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## Article

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## Labor market opportunities for women in the digital age

*Christiane Krieger-Boden and Alina Sorgner*

### Abstract

Digitalization offers a variety of opportunities for female empowerment and for a more equal female participation in labor markets, financial markets, and entrepreneurship. Currently, digitalization seems to favor female labor force, since women face on average lower risk of being replaced by machines, as compared to men. Women's often superior social skills represent a comparative advantage in the digital age, and this is particularly so when social skills are complemented with higher education and advanced digital literacy. However, the same barriers and deficits that obstruct women's current advancement in many countries may deprive them from many beneficial opportunities in the digital age, including new entrepreneurial opportunities. Major efforts by policy makers are required to invalidate these barriers. New digital technologies should be used more decisively to achieve the goal of gender equality.

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## **Introduction**

New developments in the fields of artificial intelligence, big data, cloud computing and mobile robotics that gave rise to Industry 4.0 also offer new opportunities for women to improve their participation in economic life. Thus, they may help significantly enhance their financial and social autonomy. However, the existing gender gaps in labor market inclusion, financial inclusion, and digital gender gaps can prevent women from benefiting from enormous opportunities that arise in the digital age, thus, leading to persistent gender inequalities. Moreover, it is not entirely clear whether the digital transformation of labor markets that includes automation of various tasks differently affects jobs currently held by men and women and, if yes, who profits more from it.

The digital revolution may affect gender equality in at least two ways. Firstly, it changes the composition of jobs and skills that are required to perform those jobs. The automation of work processes, facilitated by digital technologies, may affect women's labor market inclusion by changing the demand for typical women's jobs differently from that for typical men's jobs. Robots and algorithms will likely replace many jobs in occupations like assembly-line production, machine operation, bookkeeping and clerical jobs. They will, by contrast, complement jobs in occupations like management, research, engineering, legal services or health care. Secondly, innovations in digital services including mobile money, data-empowered fintech services, as well as numerous digital platforms that match employers and employees, start-ups and financiers of new businesses, may help women sidestep traditional barriers to their full economic, entrepreneurial or financial inclusion. These new digital services could help women access new markets, work flexibly and distantly, acquire and interact with customers, receive training and provide mentoring, improve financial autonomy and access finance for their ventures. Last but not least, digital technologies may help reduce discrimination against women.

In this article, we set out the directions in which gender inequalities in the digital age can develop if the still existing gaps in labor market participation, entrepreneurship and access to finance persist. In addition, we formulate policy recommendations concerning the possibilities of employment of new digital technologies for reducing the gender gaps in these areas.<sup>1</sup>

## **The gender-specific effects of digitalization on jobs**

How will women's and men's jobs be affected by the future digitalization? Technological changes will increase the relative demand for those tasks and skills they complement, and reduce the relative demand for those tasks and skills they can replace. Past computerization and automation of workplaces has been complementing primarily non-routine abstract tasks typically performed by high-skilled workers, including managers and professionals, but has

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<sup>1</sup>The present article is an extended summary of the study by Sorgner et al. (2017) conducted for Women 20. Link to the study: [http://www.w20-germany.org/fileadmin/user\\_upload/documents/20170714-w20-studie-web.pdf](http://www.w20-germany.org/fileadmin/user_upload/documents/20170714-w20-studie-web.pdf)

replaced routine tasks typically performed by medium-skilled workers, including clerical and assembly line workers (Autor et al. 2003, Acemoglu and Autor 2011, Autor 2015). In addition to this, it has increased the demand for so-called non-routine manual and interactive tasks that are performed mostly by low-skilled workers, including services workers in health care, security and domestic households.

