OVERVIEW OF LITERATURE ON GENDER EQUITY: COVID-19 AND ACADEMIA

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**Abstract**

A sizable literature examines gendered aspects of the COVID-19 era and its effects on academia, finding that women’s standing in the profession suffered substantial setbacks. This disproportionately negative impact on women’s job market outcomes is reflected outside of academia as well, in all sectors. As of April 2021, 19.9% of women and 9.7% of men aged 18-64 report being not in the labor force (for reasons other than retirement or disability).1. But this difference largely reflects pre-existing differences by gender, rather than pandemic impacts: Compared to April 2019, this represent a 1.6 percentage point increase of women not participating in the job market, and a 1.3 percentage point increase for men, thus the larger issue is that women have been shouldering a large increase in dependent care while *also* maintaining their labor market efforts. From Spring 2020, researchers document the toll of the pandemic on women’s academic productivity through early-pipeline-stage signs such as reduced pre- print submissions with female names, noting an especially large reduction among junior scholars. As the pandemic unfolded, unequal burdens of family dependent care and academic service roles compounded along gendered lines, leading to concerns about long-term impacts on psychological wellbeing, advancement and resource allocation. These pandemic studies thus build on existing research showing gender gaps that existed prior to the pandemic (e.g. the "motherhood penalty"), possible explanations for them and solutions for combating these inequities. We review the literature on academia pre- and post-pandemic, placing findings in the context of the overall literature on gender disparities in the labor market. While this review focuses on gender, readers should adopt an intersectional view in approaching this literature, as inequities are compounded by women’s simultaneous membership across other vulnerable groups. As many countries begin to see a decrease in cases, there is a sense that the pandemic–and the corresponding negative consequences–are over. However, specific institutional and policy actions are needed to ensure that setbacks suffered during the COVID-19 era in academia and on women’s labor market outcomes overall do not propagate into large long-term losses.

1Author calculations from the U.S. Current Population Survey Monthly microdata through April 2021, released 5/13/2021, h[ttps://www.census.gov/data/datasets/time-series/demo/cps/cps-basic.h](http://www.census.gov/data/datasets/time-series/demo/cps/cps-basic.html)tml

# Introduction

The academic labor force impact of the COVID-19 pandemic has exacerbated gender in- equalities. An estimated 1.2 Billion children were sent home from schools worldwide during the COVID-19 pandemic (UNESCO, 2020), causing pressures particularly for early-stage scholars and potentially setting back decades of progress in gender equality in academia. Women traditionally also play larger service and mentoring roles in their fields, and studies show this pattern continued during the pandemic. Unequal disruptions to professional lives along gendered lines affected both labor input as well output. For example, social science re- search across 18 disciplines in the past year showed a 13% drop in contributions from women authors despite a 35% increase in research overall (Cui et al., 2021). These trends reflect patterns outside of academia: in the US overall women’s (and men’s) participation in the labor market dropped sharply at the onset of the pandemic. In March 2020, the US adult unemployment rate stood at 4.4 percent for men and women. In April 2020, 15.5 percent of women and 13 percent of men were unemployed. But unemployment rates recovered fairly quickly for both genders (e.g. to 8.3% for men and 8.6% for women by August 2020) which indicates a high load carried by women in labor market work in addition to their caregiving demands. Changing norms during the COVID-era may provide silver linings as well. An increased engagement with and social acceptability of men’s caregiving responsibilities may lead to greater childcare setting. The acceptability of flexible work arranegments may also increase the ability for women and other members of the population to navigate work-life balance with greater ease.

Our review is separated into four segments. We begin with the section of greatest rel- evance to our research goals: to understand the effects of COVID-19 on gender disparities in academia. However, we acknowledge that–in many cases–the effects were not created but amplified by the pandemic. We therefore follow this section with a general description of gender disparities that were well-established prior to the pandemic. Academia, of course, is only one of many sectors of employment, all of which were affected by the exogenous shock of COVID-19. We thus end with a discussion of the general labor market, at baseline and in the midst of the pandemic. These sections allow us to contextualize the systemic cul- tural factors that may be contributing to the gendered impacts we observe in academia, and helps bolster the need for policies that address the standing of women and intersectionally vulnerable groups.

# The Effect of COVID-19 on Gender Equity in Academia

## Declines in Female Academic Productivity During COVID-19

“We are all in the same storm, but not in the same boat” (Vincent-Lamarre et al., 2020). Thus began a May 2020 analysis of the decline of women’s research production during the coronavirus pandemic. The work chronicled the decline in female contribution to preprints and registered reports—early indicators of scientific production. Several other studies rein- forced this: an analysis of the economics field demonstrated a 12% drop in preprints and registered reports in March and a 20% reduction in April for women within the discipline (Shurchkov, 2020), a study of social science research across 18 disciplines showed a 13% drop in contributions from women authors despite a 35% increase in research overall (Cui et al., 2021). Several studies (Frederickson, 2021) and anecdotal reports in early 2020 confirmed that women were not submitting to journals at expected rates (Flaherty, 2020). Most worry- ingly, the decline was seen more strongly among first—rather than last—authors, suggesting that the pandemic was disproportionately affecting junior scholars (Vincent-Lamarre et al., 2020),2. Many of these studies were conducted directly after the initial wave of stay-at-home orders. However, inequities persist. For example, looking at preprints in the biomedical sciences, we can observe that women’s contribution to preprints declined with the start of school in the autumn months (Penfold and Polka, 2020). There may also be longer-term consequences that will manifest in a few years, given the nature of publication delays.

## Explanations for gendered pandemic impact on academic pro- ductivity

Several reasons account for these declines. Academic men are four times more likely to have a partner solely responsible for domestic care than their female colleagues (Schiebinger et al., 2008). Even in dual-earner families, mothers perform more childcare than fathers (Yavorsky et al., 2015). This has a cost for women: engagement in parenting responsibilities is negatively related to productivity (Derrick et al., 2019). This “motherhood penalty” is well-documented across stages of academic life (Mason et al., 2013). Given that 1.2 billion children were sent home from school in the wake of the pandemic, there were bound to be consequences felt disproportionately by women (UNESCO, 2020). This hypothesis has been borne out in several studies, showing the short-term effects of increased childcare among

2First authors tend to be younger than last authors, a finding confirmed in a subsequent analysis of journal submissions (Andersen et al., 2020)

women academics (Deryugina et al., 2021; Myers et al., 2020).

Women are also disproportionately likely to take care of their “academic family”—in terms of increased service at the local level (Guarino and Borden, 2017). This includes increased mentoring responsibilities, as well as increased time devoted to teaching (regardless of academic rank) (Misra et al., 2012). These collective burdens were manifest during the pandemic, with the switch to online teaching, increased mentoring needs among students struggling emotionally. These inequities are particularly felt by faculty of color, who bear the extra burden of cultural taxation (Gewin, 2020). Studies have reinforced that research activities are the first to be cut when academics face time pressures (Deryugina et al., 2021). Women, despite submitting fewer journal articles, did not reduce their acceptance of peer-review invitations: meaning that although they did not have time to do research, they continued to evaluate the research produced by others (Squazzoni et al., 2020). Multitasking, fatigue, and altered peer effects all contribute to reductions in research productivity for women academics during the pandemic (Cui et al., 2021).

