

Women and the Future of Work: Fix the Present

Charles Kenny

There is a lot we don't know about what automation will mean for jobs in the future, including its impact (if any) on gender inequality. This note reviews evidence and forecasts on that question and makes four main points:

1. Past automation has been (broadly) positive for women's average quality of life, economic empowerment, and equality.
2. Forecasts of the gendered impact of automation and AI going forward based on the current distribution of employment suggest considerable uncertainty and a gender inequality of impact that is marginal compared to the potential impact overall.
3. The bigger risk—and/or opportunity—is likely to be in the combined impact of automation, policy, and social norms in changing the type of work that is seen as male or female.
4. Minimizing any potential aggravating impact of automation and AI on inequalities in economic power in the future can best be achieved by maximizing economic equality today.

PAST AUTOMATION HAS USUALLY BEEN ASSOCIATED WITH GREATER ECONOMIC OPPORTUNITIES FOR WOMEN

If you favor better economic and broader social outcomes for women, history suggests you should probably be broadly pro-automation. There are many exceptions—Ester Boserup discussed the role of the heavy plough in [entrenching discrimination](#), for example.¹ The descendants of societies that traditionally practiced plough agriculture still have [lower rates of female participation in the workplace](#) today.² Maxine Berg has suggested a complex picture in the early industrial revolution in the UK: the spinning jenny and the power loom [displaced women workers](#), even though these devices were still worked by women.³

Nonetheless, “automation” broadly defined has been and remains associated with gains for women's economic empowerment at the cross-country level and over the long term. Automation is a major force behind higher labor productivity—replacing human labor with that of machines was the secret

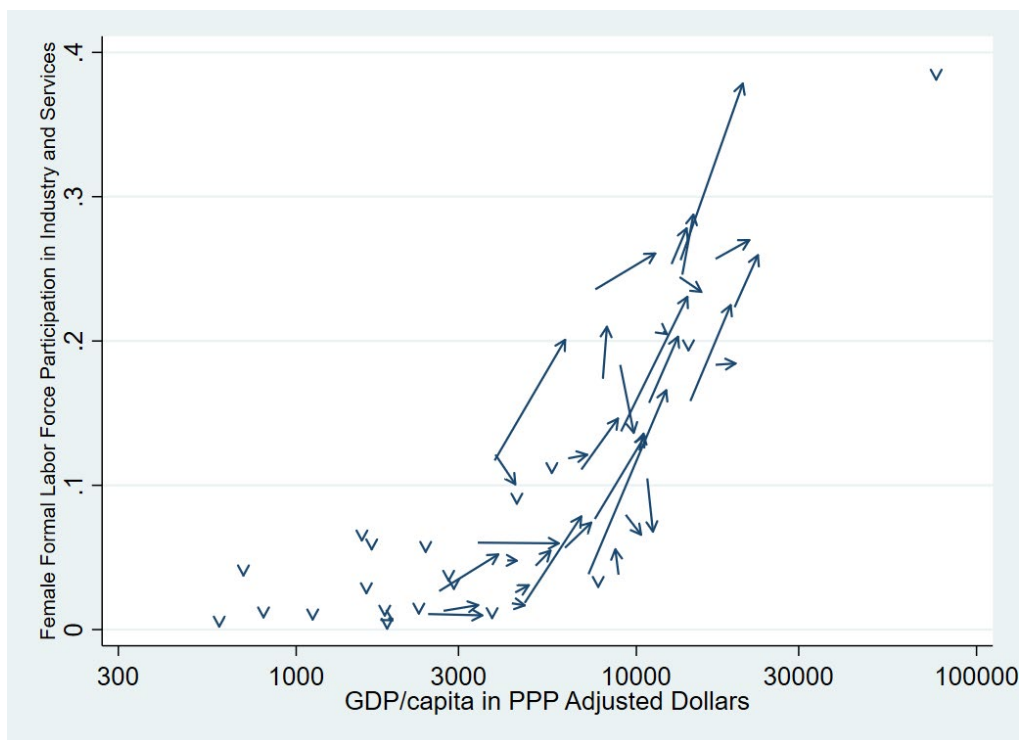
1 Boserup, E. (1970). *Woman's Role in Economic Development*. London: Allen & Unwin.