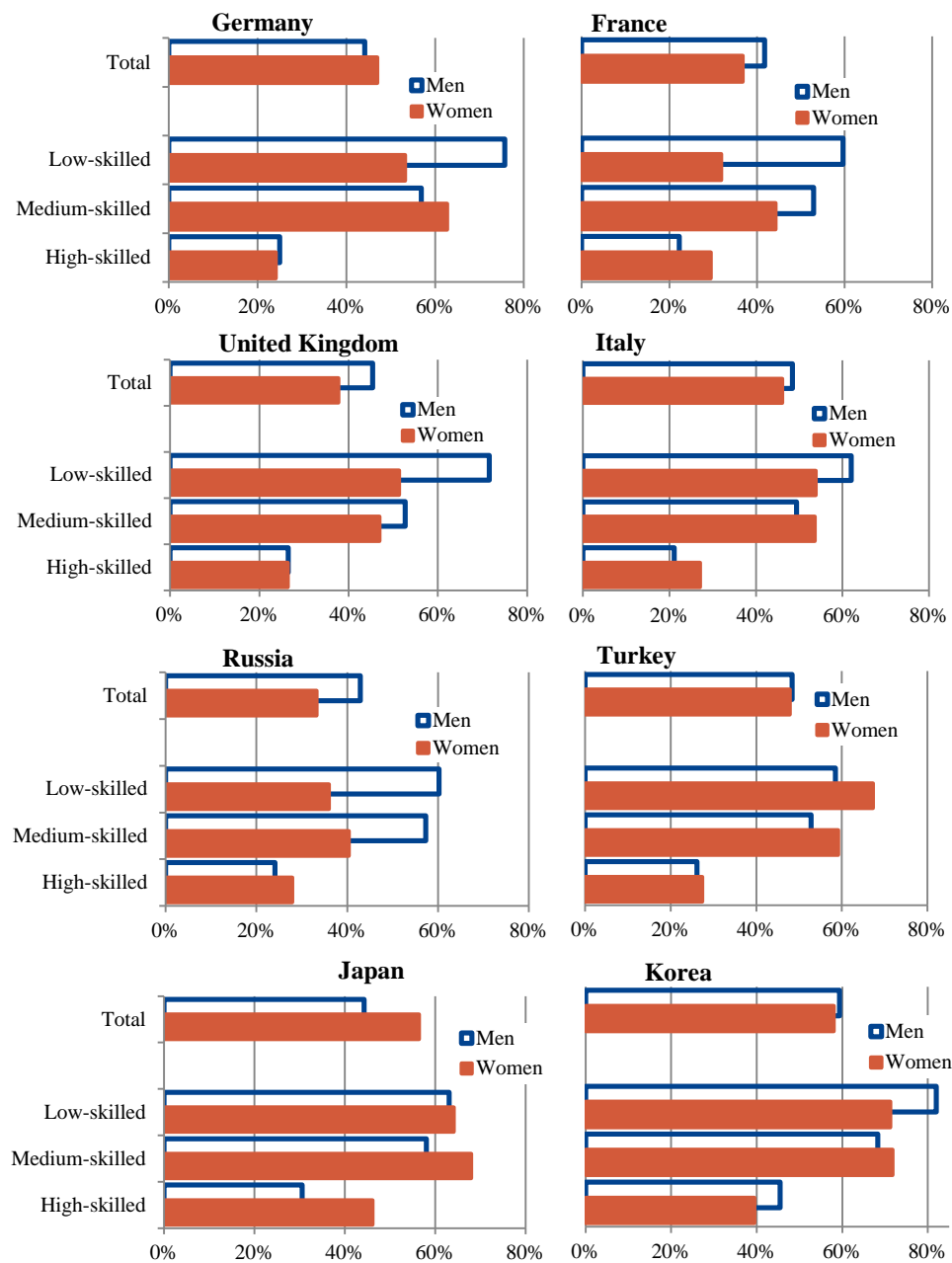
In a recent study by Frey and Osborne (2017) the authors quantify the expected susceptibility of occupations in the U.S. to digital technologies. Consulting robotics and machine learning experts, and exploiting O\*Net, a rich dataset on detailed task contents of occupations, they estimate digitalization probabilities for 702 occupations. They arrive at a conclusion that about 47 percent of the US labor force faces a very high risk of digitalization of their jobs in the foreseeable future. Among occupations that are characterized by a high risk of automation are many clerical occupations or machine operating and tending occupations. Occupations with the lowest digitalization probabilities include teaching occupations, health services, STEM (Science, Technology, Engineering, and Mathematics) occupations, and creative occupations in arts and design.

