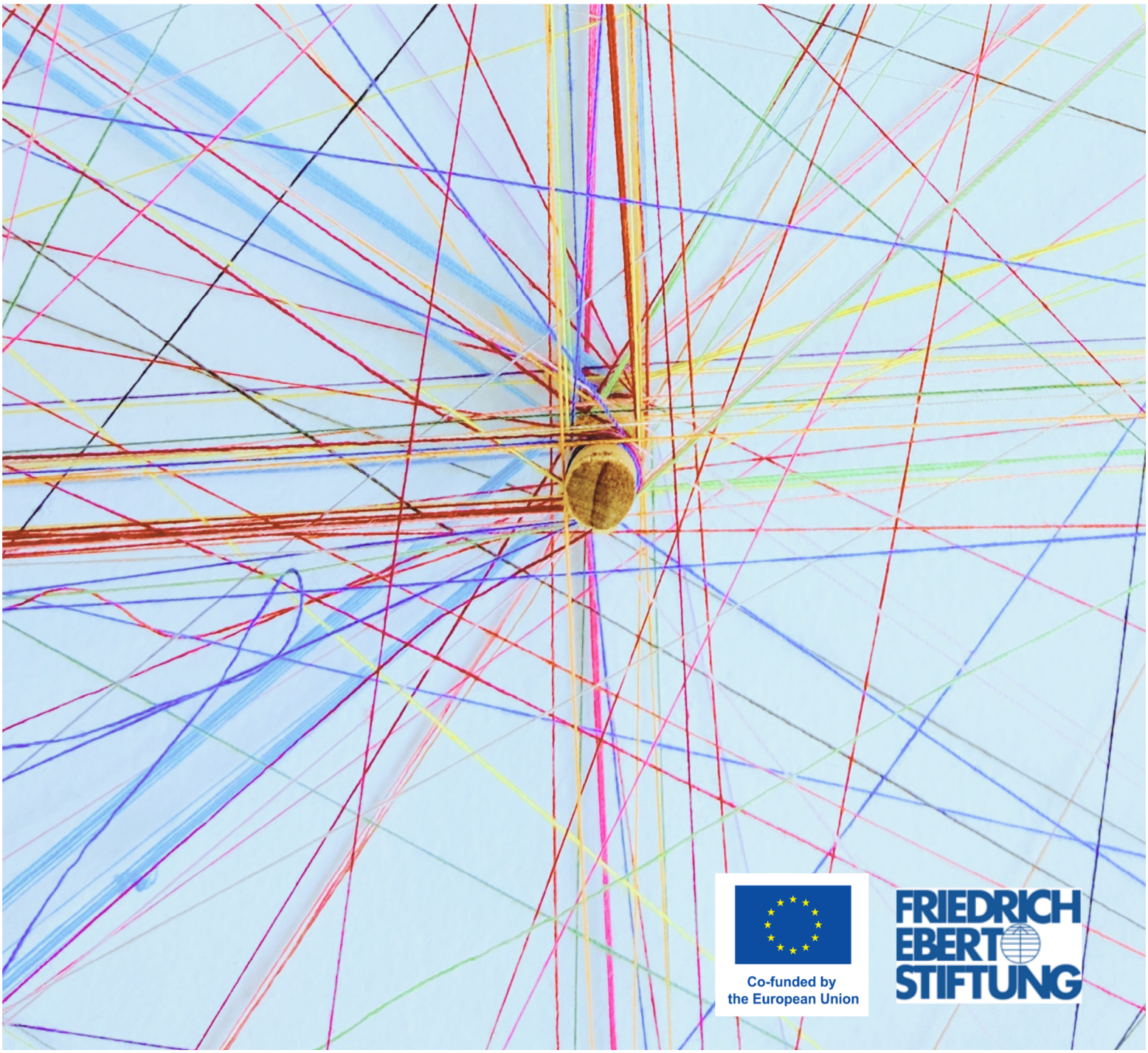
FOR BETTER OR WORSE?

How Digitally Restructured Value Chains Are Reshaping Labor Futures for Women in the Global South

Karishma Banga and Becky Faith



Acknowledgments

Research and writing

Karishma Banga, Research Fellow, Digital and Technology Cluster, Institute of Development Studies, Brighton

Becky Faith, Research Fellow and Cluster Leader, Digital and Technology Cluster, Institute of Development Studies, Brighton

Editing and review

Anita Gurumurthy and Nandini Chami, IT for Change

Copy edit

Sohel Sarkar, Communications Consultant, IT for Change

Proofreading, design and layout

Sneha Bhagwat and Sreemoyee Mukherjee, IT for Change

Funding support

This think piece was commissioned by IT for Change as part of Re-wiring India's Digitalising Economy for Women's Rights and Well-being: an Action-oriented Knowledge Intervention, a project supported by The European Union (EU) and Friedrich-Ebert-Stiftung (FES).

Table of Contents

For Better or Worse?

How Digitally Restructured Value Chains Are Reshaping Labor Futures for Women in the Global South

Karishma Banga and Becky Faith

December 2021

Abstract

The digitalization of production and digital restructuring of global value chains (GVCs), compounded with development effects of proposed global digital trade rules, are going to have important implications for economic and social futures of women in the Global South. The gendered digital adoption divide is roughly 6 percent in high-income countries but as high as 82.5 percent in low-income countries. Moreover, internet penetration is associated with higher productivity gains for female workers in upper-middle and high-income countries as compared to low- and lower-middle-income countries. Case-studies of the BPO and apparel manufacturing sector reveal how digital technologies are affecting women workers through both national and international pathways. National pathways include automation of tasks, including automation of low-end routine intensive tasks, which have traditionally been performed by female workers. New jobs are being created but women workers in the Global South are not the ones gaining, in part due to lack of key skills, but also due to national factors such as high labor mobility costs and labor market frictions which restrict labor shifts. International pathways include a) digitalization of the lead firms in GVCs, which can in turn lead to automation along the value-chain, reshoring or limited offshoring, as well as b) labor market impacts of proposed global digital trade rules through their effects on tech transfer and digital trade between lead and supplier firms. E-commerce and gig work have emerged as important opportunities, but women workers in the Global South are less likely to make meaningful contributions via digital platforms due to lower digital connectivity and lack of ownership of digital devices. Overall, persistent gaps in digital access and models of use affect women in the Global South differently; retaining policy space to navigate issues on e-commerce can therefore be an important way of safeguarding futures for labor futures of workers in the Global South.

1. Introduction

Production and value chains are becoming increasingly digitalized and embedded with digital technologies and data, creating new opportunities for some segments of the workforce. There is no doubt that digital technologies *can*, for instance, promote women's labor market participation, facilitate their financial and digital inclusion and, consequently, lead to greater economic welfare (OECD, 2017, 2018; European Commission, 2018; EIGE, 2018; Sorgner et al., 2017). They can also potentially offer women new opportunities by lowering entry barriers for micro, small and medium enterprises (MSMEs), thereby enabling entrepreneurial activities, and by providing access to foreign markets.

However, the benefits of digitalization are neither automatic nor homogenous. If not managed well, it can perpetuate or exacerbate existing socio-economic divides due to a persistent and widening gendered digital divide (ITU, 2021). [1] As per the International Telecommunications Union (ITU), globally, the proportion of women using the internet is 12 percent lower than men and this gender gap widens to around 33 percent in least-developed countries (LDCs). Whilst 54 percent of women in low- and middle-income countries now use mobile internet, women are 20 percent less likely to use it than men. Women also have less autonomy and agency in smartphone acquisition and are much less likely than men to purchase their own smartphone (GSMA Intelligence, 2020). The significance of these digital gender gaps is reflected in the United Nations' Sustainable Development Goals (SDGs). Four SDG targets (4b, 5b, 9c and 17.8) explicitly call for increasing access to digital technologies or using them to enable positive outcomes. Of these, 4, 9c and 5b focus on access and gender. Target 9c calls for significantly increasing access to information and communication technologies (ICTs) and to strive for universal internet access in least developed countries by 2020. Target 5b calls for *"enhancing the use of enabling technology, in particular ICTs, to promote the empowerment of women" (emphasis added).*

While many studies have examined the gendered digital divide, the importance of macro-level developments, such as digital trade negotiations, in shaping the future of work for women in the Global South is often neglected. In 2021, members of an Informal Working Group on Trade and Gender formed at the World Trade Organization (WTO) a year earlier, agreed with Canada's proposal for a work plan which called for reviewing gender-related analytical work; experience sharing on increasing the participation of women in trade; considering the concept and scope for a 'gender lens' and how it could be applied to the WTO's work; and supporting the WTO Aid for Trade work program, including the "importance of digital trade/e-commerce to address issues and capture opportunities". [2] The current dominant digital trade narrative and agenda is, however, being shaped by e-commerce proposals tabled at the WTO by developed countries, including US, EU, Australia and China.[3] These proposed rules are likely to affect women in developing countries differently than those in developed economies, thus necessitating a careful rethinking so as to prevent further entrenchment of gender inequalities in the Global South.[4]

This paper examines how digitally restructured value chains and the proposed global digital trade rules will

[1] Gendered digital divide is defined as "the gender differences in resources and capabilities to access and effectively utilize ICT within and between countries, regions, sectors and socio-economic groups" (UN Women, 2005).

[2] https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/INF/TGE/W1.pdf&Open=True

[3] In these plurilateral negotiations, technology is being used as a 'gender equalizer' and e-commerce rules are being promoted in the name of women's economic empowerment in low and middle-income countries.