2 Alesina, A.F., Giuliano, P., & Nunn, N. (2011). On the Origins of Gender Roles: Women and the Plough. *NBER Working Paper No. 17098*.

3 Berg, M. (1991). Women's Work and the Industrial Revolution. *ReFresh: Recent Findings of Research in Economic & Social History*. Economic History Society.

to the Industrial Revolution and making machines better at augmenting labor is the biggest force behind continued growth. This makes GDP per capita a reasonable proxy for the extent of automation in a country. Countries with very low GDP per capita tend to see hand threshing, for example, while countries with high GDP per capita use combine harvesters. And higher GDP per capita is associated with more women in better jobs. Figure 1 presents the share of women over age 15 in formal employment in industry and services; the lines represent a single country over time and the points a country at a single point in time. While the data (and the relationship) is far from perfect, the graph makes clear that women’s employment in comparatively “good” jobs (many of which are still pretty awful) is more common in rich countries and (as a rule) gets more common as countries get richer.⁴

FIGURE 1. Women’s formal employment in services and industry



A related trend towards the increased importance of human capital is a positive force not only for overall economic outcomes but also for gender equality in outcomes. Given gender equality in talent, as talent becomes more important to production, the cost of discrimination climbs.⁵ Meanwhile, technology upgrading that reduces the (perceived) need for brawn are associated with greater equality. [Juhn and colleagues](#) study the impact of NAFTA on new firms that entered the export market in Mexico and updated their technology as a result. They find that the technological upgrading led firms

4 Data from the World Bank’s databank, accessed Nov 27, 2018. Informal employment, female (% of total non-agricultural employment) employment in services, female (% of female employment) (modeled ILO estimate), employment in industry, female (% of female employment) (modeled ILO estimate) employment to population ratio, 15+, female (%) (modeled ILO estimate), PPP GDP per capita. Share calculated as follows: (Employment to population ratio, 15+, female %)*(Employment in services, female % + Employment in industry, female %)*(100- Informal employment, female %).

5 See Hsieh, C.-T., Hurst, E., Jones, C.I., & Klenow, P.J. (2018) (The Allocation of Talent and U.S. Economic Growth) on the benefits of reduced discrimination against talented women and racial minorities on US GDP/ capita. See also Janssen, I., Heymsfield, S.B., Wang, Z., & Ross, R. (2000) (Skeletal muscle mass and distribution in 468 men and women aged 18-88 yr, *Journal of Applied Physiology* 89:1, pp. 81-88).

to replace blue collar male workers with blue collar female workers and an even larger shift in the wage bill between male and female workers.⁶ The authors suggest that the new technologies reduced the importance of brawn to productivity (though note this change will likely be connected with attitudes about “men’s work” and “women’s work” more than it is with the actual distribution of muscle type between individuals and link to productivity amongst the potential applicant pool).

It is similarly worth noting that automation-as-proxied-by-GDP-per-capita is associated with longer female life expectancy (both absolutely and compared to men), higher average female wages, lower rates of violence against women, and higher average female education (both absolutely and compared to men).

That said, the continued and considerable level of gender inequality in careers worldwide which have had nothing to do with brawn for a considerable time if ever (IT programmer, investment banker, economics professor, think tank fellow, manager, head of state) suggests how much more there is to equality than an increasing share of human capital in a production function. For all automation may be a broadly positive force for gender equality, there is nothing inevitable about automation leading to further progress going forward.

FORECASTS BASED ON CURRENT JOB DISTRIBUTIONS SUGGEST A LIMITED GENDERED IMPACT

Will automation continue to be (broadly, relatively) good for women? The answer is surely “it depends.”

Much of the recent writing on automation and opportunity has been around the potential for job losses to robots and artificial intelligence. Here the evidence points to decidedly mixed impacts. **Manufacturing** is seen as particularly threatened.⁷ Globally, manufacturing accounts for 27 percent of male employment and 18 percent of women’s employment. For **services**, these figures are 43 and 50 percent,⁸ suggesting that women may be already better placed than men if manufacturing jobs go away. Again, women are overrepresented in “caring” professions (teaching, nursing) that are seen as relatively resistant to automation.

