Gendered dimensions of educational premium disadvantage in earnings in USA, 2019

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Abstract The relationships between gender-based earnings disparity and gendered dimensions of human capital gains and labor market changes are quite complex. Some scholars have argued that gender bias improves the over economy of a country/society. Others, however, have argued otherwise, adding to the narrative that despite an overall positive role of educational/human capital gains by women, the benefits reaped by them is non-linear, often with declining premiums for educational progress. This research investigates gendered earnings disadvantage and (dis)parity across US counties by employing GIS-based maps, descriptive statistics, correlations and regression analyses wherein female earnings and female-versus-male earnings ratios are regressed against select explanatory variables representing educational attainments, gender-based work-status, and their occupational over/under-representation in the labor market. Five-years estimates data (2015–2019) from the NHGIS are used for computing location quotients for major occupation-types by gender and additional statistical analyses. Females with professional, Master’s and doctoral degrees have improved earnings, even though gender parity is better for both genders among the less educated. Sadly, gender disparity in earnings is higher when male-versus-female ratio increases for those majoring in science/engineering, science and engineering-related and business degrees. Greater gender parity, however, is noted when more men major in Education—a sub-field largely deemed as feminine. This research calls for focused policy interventions toward encouraging more women in STEM and science/engineering disciplines, along with strategic programs to help attract more women into working full-time—one of the several ways toward bridging the earnings gap.

Keywords Gender-based earning disparity · Human capital gains · Labor market · Correlations and regression analyses · Science & engineering related disciplines

Introduction

The relationship between gender income inequality and broader economy of a society is complicated. Research suggests positive relationship between gender-based socio-economic parity with improved educational attainment, since better educated population promotes overall labor participation that triggers holistic economic growth (Coe et al., 2012; Sharma, 2021a). However, scholars have also suggested that the benefits of human capital attainment by females in the labor market has not been proportional as their male counterparts (Elson, 1999; Kantor, 2009;
Larger gaps in gender-based human capital accumulation reduces economic growth and overall prosperity of a country and the larger society (Schober & Winter-Ebmer, 2011). The well-known saying “You educate a man, you educate an individual; you educate a woman, you educate an entire generation” holds significance in the larger context. When you educate a female, it contributes toward economic growth not only for the individual or the current generation, but for several generations to come. It helps women make informed decisions about their overall fertility, childcare and dependent-care activities, and helps them lower child mortality rates and motivates them to invest in higher education and economic independence—all of which eventually help them develop a support system for themselves, their siblings/offspring, and the like. These steps collectively reduce overall poverty, especially female poverty, which also helps jump-start cyclic economic growth in a society (Galor & Weil, 1996; Lagerlöf, 2003, Sharma, 2021a, 2021b; Schober & Winter-Ebmer, 2011). This phenomenon has been noted in developed economies and developing economies alike (Coe et al., 2012; Sharma, 2021a).

To add to the confusion of this very complex topic, though, some scholars have theorized that discriminating the female gender in labor market favors overall economic growth because by having low supply of labor (i.e., females) in the market, males can use the artificially created labor-shortage to demand better pay and better career-choices (Barro & Lee, 1994; Barro & Sala-I-Martin, 1995). This argument, however, lacks scientifically proven work, given the difficulty of accessing internationally comparative wage-data and contextual variances to conduct this type of scientific and empirical analysis (Schober & Winter-Ebmer, 2011). To discourage this line of argument, Schober and Winter-Ebmer, (2011) used wage-data for numerous countries and found that when correct type of internationally comparable data is used and analyzed, there is no evidence that gendered wage discrimination favors broader economic growth. In contrast, these researchers find that greater gender inequality has negative association with economic growth. This is important because it provides pathways for lowering gender discrimination such that sustainable economic growth and well-being of the larger society can be achieved (Schober & Winter-Ebmer, 2011). Along somewhat related theme, Elson, (1999)’s analysis finds that labor markets are gendered institutions as they operate at the intersection of the productive and reproductive economies. As such, just by having women participate in the labor market does not automatically empower them; indeed, these differences can only be narrowed down when institutional changes are incorporated in the society and economic production system (Elson, 1999; Tzanantos, 1999). In the absence of institutional changes, this will continue to be profitable for the corporate world (Elson, 1999). Thus, there is larger agreement among social scientists that gender gaps in education and labor participation is not healthy for a country’s overall growth.

However, while most of the academic work has explored the relationship between educational attainments and broader economic growth, to what degree does a specific type of educational degree or area of specialization associate with gender participation in a labor market? How might specific fields of specialization associate with occupation-types? To what extent do these factors collectively and individually affect earnings differentials, given that many occupations/industries are notorious for low wages? How might their work-status (fulltime versus parttime) and their occupational preferences (voluntarily/involuntarily) affect their earnings potentials and the ensuing gender gaps? These factors can intertwine with each other in complex ways and impact women’s overall earnings potentials. In our review of literature discussed below, the gendered differences in educational attainments and ensuing impacts on labor participation and income potentials has not been addressed yet. This paper aims to address these questions to explain the complex ways in which these factors impact gendered wage-gaps in contemporary society. Answering all these questions may be too ambitious for this paper, hence additional lines of inquiry that may arise while addressing these questions will be addressed in subsequent pieces of research.

The rest of this paper summarizes relevant literature on gendered dimensions of wage and occupational inequalities while critically linking them with existing empirical scholarly and theoretical work on gender economic inequalities. Research design discusses the study area and scale of analyses, along with data sources and methodological steps. This is
followed by analysis and findings, and finally the discussion and conclusions summarize major take-home findings from this analysis and concludes with policies that can help reduce gender gaps in earning.

Literature review

Gender disparity and post-fordism

While the post-World War II era (1947–1975) in the US was marked by enormous economic growth and prosperity, the post-1970s became notorious for its complex social and economic polarization and rifts that got created among its population groups. These times were marked by the demise of the middle-class, and by the widening of income gaps between the top 5% versus the bottom 20% (Bakshi et al., 1995; Kearney, 2014). Post-Fordism led to enormous losses through decline of poverty eradication and welfarist programs that put significant numbers of single women with children, and especially the people of color far below poverty (Bakshi et al., 1995; Benner, 2002; Gartman, 1998; Walks, 2001; Walks & Maaranen, 2008). Subsequently, post-Fordism created an extremely bifurcated and socially polarized economy and society, along with the least egalitarian social relationships. There were significant gains noted in the high-paid jobs in the growing new economy, best suited for those with higher levels of educational attainment and human capital skills, whereas others were clustered in low-end service jobs, most of which were conducted by the minorities, low-skilled and the women (Autor et al., 1998; Autor et al., 2003; Chakravorty, 1996; Florida & Mlander, 2014; Moore, 1989; Sassen, 1994).

Simultaneously, other research has also indicated that despite adequate educational attainment and technical skills, women across the globe have continued to face occupational discrimination across industries. Even though women have economically been part and parcel of their households and family incomes since ages, largely contributing through their undervalued and unrecognized unpaid works (Islam & Sharma, 2021, 2022; Kantor, 2009), it is no surprise that their gains in earnings have had to tread through far larger burdens of discriminations and biases in a society that still favors and pays males over females, even within feminine industries (Coe et al., 2012; Sharma, 2021a, 2021b).