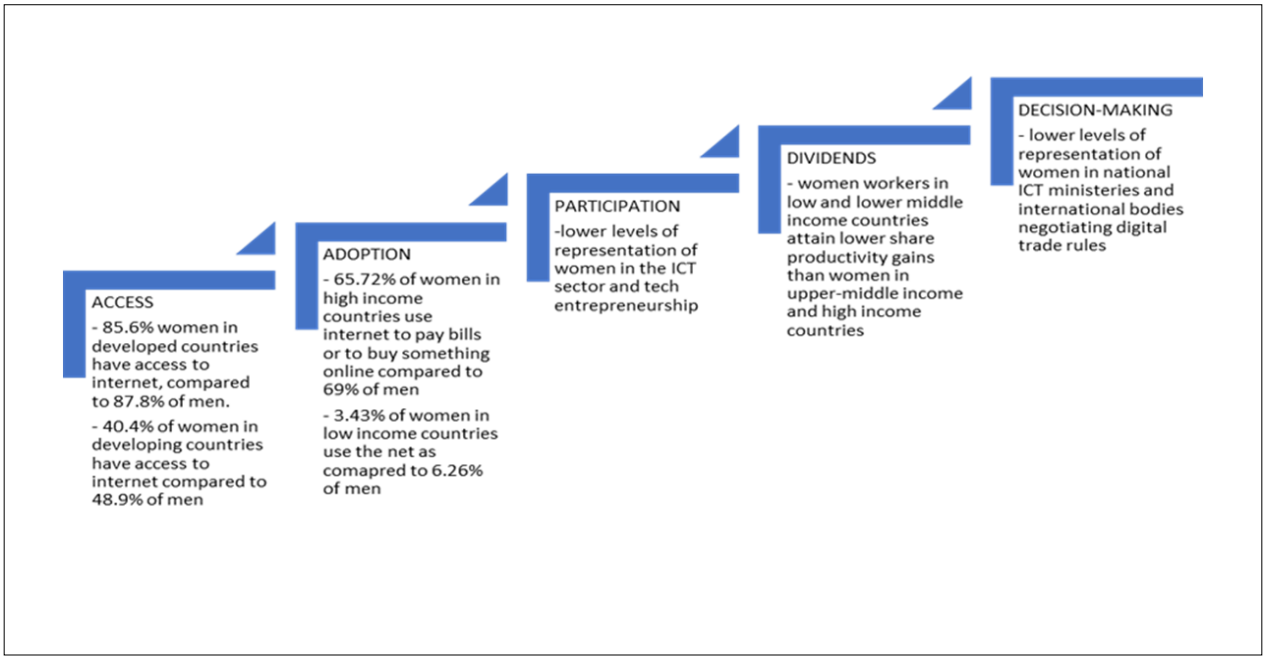
[4] https://www.twn.my/title2/wto.info/2019/ti190716.htm

affect the economic and social futures of women in the Global South. Section 2 presents a framework for understanding the multifaceted nature of the gendered digital divide and looks at how women from the Global South are located in digitalized global value chains (GVCs). Section 3 demonstrates the gendered implications of digitally restructured value chains, using case studies from the garment and the Business Process Outsourcing (BPO) sectors. Section 4 examines the gendered implications of increasing 'platformisation' of the economy. Section 5 applies a gender lens to the ongoing e-commerce trade talks, and the final section offers trade policy recommendations to support smaller women-led businesses in the Global South.

2. Women in the Global South: A Multifaceted Digital Divide Framework

The digital gender divide, that is, lower access to and use of digital technologies by women compared to men, is particularly severe in less-developed countries (Mariscal et al., 2019; Sorgner et al., 2017). Marginalized groups, including people with little or no education, ethnic and racial minorities, LGBTQI+ communities, people living with disabilities, rural populations, and the elderly, also typically have lower levels of technology access. This means that the gendered digital divide particularly affects women facing multiple and overlapping disadvantages. For instance, a poor uneducated indigenous woman living in a rural area is much less likely to be connected than a middle-class man in an urban center (World Bank, 2016). The rural-urban divide is another significant determinant of technology access. A 4 percent gender gap in mobile ownership in urban Uganda, for instance, expands to 22 percent in the rural areas. Similarly, only 11 percent of women in Senegal's urban areas are less likely than men to use mobile internet, compared to 32 percent in rural areas (GSMA Intelligence, 2020). The digital divide, however, goes much beyond binary access to technologies. In this paper, we propose a new framework for understanding the digital divide faced by women in the Global South. (see Figure 1).

Figure 1: Women in the Global South face a multi-faced digital divide



(Source: Compiled by authors with data from ITU, 2021.)

The divide occurs at three levels: at the individual level (in terms of access and adoption), at the firm/sector level (in terms of technology adoption by women-owned firms and participation in the ICT sector) and at the economy level (in terms of economic dividends and decision-making).

2.1 Gendered digital divide at the individual level

The first and the most well-researched divide is the **digital divide in access to technology at the individual level.** Here, the affordability of both data and devices remains a key barrier. Nearly 2.5 billion people live in countries where the cost of the cheapest available smartphone is a quarter or more of the average monthly income. In low- and middle-income countries, women are, on average, 8 percent less likely to own a mobile phone and 20 percent less likely to use mobile internet than men (GSMA, 2020). This is due to structural inequalities, including income inequalities, financial exclusion, negative cultural perceptions, and societal norms, and lack of resources. In India, the price of the cheapest smartphone from leading operator Jio is twice the average monthly income (Alliance for Affordable Internet, 2020). In fifteen countries across Africa, 1 gigabyte (GB) of data costs more than 10 percent of the monthly average income (Alliance for Affordable Internet, 2019). In Kenya, 38 percent of men and 33 percent of women who are aware of mobile internet but have not used it, cited affordability as the single most important barrier to adoption. Across the board, this affordability barrier is increasing (GSMA Intelligence, 2020). Even if women in the Global South have the same access to digital technologies as those in the Global North, there is a persistent **digital divide in the adoption of digital technologies** for productive purposes. This divide is not caused by negative attitudes towards new technologies, but rather, due to lower enrolment in primary and secondary education, lower technology literacy, lagging physical infrastructure (electricity, postal competence, etc.), and higher internet costs (cost of data per megabyte) (Rashid, 2016; Hilbert, 2011).

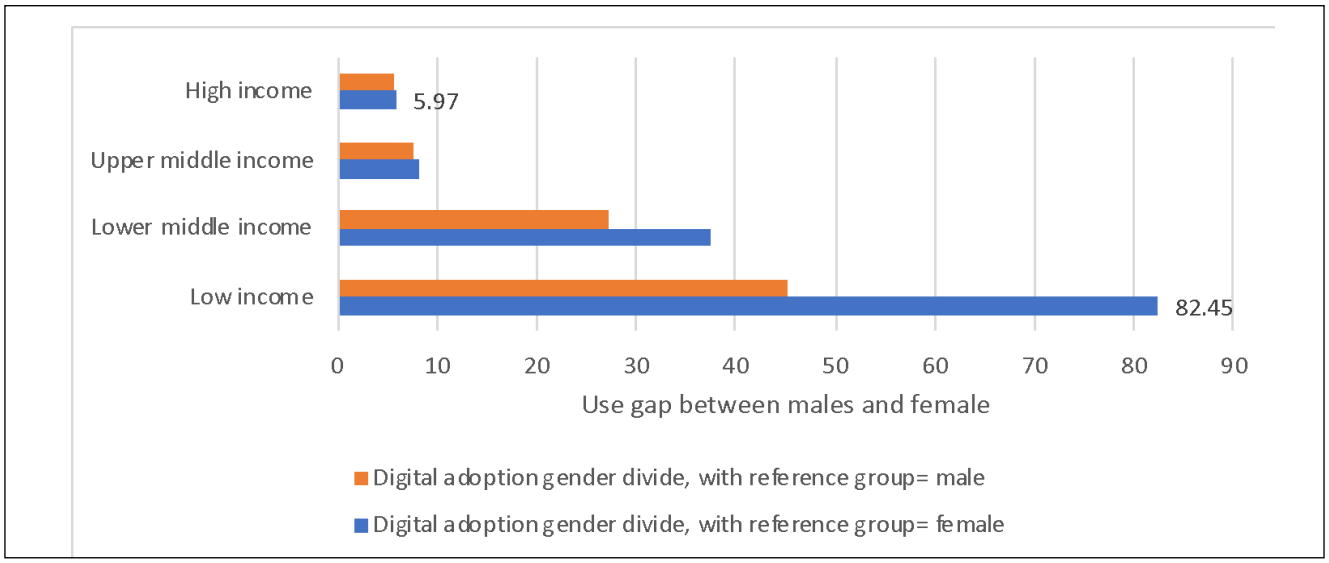
In calculating the gendered digital divide, many studies use men as the reference group. More recent studies, however, have argued for a more women-centric approach (WWW Foundation, 2020). We follow the latter approach to calculate the digital divide in technology adoption across gender and varying income groups, wherein digital adoption is captured by the percentage of the population (aged over 15) that uses the internet to pay bills or to make online purchases. This is an important indication of the proportion of consumers who productively use the internet to access digital government services such as paying taxes and bills online or participate in e-commerce. Using women as the reference group to calculate the digital divide in adoption puts the focus on the disparity and disadvantages faced by them. The lower the percentage of women online, the larger the digital gender gap will be.

As Figure 2 demonstrates, the gendered digital adoption divide is roughly 6 percent in high-income countries but as high as 82.5 percent in low-income countries. The divide is even more stark between women from countries that are classified into different income groups. The digital adoption divide between women in low-income and high-income countries is more than 95 percent (see Figure 3), meaning that women in low-income countries are 95 percent less likely to be using the internet for paying bills or buying online than those in high-income countries.

