duties with paid work, and reducing reliance on physical space and presence (Aneja and Mishra, 2017).

While platforms may have created new work opportunities for female workers, but are also at risk of entrenching traditional inequalities. For instance, remote hiring processes could potentially reduce biases by anonymising worker profiles (Barzilay and Ben-David, 2017). Conversely, a number of platforms, especially those designed for manual tasks, are allowing customers to select workers based on their personal characteristics rather than work experience. In the absence of anonymisation, there is clear evidence that platforms are at risk of retrenching or even enhancing existing biases in employment and task distribution.

In terms of intersectional inclusion, the platform economy is seen as providing "surplus gains" that can be "enjoyed by below-median income consumers" (Fraiberger and Sundararajan, 2015). This is as a result of liquid peer-to-peer rental marketplaces facilitating participation on the supply side by below-median consumers, owing to their greater propensity towards avoiding the fixed costs associated with ownership of assets (Fraiberger and Sundararajan, 2015).

Platforms could also institutionalise contractual employment without job security. This implies a lack of investment in the labourer by the employer, including benefits to cover death and illness, maternity leaves, etc., as well as protection against discrimination. Scaling and institutionalizing contractual labour in the gig economy has been critiqued by workers' movements and trade unions as a set back to progress in providing social security and decent work (Fraiberger and Sundararajan, 2015). Similarly, unregulated competition amongst workers has lowered wages and put employers at a distinct advantage. Further, gendered wage gaps have been documented across platforms, with females earning lower than men for performing the same tasks (Cook et al., 2018). Conversely, female employers are quoted higher wages by both male and female workers for the same tasks (Galperin et

al., 2018).

Providing flexibility to both male and female workers was touted as having the potential to re-balance the domestic burden more equitably, but has instead retrenched disproportional care burdens on females and increased vulnerability by scaling flexible work, instead of making structural changes to the distribution of labour (Doorn, 2017). Just as with earlier forms of employment, flexible work has increased opportunities for women entering the workforce, but has conversely led to the deterioration of their working conditions and increase in hours due to the double burden of paid and care work. This has also led to female workers performing multiple part-time roles while balancing care duties, as with other forms of non-standard employment such as paid domestic work (Ferrant et al., 2014).

These trends could have significant effects in an Indian context, given that one of the primary reasons for low FLPR is the disproportionate burden of domestic duties on females - which is the largest within all countries for which data can be accessed (Das et al., 2015). Aneja and Mishra argue that technology-focused reskilling, such as teaching female workers to use PayTM, could bring financial autonomy in the short run, but could retrench the cultural division between public and private spaces for females in India (Aneja and Mishra, 2017).

There are significant gender gaps in literacy (Census 2011), internet usage (UNICEF, 2017), mobile phone ownership (GSMA, 2018) and bank account ownership (Demirguc-Kunt et al., 2017) - some of prerequisites of effective participation in the platform economy. Emblematic of these structural impediments is the case of ride-hailing platforms in India, which, despite a burgeoning increase in ride-hailing passengers has seen negligible female participation as drivers with only 8 female drivers currently active on the Uber platform (International Finance Corporation, 2018).

Platform labour is then providing greater flexibility and generating employment for females, while retrenching traditional work conditions of non-standard employment. These will have to be met with adequate policy responses, in particular to widen social security nets and facilitate collective bargaining platforms. Some of these are discussed in the section below.

Policy suggestions

This paper argues that gendered skilling and occupational segregation will be central factors shaping the future of work for females across industries, as digital and automotive technologies are adopted and work conditions become more precarious even within the formal sector - largely owing to the increasing severance of productivity from labour. This raises several issues for policymakers to address to bring more females into the workforce in the coming years.

Social welfare systems continue to remain tied to regular, long-term employment, penalising female workers while industries are not able to create conditions to retain females in employment. There is a need for contextually appropriate social security measures with impact assessments on different social groups, along with the need to devise measures accounting for female workers in contractual or temporary forms of employment. The recent Maternity (Amendment) Bill 2017 increased the leave provided to 26 weeks from 12 weeks, leading to greater short-term unemployment as companies get further disincentivized from hiring females, especially SMEs and startups, but is expected to have a positive impact on retention of workers in the long term (Thakur, 2018).

Given the centrality of disproportional care duties in keeping women out of paid employment in

India and globally, affordable child care and creches in workplaces could go a long way in increasing female labour force participation. For instance, the anganwadi system in rural India has been quite successful in some states, including Andhra Pradesh and Himachal Pradesh (Dreze, 2017), in providing essential health and education services to children between the ages of 3 and 6. Measures to retain female workers in employment also include reworking the framework on skilling to recognise invisiblised skills in female workers.

Additionally, strong structures for collective bargaining result in increased bargaining power held by females in both living and work spaces have been shown to have a proportional effect on labour force participation. Self-help groups geared towards financial inclusion have proved the impact of greater bargaining power on mobility (Dasgupta, 2016). Policy pushes to empower such collective platforms driven by female workers would be instrumental in creating frameworks of agency and mobility.

Gurumurthy and Chami (2017) point towards the gendered and socioeconomic lines along which the economic and social benefits of the 'digital economy' accrue. This paper attempts to raise such concerns while highlighting the difficulty of measuring the gender ratio of the risk of automation of jobs. Apart from looking at demographic shifts within the workforce, this paper attempted to identify patterns in the distribution of risk. Several data gaps have emerged, including the absence of empirical research exploring the impact of technological disruption on the female workforce.

Questions about skill-biased or ICT-based polarization, and platformization remain at a theoretical level and need to be answered through context-specific research. It needs to be assessed whether precarity and formal employment continue to be distributed along traditional socio-religious and demographic metrics, to understand how the female workforce in the country will be structured in the coming years and design specific solutions to increase labour force participation. Future research will also have to reiterate or challenge the reciprocal effect of digitalisation and automation on various aspects of the nature of work, as delineated by the ILO's 'decent work framework', including flexibility, security, and wages.

Notes

1. In Autor et al.'s (2003) framework of technological change, work tasks are classified basis: i) their degree of routinisation; ii) whether they are manual or cognitive in nature. Technological progress, it is assumed, tends to replace routine tasks and to complement cognitive skills. Non-routine manual tasks and non-routine cognitive tasks, then, are less automatable than routine manual tasks and routine cognitive tasks.

2. The terms 'labour force' and 'workforce' are being used interchangeably in this paper.

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