## Consequences for science and scientists

A decline in productivity for a single year may seem trivial, but it has strong consequences given the cumulative nature of academic work (Ioannidis et al., 2014). The most immediate consequence is the loss of entire cohort of junior scholars: foreign students who were not able to attend visas and begin their studies, doctoral students who were waylaid in their research, post-doctoral students who haven’t been able to return to the lab, and assistant professors who are at risk for tenure. The academy must create bridges to support these vulnerable populations through this exogenous shock (Carr et al., 2021). Declines in productivity were seen most heavily in the biomedical sciences (Vincent-Lamarre et al., 2020). Furthermore, studies demonstrated that women were less likely to pivot to work on COVID-related top- ics (Amano-Patiño et al., 2020; Vincent-Lamarre et al., 2020; Amano-Patiño et al., 2020; Pinho-Gomes et al., 2020). This has serious implications: as shown in previous studies, the composition of the scientific workforce has significant effects on the population studies. To wit, women are significantly more likely to take sex and gender into account as an analytic variable and to incorporate women as study populations (Sugimoto et al., 2019). This has consequences for what we know about the female body and how it is affected by the variables at hand. In the context of COVID, studies are only beginning to frame sex as an important variable. For example, several scholars have called for more research examining the relation- ship between menopause and COVID-19 (Davis, 2020) as well as the effect of COVID-19 on

menstruation (Villarreal, 2021). Therefore, a decline in women’s research productivity not only effects individual scientists and their career trajectories, but affects the knowledge that science produces.

## Critique of recommendations

Several institutions have embraced tenure-clock extensions as a response to the pandemic (Bikales and Chen, 2020). While this may be a constructive bridge for some, it has some neg- ative consequences (Malisch et al., 2020). First, and perhaps most importantly, it prolongs states of vulnerability for those in the precarious academic positions. It does so without a clear expectation for how faculty will be evaluated at the end of an extension (and whether it merely multiples the expectations of productivity). Furthermore, it contributes to the concerns raised about gender-neutral leave policies, wherein women suffer while men profit (Antecol et al., 2018). Therefore, tenure extensions should come with clarity and institu- tionalized rubrics that protect those who take leave. Furthermore, institutions may want to consider retrospective salary increases that diminish the pay gap for those who request extensions (Settles and Linderman, 2020). The United States lags other developed nations in work-family policies (Collins, 2020). During the pandemic, some institutions have taken it upon themselves to create support where federal programs do not exist. For example, at Uni- versity of Florida, the College of Medicine students created a portal to UF health staff with students who could provide childcare, pet care, and other household duties (Francischine, 2020). Institutions might consider how collective commons could be an approach for aiding faculty members during times of duress. Furthermore, institutions would do well to explore how they support women generally, to reduce the tension between women as caregivers and as academics.

The conception of the “ideal worker” in academe no longer reflects the population of incoming scholars and creates barriers for changing the composition of senior ranks of aca- demics (King and Frederickson, 2021). The fact that the productivity gap during COVID-19 was most pronounced in top-ranked institutions (Cui et al., 2021) suggests that resources alone do not solve the issues. Cultural shifts are required for institutions to fully address the inequities that are cemented into the infrastructure of academic organizations. Scientific institutions must realize that the consequences of this shock did not create disparities, but only magnified inequities that were built into our organizations. To create a robust scientific environment, we must create equitable infrastructures that provide the scaffolding necessary for all members of our population to succeed—in a pandemic or times of plenty.

# Gender Equity in Academia prior to COVID-19

Pandemic-related gender disparities in academic career attainment and professional accom- plishments exacerbated long-standing gender inequalities in the academic and general work- place. In this section we review the literature on such disparities in the academic labor force before the pandemic. Furthermore, we review literature on purported causes of those dispari- ties including gender bias, social treatment, and social roles. Disproportionate representation of women and men by race/ethnicity in academic ranks illustrates evidence of disparities in career attainment. Other career disparities include differences in hiring decisions, student evaluations, publication rates, grant funding, and impact, as well as in teaching and mentor- ing loads, and service responsibilities. In addition, we review evidence of barriers to equitable career treatment such as barriers to collaboration and sexual harassment. Finally, we review evidence that burdens shouldered mostly by women for family labor in part accounts for gaps in career outcomes such as pay and promotions. The literature cited in this review is “STEM -heavy,”3 because the national attention that has been placed on careers in science, technology, engineering and mathematics. However, some research in this review does not apply strictly to STEM disciplines.

## Representation Disparities

White women4, Blacks, and Latinxs in academic careers are less likely than academic White men and Asian Asian-American and Pacific Islanders (AAPI)5 to be represented in higher academic ranks, such as full professor. Culling data from nationally representative surveys, we calculated ratios of the representation of men and women by four major race/ethnicities to their representation in the general population. For example, White men represent 31% of the U.S. workforce, but 53% of full professor positions; hence they are over-represented in this rank by a factor of 1.71. Figure **??**depicts these ratios, in deviation form (where 0 represents equal representation in the rank as their representation in the U.S. workforce), for men and women from four racial/ethnic groups in five academic ranks as a function of each subgroup’s proportion in the U.S. workforce.

3Science, Technology, Engineering and Mathematics. Other related acronyms in this review are STEMM

– where the second “M” stands for medicine, and S&E, referring to science and engineering

4We recognize that gender is non-binary. Because most of the research reviewed here categorizes people by the binary gender distinctions of women and men, we maintain those categories here and recognize the need for research on academic career matters for gender expressions other than woman and man.

5AAPI is a non-monolithic category label, as is Latinx and other ethnic categories, which masks disparities among specific ethnicities and nationalities within these groups. This review should not be construed as evidence that academic career attainment and career outcomes are equitable across these subgroups.

This figure demonstrates three important observations. First, White men in all ranks, White women in all ranks except full professor, AAPI men and women are almost always over-represented in academic ranks compared to their representation in the U.S workforce, whereas Black men and women and Latinx men and women are underrepresented in all academic ranks. Second, the over-representation of White and AAPI men in academic ranks is especially pronounced in professor ranks and conversely the under-representation of Black and Latinx men and women is particularly pronounced in professor ranks. Third, women are proportionally less represented than men in Professor and Associate Professor ranks; whereas women are proportionately more represented than men in assistant professor, instructor and lecturer ranks. These latter two ranks are the most precarious because they are contract positions without the opportunity for tenure. The ratio of men to women by race in each rank is provided in Table 1.

Table 1: Proportion of men’s women’s representation by race/ethnicity in each faculty rank (proportion of White men to women of color in each race group)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Professor** | **Associate Professor** | **Assistant Professor** | **Instructor** | **Lecturer** |
| White men/women | 1.96 | 1.14 | 0.87 | 0.79 | 0.80 |
| Black (White) men/women | 1.17 (5.98) | 1.17 (3.01) | 0.70 (1.54) | 0.70 (1.49) | 0.78 (2.63) |
| Latinx (White) men/women | 1.78 (13.68) | 1.33 (5.16) | 0.89 (2.92) | 0.71 (1.70) | 0.67 (2.26) |
| AAPI (White) men/women | 2.67 (1.71) | 1.40 (0.77) | 1.00 (0.47) | 0.75 (0.80) | 0.75 (0.85) |

Although these data demonstrate strong disparities in the representation of women of all race/ethnicities and Black and Latinxs in academic careers, the disparities are more pronounced in science and engineering. Figure **??** depicts data from the 2017 report of the National Science Foundation’s statistics on academic employment of PhD recipients in science and engineering (S&E) disciplines, presented in deviation form (where 0 represents no deviation from the representation of the subgroup in the rank from their representation in the U.S. population).