Feminization of industries and gendered wages: domestic and international perspectives

Gender inequality is an important aspect of societal injustice that affects the overall well-being of a larger society. Gender inequality not only affects the current generation, but it can hamper the progress and well-being of future generations (Bucciarelli et al., 2011). When women are paid lower wages in the labor market, they feel demotivated to even participate as the opportunity costs of the balancing act between work and home impacts their decision making (Elson, 1999; Kantor, 2009; Islam & Sharma, 2021, 2022; Sharma, 2021a, 2021b. At other times, many institutions are intentionally not inclusive enough to attract women to work (Kantor, 2009) despite their skills. This further affects the human capital accumulation for consecutive generations because opportunities lost at a moment can become generational and cyclical (Thomas, 1997).

Thomas also finds that when women have better access to overall resources at home to take care of their household-activities, their participation in the labor market improves significantly (also see Islam & Sharma, 2022). Regarding this, a recent report by the Washington Center for Equitable Growth suggests that given the constraints faced by women at the household level, they are forced to make difficult choices by undertaking a larger share of unpaid activities within their homes such that it protects their family’s overall economic wellbeing (see Glynn, 2018; Islam & Faisal, 2021; Kantor, 2009). Women’s reduced involvement in paid jobs and sacrifices toward overall economic wellbeing of the home is due to their disproportionate involvement in the household’s ‘dependent care’ and numerous other unpaid activities that are largely unaccounted for and monetarily undervalued in almost all societies (Coe et al., 2012; Islam & Sharma, 2021, 2022). To address these elements of gender inequalities, and achieve better gender equality and parity, the Washington Report, (2019) recommends various policy measures, such as the Child Care for Working Families Act, The FAMILY Act, The Schedules That Work Act, State-specific paid family leave policies, and the like. The whole idea of implementing these policies is to make
paid-work accessible and a smart choice for women as much as it is for men. This report and many others have made numerous recommendations to reduce gender gaps in education and human capital skills which can eventually reduce income gaps and create a more equitable and sustainable society.

Based upon this Washington report, (2019), gender-based segregation across industries and occupations within USA accounts toward almost 50.5% of gender wage gaps, equaling to about $403.6 billion; about 17.6% of this 50.5% wage gaps occurs due to women working in specific types of industries, whereas the rest 32.9% gap is specifically due to women’s traditional engagement in low-paid occupations—largely classified as feminine occupations/industries. Further, not only are women are overrepresented in low-paid service-sector industries, but within such feminine industries too, wages are lower for tasks traditionally performed by women—thus making women suffer from double wage penalty (Coe et al., 2012; Washington Report, 2019). The Washington Report (2019) also finds that in USA, even now, a woman makes only 80.5% against every dollar that a man makes.

There also exists a causal mechanism at play—i.e., an influx of women into an occupation lowers wages in that occupation; however, if the same tasks are performed by men, they get paid higher because men’s time and labor has been historically valued higher than females’ (also see Coe et al., 2012; Elson, 1999; Kantor, 2009). It is no surprise that within any industry, women are generally clustered at the lower-end of the wage spectrum (Coe et al., 2012; Glynn, 2018). Glynn, (2018)’s analysis finds that women comprise 52.8% in ‘law/legal’ industry, but only 37.4% of the women employed there are lawyers; the rest 62.6% are employed as the paralegals, legal assistants, etc. who make far lower wages. Thus, often, the categorization of industries and occupations under one umbrella masks the disparities which are far greater in real world.

Others argue that women’s biological clocks and societal pressures toward family-making, childcare and other reproductive needs indeed throw them out of the labor market, which imposes a distortion on the economy in the same ways as gender gaps in education (Elson, 1999; Esteve-Volart, 2004; Islam & Sharma, 2022; Sharma, 2021a, 2021b). Such family-making gaps artificially reduce the pool of talent from which employers can draw upon, per Becker, (1994), which eventually reduces the availability of the workforce (e.g. Esteve-Volart, 2004); this, in turn, distorts the employed and the self-employed in various sectors of economy (e.g., farm and non-farm activities, rural economies, and the like). This impacts access to major resources that largely feeds into the cycles of economic growth and overall productivity of these ventures by negatively affecting economic growth (see Blackden et al., 2007).

At an international scale, the United Nations suggests that due to women’s restricted participation across various industries and occupations, women have not been able to attain fuller economic empowerment (HTTP3; HTTP4; Whitmore & Ryan, 2017). Women’s restricted access to and control over productive resources, knowledge about jobs-based advertisements, professional connections and networks, familiarity with work environments, opportunities, and work cultures, as well as insufficient control over their own times and decision-making processes in largely male-dominated industries have impacted their ability and freedom to attain the required education and skills to fully pursue their dreams (Coe et al., 2012; HTTP4). To keep competitive in the job market, learning, unlearning, and re-learning are essential, and this requires women to pursue the required education and skill development and re-skilling over their entire course of life, especially in this new economy age where rapid technological and digital advancements have been affecting every industry, including the front-desk clerical and secretarial fields (Coe et al., 2012; HTTP4; Whitmore and Ryan, 2017). These skills are critical to women performing satisfactorily at workplace and for their overall economic health and social wellbeing by feeling valued in the labor market (Elson, 1999; Harriss-White, 2010; HTTP4; Kantor, 2009; Whitmore & Ryan, 2017).

While a large chunk of scholarly research has focused on women’s participation in the growing informal economy, especially in the developing countries, not many of them have linked their lack of economic wellbeing to finer categories of education/skill development. Harriss-White’s, (2010) analysis of work and wellbeing of women in informal economy examines the regulative roles of institutions of identity and the state. Since a large share of women are engaged in the informal sectors that are outside the regulative control of the state, the author suggests the
idea that such economic activities and the ensuing social (in)security are indeed institutionalized. Harriss-White, (2010) also challenges the counter intuitive proposition that social security rights are dependent upon work rights, even though the informalization of many economic sectors all over the world is happening fast (Pieters & Klasen, 2011). In her analysis of women’s labor participation, Elson, (1999) argues that labor markets are indeed gendered institutions, operating at the intersection of the productive and reproductive economies, and hence women’s participation in labor markets does not automatically empower them. Instead, the discrimination against women may persist until and unless institutional changes are made (Tzannatos, 1999); in the absence of these, the business-as-usual stays a profitable venture for the capitalists and the ultra-rich who have and will continue to exploit informalization in formal and informal markets both (Elson, 1999).

Along similar lines, Tzannatos, (1999) finds that the gender-based labor participation rates and the subsequent wage differences has narrowed much faster in the developing economies compared to the industrialized economies. Agreeing with other scholars, she also suggests that there are no real winners when gender-based discrimination continues, and gendered-inequalities can have significantly adverse effects on welfare, as has been noted since the post-Fordist market-economy that has promoted informalization of major economic sectors and the hire-n-fire policies. While Tzannatos, (1999) completely agrees that the vicious circle of women’s low initial human capital endowments and the idea that inferior labor market can be addressed by improving their educational attainments and adequate valuable skills, she too emphasizes the need to legislatively enforce equal pay and equal employment opportunities legislation, along with passing of laws for taxation and benefits structure that can treat reproduction as an economic activity and value women as equal partners within households, with better accountability of their work that has largely been masked as invisible and deemed unpaid (Elson, 1999; Tzannatos, 1999; Islam & Sharma, 2021, 2022; Sharma, 2021a, 2021b).