To understand whether the risk of digitization differs for occupations currently held by men and women, we follow the approach by Frey and Osborne (2017) and combine their estimations of digitalization probabilities of occupations with occupations data from a large international survey of adults, OECD's "Programme for the International Assessment of Adult Competencies" (PIAAC).<sup>2</sup> The results of this exercise are reported in Figure 1 for those G20 countries that are covered by these PIAAC data.

According to these estimates, the average risk of digitization of women's jobs is comparable or even less than that of men's jobs in most countries except Japan. Particularly in the field of low-skilled occupations, which are at high risk in general, women are usually much less at risk than men (30–55% compared to 60–75%), as they are rarely employed – in comparison to their male counterparts - in occupations such as machine operators or assembly line workers, but rather in the nursing professions or in household services. These occupations are resistant to automation, partly because they are performed in unstructured environments and require certain manual skills, such as finger dexterity, that robots cannot yet master. Moreover, those occupations require high levels of social competence and empathy that also currently represent bottlenecks to automation. In medium-skilled occupations, the prospects for women vary greatly from country to country. Medium-qualified women in Germany, Italy, Turkey, Japan and Korea face a somewhat higher risk of automation of their jobs, as compared to their male counterparts. Highly qualified occupations face on average the lowest risk of automation of on average 20–25 percent. The bad news is, however, that women are only a minority in the sector with the best prospects of income and promotion opportunities. The existing gender gaps in tertiary education, and particularly in STEM fields, are, therefore, a barrier for empowering women in the digital age.

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<sup>2</sup> See Sorgner, Bode, Krieger-Boden (2017) for detailed description of methodological issues and limitations of the approach, and for additional results.



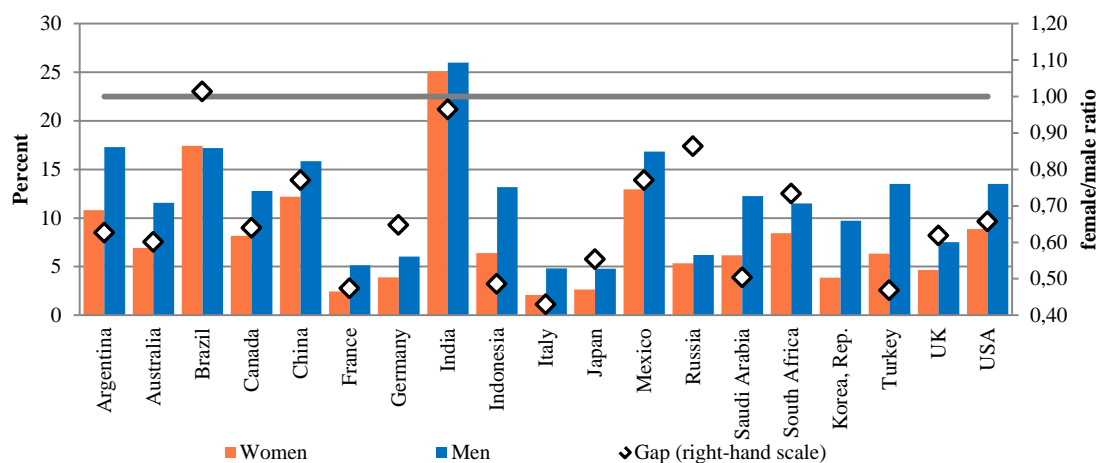
*Figure 1: Gender-specific risk of digitalization of occupations. Shares of men and women in age between 26 and 65 years old who are currently (in 2012) employed in occupations that face a high risk of digitalization in the next 20–30 years. Source: OECD (2016), PIAAC; Frey and Osborne (2017); own calculations.*

Accordingly, women often find themselves trapped in a vicious circle, where current gender gaps hinder the chances for future improvements. Thus, prevailing legal and cultural restrictions towards female autonomy in many emerging and developing economies tend to prevent women from accessing digital devices that could help overcome some of these restrictions. And even in

the most developed countries, lower female enrolment rates in higher education, especially in STEM fields deters women from fully realizing the chances offered by digitalization. Accordingly, women are at risk of missing out on the most promising jobs of the digital age.