That said, within services, **data from Europe** suggests women are more concentrated in jobs that involve repetitive tasks more prone to automation.⁹ As an example, business process outsourcing as well as garment manufacturing for exports have been formal sector jobs primarily occupied by women in many countries—both activities appear at **high risk of automation**.¹⁰

6 See Juhn, C., Ujhelyi, G., & Villegas-Sanchez, C. (2012) (Men, Women, and Machines: How Trade Impacts Gender Inequality, *NBER Working Paper No. 18106*). See also Aguayo-Tellez, E., Airola, J., & Juhn, C. (2012) (Did Trade Liberalization Help Women? The Case of Mexico in the 1990s, *NBER Working Paper No. 16195*). Although note earlier studies suggested that an increasing number of men were working in Maquilas—for example Fleck, S. (2001) (A Gender Perspective on *Maquila* Employment and Wages in Mexico, in *The Economics of Gender in Mexico: Work, Family, State, and Market*, eds. Katz, E. G. & Correia, M.C., *World Bank Directions in Development* 22242).

7 Rodrik, D. (2018). New Technologies, Global Value Chains, and the Developing Economies. *Pathways for Prosperity Commission Background Paper Series No.1*.

8 Otobe, N. (2017). Gender dimensions of employment trends and future of work: Where would women work next? *EMPLOYMENT Working Paper No. 222*.

9 Piasna, A. & Drahokoupil, J. (2017). Gender inequalities in the new world of work. *Transfer* 23:3.

10 Faith, B. (2017). *Automation, Women, and the Future of Work*. *The Impact Initiative, Rapid Response Briefing 1*. See also Klasen, S. (2017) (What Explains Uneven Female Labor Force Participation Levels and Trends in Developing Countries? *GLM/LIC Synthesis Paper No. 7*).

Looking at the skills base, [the risk of automation is lower for more educated workers](#), which should favor women.¹¹ [Huyer](#) finds that worldwide, women represent 53 percent of bachelor's and master's graduates. On the other hand, worldwide women represent only 28 percent of researchers (compared to their 43 percent share of PhDs).¹² [Krieger-Boden and Sorgner](#) report that women are only a minority in STEM. And at least in Europe, women are underrepresented amongst IT experts and in knowledge-intensive services—[job categories that may expand](#) in the future.¹³

This mixed picture is echoed in overall forecasts of the gendered impact of future automation based on the current gender distribution of jobs. [Brussevich and colleagues](#) from the IMF use OECD data on worker occupations by gender and suggest that across 30 countries, women work on average in slightly more automatable tasks. They suggest the average probability of automation among women in their sample was 40 percent compared to 38 percent for men.¹⁴

But compare the size of the difference between men and women (a couple of percentage points) to the estimated scale of jobs affected (tens of percentage points) and it is pretty clear that the answer to the question of whether automation will disproportionately affect women is “we don't really know.” Two additional factors point to this uncertainty: first, there is considerable disagreement based on different studies about [the overall level of automation risk](#)—from 2 to 41 percent of jobs in Bolivia or 6 to 55 percent in Japan, for example.¹⁵ And second, even using the same underlying (non-gendered) forecasts of automation probabilities and similar data on worker occupation by gender, small changes in the approach can flip the result: [Krieger-Boden and Sorgner](#) combine data from Frey and Osborne's 2017 estimation of digitization probabilities with the same OECD data on worker occupations by gender to conclude that “the average risk of digitization of women's jobs is comparable or even less than that of men's jobs in most countries.”¹⁶

JOB DISTRIBUTIONS CAN (WILL) CHANGE

These results suggest automation's interaction with current gender imbalances in the labor market may be a minor factor in future relative labor participation compared to shifting distributions and current (non-technology) barriers to equal participation. Again, there are reasons for both optimism and pessimism regarding shifting job shares, largely related to how technology change interacts with norms and policy choice.

In a modern economy, gender differences in employment are overwhelmingly driven by policies and norms rather than any innate differences between men and women in average suitability. That implies the gendered impact of technological change on the labor market will primarily depend on the interaction of changing demand for particular jobs and skills with evolving norms and policies regarding the role of women and men in work and in the home.