Regarding women’s growing participation in a fast-growing economy such as India, Pieters and Klasen, (2011) find that during 1999–2004, female labor participation increased rapidly in urban areas; this was in contrast to the past trends wherein female participation varied, with high participation in some communities and low in others. The most relevant finding, however, is that with lower levels of education, increase in female labor participation is driven more by distress rather than by increased economic opportunities; in contrast, with higher levels of education, women are drawn into the labor force due to their attractiveness and pay-packages. Regarding the effect of education on earnings potentials, Pieters & Klasen (2011) find that the marginal effect of the predicted market wage is negative for low-educated women and positive for the highly educated, and even though real earnings of highly educated men and women did rise after 1999, the rates were slower than before. Among the highly educated women, self-employment in manufacturing and services became more important (Pieters & Klasen, 2011). Along somewhat similar lines, Kantor, (2009) finds that women, and especially Muslim women were expected to make “appropriate choices” when choosing the work-type, and they were inherently excluded from the larger markets that encompassed other types of jobs.

In many other parts of the world, research also suggests that even now, almost 2.7 billion women globally have far lesser choices of jobs compared to men due to cultural, political, and social reasons. A study conducted in 189 economies in 2018 suggested that 104 economies out of these 189 still legally prevent women from working in specific types of jobs whereas lack of laws protecting women against sexual harassment still exists in 59 of these economies; also, husbands could still legally prevent their wives from working in 18 economies, many of which are in the Middle-east (HTTP4; Whitmore and Ryan, 2017). In sum, these author’s analysis of developing economies suggest a sure and positive role of education on earnings; however, the specific type of educational attainments and their concomitant impact on earnings is not explored yet.

Theoretical framing of gendered economic inequalities

Regarding conceptually and theoretically explaining gender gaps and inequalities, social sciences has not been free of controversies. In the past, some studies suggested that educational inequalities across gender promotes economic growth as it creates larger
market opportunities for men, leaving them with higher negotiation power (Barro & Lee, 1994; Barro & Sala-I-Martin, 1995). This sounds contradictory to our generic understanding that gain in human capital skills promotes better occupational opportunities for women in the society, thence improving overall wellbeing in the society (see discussions in Sharma, 2014a, 2014b, 2016, 2018, 2021a). Other scholars, in contrast, dig deeper and provide evidence that indeed the opposite can be the case, wherein better gender equity in educational attainment can in fact be better for overall economic growth of a society and a country (Abu-Ghaida & Klasen, 2004; Dollar & Gatti, 1999; Forbes, 2000; Kantor, 2009; Knowles et al., 2002; Klasen, 1999; Pieters & Klasen, 2011).

There are other ways of looking at gender gaps. Some scholars have suggested that gender gaps in employment and occupational opportunities are largely a reflection of educational attainments, as is promoted by the Human Capital Theory (Becker, 1994). In this regard, Glynn, (2018) likens gender gaps to Becker’s, (1964, 1994) Human Capital Theory’s (HCT) dependency on the demand-supply aspect of labor. In her 2018 report for the Washington Center for Equitable Growth, “Gender wage inequality: What we know and how we can fix it,” Glynn suggests that such greened wage gaps are manifestations of two major factors—supply side theory, linking the shortage of enough women with required human capital skills and educational attainments to perform specific jobs and activities, and the second reason being the demand-side theory, that takes into account the persisting societal, structural, cultural, and institutional norms, practices and stereotypes that are beyond women’s control. These norms and stereotypes negatively affect women within USA and in other parts of the world who internalize various aspects about themselves that influence their choices toward acquiring or not acquiring specific types of education/skills; these self-imposed restrictions and decisions, eventually, affect their occupational decisions to somehow fit into the larger society (also see Elson, 1999; Kantor, 2009; Islam & Sharma, 2021, 2022; Sharma, 2021a, 2021b). Thus, it seems like the hold of cultural and societal norms and practices have continued their control on the demand-side linkages in the labor market, which has limited opportunities for women. Thus, the choices that many women make must fit into as the “appropriate choices” so they can fit into a larger society that is socially constructed, manipulated, and controlled by men. This limits them from making the best economic choices matching their talent and skills. This has indeed impacted a large segment of highly qualified and talented women in several South Asian countries such as India (Elson, 1999; Islam & Sharma, 2022; Pieters & Klasen, 2011). It also showcases elements of the Neoclassical Economic Theory (NET) which attributes women and men making choices about specific jobs and opportunities based on their preferences, and that the labor market is exogenous to any type of discrimination and biases.1 The NET, thus, overlooks the complex interactions between the socio-economical, historical, and cultural contexts of a person’s being that might impact his/her acquisition of human capital and the ensuing occupational choices.

Anne Bonds, however, questions the simplistic and linear economic determinism of these two theories—HCT and NET—in explaining the racialized and gendered dimensions of economic inequalities (Bonds, 2013). She believes that by using a simplistic way of gender or race in economic relations, one is masking the complex processes of racialization and feminization of economic practices. In real world, a person is a product of complex dimensions of his/her geographical, socio-economical, historical, cultural, and political being that affect his/her access to opportunities and resources which eventually affect their economic decisions.

To better understand the persistence of gendered inequalities, the Labor Market Segmentation Theory (LMST) and the Feminist Political Ecological Theory (FPET) provide a far more comprehensive and contemporary understanding to the processes creating differentiation. The LMST rejects the binary or the linear connection between gendered-labor market outcomes with their educational skills or experiences. It suggests that each institution has its own set of succinct rules and socially constructed policies

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1 Kantor, (2009)’s analysis finds otherwise wherein data clearly suggested that women face constrained inclusion into labor markets in the city of Lucknow with their over-concentration in particular employment-status categories, and their choices were rather expected to be home-based work to abide by the social norms. This was truer for the Muslim women who were engaged in the embroidery work for which Lucknow is globally known.
that continue to construct and reproduce the differentiations that fits their narratives (Coe et al., 2012; Kantor, 2009). The LMST, thus, comes closest to providing the critical perspectives through the political economy ideologies posed by the FPE theorists who suggest that gender intersects with major dimensions of a society such as race/ethnicity, religion, caste, nationality, and sexuality which produce the complex hierarchies of societal power dynamics that manifest into complex and varying levels of gendered labor participation across industries (Kantor, 2009; Mollett, 2018; Nightingale, 2006; Rocheleau et al., 1996; Ross, 1997; Sultana, 2014).

2.4 Summary of scholarship on gendered economic inequality

Finally, since the onset of Covid-19, women have faced the greatest economic hit of all, especially when it comes to accessing economic opportunities, and their increased work-burden due to closure of care-institutions. Collins et al., (2020)’s analysis of changed work hours during February-April 2020, following the closures of schools and day-care centers, suggests that mothers with young children had to reduce their paid work hours four to five times more than fathers, as the burden of feeding and caring fell largely on the women of the households (also see Islam & Sharma, 2021, 2022). In addition, Collins et al., (2020) also find that these changes in work hours exacerbated the already existing wage-gaps by more than 20–50%, severely affecting their overall economic and social wellbeing.