While many jobs will disappear or face significant changes in the course of digitalization, a vast variety of new opportunities for entrepreneurship will be created at the same time. Entrepreneurship may represent an alternative attractive employment opportunity for women besides wage jobs. However, current gender imbalances like gaps in entrepreneurial skills, lack of developed social networks for female business founders, insufficient number of female role models of entrepreneurship and prevalence of financial constraints may keep women from recognizing and pursuing those entrepreneurial opportunities.

Almost all G20 countries display low gender parity for early-stage entrepreneurial activities (Figure 2). In France, Indonesia, Italy, Saudi Arabia and Turkey the female-to-male ratio of early-stage entrepreneurship is below 0.5. Only in Brazil and India women are not less likely than men to be involved in early-stage entrepreneurial activities. In both countries, the overall level of entrepreneurial activities is rather high, which may be due to the lack of alternative employment opportunities in those countries. Remarkably, gender gaps in early-stage entrepreneurship vary a lot across the G20 countries. This indicates that women in different countries may face different barriers on their way to entrepreneurship, which hinder them to realize their entrepreneurial intentions. For instance, women tend to have on average lower levels of entrepreneurial capabilities, such as managerial skills and general work experience. They may also have lower access to financial resources, which is important especially at the beginning of the start-up process and for start-ups in knowledge-intensive sectors. Higher levels of education in STEM fields are often crucially important for the decision to set up a business in such sectors. The gender gaps in entrepreneurial activities in knowledge-intensive sectors are particularly high, as is shown in Figure 3 for an example of the ICT sector.



*Figure 2.* Shares of the adult population between 18 and 64 years who are in the process of starting a business or having done so recently (nascent entrepreneurs who have not paid salaries or wages for more than three months, and new business owners who paid salaries and wages for more than three but fewer than 42 months). Source: Global Entrepreneurship Monitor (GEM) database, 2013; own calculations.

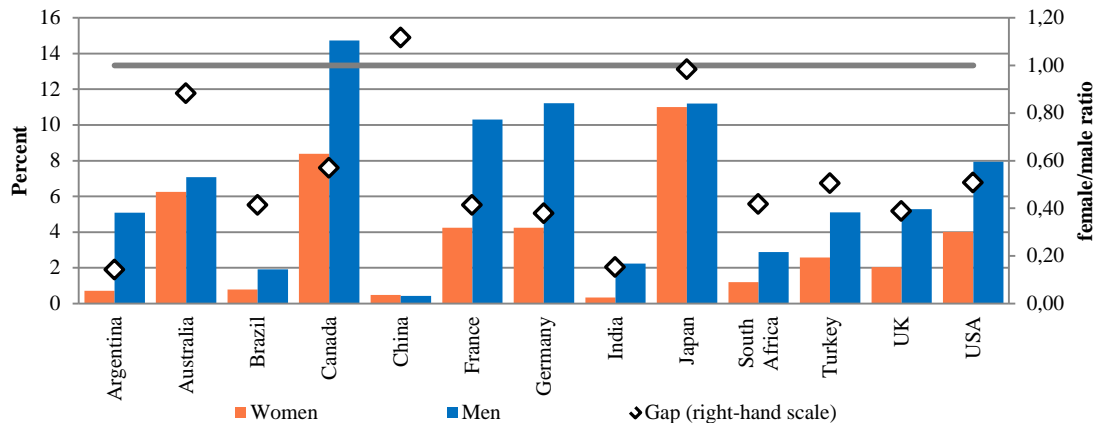


Figure 3: Share of the ICT sector in the overall early-stage entrepreneurial activities. Source: Global Entrepreneurship Monitor (GEM) database, 2013; own calculations.