These data show that AAPI men, White men, and AAPI women (except for professors) are over-represented in all S&E academic ranks. White women, Blacks, and Latinxs are underrepresented in all S&E faculty ranks, particularly the professor rank. The within-race gender disparities are also stronger in in S&E academic ranks as shown in Table 2. These disparities tend to widen when women of color (particularly Black and Latinx) are compared

to White men.

Table 2: Proportion of men’s representation to women’s representation in Science Engi- neering academic ranks by race/ethnicity in each faculty rank (proportion of White men to women of color in each race/ethniciy group)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Professor** | **Associate Professor** | **Assistant Professor** | **Other Faculty** |
| White men/women | 3.14 | 1.78 | 1.49 | 1.39 |
| Black (White) men/women | 2.72 (17.18) | 1.30 (4.38) | 1.29 (4.96) | 2.10 (6.33) |
| Latinx (White) men/women | 1.93 (12.60) | 1.83 (7.45) | 1.15 (3.91) | 1.19 (4.03) |
| AAPI (White) men/women | 5.08 (2.30) | 2.25 (0.90) | 1.88 (0.52) | 0.97 (0.47) |

These data, however, mask disparities that widen when subdisciplines of science and engineering are considered (as well as other disciplinary specialties, such as humanities, social sciences, arts, education, and health). For example, the gender differences in life sciences, such as biology and chemistry, are not as great (particularly at entry-level ranks) as the gender differences in physical and mathematically-based sciences and engineering (Ceci et al., 2014). Disparities are also wider in research-intensive universities.

Among faculty in academic medicine, a report by the Association of American Medi- cal Colleges shows that by 2018 women represent 41 percent of full time medical school faculty (of American Medical Colleges, 2019); however, women are disproportionately over- represented in instructor and associate professor ranks (58% and 46%, respectively) and underrepresented in more senior ranks of associate and full professor (37% and 25%, re- spectively). There are fairly strong gender differences in medical specialties, with women representing the majority of faculty in obstetrics (64%), pediatrics (58%), public health (54%), and psychiatry (53%). Women are most underrepresented in orthopedic surgery (19%), surgery (25%), physiology (29%), biochemistry (30%), radiology (30%), and pharma- cology (32%) (of American Medical Colleges, 2019). In general, all disciplines where women are over-represented are clinical, whereas the disciplines where women are under-represented are both clinical and basic science (of American Medical Colleges, 2019).

## Gender Disparities in Academic Work

Scholars have examined many theories and have conducted extensive empirical research on the sources of these disparities, which are summarized below. Most research in this

review examines gender differences collapsed over race and ethnicity, however it is important to keep the racial disparities in mind when considering the implications of this research. This review draws heavily from a recent consensus report by the National Academies of Science, Engineering, and Medicine (NASEM) (Colwell et al., 2020), particularly Chapter 2 by Rodriquez and Clancy. Additional factors, particularly related to academic careers beyond STEMM and citations of literature addressing gender disparities in academic career success are included in this review.

Academic papers with men in first or senior author position are more likely to be cited than those with women in these authorship positions, which becomes more pronounced in areas of the world that have the highest research productivity (Larivière et al., 2013). Women are less likely than men to receive authorship credit; research manuscripts with female first or last authors are cited less frequently; and all-male review teams, which are the most frequent composition, reject proportionately more women’s papers than men’s (Bendels et al., 2018; Chawla, 2018; Murray et al., 2018; West et al., 2013). Part of the gender disparities in citation rates may be due to men’s greater tendency than women’s to cite their own work (Ghiasi et al., 2016). Experimental studies where evaluators are presented with one or another set of materials that are identical except for author gender show that work attributed to male authors is evaluated more favorably when the topic is in a male-dominated discipline (which describes most STEM disciplines) (Knobloch-Westerwick and Glynn, 2013).

Women are less likely to get NIH funding and funding renewals (Pohlhaus et al., 2011; Witteman et al., 2018). However, the U.S. Government Accountability Office found little gender gap in evaluations of federal grant applications from NIH, NSF and NIFA (Govern- ment Accountability Office, 2016), although these auditors noted that due to insufficient data, such disparities could not be adequately tested for DoD, DOE, and NASA grants.

Women are proportionately underrepresented on the editorial boards of major medical journals (Amrein et al., 2011), environment biology and natural resource management jour- nals(Cho et al., 2014), mathematical sciences (Topaz and Sen, 2016), among many other disciplines. Women scientists are underrepresented as authors in top scientific journals and the association between citation rates and female representation in authorship is highly neg- ative (Knobloch-Westerwick et al., 2013), which negatively impacts interests in collaborating with women scientists (Aguinis and Ji, 2018).

Female faculty are more likely than their male counterparts to have high teaching, men- toring, and service loads (Armstrong and Jovanovic, 2015; Bronstein and Farnsworth, 1998; Hermanowicz, Hermanowicz; Urry, 2015; Xu, 2008). Women of color are burdened with ser- vice work related to their identity, such as serving as diversity representatives on committees,

and being expected to mentor all under-represented students (Armstrong and Jovanovic, 2015). Women’s relationship status is more likely than men’s to be considered in hiring decisions, such that heterosexual women with academic partners have been excluded from consideration from hiring committees (Rivera, 2017).Female professors receive less positive student evaluations of their teaching than male professors, even when the content of the lecture is the same (Abel and Meltzer, 2007), and male students are less likely than female students to nominate a female professor as their best professor (Basow et al., 2006).

## Gender Stereotypes

Despite evidence of small and diminishing gender differences in mathematical ability (Halpern et al., 2007), stereotypes of women’s lower competence in science and engineering skills per- sists. Furthermore, competence stereotypes affect evaluations of women (as well as Blacks and Latinxs) in nearly all professional occupations (Fiske et al., 2002). Women, for example, are perceived as lacking genius (Cheryan et al., 2017). Coupled with competence stereotypes are beliefs that attributes needed to be a successful scientist are more strongly associated with attributes that people believe men are more likely to possess than women, such as being able to separate feelings from ideas, being authoritative, and being objective (Carli et al., 2016). In addition, feminine-looking women are less likely than others to be perceived as scientists (Banchefsky et al., 2016). However, when women do not display feminine traits or characteristic, e.g., they do not appear sufficiently “communal” they encounter backlash, such as appearing unlikeable, which has career and economic consequences (Rudman, 1998; Williams and Tiedens, 2016) and are even less likely than feminine-appearing women to be viewed as legitimate victims of sexual harassment (Goh et al., 2021). Many examples of stereotypes biasing academic-related outcomes for women (which are often exacerbated for women of color) are described below.

### Employment and employment pipeline

Faculty express preferences for mentoring opportunities with White male college students who are considering applying for a doctoral program than students from other ethnic back- grounds and from women (Milkman et al., 2015). Male applicants for science lab manager positions at elite universities are considered more employable and more competent than fe- male applicants with the same qualifications (Moss-Racusin et al., 2012), and White and Asian male candidates for post-doctoral positions in physics have been viewed as more com- petent and hirable than female candidates or Black and Latinx candidates with the same

credentials (Eaton et al., 2020). Letters of recommendations for female academic candidates contain more negative abstract terms, such as not being an innovative research, whereas those for men contain more standout terms (e.g., outstanding, unique). These linguistic characteristics are associated with short-listing and hiring rates (Rubini and Menegatti, 2014; Schmader et al., 2007).

Some news is encouraging. Women are proportionately more likely than men to receive job offers in several STEMM fields (National Research Council, 2010; Williams and Ceci, 2015), which has been attributed to greater accountability in faculty hiring processes and high supply of well qualified applicants for relatively few tenure track faculty openings (Koch et al., 2015; Colwell et al., 2020). However, the female advantage in assistant professor ranks dissipates as biases, lack of career-relevant social ties, mistreatment, and the disproportionate strain of unpaid family labor for women take its toll, as shown in Table 1 and Table 2.