In short, while this pandemic has dramatically changed the lives of many all over the world, in general, women’s voluntary or involuntary restrictions on their own wellbeing occur because of historical, societal, cultural, and perceptual roles and responsibilities that have always impacted their choices. Despite gain in educational degrees and human capital skills, not all women have been able to translate them equitably, which has created varied levels of occupational under/over representation and income earnings potentials. Even today, a woman makes only 80.5% of what a man makes (Glynn, 2018) and when dissecting these by racial/ethnic groups and by age-groups, these could be far worse. Bucciarelli et al., (2011)’s analysis of numerous low-income and high-income countries finds that reducing gender gaps in education and employment not only facilitates overall economic growth in low-income countries, but they also provide incentives for other related development goals, such as reduced fertility, better child health, reduced child mortality, and more choices for decision making power, which eventually furthers holistic growth for all.

In short, my review of related scholarship suggests that the relationship between educational attainments and earning potentials has at best received superficial addressal, especially considering enormous market changes. Given the intricate ways in which globalization-induced manufacturing and service sectors have entered women’s work-life, it is critical to examine if recent gains in human capital skills have indeed translated into proportionate earnings advantage, especially in USA. Scholarships reviewed above have shown that in the developing economies, despite educational attainments, women have largely confined to low-end manufacturing (e.g., garment manufacturing) and/or service industries (call centers, front desk clericals, teaching, retailing, etc.)—both of which are low-waged industries. This research explores the relative effect of educational premiums through occupational attainments by addressing this issue across US counties. This analysis will expand our understanding of gendered wage/earnings gaps by exploring its relationships with various types of human capital skills, proxied by educational attainments (overall and by major fields of specialization), and other predictors such as occupation-types and work-status-by-hours. This detailed analysis will capture the complex intertwining of cultural, historical and sub-regional economy, and how might that impact gendered earnings.

Study area, data and methodology

This analysis focuses on the 3,142 counties of USA, excluding Puerto Rico and including Alaska and Hawaii Islands. Counties are used as the scale of analysis to capture local-scale perspectives on gendered dimensions of inequalities across education, earnings and occupations that inform each other in complex ways. Given the large size of USA, using counties as a scale of analysis serves well to capture the nuanced variations across the rural, urban and mega-urban spaces. Given the proposed research questions, I use detailed categories of educational
attainment and major fields of specialization in Bachelor’s as a proxy for human capital skills. The American Community Survey (ACS) five-year estimates (2015–2019) data, available from the Minnesota National Historical Geographic Information Systems of the Minnesota Population Center (Manson et al., 2020) are used for computing the location quotients (LQs) for major occupation-types-by-gender and for conducting descriptive analysis of educational attainments, work-status by gender, and share analysis by occupation-categories, followed by correlations and regressions analyses. LQ-values are computed using the following specifications in Moineddin et al., (2003). A generic equation for location quotient (LQi) for an occupation i in a county is:

$$LQi = \left(\frac{ei}{e}\right) \left(\frac{Ei}{E}\right)$$  \hspace{1cm} (1)

where $ei$ is the employment in occupation $i$ in the local region/county; $e$ is the total employment in the country; $Ei$ is the employment of the gender (male/female) in occupation $i$ at the national level, and $E$ is the total employment at a national level (adding total employment in all five major occupation categories taken together). I compute the LQs for five major occupations for males and females both.

After completing the descriptive analyses and mapping important variables of earnings, educational attainments and work-status using ArcGIS (Figs. 1, 2 and 3), I delve into the process analysis by conducting Pearson’s bivariate correlations and regressions. The decision to pick up specific variables of education—proxying human capital skills, work-status (worked fulltime versus otherwise), and gender-based occupational-share/representations is based on the literature reviewed above and analytical findings from my ongoing big-data analyses. In the regression models (“Female disadvantage in income earnings: human capital and occupational framework” “Female (dis)parity in earnings across us counties, 2019” sections), I start with the OLS regression with 28 explanatory variables, eventually returning with 13 variables only as the rest 15 showcase multi-collinearity and insignificant. Thus, for final model specification, I employ stepwise regression method that produces the best fit models for each of the following four dependent variables. Variables $Y_1$, and $Y_2$ measure female earnings whereas variables $Y_3$, and $Y_4$ measure gender earnings gaps and disparity in our sample.

$Y_1$: Female Median Earnings (overall), and.
$Y_2$: Female Median Earnings (worked full time).
$Y_3$: Ratio of Female/Male Median Earnings (worked full time), and
$Y_4$: Female Median Earnings minus Male Median Earnings (i.e., the difference in F-M-median earnings, worked full time).

Since I use stepwise regression, each of these models identify and select the explanatory models that create the best fit model and best R-square value. I pick up the best-fit model based on the variables captured in each model, and its suitability in explaining the research question. The generic

Fig. 1  Female vs. male ratio-median earnings, worked full-time (left) vs. worked part-time (right)
regression equation for these regression models include:

\[
Y_{n(1-4)} = \alpha + X_1 \beta_1 - 127 + X_2 \beta_2 + \ldots + X_n \beta_n + \varepsilon
\]

where \( Y_{n(1-4)} \) are the dependent variables in the four regression models shown above whereas, \( X_{1-n} \) are the independent variables in the four distinct regression models, \( \alpha \) is the intercept (constant) on each model, \( \beta_{1-n} \) are the coefficients on each of the independent variables picked up in these four regression models, and \( \varepsilon \) is the residuals in each model.

Analysis and findings

Overview of study area and gender-based earnings and educational attainments in USA, 2019

The total study area (3,142 counties) had a total population of 324,697,795 in 2019, with non-Hispanic Caucasians comprising the largest share (60.70%, 197,100,373 people) out of total, followed by Hispanics (18.01%; 58,479,370), Blacks (12.31%; 39,977,554), Asians (5.62%; 18,249,465), All-Others (2.69%; 8,730,655) and non-Hispanic American Indians/w-Hawaiian/Pacific-Islanders (0.67%; 2,160,378). Compared to 2000 census, the ACS (2015–2019) shows gain for Hispanics and Asians and decline for Caucasians (69.13% in 2000 to 60.70% in 2019), whereas Blacks maintained consistency at 12.31% (Table not shown here).

A quick statistical overview of major dimensions of gendered earnings/income (inflation adjusted) in 2019 (Table 1A) suggest that on an average, for the entire study area, the mean and maximum median earnings for males is far higher ($37,903 and $97,570) than those for females ($24,426 and $64,147); same holds true for minimum earnings and across all percentiles—35th, 50th and 65th—with males earning higher than females. Median earnings for fulltime workers show similar trends, with significant gaps between male and female earnings. The only category where these differences are narrower include the median earnings for those who did not work fulltime, with the male–female difference in earnings at about $1,000-to-$1,500. Thus, the median earnings for female and male are at better parity for those not working fulltime—this speaks of a worrisome aspect of the larger society wherein women working fulltime are penalized with work penalty—i.e., the more fulltime a woman works, greater is the risk that her proportionate earnings will be lower than those who work fewer hours. This is also evident in the female/male ratio of median earnings for fulltime and not-fulltime workers, with the ratios being lower for fulltime worked category. Table 1A also suggests that for those working fulltime, on an average, females earn only $0.7674 against every dollar earned by males; when looking at those working less than fulltime, the mean value changes to $0.9312 for every $1 earned by men.