11 Krieger-Boden, C. & Sorgner, A. (2018). Labor market opportunities for women in the digital age. *Economics Discussion Papers No. 2018-18*, Kiel Institute for the World Economy (IfW).

12 Huyer, S. (2015). 03: Is the gender gap narrowing in science and engineering? *UNESCO Science Report: Towards 2030*, pp. 84-103.

13 Piasna and Drahokoupil (2017)

14 Brussevich, M., Dabla-Norris, E., Kamunge, C., Karnane, P., Khalid, S., & Kochhar, K. (2018). Gender, Technology, and the Future of Work. *IMF Staff Discussion Note SDN/18/07*.

15 World Bank. (2019). *World Development Report 2019: The Changing Nature of Work*. Washington, DC: World Bank, p. 22.

16 Krieger-Boden and Sorgner (2018). See also this report from Brookings using a different dataset and methodology which concludes men are at slightly more risk than women. (Muro, M., Maxim, R., & Whiton, J. (2019), Automation and Artificial Intelligence: How machines are affecting people and places, *Metropolitan Policy Program*, Brookings).

One reason to think women may gain from a (more rapidly) changing landscape of employment is that they have proven more adept to such change over the past century. Hanna Rosin, in *The End of Men*, notes that “[o]ver the past century, feminism has pushed women to do things once considered against their nature—first enter the workforce as singles, then continue to work while married, then work even with small children at home. Many professions that started out as the province of men are now filled mostly with women.... Yet I’m not aware of any that have gone the opposite way.” She points, for example, to the failure to get men into teaching and nursing in greater numbers.¹⁷ In 2000, men accounted for 9 percent of full-time registered nurses in the US. In 2017, that proportion had reached just 11 percent.¹⁸ Men as a percentage of elementary and secondary school teachers rose from 18 to 22 percent over the same period, a slow progress.¹⁹

The rise of gig economy jobs may also favor women who need more flexible or home-based employment because of norms (and/or laws) around parental responsibilities or women leaving the home to work. There has been interest around the flexibility combined with the greater security for women entering ride-hailing services compared to the traditional taxi business, for example—although a recent six-country survey found that the highest proportion of female Uber drivers was in Mexico and even there it was only just above 5 percent, suggesting norms may be hard to shift rapidly.²⁰

Again, *Cortes and colleagues* suggest that college educated men have seen a falling likelihood of working in a cognitive/high wage occupation since 1980, while college educated women have seen a rising likelihood of working in such jobs. Using occupation-level data, they suggest this might be connected in part with the increasing importance of social skills within such occupations.²¹ That said, *Paul Costa and colleagues* find that gender differences in personality are small compared to individual variation within genders.²² And gender character differences as well as the importance of social skills to particular jobs are both themselves (considerably) socially constructed.

That suggests that, even to the extent the averages are slow to change and personality differences matter to job performance, expectations about “female characteristics” versus “male characteristics” probably matter far more than the actual personality traits within an applicant pool. And in response to a changing labor market, men may (be seen to) become “more nurturing” or “nurturing jobs” may become more “disciplining.” Again, as more men enter a career, it may become higher-status and better-paid—with the reverse occurring when women enter in greater numbers. There is *evidence* in the US that as women

17 Rosin, H. (2010). *The End of Men*. *The Atlantic*, July/August Issue.

18 Data from FRED Economic Data, Federal Reserve Bank of St. Louis. Employed full time: Wage and salary workers: Registered nurses occupations: 16 years and over: Men (LEU0254594700A) Employed full time: Wage and salary workers: Registered nurses occupations: 16 years and over: Women (LEU0254701500A)

19 Employed full time: Wage and salary workers: Elementary and middle school teachers occupations: 16 years and over: Women (LEU0254697700A) Employed full time: Wage and salary workers: Elementary and middle school teachers occupations: 16 years and over: Men (LEU0254590900A). One further bit of good news for women: as new careers replace old ones, old legal restrictions on women’s employment in those old jobs will bind less.