### Awards and Invitations

Men receive more academic-related awards than women in Psychology (Eagly and Riger, 2014), and in other STEM disciplines, women receive proportionally more awards for teaching and service and fewer awards than men for research excellence (Lincoln et al., 2012). Female faculty are less likely than similarly qualified male faculty to be invited to give research talks – an effect that diminishes when women chair colloquium committees (Nittrouer et al., 2018).

An investigation of characteristics of research productivity, measured by publications in top journals in several scientific disciplines found support for the theory that gender differences in the inputs that predict scientific output, including social capital, work hours, and funding explain why there are fewer female academic “stars” than men (Aguinis and Ji, 2018; Eagly and Miller, 2016). Gender discrimination most clearly explains why there are gender differences in these inputs to productivity, according to Aguinis and Ji (2018). Despite equal talent and motivation between women and men, men may acquire more publications due to gender biases in peer reviews (Knobloch-Westerwick and Glynn, 2013) and grant funding (Pohlhaus et al., 2011), and to get access to influential social networks that lead to productive and impactful collaborations (Larivière et al., 2013). In addition, the differential impact on social role demands for family labor (see below) constrain women’s academic work productivity relative to men’s – a fact that has been exacerbated during the COVID- 19 pandemic.

### Social Networks and Interpersonal Mistreatment

Collaborations, professional impressions, informal mentoring and other social factors that reap benefits to academics’ careers accrue from social ties that are built from informal inter- actions. Junior faculty who collaborate with eminent scientists enjoy a persistent advantage throughout their careers (Li et al., 2019). However, research has demonstrated that aca- demics discuss their research with other men when they are in informal settings but not with women (Holleran et al., 2011). Moreover, the gendered and racial barriers to mentor- ship and early career science employment opportunities described above mean that women and underrepresented minorities will be less likely to form ties with senior scientists. Com- pounding the impact to women’s academic careers for being less likely than men to establish important social networks that can turn into fruitful collaborations is the evidence that team collaborations are improved by the presence of women (Bear and Woolley, 2011).

Women and people of color are more likely than White men in academic careers to experi- ence interpersonal mistreatment, including exclusion, microaggressions and acts of incivility (Case and Richley, 2013). Women students, post-doctoral fellows, and faculty experience alarming rates of sexual harassment, particularly those in academic medicine programs (Ay- cock et al., 2019; Clancy et al., 2014; Cortina and Jagsi, 2018; Johnson et al., 2018). The typical form of harassment is gender harassment, defined as “verbal and nonverbal behav- iors that convey hostility, objectification, exclusion, or second-class status about members of one gender” (Johnson et al., 2018) (p. 45), which tends not to be recognized as sexual harassment and often goes unpunished, but is nonetheless harmful. Risk of experiencing sexual harassment is higher for women of color and non-heterosexual women (Buchanan and Fitzgerald, 2008; Clancy et al., 2017; Cortina, 2004; Cortina et al., 1998; Rabelo and Cortina, 2014). Sexually harassed students are more likely than others to suffer adverse academic outcomes which forestalls their advancement into academic careers (among other consequences) (Duffy et al., 2004; Fitzgerald, 1990; Lee et al., 1996). (Stockdale and McCul- lough, 2018) outlined a vicious cycle where women in male-dominated environments (such as science and engineering) are at greater risk of experiencing sexual harassment and other forms of sexist treatment, which leads to negative academic and job-related outcomes often resulting in leaving such fields, which further exacerbates occupational segregation of women from such fields.

A sense of lack of belonging in STEM and other academic pursuits also hinders women’s, particularly minority women’s academic career progress (Cheryan et al., 2015; Hurtado et al., 2007; Johnson et al., 2018). Experiences of racial stereotyping, tokenism, masculine stereo- types, and lack of role modeling all contribute to belongingness concerns which negatively

impacts academic and career progress.

## Social Roles: Career Interests and Values and Work/Non-Work Roles

Social role theory (Eagly and Wood, 2012) explains that women and men have sorted into dif- ferent roles throughout the ages, which required different competencies. Physical roles, which evolved into economic roles, required agentic characteristics (competitiveness, instrumen- tality); and reproductive roles required communal characteristics (caregiving, nurturance, expressiveness). Over time, we have come to associate men with agentic characteristics and women with communal characteristics, which fosters both gender stereotypes and gendered self-concepts. Although technological advances and attitudinal shifts toward gender egalitar- ianism have diminished differences in men’s and women’s role adoption, the fact persists that women have greater responsibility for caregiving and family labor than men. Even among those in high-achieving professional careers, women spend more time than men on domestic activities (Bertrand et al., 2010; Coltrane, 2000; Jolly et al., 2014). Recent research shows that among highly educated professional women and men, gender gaps in career outcomes (e.g., pay) widen after the birth of the first child (Bertrand et al., 2010; Cortes and Pan, 2020; Goldin and Katz, 2011), primarily because of career interruptions and reductions in weekly hours in paid work, with lasting consequences.

As noted above social role theory can account for the effects of stereotypes on women’s (and men’s) career-related outcomes, but it also accounts for women’s and men’s role adop- tions, including career interests and values. Boys’ and men’s greater interest in occupations that involve working with “things” (non-living objects such as machines and tools) and girls’ and women’s greater interest in occupations that involve working with people account for much of the variance in STEM career interests (Su et al., 2009), although advances in voca- tional interest measurement have tempered these distinctions (Su et al., 2019). Some scholars argue that the combined impact of women’s disproportionate family role obligations (Ceci and Williams, 2010; Ceci et al., 2014) and relative disinterest in STEM careers that do not have strong social attributes, or are otherwise masculinely stereotyped (Cheryan et al., 2017; Thébaud and Charles, 2018) operate to dampen women’s interest and persistence in many STEM careers (Kossek et al., 2017).

A final postscript on this section: Although the extensive review of research evidence documenting gender bias and gender disparities in academic career matters is intended to draw attention and resources to these concerns, there is concern that it may fall on deaf ears

because another plaguing issue is that male scientists, particularly those in STEM disciplines, are less likely than their female colleagues to accept the conclusions of such research (Handley et al., 2015). This should not be the case for Indiana University.

# The Effect of COVID-19 on Gender Equity in the Gen- eral Labor Market

In this section we broaden our focus on how the COVID-19 pandemic has expanded gender inequity across the entire labor market. Many studies document greater burdens across the globe on women’s work (both labor market and household work) relative to men’s work as a result of the COVID-19 pandemic. As noted throughout this report, we and other scholars emphasize the importance of intersectional identities, as gender operates within a context of many other exacerbated inequities along race and other socioeconomic lines (Fisher and Ryan, 2021). Even when vaccines are expected to relieve pandemic conditions in the foreseeable future, longer term impacts can persist because of the "permanent scarring" workers suffered in earlier recessions (Kahn, 2010).

There are two general explanations for the greater burden of COVID-19 on women’s work. One is that labor demand fell for the type of employment performed by women. Women are, for example concentrated in service sectors, which experienced greater closures of economic activity during Spring 2020, and where demand remained low both because of state closure policies and because of nationwide, private responses (Gupta et al., 2020). The second explanation is that in the face of dependent care disruptions, pre-existing gender norms of women shouldering larger care burdens (e.g. Cortes and Pan, 2020; Blundell et al., 2018) were exacerbated and lead to reduced labor supply; women’s formal employment was thus reduced for both "push" and "pull" reasons.