Table 1B illustrates the descriptive statistics for educational attainments by gender, and for overall population by their major fields of specialization by age cohorts (25–64 years, above 65 years. While it is known that a college degree positively associates with earnings, the over/under-representation in specific types of occupations/industries is linked with their earnings potentials. As expected, the mean values for females majoring in the sub-fields of Education (0.164) and Arts/Humanities/Others (0.109) is far greater than males at 0.056 and 0.088 respectively; likewise, males specialize in male-dominated sub-fields of Science & Engineering (0.183) and Business (0.095) at far greater levels than females. This raises concerns and poses questions about limited participation by women in science/engineering and STEM disciplines. Women’s educational skills development, especially in STEM disciplines, is critical for achieving economic parity and progress.

Visual analyses of gendered earnings, educational attainments and work-status

Visual inspection of female and male earnings shows that in general there are some counties (darkest colors) where a woman earns significantly higher ($1.206) against every dollar earned by a man. However, a large part of the country shows the 1st four categories of earnings differentials where a woman earns only $0.629 against every dollar earned by a man (lightest colors). Parts of deep US Southeast, Nevada, the mountain states, the Appalachia, and the Dakotas have counties with lowest earnings for females. The west coast, in general, shows better parity in gendered earnings, with females earning around $0.93-$1.206 against every dollar by a man. These patterns
get more pronounced in the right-side map (Fig. 1: female versus male earnings for part-time workers), though in rare counties a female makes almost $2.2-$9.3 against every dollar that a man makes.

Regarding major areas of specialization, Fig. 2 displays the spatial disparity in science/engineering, science & engineering-related fields, and business, with the maps showing almost bland patterns. Regarding traditionally feminine fields of specializations (Education, Arts/Humanities/Others), the yellows (education) are generic pattern in the U.S Southeast and randomly distributed in the western half, except the west-coast and central-half of California with blue patches—likely due to the school/university townships having more educated gentry. The most interesting is the male versus female distribution of Masters/above degrees, with distinct clusters of dark patches—in the northeastern megapolitan sub-region of USA, the Pacific/west coasts, and random patches in numerous parts of the mountain-states/mountain time region. These could be larger reflections of industries specific to these counties—something for detailed future investigation.

Regarding gendered work status (male/female ratio), in general the western half of the country has greater work-status advantage for males compared to females (Fig. 3 bottom rows). However, when dissecting these by the numbers of hours worked per week, for those who worked 50–52 weeks (in last 12 months), males exhibit advantage (very high ratios) when they work for 35 h or more; these ratios become weaker as the numbers of hours worked declines to 15–34 h/week, and lesser. The middle-right-map illustrates male/female who did not work at all in last 12 months. These patches of counties along the Mississippi Delta, and in select parts of the US Southwest have higher numbers of males who did not work compared to females. It would be an interesting to explore these patterns with the overall educational/human capital resources availability as well as institutional/economic opportunities or lack thereof, which might be attributing to these types of work-status patterns—something to be pursued in forthcoming analysis. However, it is well known that the Mississippi Delta and the U.S Southeast also have disproportionately higher numbers of Black poverty, and this sub-region also lack major industries. Digging deeper into the male versus female work-status ratios for those working for fewer than 50–52 weeks/year also shows interesting spatial patterns—the details of which will be soon pursued.

Gendered representation in occupations: overview of location quotients, 2019

As noted in Table 1C, the descriptive statistics of computed location quotients (LQs) for both genders for major occupation-types exhibit expected patterns. Males are over-represented in management (maximum value of 1.055), in natural resources/construction/maintenance (median and maximum values for LQs are 1.302 and 5.19 respectively), in production/transportation/material-moving (median and maximum values for LQs are 0.997 and 4.806 respectively); for females, the median and maximum values of LQs for service occupations are 0.6007 & 1.696, and for sales/office, these are 0.6347 & 1.344 respectively. These values are far greater than those observed for males in these occupations. The enormously high LQ-max values of 5.19 and 4.81 for males in natural resources/construction/maintenance and production/transportation/material-moving compared to those by females (Table 1C) speak about the masculinity of these occupations; likewise very high LQ-values for females in service and sales/office occupations reflect the feminine nature of these occupations.

Further, though the LQ-values for females are slightly higher than males in the main occupational category of management/business/sciences/arts occupation, the difference between the genders is small; and these differences get masked when one looks deeper into the sub-categories of occupations within this broad occupation (Table 1D). When broken into 3-sub-categories, the highly paid sub-occupation—management/business/financial—largely a ‘masculine’ occupation, has over-presence of males whereas the sub-categories of education/legal/community-service/arts/media and healthcare-practitioners/technical have over-presence of females—alligning with prior research (Glynn, 2018) that within each occupation/industry, females are still clustered in the
sub-occupation-types that are associated with lower pay—reflecting the inertia and continuity of historically feminine and culturally accepted practices of women performing the low-waged jobs.

Gendered earnings and select predictors: bivariate correlations analysis

Table 2 details the Pearson’s bivariate correlation and their strengths with major types of dependent
Table 1  Descriptive statistics of income, education, location quotients and occupation by gender, 2019

| A: Income/earnings by gender by work-status, 2019 |
|---------------------------------------------------|
| **Earnings by gender, 2019 (Infl adj)** |
| Male, med-earnings | 37,903 | 92,510 | 5060 | 97,570 | 34,604 | 37,186 | 40,139 |
| Male, med-earnings, worked full-time | 48,034 | 86,528 | 23,472 | 110,000 | 44,094 | 46,920 | 49,860 |
| Male, med-earnings, worked others | 11,956 | 33,872 | 2,499 | 36,371 | 10,810 | 11,620 | 12,434 |
| Female, med-earnings | 25,426 | 57,082 | 7065 | 64,147 | 23,393 | 25,029 | 26,339 |
| Female, med-earnings, worked full-time | 36,618 | 63,862 | 17,273 | 81,135 | 33,304 | 35,572 | 37,681 |
| Female, med-earnings, worked others | 10,684 | 22,722 | 3528 | 26,250 | 9890 | 10,655 | 11,278 |
| Ratio, female/male-med-earnings, worked full-time | 0.7674 | 1.2984 | 0.0000 | 1.2984 | 0.7404 | 0.7674 | 0.7977 |
| Ratio, female/male-med-earnings, worked others | 0.9312 | 9.3609 | 0.0000 | 9.3609 | 0.8496 | 0.9200 | 0.9814 |

| B: Educational attainments, major field in bachelor's degree by gender, 2019 |
|-----------------------------------------------|
| Share, science & engineering, male | 0.183 | X | 0.000 | 0.571 | 0.167 | 0.182 | 0.196 |
| Share, science & engineering-related field, male | 0.029 | X | 0.000 | 0.166 | 0.024 | 0.028 | 0.033 |
| Share, business, male | 0.095 | X | 0.000 | 0.312 | 0.083 | 0.095 | 0.108 |
| Share, education, male | 0.056 | X | 0.000 | 0.459 | 0.042 | 0.052 | 0.063 |
| Share, arts, humanities, others, male | 0.088 | X | 0.000 | 0.750 | 0.079 | 0.088 | 0.097 |
| Share, science & engineering, female | 0.111 | X | 0.000 | 0.545 | 0.096 | 0.108 | 0.121 |
| Share, science & engineering-related field, female | 0.081 | X | 0.000 | 0.271 | 0.070 | 0.079 | 0.089 |
| Share, business, female | 0.082 | X | 0.000 | 0.426 | 0.071 | 0.081 | 0.091 |
| Share, education, female | 0.164 | X | 0.000 | 0.477 | 0.139 | 0.160 | 0.182 |
| Share, arts, humanities, others, female | 0.109 | X | 0.000 | 0.432 | 0.098 | 0.109 | 0.121 |