2.2 Gender digital divide in the ICT sector

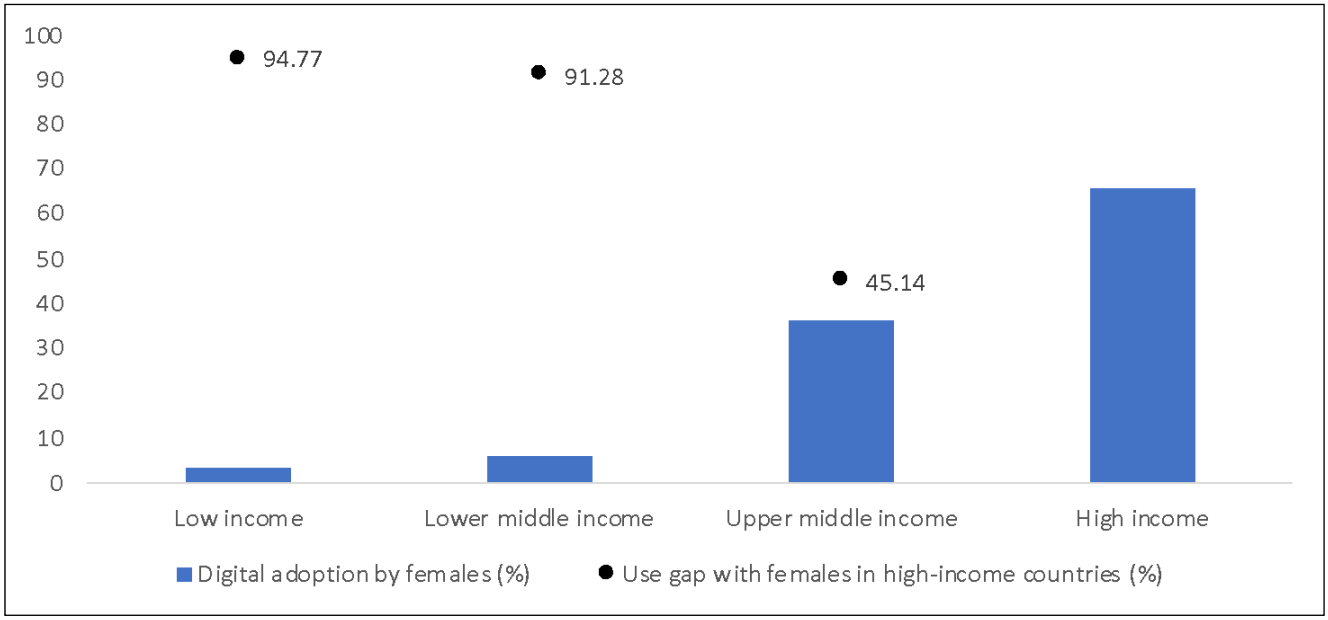
There is a persistent global divide in women's employment at all levels of the technology and ICT sectors, from design to management. This has negative impacts not only on women's economic status but also on their education and

Figure 2: Gendered digital adoption divide, across income groups



Source: Compiled by authors using ITU data as of 2017. Digital adoption divide calculated as (percent of men using the internet – percent of women using the internet) / percent of women using the internet.

Figure 3: Digital adoption gap in women, across income groups (%)



Source: Compiled by authors using ITU data. (Notes: a = % of women in high-income countries above 15 years using the internet to pay bills or to buy something online in the last year, b = % of women in income category x using the internet to pay bills or to buy something online in the last year. Digital adoption gap calculated as [a-b/a]*100).

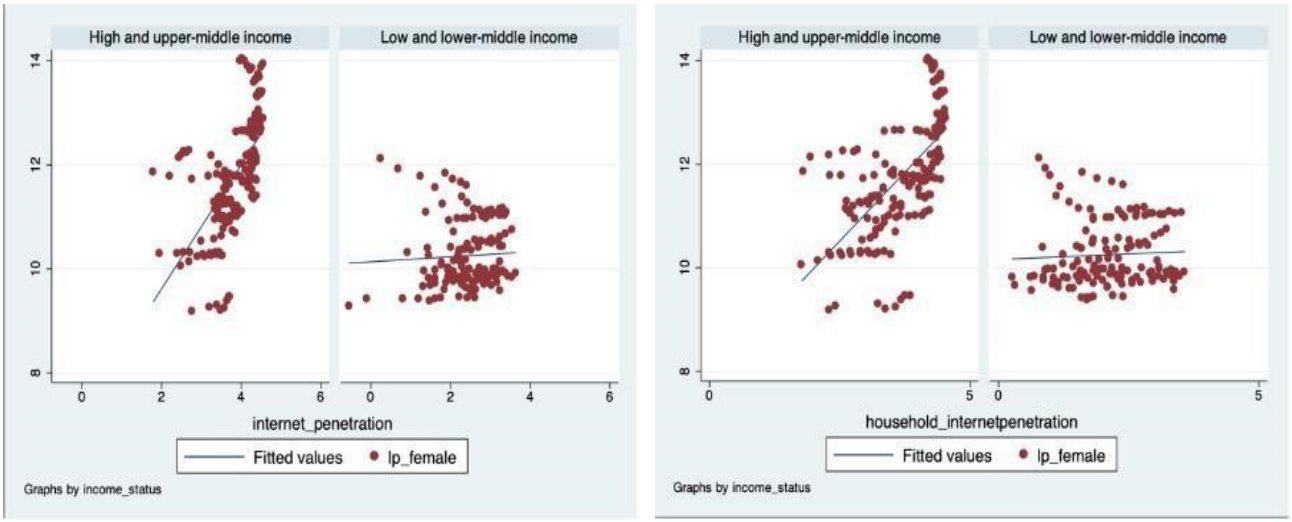
employment prospects, and ultimately, on the outputs from these industries. Globally, women constitute less than 35 percent of the ICT and related workforce (Sey and Hafkin, 2019) and are 20 percent less likely than men to hold a senior leadership position in the ICT industry (OECD, 2018). This is, in part, due to the lower female enrolment rates in science, technology, engineering and mathematics (STEM) and technical and vocational education and training (TVET) fields. In Chile, for instance, about 50 percent of male students enroll in STEM-related programs at the post-secondary level, compared with only 15 percent women (UNESCO, 2018). The lack of female role models is arguably one of the reasons for lower female participation in tech entrepreneurship, particularly in developing countries where the entry barriers

are also higher due to socio-cultural perceptions and norms. These divides start in school where girls have lower levels of exposure to digital tools as they grow up and are less likely both to study ICT and recognize the potential economic benefits of digital skills (Gurumurthy and Chami, 2014). This leads to a lower demand for ICT subjects among women at all educational levels.

2.3 Gender digital divide at the economy level

The lower involvement of women at all levels — from skills and agency to ownership of technologies — is a potential contributory factor to the fourth stage of the digital divide, that is, in the economic dividends reaped from the use of technology. Globally, the productivity benefits from digitalization manifest differently across income status of countries, due to structural problems arising from poorer infrastructure in developing countries as well as lower levels of skill development among the workforce in these countries and a lagging absorptive capacity. Based on a panel of low- and middle-income countries, Banga and te Velde (2018) found that a doubling of internet penetration boosts manufacturing labor productivity in middle-income countries by 11.3 percent but the corresponding impact on low-income countries is 3.3 percent — a differential of 8 percentage points. Higher internet-related productivity in developed countries leads to higher output, exports, and employment generation, as compared to countries in the Global South.

Figure 4 (a and b): Scatter plot of industrial female labor productivity and internet penetration



Source: Compiled by authors based on WDI and ILO estimates for 2000-2017. Figure a reports internet penetration as % of population that has access to the internet. Figure b reports internet penetration as % of households with access to the internet.

Such productivity differentials across countries' income levels further disadvantage female workers in the South. Using a panel of low-, middle- and high-income countries between 2000-2017, Figure 4 demonstrates a positive and stronger correlation between internet penetration and female industrial labor productivity in upper-middle-income and high-income countries as compared to low- and lower-middle-income countries. This holds true for internet penetration at both the individual and household levels. The same level of internet penetration — say 25%, which is considered in the literature as the minimum level required to leverage network effects of the internet — is associated with higher value-added generated by female workers in upper-middle-income and high-income countries as compared to low- and lower-middle-income countries. This replicates broader societal gender inequalities. The

varying female labor productivity could be due to lower levels of skill development in women workers in the Global South, which restricts their ability to engage with the internet in a productive manner, such as accessing online trainings in the manufacturing sector. Another reason for the lower productivity impact could be the limited ability of women in the Global South to move from one task onto another due to higher mobility costs and labor market frictions as compared to the North.

At the economy level, there is also a **digital divide in decision-making related to technology development and use.** Women have a very low rate of leadership in ICT policymaking. Worldwide, only 28 countries have a woman ICT minister, and only 25 have a woman heading the telecom regulator (Sey and Hafkin, 2019). Mechanisms to address gender inequalities in digital access through communal public funds dedicated to expanding internet connectivity (Universal Service and Access Funds) are underused (Thakur and Potter, 2018) and broadband plans fail to prioritize gender equality (van der Spuy and Aavriti, 2018). Women are also under-represented in global e-commerce negotiations. The overall lack of gender focus in policymaking impedes the achievement of gender equality.

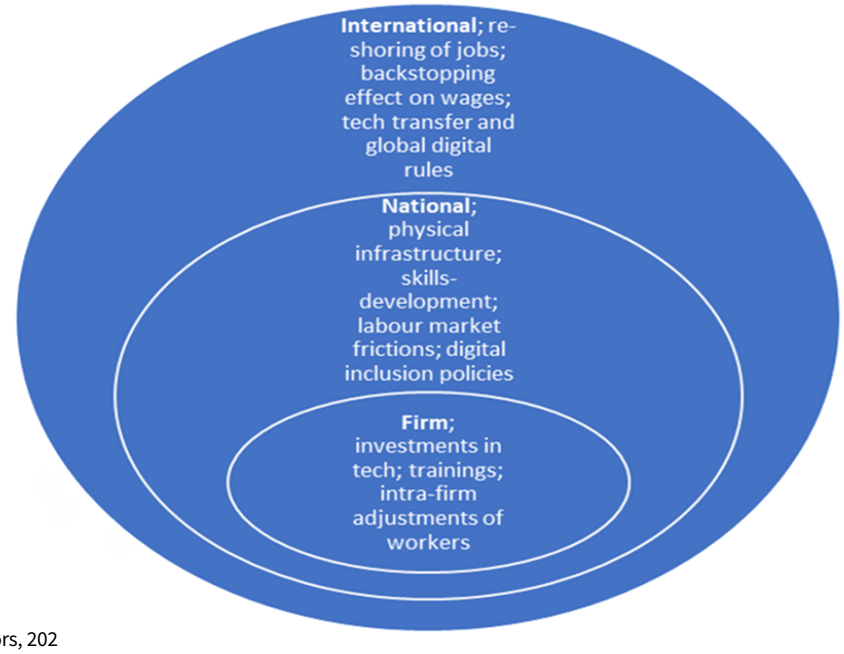
3. Automated Value Chains and Women Workers in the Global South

The multifaceted digital divide faced by women workers in the Global South suggests that they will experience the impact of automation through both national and international pathways (see Figure 5). For the purpose of this study, we assume a hypothetical Country A where the national pathways include automation by domestic firms, training strategies for displaced workers, and intra-firm adjustments of workers. The uptake and impact of digital technology on workers will be further related to the broader national physical infrastructure, skill levels in the economy as well as labor market frictions such as strict hiring and firing policies. International pathways include effects of automation in trading partners (say Country B) and global digital trade rules which affect tech transfer and digital trade between Country A and B. To further explore the impact of automation on women workers, we apply this framework and deep dive into the specific value chains of garments and BPO, which are labor-intensive and dominated by women workers in developing countries.