## Policy recommendations

Policy is thus required to pave the way for a successful adoption of the new digital age opportunities by women. Given the potential for gender gap persistence to undermine any future gains to women from digitalization, it is indispensable for policy makers to reduce the well-known traditional gender gaps in tertiary education and STEM occupations. At the same time, policies should provide universal, affordable, secure and open broadband internet access; foster female digital literacy; facilitate web-based female entrepreneurship; and empower women financially through innovative digital finance tools and e-government. These suggestions are not new and have already been proposed in previous studies on women's inclusion. The recent study by Sorgner et al. (2017), while also corroborating the recommendations of the earlier studies, suggests that more attention should be paid to the five following areas:

1. *Establish an early warning system for potential adverse effects of digitalization on gender equality.* The G20 should continuously monitor changes in female employment prospects that accompany digitalization developments. Such a cross-country initiative should help to spark an early warning system, which in turn can trigger timely policy responses. The G20 should not confine its focus to digitalization impacts for the female workforce in developed countries only. Rather the G20 should also consider initiating high-profile research for emerging and developing countries since they may be particularly vulnerable to digitalization. More research is urgently required on the vulnerability of female employment in emerging and developing countries, which often rely on low-skilled labor.
2. *Help women complement their social skills with higher education and advanced digital skills in all G20 countries.* The G20 should more actively foster female participation in higher education and research as well as the acquisition of advanced digital skills by women.

Digitalization is likely to promote jobs that will strongly rely on complementarities between social and emotional intelligence and abstract (or cognitive) skills that can be acquired through higher education, such as creativity and critical thinking. In addition, high proficiency in digital skills will become a core requirement in the digital age. Since many women are found to possess stronger social skills and empathy than their male peers (Petrides and Furnham 2000, Pohl et al. 2005), they could benefit from exploiting these complementarities. However, the current gender gaps in higher education and digital literacy that are particularly strong in emerging economies may deprive women of these opportunities, and they may hinder them to occupy those high-profile jobs in management, STEM occupations or entrepreneurship that are expected to flourish best in the digital age.

Many of the G20 countries have introduced various initiatives to promote advanced digital literacy and to increase interest towards STEM fields among girls and young women, for instance, in form of hackathons, coding workshops or mentoring programs. Such programs are a key step towards achieving the goal of gender equality, and G20 need to support more of such initiatives to help women be best prepared for new requirements on labor markets of the digital age. These programs should not be only restricted to women of younger age. Instead, they should be also extended to women of older age cohorts, since it is likely that digitalization will affect people who have been already employed for some time. Life-long learning will become indispensable in flexible and continuously changing labor markets in the digital age.

3. *Use digital tools to foster women's entrepreneurial skills.* The G20 should make use of digital opportunities to enhance women's entrepreneurial skills. Those can be developed and supported, for instance, by means of high-quality online platforms that provide training to novice female entrepreneurs and facilitate knowledge exchanges with experienced female entrepreneurs.

Digitalization is likely to create new opportunities for entrepreneurship. Women often lack sufficient entrepreneurial skills and role models, which hinders them (compared to their male peers) from recognizing and pursuing more promising entrepreneurial opportunities in the digital age. Entrepreneurship-relevant human capital can be acquired by means of higher education and work experience, particularly in STEM fields, as well as through frequent interactions with entrepreneurial peers. Internet platforms represent a promising new tool for disseminating entrepreneurial skills among women and providing them an interface to mentors and role models. High-quality online training and mentoring platforms for female entrepreneurs should prove particularly beneficial for women in regions with few entrepreneurial role models or who face restrictions in access to these role models.

4. *Popularize innovative web-based instruments that improve female entrepreneurs' access to financial capital.* The G20 should promote innovative web-based instruments for women-led businesses to raise financial capital for their ventures. It should popularize high-quality digital platforms for angel investors, venture capital investors or equity crowdfunding that bring together female entrepreneurs and female investors. It should also promote innovative



ways of risk assessment that rely on transaction histories and other Big Data, in addition to traditional forms of securities.

In addition to less developed entrepreneurial skills, female entrepreneurs face difficulties in accessing the necessary financial capital to set up and grow their businesses. One reason for these difficulties is that many women lack the necessary collateral required by traditional financial institutions. Innovative risk assessment methods like those used by the Goldman Sachs' internet-based 10,000 Women program help to overcome the lack of collateral available to lenders from women by using the online transaction and behavior histories to make inferences about the client's creditworthiness. Another reason for lower availability of financial capital for women is that angel and venture capital networks, which are still male-dominated, often prefer funding male-led businesses. Promoting female participation in financial sectors, also by means of web-based platforms that provide training programs and mentoring for novice female investors by their more experienced peers, are crucial to overcome this obstacle for better financial inclusion of women.

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