| C: Location quotients by gender, major occupations |
|-----------------------------------------------|
| **LQ for males by occupation-type, 2019** |
| Management, business, science, and arts | 0.3745 | 0.9709 | 0.0843 | 1.0551 | 0.3209 | 0.3573 | 0.3966 |
| Service- occupations | 0.4045 | 1.2700 | 0.0000 | 1.2700 | 0.3541 | 0.3939 | 0.4335 |
| Sales and office occupations | 0.2991 | 0.6851 | 0.0000 | 0.6851 | 0.2707 | 0.3001 | 0.3303 |
| Natural resources, construction, & maintenance | 1.3469 | 5.1906 | 0.0000 | 5.1906 | 1.1481 | 1.3020 | 1.4650 |
| Production, transportation, and material moving | 0.9912 | 4.8066 | 0.0000 | 4.8066 | 0.8472 | 0.9917 | 1.1996 |
| **LQ for females by occupation-types, 2019** |
| Management, business, science, and arts | 0.4638 | 0.8979 | 0.0000 | 0.8979 | 0.4315 | 0.4588 | 0.4874 |
| Service- occupations | 0.6087 | 1.6961 | 0.0000 | 1.6961 | 0.5582 | 0.6009 | 0.6439 |
| Sales and office occupations | 0.6341 | 0.9921 | 0.1423 | 1.1344 | 0.6044 | 0.6347 | 0.6644 |
| Natural resources, construction, and maintenance | 0.0739 | 1.3251 | 0.0000 | 1.3251 | 0.0402 | 0.0547 | 0.0706 |
| Production, transportation, and material moving | 0.2893 | 1.0746 | 0.0000 | 1.0746 | 0.2064 | 0.2562 | 0.3192 |

| D: Summary of males versus females employed by major occupation-types, 2019 |
|-----------------------------------------------|
| **Occupation categories by employment, 2019** |
| Employed | Shr. occupation | Difference, male–female (gain/losses) |
| ML | FL | ML | FL |
| Total civilians, employed (16 years/older) | 81,305,624 | 73,536,561 | 0.525 | 0.475 | 7,769,063 (M>F) |
| Management, business, science, and arts | 28,273,415 | 31,373,868 | 0.183 | 0.203 | −3,100,453 (F>M) |
| Management, business, and financial | 13,225,992 | 10,881,370 | 0.085 | 0.07 | 2,344,622 (M>F) |
| Education, legal, community service, arts, & media | 5,889,127 | 11,051,160 | 0.038 | 0.071 | −5,162,033 (F>M) |
| Healthcare practitioners and technical | 2,310,173 | 7,020,935 | 0.015 | 0.045 | −4,710,762 (F>M) |
| Service | 11,935,283 | 15,554,218 | 0.077 | 0.101 | −3,618,935 (F>M) |
| Sales and office | 12,415,204 | 21,076,422 | 0.08 | 0.136 | −8,661,218 (F>M) |
| Natural resources, construction, maintenance | 13,039,229 | 674,567 | 0.084 | 0.004 | 12,364,662 (M>F) |
variables and select predictors chosen in this analysis. While I don’t create regression models for each dependent variable shown here, it is worth studying the r-values to understand the intricate ways in which detailed categories of educational attainments-by-gender, their work-status (fulltime versus parttime) and their under/over representations in specific occupations are associated with gendered earnings and disparities. Given my emphasis on four dependent variables to stay focused in this research paper, my Y-variables include (see Table 3A, B, C and D): A: Female-Med-Earnings, 2019; B: Ratio, Female-Med-Earnings vs Male-Med-Earnings, Worked Full-time; C: Difference (Female-Med-Earning-Male-Med-Earnings), Overall; D: Difference (Female-Med-Earning-Male-Med-Earnings)-worked full-time.

Regarding Y-A: Median Earnings for Females, r-values for the predictor male–female ratio who worked fulltime (35 h/week, 50–52 weeks/year) is negative (−0.192** and −0.171**) and as the male/female work hours decline, they become insignificant. The same variable has strong positive association with Male-median earnings, and they become negative when the work-status becomes parttime. This suggests the role of fulltime work-status versus parttime, and their varying contribution to median earnings for females versus males. Considering Y-B, the coefficients are strong negative for fulltime (r = −0.123** and −0.122**), which eventually changes when females work lesser hours. This is also evident in the coefficients illustrated in Y-C & Y-D: Male–Female earnings difference (overall and fulltime) wherein strong positive coefficients exist for fulltime workers, which becomes negative with parttime work. These r-values and patterns imply that female versus male parity in earnings is better when females work parttime. This is the sad reality of contemporary America where equity is better when women work less, and disparity is higher for when women work fulltime—reflecting work penalty for women.

For this set of Y-variables, the educational attainments (overall and by major fields in Bachelors for both genders), all the sub-disciplines in Bachelors have negative r-values for median earnings for females and for female/male earnings ratio (fulltime); these become positive for most categories for male–female earnings difference (overall and for fulltime workers). These become negative for those in sciences/engineering-related disciplines, especially for those above 65 years—which is negative for all Y-variables. This indicates negative role of ageing on income, no matter what gender, even for the best educated. However, how does ageing in different sub-disciplines of work specialization impact gendered earnings is an interesting line of research that can be pursued in near future. For those majoring in education and arts/humanities/others, however, males and females both have negative r-coefficients, and insignificant when one looks at the earnings advantage for males (overall and fulltime workers). Male versus female earnings advantage, however, is positive and significant for parttime workers with education and/or arts/humanities/others specialty.

When examining the finer categories of educational attainments for those 25 years/older, higher education (Masters, doctorates) for males and females are strongly and positively associated with all Y-variables (Female median earnings, female/male median earnings ratio, male advantage in earnings against females, overall and full time), except for females with professional degrees that have negative coefficients for male–female earnings advantage and insignificant for females with doctoral degrees. This
Table 2  Pearson’s bivariate correlations analysis for gender-based earnings and major predictor variables, 2019

| Pearson’s bivariate correlation analysis | Med-earnings ($S$), 2019 | Ratio, FL/ML earnings-by-work-status (fulltime vs others) | (Male–female)-median HH income, diff.-by-work-status | Median earnings by work status |
|-----------------------------------------|--------------------------|----------------------------------------------------------|-----------------------------------------------------|--------------------------------|
|                                         | Female: Total            | Male: Total                                              | C:Total                                             | D:Full: Others               |
|                                         | A:Total                  | B:Full: Others                                           | D:Full: Others                                      | Full: Male                   |