3.1 Digitally restructured value chains in garments

Female workers in developing countries face significantly higher risk of computerization in their occupations compared with male workers. This is because women are concentrated in routine-intensive tasks that can be automated more easily (UNIDO, 2019). This is particularly true for manufacturing subsectors such as food, beverages and tobacco; textiles and leather; and chemicals (ibid). While genuine artificial intelligence (AI) applications in garment technologies are still at an embryonic stage (Nayak and Padhye, 2018), the severe demand shocks witnessed by the sector during the Covid-19 pandemic are likely to accelerate a major reshaping of the industry, heralding a digitalized future. In some products, such as T-shirts, complete robot-based automation may become a reality as soon as 2025 (Andersson et al., 2018). Below we list some of the impact pathways through which automation of the garment value chain will affect women workers in the Global South.

Figure 5: Pathways of impact of digitalized value chains on women workers in the Global South

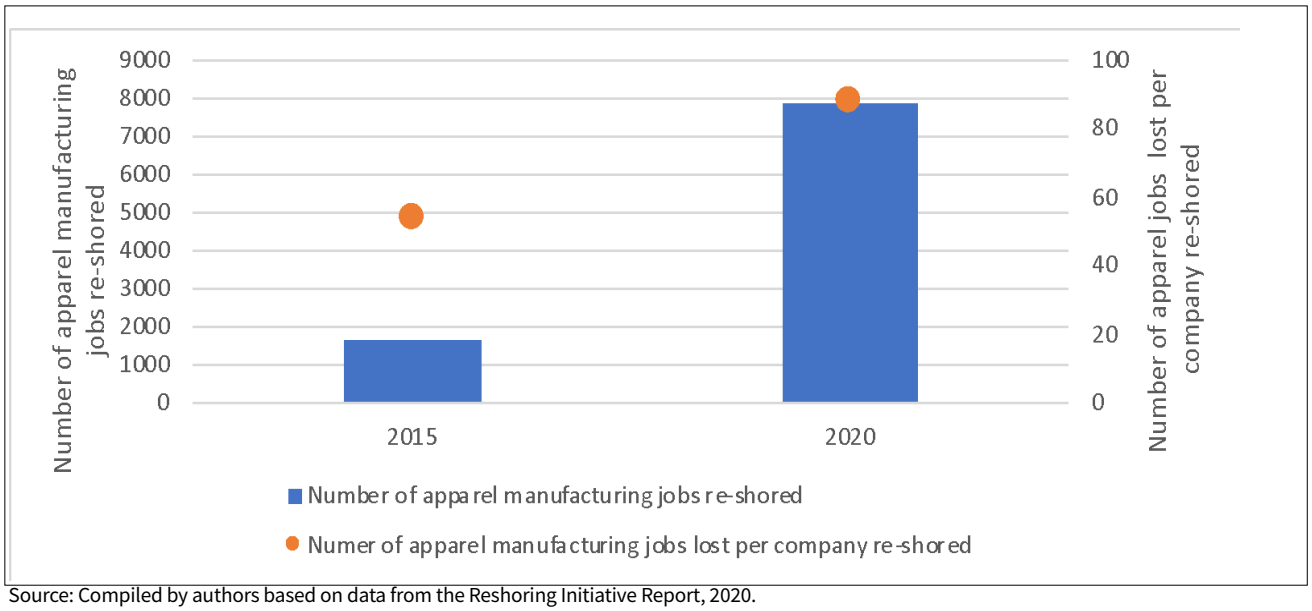


Source: Compiled by authors, 202

3.1.1 International pathways

Automation by lead firms and reshoring of apparel manufacturing jobs from the Global South: Lead companies are rapidly investing in digital technologies such as 3D printing and digital imaging, which can potentially reconfigure garment value chains. Levi's, for instance, has invested in digital imaging and automation of finishing tasks in its jeans. Designers in its San Francisco factory send digital files to the depot, where lasers mass-produce customized jeans within minutes, which can then be delivered to nearby customers.[5] While automation of finishing tasks does not directly take away jobs from developing countries — since higher-value-added activities such as designing have remained with lead firms — the subsequent increase in cost competitiveness and the growing demand for mass customizable production may lead to Levi's bringing its other manufacturing tasks that have been offshored closer to home (Banga and te Velde, 2018).

Figure 6: Number of apparel manufacturing jobs reshored to the US



Source: Compiled by authors based on data from the Reshoring Initiative Report, 2020.

[5] https://www.ft.com/content/b95da4ec-1b75-11e8-aaca-4574d7dabfb6

This process, termed 'reshoring', could lead to manufacturing job losses for workers in the Global South, disproportionately affecting women concentrated in low-skill and routine tasks. Although reshoring has not occurred on a large scale yet, data from the Reshoring Initiative 2020 shows that the number of apparel manufacturing jobs reshored to the US more than quadrupled between 2015 and 2020, with the number of job losses per company engaged in reshoring jumping from 54 to 88 workers in just five years (see Figure 6). **Increasing automation in lead garment firms may also have a 'backstopping effect' on wages of women workers,** whereby suppliers in developing countries lower wages to remain competitive. For instance, exposure to automation in the United States reduced manufacturing wage employment in Mexico, especially in those occupations which were initially more susceptible to being automated (Artuc et al., 2019).

3.1.2 National pathways

Automation by garment manufacturers in the Global South: Previous literature identifies important gender differences in occupational susceptibility to digitalization, but this evidence is mostly based on data from developed economies (see for example Sorgner et al., 2017; Brussevich et al., 2018). For developing countries, the evidence thus far is largely anecdotal, but it is clear that the decision to automate production by a developing country firm depends on both technological and economic feasibility. Consider the case of garment value chains. Some tasks, such as cutting, are easier to automate than others, such as stitching, indicating that automation may displace workers in some tasks across the value chain but create employment opportunities in others. For instance, the deployment of modern cutting lasers in the A-Z garment factory in Tanzania displaced workers engaged in cutting, but resultant productivity gains in this area of operations led to greater output and created jobs in the next stage, that is, stitching, which requires relatively more skill (Banga and te Velde, 2018). The sewing jobs, held largely by women (Staritz and Bamber, 2016; Barrientos, 2019), have been relatively protected from automation so far; the dexterity required in handling and stitching fabrics made the process of automating sewing operations technologically difficult.

However, successful trials of Sewbot have proved that robots can eliminate the role of sewing machine operators in the production of basic apparel, which constitutes a major proportion of the garment industry's workforce in developing countries. In Indian factories, for instance, tailors and sewing machine operators account for as much as 65 percent of the workforce (Vashisht and Rani, 2019). Moreover, the use of collaborative robots or cobots[6] can lead to significant job displacement as well as reduction in working hours in garment manufacturing (Kucera and Mattos, 2020). Some leading garments firms in the Global South may also choose to shift their production and open up capital-advanced factories in the North. Consider the case of Vietnam-based garment manufacturing firm Saitex International which opened a semi-automated garment factory in Los Angeles in 2021. This factory, which deploys two gigantic lasers, would have employed 40-50 workers in Vietnam for cutting. It also uses four robots for spraying which would have otherwise employed 25 workers.[7] The fast-declining cost of capital in the Global North, coupled with rising wages in the Global South, can lead to a significant loss of such 'could have been jobs' in key labor-intensive manufacturing sectors in developing countries, but evidence of this is as yet largely anecdotal.

[6] Collaborative robots are a form of robotic automation built to work collaboratively alongside humans

[7] https://karmelmall.net/the-new-automated-jeans-factory-in-l-a-a-blueprint-for-reshoring-apparel-manufacturing/

Automation and the changing demands for skills: Not only are women workers in developing countries more adversely affected by automation than male workers, but they are also less likely to gain from the new jobs produced by digitalization. New jobs in the garments value chain may be created, for instance, in the operation and maintenance of computer-controlled equipment and in STEM-related occupations, in managerial capacities and in entrepreneurship (Kucera and Mattos, 2020). But women in the Global South are less likely to get these jobs as they continue to lag in analytical and ICT skills, social and leadership skills, as well as entrepreneurship-related skills (Stoet and Geary, 2018; Ramirez and Kwak, 2015; Strohmeyer et al., 2017). Moreover, national factors such as high labor mobility costs and labor market frictions in developing countries will further disadvantage women in the Global South when it comes to transitioning from one task or sector onto another.