Research since the start of the pandemic draws on newly deployed or existing surveys as well as administrative data, to document changes in the extensive margin (having a job or being part of the active labor market) and the intensive margin (hours worked, etc), the nature of household and dependent care, mental/emotional wellbeing impacts, and how the experience differs by presence of young children and presence of a partner. A smaller literature addresses this intersectionality by statistically decomposing the gender gap into parts attributed to other observed characteristics and disparate impacts of the pandemic on those factors (such as female workers tending to be younger than male workers, and all younger workers being more negatively impacted). A few papers also consider the impact

of policies (such as specific business closures, or school closures) on gender equity. Going forward, research that examines the causal factors responsible for gendered burdens during COVID-19, and the evidence on what helps in the recovery phase are crucial for turning back the clock on gender labor market inequities from COVID-19.

## Evidence from the U.S

### How is the COVID-19 Recession Different For Women than Other Reces- sions?

Earlier U.S. recessions were more harmful for men than for women (e.g. Albanesi and Kim, 2021; Alon et al., 2020b; Montenovo et al., 2020; Albanesi, 2019). In past recessions, women fared better as they tend to work in sectors not typically hit as hard by recessions (such as education and healthcare, compared to, for example, construction). Additionally, women may increase their labor force participation during recessions by transitioning (perhaps tem- porarily) from unpaid domestic labor to paid labor to make up for earnings losses by male family members (Albanesi and Kim, 2021).

Unlike past recessions, the COVID-19 recession has been more harmful for women’s than men’s work, starting from the sudden reduction in economic activity that took place in Spring 2020. Although the US pandemic experience started the weekend of March 13th, changes in labor markets were not visibly noticed until the April 2020 Current Population Survey (CPS) (which records employment status as of mid April) were released in early May 2020. In March 2020, the unemployment rate stood at 4.4 percent (equal among adult men and women). By April 2020, the rates of male and female labor force participation and unemployment began to diverge. Figure 1 shows the unemployment rate for men and women by month, during 2020. (Bureau of Labor Statistics, 2020) 6. Figure 2 displays gender differences in the labor force participation rate by month. In March 2020, the labor force participation rate stood at at 62.7 percent (68.5 for men and 57.1 for women). As the Figures show, the April 2020 labor force participation rate dropped to 60.2 (66.2 for men,

54.6 for women), the unemployment rate rose to 14.7 percent (13 percent for men and 15.5 percent for women) exposing the first signs of COVID-19 era gender disparity in US job markets.

By May 2020, there were signs of improvement; unemployment rate fell slightly to 13.3 percent (although it dropped to 11.6 for men and only to 13.9 for women). As of March 2021 BLS reports the unemployment rate at 6 percent and the labor force participation rate at

6All BLS statistics taken from data.bls.gov/pdq and are for aged 18 and up, seasonally adjusted.

61.5 percent. For men, the rate of labor force participation changed from 69.2 in Feb 2020 to 67.3 in March 2021. For women, the corresponding rates are 57.8 and 56.1.

### Evidence on Female Labor Supply During COVID-19 from Current Pop- ulation Survey Microdata

Despite these simple aggregate CPS figures showing a larger fall in labor supply for women than men, examining microdata reveals many other disparities. For example, Montenovo et al. (2020) show that early in the pandemic, women were more likely to report increases in being absent from work while reporting that they are employed. This suggests the importance of tracking presenteeism in addition to employment. Albanesi and Kim (2021) showed the largest gender gap occurs through the rise in labor force non-participation, and further pointed out the importance of tracking work behavior within couples, as mothers and fathers appear to have reacted to the sudden demands of increased childcare responsibilities.

The CPS is the primary source of data on monthly labor market statistics in the U.S. It is a monthly, nationally representative survey of approx 60,000 households, with jobs information on the civilian non-institutionalized population aged 16 and older. Although near-census administrative sources of U.S. jobs exist (LEHD), they are not available in close to real time, prompting the early literature to primarily focus on CPS. The CPS measures each month whether someone is in the labor force, whether they are employed, and, for the prior week, whether they are not working, their hours worked, weekly earnings, and hourly wages.

Montenovo et al. (2020) and Albanesi and Kim (2021) analyzed CPS microdata to docu- ment declines in female labor force participation during the early COVID-19 period, bench- marked against previous recessions (e.g., see Figure3 adapted from (Montenovo et al., 2020)

). Re-employment in May 2020 for women was broadly proportional to the employment drop that occurred through April, but that still left women lacking work at greater rates. Before COVID-19-era CPS data were released, researchers predicted women’s jobs would be hurt more because essential industry workers (whose jobs were more likely to be retained) are predominantly male (Blau et al., 2020). Occupational sorting may also imply different experiences for women’s jobs if their work was less able to adjust to new labor supply and demand conditions.

Two ways to measure if an occupation might be affected by COVID-19 are to create an index of whether work in that occupation can be conducted "remotely" and whether work requires "face-to-face" contact with others (**?**Albanesi and Kim, 2021; Montenovo et al., 2020; Alon et al., 2020a). Job loss was larger in occupations that require more interpersonal contact

and that cannot be performed remotely. The extent to which workers in various demographic groups sort (pre-COVID-19) into occupations and industries may explain a sizeable portion of the gender gaps in unemployment. But "remote" and "face-to-face" occupational job features tend to not be very highly correlated thus a statistical decomposition exercise leaves a large amount of differences in employment losses across genders unexplained by these factors. One reason for this is that while women are less represented in remote work jobs (which could have explained their greater job loss), women are also less represented in face- to-face jobs which carried the opposite implication, thus cancelling out much of what could have been explained by occupational characteristics (Montenovo et al., 2020).

The gender gap in employment shortfalls persist throughout the pandemic (Albanesi and Kim, 2021), and is largest among married adults with children. Also using the CPS (February to April 2020), (Collins et al., 2021) find that married mothers with children reduced work hours far more (4 to 5 times) than fathers, especially if they have children under 13 years of age.

The labor measure that shows the largest gender gap is the rise in labor force non- participation; almost all the rise is due to women (Albanesi and Kim, 2021). Here too there is an especially large gap between men and women with children. Male non-participation improves over time while women continue to be participating less than in pre-pandemic times. Consistent with earlier findings, controlling for occupation attenuates the gender gaps only to a small extent even in later periods of the pandemic. Within couples with children, we might expect that a mother’s lower wages may lead her to leave the labor market to care for children, allowing the father to specialize in labor effort.

CPS data allow longitudinal analysis so they can address gender differences in the flows from employment to unemployment (EU), and in flows from employment to non-participation (EN). Albanesi and Kim (2021) find both types of negative employment flows rose more for women than men (the reverse of the Great Recession experience), especially among married adults with children; the gender gaps do not abate much with controls for occupation.

### Role of Children in Shaping Women’s Labor Market Outcomes During COVID-19

Researchers also point out that there may be a silver lining for working women as a result of the practices adopted in the era (Alon et al., 2020a). The availability of flexible work arrangements are of particularly high value to working mothers and other caregivers. Their model also suggests that over time, the gender norms may change due to the pandemic as well–for example, in a substantial fraction of jobs, the husband’s job may be more flexible in

telecommuting than the wife’s job (Alon et al., 2020b). Working norms may also change as it has become more acceptable for fathers too to balance childcare and work. Evidence from surveys also shows that men are increasing household work relative to pre-pandemic (Carlson et al., 2020). Hence, the time may be right for men to increase their share of family labor. This silver lining, however, may be overshadowed by forecasts of loss of service jobs (which women tend to occupy) and jobs that do not accommodate flexible work arrangements, because such jobs may be permanently lost or risk automation (Alon et al., 2020a).