**ML/FL ratio-work-status, Hrs/week/year**

|                          |                          |                                                          |                                                    |                                |
|--------------------------|--------------------------|----------------------------------------------------------|-----------------------------------------------------|--------------------------------|
| Worked in Past 12 months | −.082** −.002            | −.053** .002                                             | .089** .066** .117** −.093** −.029                  |                                |
| 35 Hrs/more, Total       | −.192** .117**           | −.123** −.077**                                          | .339** .164** .194** −.051** .063**                |                                |
| 15–34 Hrs/week, Total    | −.003 −.272**            | .099** .224**                                            | −.378** −.128** −.137** −.040** −.105**            |                                |
| 15–34 Hrs/week, 50–52 wks| −.02 −.177**             | .106** −.084**                                          | −.230** −.113** −.059** −.043** −.101**            |                                |
| 1–14 Hrs/week, 50–52 wks | −.029 −.095**            | .031 .053**                                             | −.109** −.044** −.024 −.057** −.069**             |                                |
| Did not work at all      | −.086** −.230**          | .088** .093**                                            | −.248** −.133** −.115** −.118** −.171**            |                                |

**BSc-specl, ML/FL ratio by age**

|                          |                          |                                                          |                                                    |                                |
|--------------------------|--------------------------|----------------------------------------------------------|-----------------------------------------------------|--------------------------------|
| Bachelors major, total > 25 yrs | .051** .152** −.123** −.077** | .168** .171** .056** .167** .227**                   |                                                    |                                |
| Sc. & Engr., 25–64 yrs   | −.107** 0.033 −.159** −.046** | .140** .129** .086** −.123** .006**                   |                                                    |                                |
| Sc. & Engr., > 65 yrs    | −.086** −.018             | −.084** −.033                                          | .054** .050** .071** −.114** −.058**              |                                |
| Sc./Engr-related field., 25–64 yrs | −.009 0.033 −.075** −.028 | .055** .083** .042** .01 .042**                      |                                                    |                                |
| Sc./Engr-related field., > 65 yrs | −.070** −.072** −.013 0.004 | −.040** −.017 −.004 −.089** −.078**                  |                                                    |                                |
| Business, 25–64 yrs      | −.039* −.027              | .02 0.04                                               | −.004 −.012 −.01 −.034 −.033                      |                                |
| Business, > 65 yrs       | −.019 0.009               | −.015 −.025                                           | .032 0.005 .017 −.02 −.012                          |                                |
| Education, 25–64 yrs     | −.054** −.043*            | −.006 −.02                                           | −.012 −.002 .036* −.023 −.019                      |                                |
| Education, > 65 yrs      | −.102** −.040*            | −.057** −.032                                          | .035 .042* .077** −.072** −.029                     |                                |
| Arts/Human./others, 25–64 yrs | −.100** −.068** −.105** −.022 | −.007 0.031 .039* −.112** −.062**                    |                                                    |                                |
| Arts/Human./others, > 65 Yrs | −.057** −.040* −.013 0.018 | −.005 −.008 −.012 −.087** −.071**                   |                                                    |                                |

**Shr, Educ.-Attain. 25 yrs/abv**

|                          |                          |                                                          |                                                    |                                |
|--------------------------|--------------------------|----------------------------------------------------------|-----------------------------------------------------|--------------------------------|
| Shr, total males, 25 yrs/abv | −.051** −.060** 0.001 0.032 | −.035* −.009 .029 −.034 −.033                      |                                                    |                                |
| Shr, ML, no-school at all | −.161** −.197** .051** −.079** | −.136** −.115** .039* −.189** −.213**           |                                                    |                                |
| Shr, ML, no-HS-diploma   | −.361** −.428** .026 −.018 | −.281** −.197** .053** −.481** −.482**             |                                                    |                                |
| Shr, ML, HS-diploma      | −.341** −.301** −.085** .03 | −.124** −.074** .015 −.491** −.417**           |                                                    |                                |
| Shr, ML, some college/assoc | 0.013 .136** −.070** .017 | .186** .113** .016 .060** −.113**                       |                                                    |                                |
| Shr, ML, Bachelor’s      | .507** .469** .073** −.009 | .210** .140** −.022 .667** −.589**                        |                                                    |                                |
| Shr, ML, Master’s        | .511** .439** .091** .016 | .166** .144** −.068** .706** −.622**                      |                                                    |                                |
| Shr, ML, Professional     | .436** .307** .128** .011 | .047** .047** −.055** .572** −.462**                       |                                                    |                                |
| Shr, ML, Doctorate       | .191** .133** .085** −.001 | .019 .050** −.051** .421** −.349**                        |                                                    |                                |
| Shr, total females, 25 yrs/abv | .051** .060** −.001 −.032 | .035* .009 −.029 .034 0.033                      |                                                    |                                |
| Shr, FL, no-school at all | −.120** −.159** .046** −.061** | −.119** −.095** .037* −.123** −.152**           |                                                    |                                |
| Shr, FL, no-HS-diploma   | −.373** −.382** −.009 −.045* | −.211** −.151** .069** −.476** −.451**           |                                                    |                                |
| Shr, FL, HS-diploma      | −.337** −.240** −.152** −.040* | −.044 −.01 .041* −.504** −.385**                       |                                                    |                                |
| Shr, FL, some college/asso | −.102** .004 −.076** .028 | .101** .058** −.03 −.097** −.038*                      |                                                    |                                |
| Shr, FL, bachelor’s      | .535** .478** .100** .015 | .199** .122** −.047** .670** −.581**                       |                                                    |                                |
| Shr, FL, master’s        | .490** .326** .184** .034 | .026 0.008 −.089** .662** −.504**                       |                                                    |                                |
| Shr, FL, professional     | .443** .247** .202** .038* | −.043 −.03 −.068** .561** −.407**                      |                                                    |                                |
| Shr, FL, doctorate       | .278** .156** .160** .013 | −.025 −.018 −.067** .477** −.350**                      |                                                    |                                |
| Shr, males, masters/abv | .477** .386** .109** .013 | .122** .115** −.069** .692** −.594**                      |                                                    |                                |
| Shr, females, masters/abv | .493** .315** .201** .034 | .007 −.002 −.090** .676** −.509**                      |                                                    |                                |
means that when women have professional degrees, the male-advantage in earnings is narrower than in other categories of education. For females with professional degrees, the r-values become negative, and these values become stronger (−0.043* to −0.068**) and from −0.025 to −0.067** for females with doctoral degrees. This indicates that the relative male advantage in earnings become lower when females also have higher education; however, the strength of this advantage is stronger for those working less than fulltime, given the stronger coefficients. These findings flesh out interesting dynamics of differential levels of educational attainments, and how might they work for females versus males when they are employed fulltime versus parttime. When one looks at lower levels of education (no schooling, no high school diploma, high school diploma and some college/associate degree), both genders have negative r-coefficients for Y = median earnings for males and females both (A), as well as for the male advantage in

**Correlation is significant at the 0.01 level (2-tailed); *Correlation is significant at the 0.05 level (2-tailed)**
median earnings (C and D); however, the female/male ratio in median earnings become positive and significant when males and females both have no schooling at all—suggesting better parity in income. This, however, reflects a distressed economic situation.

Regarding the association between gendered-representations in various occupation-types and the dependent variables (gendered earnings), Table 2 suggests that higher male presence in three occupations—management, service and sales/office—associate with lower female median earnings, lower female/male ratios in earnings, and greater male advantage in earnings (overall and fulltime employed); these associations change signs for the masculine occupations (natural resources/construction and production/transportation/material moving). These suggest that in general, the occupations with higher presence of females are negatively associated with female-median earnings as well as female/male income parity.