3.2. Digitally restructured BPO value chains

3.2.1 International pathways

Automation and reshoring of BPO operations by lead firms: Post Covid-19, efforts have been underway to enhance the organizational flexibility in BPO value chains through a shift to more dispersed and remote workplaces while building the necessary digital infrastructure (Deloitte, 2020a; NASSCOM, 2020). Lead firm in the BPO chains can adopt digital technologies such as robotic process automation (RPA) and cloud computing, which can potentially slow or reverse services offshoring to BPO offshoring hubs such as India, Philippines, and Kenya. There is already evidence of this happening. As noted in Tejani and Fukuda Parr (2021), some firms such as the United Kingdom's Virgin Media and Australia's Telstra and Optus operating in India and the Philippines have begun to reshore and recruit workers in their home countries to cope with surging demand during the lockdown. Millietech System reshored 465 IT jobs from Brazil to Atlanta citing lack of availability of skilled workforce while Whirlpool reshored 400 call centre jobs back to the US. [8] Here, gender disaggregated data could be critical in examining the types of jobs reshored.

3.2.2 National pathways

Automation of BPO operations in the Global South: Globalisation and accelerating digitalization during Covid-19 — particularly the rapid adoption of RPA and digital platforms — are poised to affect some segments of the BPO workforce more adversely than others. Chatbots are automating low-end repetitive jobs (Sagara and Das, 2020), which may disproportionately impact women workers, given that women tend to be concentrated in relatively lower-value BPO activities (Tejani and Fukuda-Par, 2021), particularly in call centres where their "feminine social skills" are considered an asset (Nasscom, 2016; Domingo-Cabarrubias 2012). BPO jobs held by women are intensive in routine or repetitive tasks that are at higher risk of being automated compared to those that require complex cognitive skills and judgement (Brussevich et al., 2018). Workers displaced by automation also typically earn less in the long term (Jacobson et al., 1993). For the BPO sector as a whole, sizable job losses due to automation (Kearney, 2017; ILO, 2017) are likely to be accompanied by a decline in the employment intensity of the sector, with only one new job being created for every four lost (Kearney, 2017).

Changing skill needs in the BPO chains: Women workers in the Global South may have access to more work in the sector through digital platforms, but this will include low-end, short-term and precarious tasks, with increased informalization and deskilling. New high-skilled jobs may be created on digital platforms but women are unlikely to get them as they

[8] https://reshorenow.org/library/9267/whirlpool-looking-to-add-400-more-jobs-to-cleveland/

remain globally under-represented in STEM fields and make up only 22 percent of AI professionals worldwide (WEF, 2018; ILO, 2017).

4. Gendered Implications of Platformization of the Economy

Global digital marketplaces, the rise of the gig economy and the platformization of economic activity across different sectors have often been touted as pathways for women's empowerment. They are expected to reduce gender gaps by improving women's access to digital skills, finance/credit, and work opportunities, and by reducing information asymmetries and training gaps. However, a change from 'business as usual' is needed for women in the Global South to realize gains from digital technologies and platforms. Women in the South not only have lower access to these platforms, they also benefit less from engaging with them as compared to both men in the Global South and women in the Global North. Technology is not gender neutral, and persistent gaps in access affect women in the Global South differently, highlighting the importance of not extrapolating evidence and ideas from the North onto women workers in the South.

4.1 Women and e-commerce models: Evidence from Africa and Asia

As shown in Figures 2 and 3, there is a significant gender gap in **access to e-commerce.** Women in low-income countries are 95 percent less likely to be using the internet for paying bills or making online purchases compared with women in high-income countries. Second, **adoption of e-commerce** varies depending on gender and income status of countries. Just 10 African countries, for instance, account for 94 percent of all online business on the continent, and cross-border e-commerce is limited as most platforms that facilitate transactions place restrictions based on the origins of sellers — 57 percent of marketplaces allow only domestic sellers on their platform and only 28 percent offer integrated online payment solutions (ITC, 2020). The high commissions charged by both domestic and international third-party e-commerce platforms further constrain the uptake of e-commerce platforms by sellers (ibid). Data from interviews with 31 African businesses, mostly MSMEs, revealed that only four all male-owned enterprises were selling on third-party e-commerce platforms in 2020 (Banga et al., 2021a). Women-owned African firms tend to sell through their own websites, either via an e-commerce-enabled website or through online contact forms (ibid). Lower participation of women sellers on third-party e-commerce platforms in the Global South could partly be explained by lower access to credit and financing, making it difficult to afford the higher commissions charged by these platforms, information asymmetries and training gaps. Interview data from (mostly women-owned) MSMEs further reveals that the development of e-commerce related websites, their maintenance and repair at reasonable rates, and enabling the integration of these website with online payment solutions, such as M-Pesa, remain obstacles for e-commerce uptake in African countries (ibid).

An important e-commerce divide manifests in the intersections of gender with firm size. Smaller firms (fewer than 50 employees) with female CEOs tend to suffer more from inefficiencies in IT connectivity and infrastructure, and digital regulations (WTO and World Bank, 2020). For cross-border e-commerce, medium-sized firms (51-500 employees) with female CEOs reported gaps in connectivity and IT infrastructure, e-commerce related logistics, and online payments as well as shortages in the team's capacity to engage in e-commerce as major constraints (ibid).

In some Asian and African countries, 'f-commerce' — conducting online business through informal channels on social media platforms — is the most dominant form of e-commerce. In Bangladesh, for instance, 90 percent of e-commerce is business-to-consumer (B2C), typically organized on WhatsApp or Facebook, dominated by women and MSMEs, and boasting 30 million users and 50,000 business pages. Data gathered from interviews with two e-commerce merchants and four sellers on social platforms in Bangladesh reveals that while women make up 18 percent of sellers on e-commerce sites, they constitute 83 percent of sellers on social media platforms. [9] But f-commerce remains fragmented and situational; buyers and sellers connect through online platforms but do not necessarily engage in other aspects of online commerce such as payment or delivery due to low online consumer trust and lack of payment gateway provisions integrated with social media sites (Islam and Roest, 2020).

4.2 Platformization of agricultural value chains: Evidence from Uganda

Evidence emerging from the Ugandan agricultural sector highlights the perils of platformization for women workers. The national lockdown in Uganda during Covid-19 affected businesses in the sector due to a range of supply-side disruptions, exacerbating problems related to availability of transport and agricultural inputs, accessing physical training and topping up mobile phones. A survey of 400 Ugandan entrepreneurs engaged in different stages of agricultural value chains found that access to and ownership of mobile phones, which appear to be positively correlated with enterprise development, both in terms of the growth of existing business and expansion into new businesses, can make firms more resilient to such economic shocks (Banga et al., 2021b). But there is a prominent gendered digital divide in ownership: 72 percent of male entrepreneurs own a mobile phone compared with only 45 percent of female entrepreneurs. Several young women reported that their husbands do not allow them to own a phone (ibid). Less than 5 percent of the 400 entrepreneurs involved in the survey were found to be on any type of ag platform.[10] Over 70 percent of those who did not use any such platform, most of them women, cited lack of awareness as the main reason (ibid). Interviews with young female agri-entrepreneurs revealed unique challenges related to formalization. Women avoid registering their businesses and formalizing, as keeping their business 'invisible' can be an important way to protect themselves against their husbands or male relatives taking charge of their earnings and resources (ibid). Ultimately, gender norms, societal pressures and childbearing shape young women's business aspirations and mediate access to technology and the growth and sustainability of their businesses.

Female farmers on digital platforms are not able to attain the same productivity gains as their male counterparts due to problems related to tenure security, informal institutional constraints and intra-household dynamics (Kilic et al., 2015). A separate survey of 800 farmers in Ugandan revealed that male maize farmers have significantly higher yields than female maize farmers which could be attributed to women's lower access to internet, agricultural training and credit, and land which is usually inherited by young men due to prevailing gender norms and patrilineal customs (ODI, 2020). The higher yields obtained by men from leveraging ag platforms can be used to rent more land, thus creating a vicious cycle. Female farmers also lag in digital skills to effectively use the platforms. While women on platforms have higher access to formal work than those who are not on platforms, the share of platformized female farmers who receive a contract for their produce remains critically low since buyer–farmer relationships have not been formalized to the

[9] https://www.cgap.org/blog/hiding-plain-site-informal-e-commerce-among-women-asia

[10] Broadly defined as apps or services accessed via mobile phones, by means of SMS, unstructured supplementary service data (USSD), social media apps, e-commerce apps or other apps for finding information on weather, land use, seeds, buyers and sellers.

extent of providing contracts. This implies low trust in online services and e-commerce and limited cohesion in the relationship (ODI, 2020).

4.3 Platformization of service work: Evidence from the gig economy

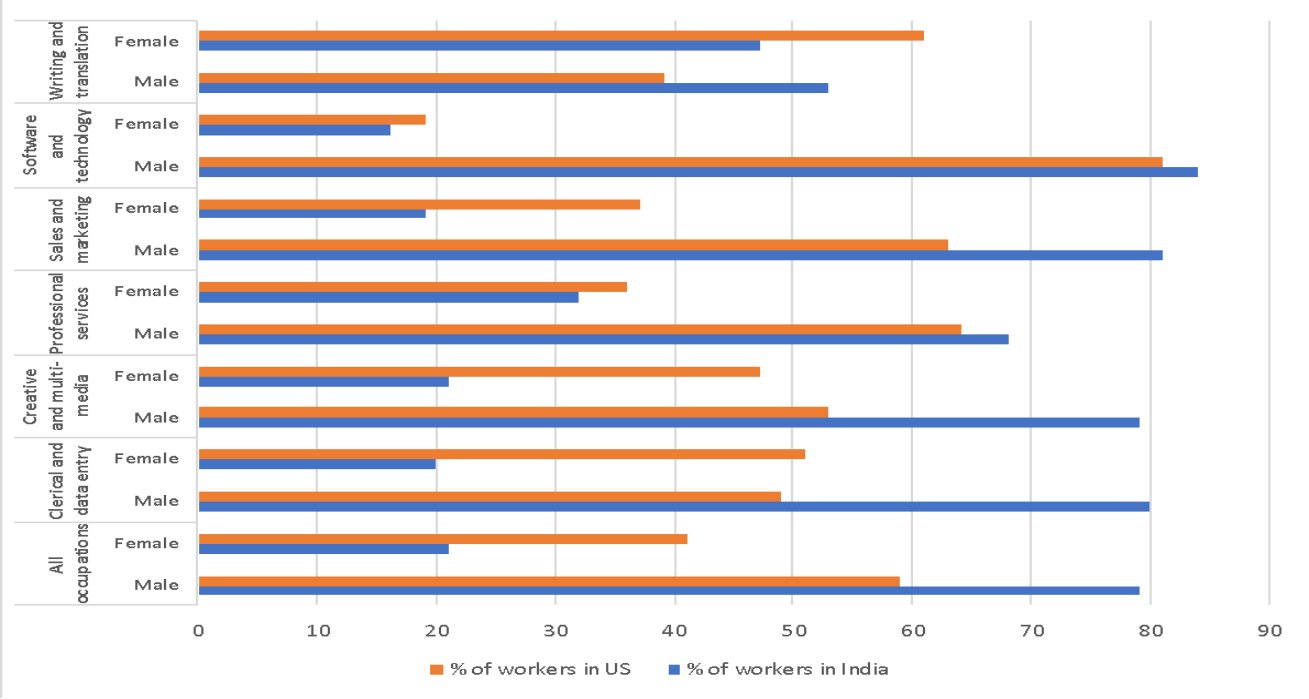
Although the rise of the gig economy presents important opportunities for women to find new work and gain more flexibility in work practices, this type of work has several gendered imbalances. Firstly, gig work displays a North-South disparity, wherein the demand for such work mainly comes from developed countries while the supply is provided primarily by developing, and particularly Asian, countries (Graham et al., 2017). As per the Online Labor Index — the first economic indicator that provides an online gig economy equivalent of conventional labor market statistics — the share of online labor supply from India has increased significantly between 2017 and 2021. A third of all freelancers are located in India, and more than half of online workers are from India, Pakistan and Bangladesh (Stephany et al., 2021).