Alon et al. (2020b) use a quantitative macroeconomic model that captures differences in the composition of US household and how they may respond to the pandemic, to understand the supply side vs demand side factors for why women experience larger employment losses in the COVID-19 recession. Their model builds in a sophisticated set of relationships, including the depreciation of job market skills that happen as people remain out of the labor market. Their work sheds light on an important mechanism that might be lost in a typical discussion of descriptive statistics. They argue through their model that family insurance plays a key role in this recession. In typical recessions men are more likely to lose a job, but women (wives) typically increase labor supply to compensate (Lundberg, 1985), and this means that there are built-in family level consumption "shock absorbers". This sort of insight suggests that if not for stimulus spending, there would be more negative consequences for transmission of the initial shocks.

There is currently little work on how closure policies have affected female labor markets, as opposed to the general forces of the pandemic era which are captured by simple time series comparisons for the nation as a whole. In one of the few studies on this, Heggeness (2020) examined the role of school closures using monthly CPS data collected in March 2020. The basic premise was that in the week of March 12th there were differences in what states were closed, so we might expect to see immediate impacts on job losses. However, this research showed that there were no immediate impacts on job losses. Perhaps because there was uncertainty of whether this was just a very temporary impact that would be felt, it appears employers and workers did not react right away. The take-away is that there is no change in job gains that is detectable, in aggregate or differences between men and women, in the immediate period. But mothers reported being more likely (by 68%) to be "employed but absent" in states that had closed in the March 12th week, compared to other states. No differences were detected among working fathers or working women without school age children.

Lyttelton et al. (2020) use data from pre-pandemic to comment on what we know about housework and childcare provision among parents when they telecommute (work from home,

at least part of the time). Using the nationally representative 2003-2018 American Time Use Survey they found that the male-female gap in housework was larger among those who telecommuted (and especially large on days in which both men and women telecommute), but that the opposite occurred for childcare–there was a more equal distribution of childcare between men and women among those who telecommute. Using the the April and May 2020 COVID Impact Survey they show elevated levels of anxiety and depression among telecom- muting mothers than telecommuting fathers. These observations raise the importance of continuing to track the labor market for women as we face predictions of an economy with continued increases in telework and automation post pandemic (Reynolds, 2020).

Prados and Zamarro (2020) report greater childcare burdens and greater losses of em- ployment and work time among women than men, during the COVID-19 crisis using data from the Understanding Coronavirus in America Tracking Survey, conducted March 10th to July 22nd, 2020. Their analysis focused on those who are partnered and of working age and found that during the pandemic, women reported more than men that they are child care providers, regardless of whether they work outside the household. Specifically, one third of working mothers report being the only provider of childcare, while for working fathers this is one in ten. More working women than working men reported reducing their work hours during the pandemic, and more women than men report newly becoming the sole provider of childcare during the crisis. They find that since April 2020 there was an increase in employ- ment rates, except for college-educated women. They also report elevated mental distress among women with children compared to women without children, during the pandemic compared to before. Among men, there is no sign of deterioration of mental health among father compared to men without children. Reports of psychological distress are always higher among women than men. Among women, distress measures are always higher among those with children than without children, but among men the pattern is reversed.

## International evidence

### Cross-Country Studies

Data from across the world reflects the U.S. experience that women have been economically harder hit with larger job losses in almost all countries, and in most cases also experiencing greater increases in childcare. Most of the evidence to date comes from the early period of the pandemic closure, making it important for the literature to assess medium term consequences at the one year mark of the pandemic experience. Literature is also needed assessing root causes of the gender labor market disparities, to assess policy actions needed to

address existing labor market vulnerabilities (e.g. whether women work disproportionately in jobs more vulnerable to pandemic related closures or demand shocks) or whether these disparities represent unequal cultural expectations regarding the division of childcare and other household duties.

Adams-Prassl et al. (2020) shows data from UK, US, and Germany on the immediate labor market impacts, showing differences across countries, obtained from a new survey (COVID Inequality Project) collected in April 2020, of roughly 4,000 adult respondents who were working pre-pandemic. They find differences across the countries in share reporting job loss, with 20% of US workers and 17% of UK workers reporting job losses but only 5% in Germany, attributed in large part to labor market policy that reduces hours but keep people employed in Germany. In the US and UK data examined, authors report larger losses in jobs among women, which is not explained by their industry or occupation characteristics; in Germany, they do not find gender differences in job losses. In all three countries, conditional on keeping a job, women experienced greater losses in income.

Dang and Nguyen (2021) use data from six countries, reporting that women are more likely (24%) to report job losses from which they did not expect a recall, although there is no gender difference in the job losses expected to be temporary. Women also were more likely to report expecting substantial falls in income. The survey was conduced in late April 2020 in China, Italy, Japan, South Korea, the United Kingdom, and the United States and consists of about 1,000 respondents in each country. Documenting such differences is a first step to understanding root causes, as some differences could come due to the sectors of work. As in (Montenovo et al., 2020), the authors conduct a Oaxaca-Blinder decomposition to assess this possibility, finding (in Table 3 and appendices) that some portion of the gender gap in job loss is due to differences in men and women workers across demographic characteristics (such as age, as younger workers were more likely to lose jobs across the board than other workers); the analysis does not consider differences by occupation or industry, which (Montenovo et al., 2020) find are important determinants of COVID-19 gender gaps in labor market outcomes in the U.S..

### Single-Country Studies

Kristal and Yaish (2020) report that in Israel, "consequences of the economic downturn fol- lowing the coronavirus for gender equality are harsh, with women’s employment and income more severely affected than men’s." The findings are from a convenience sample of 2,040 surveyed adults who were employed in the first week of March (pre pandemic) and surveyed again in the last week of April, before economic reopening occurred.

Farre et al. (2020) document that in Spain, a country experiencing one of the strictest economic closures, that despite large initial job losses for all, there was a large degree of recovery shortly afterwards. However "Women were slightly more likely to lose their job than men, and those who remained employed were more likely to work from home." Data come from a new survey conducted in May 2020 of about 5,000 representative households. " We find that men increased their participation in housework and childcare slightly, but most of the burden fell on women" so that "Overall, we find that the covid-19 crisis appears to have increased gender inequalities in both paid and unpaid work in the short-term."

Qian and Fuller (2020) reports that in Canada, "gender employment gaps among parents of young children widened considerably between February and May 2020". The data that comes from the country’s (n = 744,654) ongoing Labour Force Survey also comments on the timing of job losses for men and women, consistent with reports in (Government of Canada, Statistics Canada, Government of Canada, Statistics Canada): job losses in March were larger among women but April job losses were larger among men. When subsequent economic reopening occurred in May, more men returned to work than women.

Zamberlan et al. (2021) show that in the UK, "among breadwinners whose paid hours reduced: while men did not significantly change the share of time they spent in unpaid labour, women increased it disproportionately." The findings come from surveys conducted in January/February 2020 to April 2020 from the UK Household Longitudinal Study and the Understanding Society COVID-19 study, starting with a sample of 2,453 couples.

Andrew et al. (2020) finds women to have experienced larger increases in job loss and larger increases in childcare burdens, using a survey of 4,915 parents with children conducted in April-May 2020. But (Hupkau and Petrongolo, 2020) finds that in the UK, job loss or furlough was reported about equally by women as by men in a COVID-19 supplement to an ongoing survey of roughly 10,000 respondents (all ages, all family statuses) that "if anything, women suffered smaller losses at the intensive margin, experiencing slightly smaller changes in hours and earnings." They also find that "women provided on average a larger share of increased childcare needs, but in an important share of households fathers became the primary childcare providers."