20 International Finance Corporation & Accenture. (2018). *Driving Toward Equality: Women, Ride-Hailing, and the Sharing Economy*. *IFC*.

21 Cortes, G. M., Jaimovich, N., & Siu, H. E. (2018). The “End of Men” and Rise of Women in the High-Skilled Labor Market. *NBER Working Paper No. 24274*.

22 Costa, P.T., Terracciano, A., & McCrae, R.R. (2001). Gender differences in personality traits across cultures: robust and surprising findings. *Journal of Personality and Social Psychology* 81:2, pp. 322-331

Costa and colleagues also found that self-reported personality traits were closer between men and women in developing countries than in richer countries.

enter a profession, wages go down,²³ and linking teaching as a woman’s profession to low pay.²⁴

There is also cross-country evidence suggesting that what makes a career “women’s work” depends considerably on its relative attractiveness. In Europe, primary and secondary teacher pay is typically worth between a little under GDP per capita and twice GDP per capita. In sub-Saharan Africa, [teacher pay is between three to seven times GDP per capita](#).²⁵ In the European Union, 85 percent of primary school teachers are women. In a number of the poorest African countries, including Togo, the Central African Republic, Djibouti, Côte d’Ivoire, Sierra Leone, Mali, and Senegal, over two-thirds of primary teachers are men; the average for sub-Saharan Africa as a whole is 47 percent female. At the secondary level, 64 percent of teachers are women in the EU compared to 31 percent in sub-Saharan Africa.²⁶

In short, gender disparity in economic empowerment could easily persist even in a changed environment where, given the current distribution of jobs, we would expect women to do better. More hopefully, the reverse is also true—where there is less disparity in outcomes today, there is no reason to assume that low disparity will not persist in the age of robots. The present may be a (depressingly?) reliable guide to the future on overall outcomes.

THE GENDERED IMPACT WILL BE LARGER WHERE THERE IS GREATER DISCRIMINATION IN THE WORKFORCE FOR “BETTER JOBS” AND AT HOME OVER PARENTING

Imagine if jobs become scarce thanks to automation. This will be particularly problematic in countries where people tend to believe that when jobs are scarce, men have a greater right to the jobs that remain. Those are also the countries where the gap between female and male labor force participation is highest today (see figure 2). These are also the countries that have [stronger beliefs that women with young children should not work](#),²⁷ the countries that place the [most legal restrictions on women in the workplace](#),²⁸ and have the [weakest legislation regarding maternity leave and child benefits](#).²⁹

And a major reason for different outcomes in the labor force is attitudes about activities that do not show up in the national accounts and are unlikely to be automated in a way that reduces labor burden. A [US Census Bureau analysis](#) suggests the earnings gap between husbands and wives doubles in the period between two years before and one year after the birth of a child, and grows after that.³⁰ Again, [Ilyana Kuziemko and colleagues](#) find that US mothers born in the years around 1967 are 26 percent less likely to be working than they were before motherhood, with little recovery in the 10 years

23 Levanon, A., England, P., & Allison, P. (2009). Occupational Feminization and Pay: Assessing Causal Dynamics Using 1950-2000 U.S. Census Data. *Social Forces*.

24 Levanon, England, and Allison (2009).

25 Sandefur, J. (2018). Chart of the Week: Teacher Pay around the World: Beyond “Disruption” and “De-Skilling”. *Center for Global Development Blog*, Feb 20.

26 World Bank. (2019). Primary education, teachers (% female). *World Bank Data*. Accessed Feb 8, 2019.

27 Giavazzi, F., Schiantarelli, F., & Serafinelli, M. (2013) (Attitude, policies and work, *Journal of the European Economic Association*, 11:6:12561289) find that attitudes towards women’s role in the family are significantly related to female labor force participation even after controlling for policies, institutions and structural factors of economies.

28 Kenny, C. & Patel, D. (2017). Gender Laws, Values, and Outcomes: Evidence from the World Values Survey. *Center for Global Development Working Paper 452*.

29 Gonzales, C., Jain-Chandra, S., Kochhar, K., & Newiak, M. (2015). Fair Play: More Equal Laws Boost Female Labor Force Participation. *IMF Staff Discussion Note SDN/15/02*.