Secondly, recent sex-disaggregated data shows that 79 percent of Indian online workers are male as compared to 59 percent in the US, while only 21 percent of Indian online workers are female versus 41 percent in the US (Figure 7). Across all occupations, the percentage of online women workers in the US is higher than the percentage of online women workers in India. This is particularly true for sales and marketing, creative and multimedia, and clerical and data entry jobs. In India, barring writing, translation and professional services, the share of women workers on digital platforms is below 30 percent. The lower participation could be attributed to a number of factors, such as lack of proficiency in the English language, fewer technical skills, lower awareness of the existence and benefits of such platforms, and poorer technical infrastructure at the country level such as unreliable electricity and broadband telecommunications (Martin et al., 2016). Ownership and access to devices are also critical for gig work (Malik et al 2017). In particular, ownership of computers is a critical determinant of participation in the digital labor market (Research ICT Africa, 2021). Women workers in low- and lower-middle-income countries are less likely to make meaningful contributions via online digital platforms due to lower access to computers and fixed broadband, particularly in African countries where the internet is accessed largely via smartphones, and ownership of computers and laptops is low at 3 percent and 6 percent respectively (ibid). This explains why most online workers in the African continent participate in microtasks that are generally sourced through online platforms, but performed offline (ibid).

Whilst the platform economy has the potential to formalize and improve conditions in the low-paid, informal service economy which typifies many women's working conditions in the Global South, current models do not seem to offer these improvements. Research on the on-demand cleaning service app SweepSouth, which currently operates in South Africa with plans to extend to other African countries, shows that women workers signed up in the hope of finding regular, permanent work (Tandem Research and The Cloudburst Group, 2020). However, despite the platform's promise that workers would be offered certain types of social protection, including maternity benefits, health benefits and unemployment pay through enrolment in government schemes, these benefits were out of the reach of most women working on the platform.

In fact, gig work has become increasingly precarious with high working hours and low and unreliable wages.

Figure 7: Gender distribution of labor supply on web-based platforms, by occupation and selected countries, between October 2020 to January 2021



Source: Compiled by authors based on data from WESO, 2021.

Margaryan (2016) reports that 25 percent of digital platform workers work more than 40 hours per week. Even on digital platforms, structural gendered inequalities persist. A recent survey of almost 5,000 platform workers in 15 countries showed that women were less likely to be performing higher-paid platform work, such as taxi driving, and earned less overall. This is perhaps partly due to women's greater care responsibilities at home, which leaves fewer hours for paid work. The survey showed, for example, that in Pakistan, women gig workers spent two hours a day less than men on paid work (Siddiqui and Zhou, 2021). Some digital labor platforms have excess labor supply, leading to greater competition among workers for task assignment and putting downward pressure on the price of tasks to be performed; micro tasks are often re-outsourced to the Global South under worse conditions (Graham et al., 2017). New jobs are posted in the early hours of the morning in Asian countries, and work — or at least the bidding — must be undertaken at that time (D'Cruz and Noronha, 2016; Martin et al., 2016). Due to women's greater care work burden, this adversely affects their ability to bid for tasks. Women crowd workers in developing economies of Asia, Africa and Latin America perform fewer hours of paid work than men, though the number of hours spent on unpaid tasks (e.g., searching for tasks) was similar for both (Rani and Furrer, 2020). Not only do gig work platforms like the Amazon Mechanical Turk (AMT) exploit women's digital labor for profit, they also invisiblize the care work they must perform in the ostensible flexibility afforded by platform capitalism (Gurumurthy et al., 2021). Indian women on AMT must reconcile themselves to lower-paying tasks aligned to the US-based workday, spaced almost 12 hours apart, after delivering on their household care work (ibid).

5. Gendered Implications of Proposed Global Digital Trade Rules

As shown in Figure 5, international factors play an important part in shaping the future of women workers in the Global South. Currently, a number of developed countries are proposing global digital trade rules under a Joint Statement Initiative (JSI) but negotiations at the multilateral level have not yielded any consensus. The agenda is being pushed forward largely through bilateral and regional trade agreements, while a subset of interested members in the WTO continue to pursue a plurilateral agreement on e-commerce. Critically, the norms that are established in these smaller groupings can strongly influence the evolution of future multilateral agreements. It is important to understand the gendered implications of some of the proposals being tabled by developed economies like the US and the European Union. These are as follows:

5.1 Permanent moratorium on customs duties and national treatment for foreign e-commerce players

In 1998, the WTO adopted a Declaration on Global Electronic Commerce, which included a two-year moratorium on customs duties on electronic transmissions (ET), that is, a ban on the imposition of custom duties on digitizable products (that can be delivered online) such as music files, video games, software, e-books, etc. Since then, the moratorium has been renewed every two years, except for 2003-05, with some members demanding to make it permanent. In addition, these members, mostly developed countries, **demand most-favoured nation (MFN) status for themselves. They also insist on national and non-discriminatory treatment for e-commerce players,** essentially demanding that domestic firms in developing countries not be given any different/favorable treatment compared to foreign firms.[11] In 80 percent of its existing trade agreements, the US asks for national treatment for American e-commerce firms, and in over 70 percent of its trade agreements, it does not offer any special provision to facilitate MSMEs' access to e-commerce (TAPED dataset, 2021) despite the well-documented gap between large firms and MSMEs, where women tend to be concentrated. In fact, traditionally, "the most effective gender equality policies seem to consist of various forms of positive discrimination in national regulation, such as the gender-sensitive domestic services initiative" (Trommer and Hannah, 2017) .[12] Moreover, new digital trade proposals are being discussed for US-Indo-Pacific trade as the Biden administration seeks a way to check China's influence in the region.[13]

Except for China, countries in the Global South face similar capacity issues and contextual and political constraints to innovation, and are relative digital latecomers, struggling to achieve convergence with countries in the North. Global South countries are largely importers of ET. Retaining policy space to impose customs duties on imported digitizable products could therefore be an important channel for low- and middle-income countries to raise taxes, which could then be spent on welfare activities. India and South Africa's communication at the WTO in March 2020 (WTO, 2020b) expresses concerns over the scope of and the tariff revenue losses due to the moratorium, as well as the consequent implications on industrialization, including digital industrialization, for developing countries. While a ban on ET customs duties is one of the most common provisions found in preferential trade agreements

[11] https://www.twn.my/title2/wto.info/2019/ti190716.htm

[12] https://blog.policy.manchester.ac.uk/posts/2017/10/gender-trade-wto-who-benefits/

[13] https://www.business-standard.com/article/international/biden-administration-weighs-digital-trade-deal-to-counter-china-in-asia-121071301461_1.html

(PTAs) with digital trade rules (Burri and Polanco, 2020), only nine of the existing 60 South-South trade agreements have commitments on non-imposition of custom duties and only five provide for MFN treatment in e-commerce (Banga et al., 2021c). A moratorium on customs duties could lead to a tariff revenue loss for LDCs in the WTO to the tune of $1.5 billion and a loss of around $2.6 billion for sub-Saharan countries (UNCTAD, 2019). A weakening of the fiscal revenue base can, in turn, put pressure on care-relevant infrastructure such as social security net, health and sanitation services, disproportionately impacting women, a majority of whom work in the informal economy and lack employment contracts (IT for Change 2019).

5.2 Free cross-border flow of data for leveraging cross-border e-commerce

The US has also used trade agreements with other countries to l**imit restrictions on the free flow of data across borders in the name of mutually leveraging e-commerce.** One of the ways in which the free flow of data is operationalized is by banning requirements for data localization, thereby allowing foreign firms collecting data in a country to move it across borders and store it in any part of the world. Some developing countries at the WTO — especially the Africa Group and India — have been vocal in resisting free cross-border flow of data, pointing out the need to first build national capabilities (WTO, 2017a), including thinking through data ownership frameworks, policy support for internet access, incentives for SMEs' online participation and building digital infrastructure. China, Russia, Indonesia, Brazil, Panama, Nigeria and South Korea already have data localization requirements for building local data storage, processing and use of local technologies, driven by security, domestic surveillance and economic reasons.