Sevilla and Smith (2020) survey families in the UK with children under the age of 12, find that women’s time spent in childcare increased, with "The additional hours of childcare done by women are less sensitive to their employment than they are for men" But there is evidence of some increases in male household work as well. as "some households, those in which men have not been working, have taken greater steps towards an equal allocation".

Blundell et al. (2020) finds that the sectors that were ordered to close down in the early pandemic stages in the UK were historically ones with larger shares of female workers, and that the workers in these sectors are" disproportionately female, young and low-paid.

Fisher and Ryan (2021) A recently published review documents evidence on gender in- equality during COVID-19 in terms of health and well-being, the home, relational violence, work and poverty, and leadership and considers social psychological theories that provide a context for the roots of these inequalities and complements the analysis of gender disparities on economic and social factors. The review considers research from Brazil, Hungary, India, Israel, Nepal, Spain UK, US among other countries.

Carli (2020) also provide a review of existing literature focusing on labor market equity in terms of work roles, job status, occupations, pay and advancement as well as hours spent in household work. They bring in pre-covid labor market and gender roles literature to highlight how women’s employment concentration in service occupations means also greater exposure to infection and psychological stress. This also emphasizes how telecommuniting might increase availability for childcare and benefit womens roles but at the same time maybe detrimental to women in work, for example, because of past evidence that women tend to opt more for telecommunity and that this maybe detrimental for job advancement in previous studies.

## Take-aways from Research on COVID-Era Labor Market Gen- der Disparities

An evolving but already large literature documents how the COVID-19 recessions has im- pacted women and men differently in market and non-market work. The research on women should be viewed in an intersectional light, as there is much heterogeneity in women’s ex- periences, dependent on their age, the age of their children, their race/ethnicity and their level of skill acquisition, as well as industry, occupation, and region. Researchers draw on either newly fielded surveys or existing ongoing surveys, as well as administrative data from country departments of labor. These differences in male and female experiences largely re- flect existing disparities in society worldwide, whereby women’s work is more concentrated in sectors that were more hard hit during this recession than in earlier recessions, and cultural norms of women providing more dependent care than men.

There are several areas for research to consider in future steps. One is to understand the medium term experiences and how work recovers. Only some of the prior studies con- duct decomposition exercises to understand how much intersectionality explains women’s

employment losses, Knowing whether its due to concentration in sectors that are temporar- ily closed (such as tourism) is important for understanding how disparities maybe shaped by the gradual return to normal in consumption patterns. Especially as dependent care (childcare, schools, non residential eldercare) reopen, it will be important to see factors that enable women returning to pre-pandemic levels of employment. Important for knowing what recovery will be like, what policies should aid recovery, and what ways to create greater re- silience and better informed toolkit for future pandemics and other emergency responses. Many measures of wellbeing are not captured by labor market data; domestic violence con- sequences(Bullinger et al., 2020) and mental health consequences, impacts on prenatal and postnatal health, remain areas for further research. Research should also understand further the policy actions that helped or hurt women’s employment during the pandemic. Regard- less of the path of reopenings, past recession evidence points to scarring that will need to be addressed by policy actions.

# Gender Equity in the General Labor Market prior to COVID-19

The literature about gender gaps across several occupations during the pre-pandemic is vast and can be divided in mostly three streams. First, there is considerable literature that identifies the determinants and consequences of gender gaps in the labor market. This set of papers also investigates how these determinants have evolved over time, with losses and gains in explanatory power. Second, several research papers present and discuss potential solutions to gender biases in the workplace. Within this set of works, particular focus has been put on STEM and academic occupations. Finally, several researchers studied gender bias in occupations and education in an experimental setting, for a deeper understanding of how biases originate and operate, and to quantify the presence of discrimination.

## Determinants and consequences of gender gaps

There is overall a strong consensus that gender equality in the labor market has increased over time. Goldin (2006) writes about the changes that led to the relative closing of the gap. She explains that the income elasticity of female labor supply has decreased considerably over time increasing women’s incentives to enter the labor market as wages offered to them increased. This, associated with the increased availability of good jobs offered to women, the presence of part time options, and increased education achievement, led to higher female

labor market participation. Other strong contributors towards equality were women’s ability to plan fertility, and a lower reliance on their husbands’ earnings (i.e. divorce rates increased). All these transitions increased women’s earnings relative to men, and made the distribution of women across occupations more equal. Similarly, **?** claim that the gender wage gap declined over time. They find, however, that this is less true for women at the top of the wage distribution. In addition, they show that differences in sorting across occupations and industry kept having a crucial role in explaining the gap. Further, they note that one of the main factors contributing to the wage gap is the women’s work force interruptions and part time hours, especially among high-skilled workers. Hence, unequal division of tasks within the household does lead to increased gender inequality in the labor market. A weaker but non-negligible role is played by psychological attributes and noncognitive skills, which, they write, represent a new explanation arising in the literature. Apart from all the objective differences across genders, that translate in labor market gaps, they note that discriminatory behavior in the labor market remains one of the contributing factors. On the contrary, they conclude that the traditional human-capital variables have mostly lost explanatory power for the differences in labor market outcomes across gender. Other authors also found that the division of home labor has strong implications on the ability of women to catch up with men workers. Albanesi and Olivetti (2006) consider the presence of a self-fulfilling mechanism. On the one hand, gender differences in home hours generate incentives problems that worsen women’s labor market outcomes. On the other hand, gender differences in earnings in the labor market decrease women’s incentives to invest in education and training that improve their labor market performance. Tamm (2019) looks at the role of fathers’ parental leave on the time they spend with their children, the home tasks they carry out, and their labor supply. The findings show that parental leave leads to increased time fathers spend with their children and doing household duties. While there is also a negative effect on their labor supply, this is short-lived instead. The importance of the division of house keeping tasks in shaping gender differences in the labor market is established. Home labor is strongly correlated with fertility, and plenty of research focuses on fertility and its role, in isolation, in the formation of gender gaps. The crucial role that fertility plays in the perpetuation of gender gaps in the labor market is highlighted by Adda et al. (2017). Interesting, they show that expected fertility, in addition to realized fertility, impacts women’s labor market outcomes. In fact, based on projected fertility, women make human capital investment and career choices that condition their labor outcomes down the line. The authors measure the costs of fertility: they find that fertility decreases women’s life earnings by 64 percent, mostly through their lower participation at both the extensive and intensive margin. However, other channels

are involved as well: these include career choices, atrophy, and human capital accumulation. Using data from Denmark, Kleven et al. (2019) study the impact of fertility on gender gaps in the labor market. They find that fertility generates an earnings gap across genders of about 20%, and that this fertility penalty has increased significantly over the last 30 to 40 years. They identify similar channels as Adda et al. (2017): less hours worked and lower participation. In addition, they identify a lower wage rate among the channels. Interestingly, they also find that the fertility penalty is transmitted from parents to daughters, hinting at the importance of the childhood environment in shaping women’s performance in the labor market when they grow up.

## Potential solutions to gender biases in the workplace

Grogan (2019) highlights the presence of overwhelming evidence of barriers to women in STEM research fields. These barriers can be found at several different stages of the career path, including funding, publishing, hiring and promotion. She highlights the role of data and suggests we exploit the presence of very detailed information at any level to recognize the best plan of action against gender gaps in labor outcomes. Goldin (2014) points at reforming the ways jobs are structured and remunerated as the key move to overcome gender gaps in the labor market. This involves, generally speaking, both the type of hours and occupations women work.