30 Chung, Y., Downs, B., Sandler, D. H., & Sienkiewicz, R. (2017). The Parental Gender Earnings Gap in the United States. *Discussion Papers CES 17-68, Center for Economic Studies, U.S. Census Bureau*.

FIGURE 2. Participation gaps and attitudes to scarce jobs



after birth.³¹ They note that changing norms around breastfeeding and childcare may help account for this: in 1994, mothers aged 25–34 spent about 11 hours a week on childcare activities; by the early 2000s, that had climbed to 16 hours amongst less educated women and above 20 hours for more educated women. [Suzanne Bianchi of UCLA and colleagues](#) have studied trends in housework and childcare over the past half-century. In 2010, men spent only 53 percent of the time that women did on childcare and married fathers spent 52 percent of the time on housework that married mothers did.³²

Norms can change, and policies can help both change norms and reduce their impact on outcomes. For example, the “mommy effect” is smaller in countries with more generous leave and childcare policies. Countries which spend more on early childhood education and childcare support [see higher women’s labor force participation as a result](#).³³ But progress on these measures—perhaps particularly on norms—can be very slow: [Kenny and Patel](#) find that the average country has moved about one-tenth of a standard deviation over the course of about a decade towards believing that when jobs are scarce, women have equal rights to a job as do men. At that rate, it would take about 450 years for a country to move from 100 percent agreement that men deserve a job more than women when they are scarce to 100 percent disagreement.³⁴

Given that the burdens of childcare and eldercare are rising rather than falling, and that it appears unlikely such work will be rapidly substituted by robots, there may be cause for pessimism that automation or AI will improve the broader environment in which decisions about careers are taken,

31 Kuziemko, I., Pan, J., Shen, J., & Washington, E. (2018). The Mommy Effect: Do Women Anticipate the Employment Effects of Motherhood? *NBER Working Paper No. 24740*.

32 Bianchi, S. M., Sayer, L.C., Milkie, M.A., & Robinson, J.P. (2012). Housework: Who Did, Does or Will Do It, and How Much Does It Matter? *Social Forces* 91:1, pp. 55-63.

33 Olivetti, C. & Petrongolo, B. (2017). The Economic Consequences of Family Policies: Lessons from a Century of Legislation in High-Income Countries. *Journal of Economic Perspectives* 31:1, pp.205-230.

34 Kenny and Patel (2017)

which itself appears to be an increasingly important part of the explanation for the gender labor participation and wage gap.

THE POLICIES THAT REDUCE (CURRENT) DISCRIMINATION WILL LIMIT (FUTURE) DISADVANTAGE TO WOMEN

When it comes to the overall impact of automation/AI on jobs and inequality, the answer is ‘that depends on policy.’ The same answer applies to the gender impact of technology. Automation, particularly in countries that are currently less automated, is likely to be a force for creating better economic opportunities for women. But that depends considerably on the policies and norms that drive who *gains* from automation. And most of those policies and norms are the same ones that determine who gains more and who less from current technologies and economic institutions.

What seems clear is that the gender differential impact of technological change will be less in countries where underlying norms and policies favor equal opportunities for men and women and so the labor market is already more equal. And that suggests the answer to “what should we do with regard to gender discrimination in the world of work given technological change?” is pretty much “what we should do with regard to gender discrimination in the world of work.” Those worried about automation and women’s economic empowerment should ensure generous parental leave, provide support for child-care and early childhood education, educate kids equally and about equal ability, pass equal opportunity laws and scrap legislation and regulations that discriminate against women, pass and enforce tough harassment laws, and so on. These policies have the added advantage that even if the impact of the “fourth industrial revolution” turns out to be overblown, they are still the right thing to do.

Thank you for comments, corrections and advice from Tanvi Jaluka, Pamela Jakiela, Mayra Buvinic and Emily Schabacker.



WWW.CGDEV.ORG

This work is made available under the terms of the Creative Commons Attribution-NonCommercial 4.0 license.

CHARLES KENNY is a senior fellow and the director of the technology and development program at the Center for Global Development.

CONTACT:

John Polcari, research assistant
jpolcari@cgdev.org