Free flow of data will benefit those firms with the capacity to analyze Big Data and convert it into data intelligence, which can be used to increase economic competitiveness. Power asymmetries between the Global North and South are exercised along the entire 'data value chain' at the point of data collection, but also at the level of data storage, aggregation, localization and use by businesses (and potentially governments). For instance, digital platforms remain concentrated largely in developed countries, and the astounding power of network effects ensures their size and dominance.[14] With 1,800 centers, the US alone accounts for 38 percent of colocation data centers globally[15] and 40 percent of hyperscale data centers.[16]

Free flow of data will not benefit developing countries that are still in the nascent stages of developing a local digital industry. This was evident in Banga et al.'s (2021a) survey of African businesses. Of the 31 firms surveyed, 22 reported capacities to analyze and process e-commerce sales data within the firm, five were sure about their capacity and four reported having no capacity to analyze data. Female-owned firms were more hesitant in sharing their data. Among female-owned enterprises, only 50 percent of respondents want intra-regional data sharing compared with 70 percent of male-owned enterprises (Banga et al., 2021a). These gaps in capacity reflect a lack of awareness about the potential economic value that could be leveraged by monetizing data as well as reiterate the broader gendered inequalities in the ICT sector discussed earlier. A recent report in the data science and AI industry highlighted that whilst women in this industry have higher formal educational levels than men, they are

[14] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/785547/unlocking_digital_competition_furman_review_web.pdf

[15] https://www.datacentermap.com/datacenters.html

[16] https://www.datacenterdynamics.com/en/news/synergy-there-are-541-hyperscale-data-centers-world/

under-represented in senior roles and are more likely than men to occupy a job associated with lower status and pay (Young et al., 2021).

5.3 Ban on source-code sharing

Evidence suggests that the use of algorithmic techniques in global digital marketplaces to match customers with sellers ends up unfairly excluding and marginalizing women-run small businesses and women workers associated with service industries.[17] Having the right to access these algorithms could be a crucial tool for governments in developing countries to protect the economic and social future of women workers. However, developed countries propose **banning source code/algorithmic disclosure requirements on transnational digital corporations.** The US' proposal at the WTO on source-code sharing, for instance, states that "trade rules may be developed to prohibit requirements on companies to transfer technology, production processes, or other proprietary information" and "[i]nnovators should not have to hand over their source code or proprietary algorithms to their competitors or a regulator that will then pass them along to a state-owned enterprise" (WTO, 2016a). The proposed e-commerce rule in the **JSI does not include any exceptions or special or differential treatment** for developing countries or LDCs.

The increased use of automated decision-making has also led to increased algorithmic biases against women,[18] making it all the more important for developing country governments to retain policy space to obtain access to source codes, especially where there are suspicions of gender or other biases in company algorithms. Discrimination on online web-based platforms is associated with exclusion from work opportunities or low pay on the basis of nationality and gender, particularly of women workers and those residing in developing countries (WESO, 2021). The following are examples of such algorithmic biases against women:

- Facebook's algorithm learns from existing societal biases and perpetuates existing inequalities in employee demographics online (Imana et al., 2021). For instance, 98 percent of pizza delivery drivers in Domino's are male while 50 percent of delivery drivers for Instacart (a grocery retailer) are females. Alarmingly, there is a statistically significant gender skew in the delivery of Domino's ads on Facebook, that is, the platform displays Domino's advertisements for delivery jobs to a higher fraction of men than Instacart jobs. Similarly, Facebook's algorithm mimics the existing gender biases when it delivers a Reeds ad (for jewelry) to relatively more women than a Leith ad (for automotive dealership).

- Online discrimination is also faced by women suppliers on e-commerce platforms. A majority of women-led enterprises were disadvantaged in the data-based scoring processes of Amazon's buy box algorithm.[19] Whenever someone visits a product page on Amazon, the buy box algorithm compares a range of data points from all sellers on that listing who are buy box eligible and then ranks each vendor based on performance metrics: competitive pricing, free shipping, low product defect rates, responsiveness to customer communication and product stock levels maintained. The best offer is then displayed in the buy box. Despite

[17] https://itforchange.net/Dominant-Digital-Trade-Paradigm-Women-Global-South-justice

[18] https://cepr.net/wp-content/uploads/2020/07/digital-trade-2020-07.pdf?__cf_chl_jschl_tk__=pmd_38ed494059fd2d7acdc81cb5f002c0723e417048-1627485945-0-gqNtZGzNAk2jcnBszQjO

[19] https://medium.com/commentary-itforchange/why-the-dominant-digital-trade-paradigm-will-not-work-for-women-in-the-global-south-d053cd3b470f

paying high commissions, women-led entreprises in developing countries are often disadvantaged and placed lower down in this ranking as they tend to be small size businesses with low output levels, limited growth potential, thin price margins and very little capacity to bear inventory and customer service overheads.

6. Conclusion and Policy Recommendations

The evidence presented in this paper shows how gendered digital structural inequalities at all levels — from firms and policymaking to skills and education — risk leaving women behind without appropriate policy interventions. Women in the Global South face a digital divide that goes beyond binary access to technologies; it is five-staged and manifests in the form of access to technology, adoption of technology, participation in the ICT sector, dividends from participation and in tech-related rule making. The garment and BPO sector case studies discussed in this paper further demonstrate that women workers in the South are more adversely affected by automation than male workers and are also less likely to benefit from new jobs arising from digitalization. While e-commerce is often presented as an economic silver bullet for women-led SMEs, women will be left behind and existing inequalities will be amplified without active intervention in digital trade frameworks and promotion of policies which enable a gender-inclusive digital economy. Digital industrialization roadmaps at the domestic level should enable women workers and entrepreneurs to move to higher value segments of the digital value chain. Dialogue between policymakers, the private sector and civil society on how to empower women in the digital economy should be encouraged at all levels, especially in developing countries. This paper suggests the following interventions:

- Female-led companies, particularly smaller firms (with less than 50 workers), suffer more from inefficiencies in IT connectivity and infrastructure and digital regulations. With this constraint in mind, targeted digital connectivity policies need to be developed.

- New investments in digital industrialization are needed to open up opportunities for women's entrepreneurship and economic participation in the digital economy. Policies need to shift focus from purely increasing access to technology to addressing challenges related to adoption (for example, affordability and skills) and tech entrepreneurship.

- National policies need to address gender inequalities in digital access through communal public funds dedicated to expanding internet connectivity, higher enrolments of women in STEM and TVET to increase exposure of women to tech from an earlier stage, and meaningful representation in national ICT ministries and global rulemaking.

- Decisions to automate production at the firm level need to incorporate women in decision-making. Robotics and automation will likely take away some jobs but also create jobs in other tasks and sectors. Gender-sensitive training at the firm level can ensure female workers are equipped to take up new jobs created by digitalization.

- E-commerce-related laws need to account for gender-specific challenges. While online selling is often touted as a silver bullet for women's inclusion, in reality, lower access to credit and finance, high commissions charged by third-party platforms, and information asymmetries and training gaps constrain participation of women sellers on third-party e-commerce platforms in the Global South.

- Any cooperation provisions for e-commerce in trade agreements should include digital training and capacity-building for women to help close the gender digital divide. At present, 44 PTAs include targeted provisions to facilitate e-commerce use by SMEs (Burri and Polanco, 2020).

- While awareness building and longer-term training (in local languages and digital skills) on platforms can enable women workers to leverage digital platforms more effectively, meaningful connectivity will arisefrom facilitating women's ownership of computers and broadband. New models need to be developed for the platform economy to realize its potential to formalize and improve conditions in the low-paid informal services sector.

- Development of a national digital industry can be facilitated through creation of data and platform-based public goods to incentivize local digital startups and online marketplaces that promote women producers, micro-entrepreneurs, artisans and service providers.

- Digital trade policy frameworks in the Global South need to retain policy space to navigate issues on data flows, data localization and source-code sharing. Retaining policy space in trade agreements for source-code sharing in order to access aggregate, de-identified data sets held by private platform companies can check for algorithmic biases against women.

References

Alliance for Affordable Internet (2019). 2019 Affordability Report. Available at https://a4ai.org/affordability-report/report/2019/

Alliance for Affordable Internet (2020). 2020 Affordability Report. Available at https://a4ai.org/2020-affordability-report/

Andersson, J., Berg, A., Hedrich, S., Ibanez, P., Janmark, J., and Magnus, K. (2018). Is apparel manufacturing coming home? Nearshoring, automation, and sustainability – establishing a demand-focused apparel value chain. London: McKinsey Apparel, Fashion and Luxury Group.

Artuc, E., Christiaensen, and Winkler, H. (2019) Does Automation in Rich Countries Hurt Developing Ones? Evidence from the U.S. and Mexico. Available at http://conference.iza.org/conference_files/worldbank_2019/winkler_h23742.pdf

Banga, K. and te Velde, D.W.(2018). *Digitalisation and the Future of Manufacturing in Africa*. ODI.

Banga, K., Gharib, M., Mendez-Parra M and Macleod, J. (2021a) E-commerce in preferential trade agreements: implications for African firms and the AfCFTA. ODI report.

Banga, K., Njambi-Szlapka, S. and Phiona, S., (2021b). Youth enterprise growth; evidence from Youth Forward in Uganda. ODI report. Available at https://cdn.odi.org/media/documents/ODI-ET-YouthEnterpriseGrowth-Report-Jun21-Proof04_FINAL.pdf.

Banga, K., Macleod, J. and Mendez-Parra, M., (2021c). Digital trade provisions in the AfCFTA; what can we learn from South–South trade agreements? Supporting Economic Transformation. Available at https://set.odi.org/wp-content/uploads/2021/04/Digital-trade-provisions-in-the-AfCFTA.pdf.

Barrientos, S. (2019). Gender and work in global value chains. Cambridge: Cambridge University Press.

Brussevich, M., Dabla-Norris, M.E., Kamunge, C., Karnane, P., Khalid, S. and Kochhar, M.K.(2018). *Gender, technology, and the future of work*. International Monetary Fund.