In their book, Colwell et al. (2020) note the mismatch between the increased number of women obtaining degrees in STEM and their unchanged underrepresentation in the labor market. Differences are present even among women: career stage, race, ethnicity and disci- pline play a role in worsening such underrepresentation among some. The authors list several evidence-based strategies that might help with women’s underrepresentation in STEM oc- cupations. These include improving a committed leadership at all levels, dedicated financial and human resources, and, resembling Grogan (2019) point, accountability and reliance on data. However, the authors remind us that while these strategies have already proven effec- tive for the recruitment and participation of White women in STEM jobs, more evidence is needed to identify what supports the participation of women of color in these occupations.

## Role of bias and stereotypes in generating and reinforcing the gap

Abundant applied research shows the presence of discriminatory behavior and biases in sev- eral different fields, occupations, and stages. The experimental evidence below is important

because the findings hint at the mechanisms and sources of gender gaps. Tate and Yang (2015) use data from plant closure and employment trajectories to measure gender gaps in wage changes that workers experience after their plant closes. They do find the presence of gender gaps, and show that these gaps are smaller whenever the hiring firm has female leadership, and larger when the closing plant is male-led. Their results indicate that female leadership can play an important role in helping close the gender wage gap. Cheryan et al. (2015) explore the hypothesis that female students’ bias about particular characteristics of STEM fields, like the people, the tasks, and the values in these occupations, keep them away from wanting to enter them. In an experimental setting, they test this hypothesis and find that a higher salience of the stereotypes does make girls more skeptical about joining the fields, while weakening these stereotypes leads to the opposite outcome. Their results show the importance of stereotypes in reinforcing gender gaps in STEM fields. Milkman et al. (2015) investigate the possibility that a knowledge gap undermines females and minorities entrance into academia. In the experiment, fictional students with names that signal dif- ferent gender and race contact 6,500 professors at top U.S. universities. The messages were identical, and they involved requests of mentoring and discussion of possible research op- portunities. Findings point at differential responsiveness of professors: white males received more responses than anyone else among the fictional students. Also, they found that rep- resentation is not correlated with the discrimination experienced by the students, implying that the increased representation does not necessarily solve the discrimination problem. This experiment shows that, when trying to shrink the gender gap, attention should be put in the points of access into educational and occupational paths. **?** study the relationship be- tween power and volubility across genders. Both using archival data and an experiment, she finds a strong positive relationship between power and volubility among men, but not among women. Moreover, she shows that volubility among women actually hurts them, as they face backlash when they do.

This review has brought up several different mechanisms that generate and reinforce gender gaps over time. These factors take different shapes and arise at various stages of the professional growth of women. This, on the one hand, makes the problem multifaceted and complex. However, on the other hand, it gives policy makers plenty of scope and possibilities to alleviate the gender disparity problem. Saraceno and Keck (2011) write about the heterogeneity across countries in the mix of policy they have in place to achieve gender equity. They claim how policies on gender equity and child care can take several dimensions, and how they actually do in several countries. This introduces some apparent

ambivalence on where countries stand in the path towards gender equality. The authors, however, explain that this diversity is only normal if one considers the specific histories of the different policies, as well as the recent changes of the norms about gender division of labor. The various social policy frameworks integrated these changes in different ways, giving rise to policy making that may appear to be contradictory, but that it’s necessarily so given the complexity of the issue and its evolution.

# Conclusion

Worldwide, the pandemic damaged women’s professional roles as venues for dependent care closed and societal norms of caregiving responsibilities fell along gendered lines. In general, measures of women’s labor market worked stayed surprisingly similar to men’s labor market measures, reflecting underlying increased workloads during the pandemic period because on inequities in division of household/care giving work. Within academia, the pandemic ex- acerbated gendered inequities already present in institutions, particularly when viewed in an intersectional context of vulnerability. Although a large body of research evidence doc- uments gender bias and disparities in academic careers, there is concern many disciplines, particularly in STEM areas, have not acknowledged and addressed these concerns. During the pandemic, many universities responded with immediate measures such as tenure-clock extensions. However, a forward looking strategy to create a robust scientific environment goes beyond such measures, and considers impacts of tenure clock extensions themselves on women’s standing in academia. This requires institutions address overall support available to women generally, whether it be in times of pandemic or plenty, to reduce the tension between women as caregivers and as academics. Such strategies will provide the scaffolding necessary for all members of our population to succeed. Emergence from the pandemic affords opportu- nities to consider both incremental and radical changes to address intersectionally-informed gender inequalities in academic careers. Low hanging fruit include a broader embrace of workplace flexibility. Furthermore, formally recognizing faculty work in diversity, equity, and inclusion such as recent changes to IUPUI’s tenure and promotion criteria, will go a long way to signal the value this work, which has disproportionately been performed by White women and Black, Indigenous and other People of Color. Lifting the importance of family support structures, such as campus or near-campus childcare remains a priority. More broadly, we should expand practices university wide that have been studied and supported by the National Science Foundation to increase the participation and advancement of women in STEM academic careers (i.e., through NSF’s ADVANCE program). These include practices

that actively monitor equity, address implicit bias that this review has shown invades every aspect of social networking and evaluation, and build women’s leadership capacity so that we benefit from the full range of talent to address the challenges we face in the post-pandemic future.

## Acknowledgements

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# Tables and Figures

Figure 1: Male and Female Unemployment Rate, 2020



Source: Bureau of Labor Statistics, data retrieved from data.bls.gov/pdq and are for ages 18 and up, seasonally adjusted.

Figure 2: Male and Female Labor Force Participation Rate, 2020



Source: Bureau of Labor Statistics, data retrieved from data.bls.gov/pdq and are for ages

18 and up, seasonally adjusted.

Figure 3:



Source: Adapted from Montenovo et al. (2020), data from CPS

Figure 4:



Figure 5:



Table 3: Proportion of men’s women’s representation by race/ethnicity in each faculty rank (proportion of White men to women of color in each race group)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Professor** | **Associate Professor** | **Assistant Professor** | **Instructor** | **Lecturer** |
| White men/women | 1.96 | 1.14 | 0.87 | 0.79 | 0.80 |
| Black (White) men/women | 1.17 (5.98) | 1.17 (3.01) | 0.70 (1.54) | 0.70 (1.49) | 0.78 (2.63) |
| Latinx (White) men/women | 1.78 (13.68) | 1.33 (5.16) | 0.89 (2.92) | 0.71 (1.70) | 0.67 (2.26) |
| AAPI (White) men/women | 2.67 (1.71) | 1.40 (0.77) | 1.00 (0.47) | 0.75 (0.80) | 0.75 (0.85) |

Table 4: Proportion of men’s representation to women’s representation in Science Engi- neering academic ranks by race/ethnicity in each faculty rank (proportion of White men to women of color in each race group)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Professor** | **Associate Professor** | **Assistant Professor** | **Other Faculty** |
| White men/women | 3.14 | 1.78 | 1.49 | 1.39 |
| Black (White) men/women | 2.72 (17.18) | 1.30 (4.38) | 1.29 (4.96) | 2.10 (6.33) |
| Latinx (White) men/women | 1.93 (12.60) | 1.83 (7.45) | 1.15 (3.91) | 1.19 (4.03) |
| AAPI (White) men/women | 5.08 (2.30) | 2.25 (0.897) | 1.88 (0.52) | 0.97 (0.47) |

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