D'Cruz, P. and Noronha, E. (2016) Positives outweighing negatives: the experiences of Indian crowdsourced workers, Work Organisation, Labour and Globalisation, 10(1), 44-63

Deloitte (2020a). Covid-19: A wake up call for the BPO industry, Part 2 of Impacts of Covid. UK: Deloitte MCS Limited.

Domingo-Cabarrubias, Leavides G. (2012). "Gender Matters in the Call Center Industry: A Review of Literature on the Effects of Call Center Work on Women". Review of Women's Studies 21 (2): 72–95

EIGE (2018): Gender Equality and Digitalisation in the European Union. https://eige.europa.eu/publications/gender-equality-and-digitalisation-european-union

European Commission (2018): Women in the Digital Age. A study prepared for the European Commission. https://ec.europa.eu/digital-single-market/en/news/increase-gender-gapdigital-sector-study-women-digital-age

Graham, M., Hjorth, I. and Lehdonvirta, V.(2017). Digital labour and development: impacts of global digital labour platforms and the gig economy on worker livelihoods. *Transfer: European review of labour and research*, *23*(2), pp.135-162.

GSMA Intelligence (2020) *The Mobile Gender Gap Report 2020*, https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2020/02/GSMA-The-Mobile-Gender-Gap-Report-2020.pdf (accessed 4 March 2020)

Gurumurthy, A., Zainab, K. and Sanjay, S.(2021). The Macro Frames of Microwork: A Study of Indian Women Workers on AMT in the Post-Pandemic Moment. Available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3872428

Gurumurthy, A. and Chami, N.(2014). Gender equality in the information society. *Bangalore: IT for Change*.

Hilbert, M. (2011).Digital gender divide or technologically empowered women in developing countries? A typical case of lies, damned lies, and statistics. Women's Studies International Forum, 34, 479-489.

ILO (2017). "ASEAN in Transformation: How technology is changing jobs and enterprises", The Philippines Country Brief, The Bureau for Employers' Activities, International Labour Organization.

Imana, B., Korolova, A. and Heidemann, J.(2021). Auditing for Discrimination in Algorithms Delivering Job Ads. In *Proceedings of the Web Conference 2021* (pp. 3767-3778). Available at https://arxiv.org/pdf/2104.04502.pdf

Islam, P. and Roest, J.(2020) 'Hiding in plain site: informal e-commerce among Women in Asia'. CGAP Blog, 18 February (https://www.cgap.org/blog/hiding-plain-site-informal-ecommerce-among-women-asia)

ITC (2020) Mapping e-Marketplaces in Africa. Available at https://www.intracen.org/uploadedFiles/intracenorg/Content/Publications/B2C-marketplaces-20201221_final_Low-res.pdf

Jacobson, L., LaLonde R.J. and Sullivan, D.G.(1993). Earnings Losses of Dispalced Workers. Available at ahttps://research.upjohn.org/up_workingpapers/11/

Kearney (2017). 2017 A.T. Kearney Global Services Location Index: The Widening Impact of Automation. UK: A.T. Kearney, Inc.

Kilic, T., Winters, P. and Carletto, C. (2015) 'Gender and agriculture in sub-Saharan Africa: introduction to the special issue' Agricultural Economics 46(3): 281–284.

Kucera, D. and F. B. Mattos (2020). "Automation, employment and reshoring: Case studies of the apparel and electronics industries", Comparative Labor Law and Policy Journal, Vol. 41, No. 1.

Malik, F., Nicholson, B. and Heeks, R. (2017) Understanding the development implications of online outsourcing, in: Information and Communication Technologies for Development: ICT4D 2017, J. Choudrie, M. Islam, F. Wahid, J. Bass and J. Priyatma (eds), Springer, Cham, 425- 436

Margaryan, A.(2016). Understanding crowdworkers' learning practices. Available at http://repository.uwl.ac.uk/id/eprint/4824/

Mariscal, J., Mayne, G., Aneja, U. and Sorgner, A.(2019). Bridging the gender digital gap. *Economics*, *13*(1).

Martin, D., O'Neill, J., Gupta, N., and Hanrahan, B.V. (2016) Turking in a global labour market, Computer Supported Cooperative Work, 25(1), 39-77

Nasscom (2020b). Navigating Covid: Indian tech sector benchmarks and way forward. Noida: National Association for Software and Service Companies.

Nayak, R. and Padhye, R.(2018). Artificial intelligence and its application in the apparel industry. In *Automation in garment manufacturing* (pp. 109-138). Woodhead Publishing.

ODI (2020). Ag-platforms as disruptors in value-chains: evidence from Uganda. Overseas Development Institute. Available at https://odi.org/en/publications/agplatforms-as-disruptors-in-value-chains-evidence-from-uganda/.

OECD (2017).Going Digital: The Future of Work for Women. OECD Publishing, Paris.https://www.oecd.org/employment/Going-Digital-the-Future-of-Work-for-Women.pdf

OECD (2018).Bridging the Digital Gender Divide: Include, Upskill, Innovate, OECD Publishing, Paris. http://www.oecd.org/internet/bridging-the-digital-gender-divide.pdf

Pew Research Center (2018) *Social Media Use Continues To Rise in Developing Countries, but Plateaus Across Developed Ones*, Pew Research Center, https://www.pewresearch.org/global/2018/06/19/social-media-use-continues-to-rise-in-developing-countries-but-plateaus-across-developed-ones/ (accessed 6 September 2019)

Ramirez, F.O. and Kwak, N.(2015). Women's enrollments in STEM in higher education: cross-national trends, 1970–2010. In *Advancing women in science* (pp. 9-49). Springer, Cham.

Rani, U. and Furrer, M.(2021). Digital labour platforms and new forms of flexible work in developing countries: Algorithmic management of work and workers. *Competition and Change*, *25*(2), pp.212-236.

Rashid, A.T. (2016).Digital Inclusion and Social Inequality: Gender Differences in ICT Access and Use in Five Developing Countries. Gender, Technology and Development, 20(3), 306– 332

Research ICT Africa. (2021). Digital labour in Africa: Opportunities and Challenges. Available at https://media.africaportal.org/documents/Digital-labour-in-Africa-Jan-2021.pdf

Sagara, H. and Das, K.(2020). Technological disruptions and the Indian IT industry: Employment concerns and beyond. In *Digitalisation and Development* (pp. 119-143). Springer, Singapore.

Sey, A. and Hafkin, N. (2019). Taking stock: Data and evidence on gender equality in digital access, skills and leadership. *United Nations University, Tokyo*.

Siddiqui, Z and Zhou,Y. (2021). How the platform economy sets women up to fail. Available at https://restofworld.org/2021/global-gig-workers-how-platforms-set-women-up-to-fail/

Sorgner A., Bode, E., and Krieger-Boden, C. (2017)The Effects of Digitalization on Gender Equality in the G20 economies. E-book. Kiel Institute for the World Economy, Kiel, https://www.ifw-kiel.de/pub/e-books/digital_women-final_report.pdf

Staritz, C. and P. Bamber.(2016). The gender dimensions of global value chains. Issue Paper. Geneva: International Centre for Trade and Sustainable Development

Stephany, F., Kässi, O., Rani, U. and Lehdonvirta, V.(2021). Online Labour Index 2020: New ways to measure the world's remote freelancing market. *arXiv preprint arXiv:2105.09148*.

Stoet, G. and Geary, D.C.(2018).The gender-equality paradox in science, technology, engineering, and mathematics education. *Psychological science*, *29*(4), pp.581-593.

Strohmeyer, R., Tonoyan, V. and Jennings, J.E.,(2017).Jacks-(and Jills)-of-all-trades: On whether, how and why gender influences firm innovativeness. *Journal of Business Venturing*, *32*(5), pp.498-518.

Tandem Research and The Cloudburst Group.(2020).*GIG WORK ON DIGITAL PLATFORMS Case Study 3: SweepSouth – Platform-Based Domestic Work*. Available at https://www.tandemresearch.org/assets/SweepSouth-Case-Study-Final-2020-05-15.pdf

Tejani, S. and Fukuda Parr, S.(2021).Gender and Covid19: Workers in global value chains. *International Labour Review*.

Thakur, D. and Potter, L. (2018) 'Universal Service and Access Funds: An Untapped Resource to Close the Gender Digital Divide', *Washington DC: Web Foundation*

TWN (2019). E-com rules promoted in name of women's economic empowerment. Third World Network. Available at https://www.twn.my/title2/wto.info/2019/ti190716.htm

UN Women.(2005).Gender Equality and Empowerment of Women through ICT, UN Division for the Advancement of Women, Department of Economic and Social Affairs of the United Nations Secretariat, www.un.org/womenwatch/daw/public/w2000-09.05-ict-e.pdf.

UNIDO.(2019).THE IMPACT OF NEW DIGITAL TECHNOLOGIES ON GENDER EQUALITY IN DEVELOPING COUNTRIES. Available at https://www.unido.org/api/opentext/documents/download/16760725/unido-file-16760725

Van der Spuy, A. and Aavriti, N. (2018) *Mapping Research in Gender and Digital Technology* (p. 144), Association of Progressive Communications, https://www.apc.org/sites/default/files/IDRC_Mapping_0323_0.pdf (accessed 12 July 2018)

Vashisht, P., and Rani, N.(2019). Automation and Future of Garment Sector Jobs: A Case Study of India. ICRIER working paper 385. Available at https://icrier.org/pdf/Working_Paper_385.pdf

WEF (2018). The global gender gap report 2018. Geneva: World Economic Forum.

World Bank (2016) *World Development Report 2016: Digital Dividends*, Washington DC: The World Bank, http://elibrary.worldbank.org/doi/book/10.1596/978-1-4648-0671-1 (accessed 25 May 2016)

WWB Foundation.(2020). The gender gap in internet access: using a women-centred method. Available at https://webfoundation.org/2020/03/the-gender-gap-in-internet-access-using-a-women-centred-method/

Young, E., Wajcman, J. and Sprejer, L. (2021). Where are the Women? Mapping the Gender Job Gap in AI. Policy Briefing: Full Report. The Alan Turing Institute.