Table 3 Regression models (stepwise method) for female earnings

| A. Y: Female median earnings, overall (inflation adjusted) | B  | Beta | t    | Sig |
|----------------------------------------------------------|----|------|------|-----|
| Constant                                                 | 53,675.51 | 34.11 | 0.00 |
| Shr, males, master’s degree                             | 65,904.25 | 0.20  | 7.46 | 0.00 |
| Shr, males, doctorate degree                            | −220,469.89 | −0.27 | −11.52 | 0.00 |
| Shr, females, doctorate degree                          | −138,404.49 | −0.11 | −4.28 | 0.00 |
| Shr, females, professional degree                       | 139,713.83 | 0.12  | 5.89 | 0.00 |
| Shr, females, no-HS-diploma                             | −69,984.32 | −0.37 | −20.45 | 0.00 |
| Shr, females, HS-diploma                                | −42,988.17 | −0.31 | −13.95 | 0.00 |
| Shr, females, some college/associate                     | −58,749.58 | −0.33 | −16.47 | 0.00 |
| M/F ratio, did not work at all                          | −1811.62 | −0.18 | −10.74 | 0.00 |
| M/F ratio, worked 15–34-Hrs/week, 50–52 weeks           | −922.00 | −0.05 | −3.72 | 0.00 |
| M/F ratio, worked 35 Hrs/more, 50–52 weeks              | −4718.34 | −0.23 | −15.06 | 0.00 |
| Diff, male–female, production, transp., material-moving, etc | −0.08 | −0.17 | −2.79 | 0.01 |
| Diff, male–female, sales/office                         | −0.17 | −0.27 | −4.23 | 0.00 |
| R-value                                                  | 0.680 |
| R-square                                                 | 0.463 |

| B. Y: Female-med-earnings, worked fulltime |
|---------------------------------------------|
| (Constant)                                  | 53,783.03 | 35.33 | 0.00 |
| Shr, males, master’s degree                 | 133,152.95 | 0.29  | 11.70 | 0.00 |
| Shr, males, doctorate degree                | −155,113.40 | −0.14 | −8.85 | 0.00 |
| Shr, males, no-HS-diploma                   | −18,768.23 | −0.09 | −3.69 | 0.00 |
| Shr, females, no-HS-diploma                 | −58,477.93 | −0.23 | −10.62 | 0.00 |
| Shr, females, HS-diploma                    | −44,885.10 | −0.23 | −13.37 | 0.00 |
| Shr, females, some college/associate         | −48,535.58 | −0.20 | −11.90 | 0.00 |
| Shr, females, master’s degree               | 48,970.18 | 0.12  | 5.48  | 0.00 |
| Shr, females, professional degree           | 166,112.37 | 0.10  | 6.28  | 0.00 |
| M/F ratio, Sc. & Engr., 25–64 Yrs           | −262.08 | −0.03 | −3.06 | 0.00 |
| M/F ratio, Sc./Engr-related field., 25–64 Yrs | −606.00 | −0.04 | −3.89 | 0.00 |
| M/F ratio, business-major-Educ., 25–64 Yrs  | −264.40 | −0.03 | −3.12 | 0.00 |
| M/F ratio, did not work at all              | −822.76 | −0.06 | −4.14 | 0.00 |
| M/F ratio, worked 15–34-Hrs/week, 50–52 weeks | −1580.16 | −0.06 | −5.58 | 0.00 |
| Diff, male–female, natural res. construction, maintenance, etc | 0.05 | 0.09 | 7.41 | 0.00 |
| R-value                                     | 0.795 |
| R-square                                    | 0.632 |
Female disadvantage in income earnings: human capital and occupational framework

As discussed in methods section, I used 28 explanatory variables in OLS regression model, and based on the significance of the variables and the R-square values, I decided to employ the Stepwise method which showed better regression models. Thus, using stepwise regression method as an analytical tool, I discuss major findings from these four regression models (Tables 3 & 4).

Regarding female earnings and its predictors, Tables 3(A & B) suggest that females with professional degrees associate with higher female median earnings ratios. For example, females with doctorate degrees have a higher median earnings ratio compared to males with no high school diploma. Conversely, males with some college or associate degrees have a lower median earnings ratio compared to females with professional degrees.

| A. Y: Female/male median earnings ratio, worked fulltime (infl adj) | B | Beta | t | Sig |
| --- | --- | --- | --- | --- |
| (Constant) | 0.80 | 0.12 | 42.23 | 0.00 |
| Shr, females, doctorate degree | 2.75 | 0.12 | 3.80 | 0.00 |
| Shr, females, professional degree | 1.83 | 0.09 | 3.49 | 0.00 |
| Shr, females, master's degree | 0.98 | 0.19 | 5.51 | 0.00 |
| Shr, females, HS-diploma | −0.52 | −0.21 | −8.05 | 0.00 |
| Shr, males, no-HS-diploma | 0.21 | 0.08 | 3.72 | 0.00 |
| Shr, males, HS-diploma | 0.24 | 0.12 | 4.20 | 0.00 |
| Shr, males, master's degree | −0.83 | −0.14 | −3.75 | 0.00 |
| Shr, males, doctorate degree | −1.68 | −0.12 | −3.91 | 0.00 |
| M/F ratio, Sc. & Engr., 25–64 Yrs | −0.01 | −0.11 | −6.01 | 0.00 |
| M/F ratio, Sc./Engr-related field., 25–64 Yrs | −0.01 | −0.07 | −3.86 | 0.00 |
| M/F ratio, arts/humanities/others, 25–64 Yrs | −0.01 | −0.04 | −2.27 | 0.02 |
| M/F ratio, worked 15–34 Hrs/week, 50–52 weeks | 0.02 | 0.05 | 3.07 | 0.00 |
| M/F ratio, worked 35 Hrs/more, 50–52 weeks | −0.01 | −0.04 | −2.02 | 0.04 |
| Diff, male–female, management, business, science & art | 0.00 | −0.11 | −6.14 | 0.00 |
| Diff, male–female, natural res. construction, maintenance, etc | 0.00 | 0.24 | 3.16 | 0.00 |
| Diff, male–female, production, transp., material-moving, etc | 0.00 | −0.19 | −2.49 | 0.01 |
| R-value | 0.376 | | | |
| R square | 0.141 | | | |

| B. Y: Female median earnings minus male median earnings, overall | B | Beta | t | Sig |
| --- | --- | --- | --- | --- |
| (Constant) | −6506.24 | −3.85 | 0.00 |
| Shr, males, no-HS-diploma | 39,305.53 | 0.23 | 9.61 | 0.00 |
| Shr, males, HS-diploma | 19,637.28 | 0.15 | 6.15 | 0.00 |
| Shr, males, some college/associate | 17,475.32 | 0.09 | 3.77 | 0.00 |
| Shr, males, master's degree | −70,066.51 | −0.19 | −6.10 | 0.00 |
| Shr, females, HS-diploma | −18,652.34 | −0.12 | −4.64 | 0.00 |
| Shr, females, professional degree | 123,736.99 | 0.12 | 5.48 | 0.00 |
| Shr, females, doctorate degree | −9171.16 | −0.41 | −25.23 | 0.00 |
| M/F ratio, Sc. & Engr., 25–64 Yrs | 1677.54 | 0.06 | 3.88 | 0.00 |
| M/F ratio, education-major, 25–64 Yrs | 181.37 | 0.06 | 3.72 | 0.00 |
| M/F ratio, worked 1–14 Hrs/week, 50–52 weeks | −9171.16 | −0.41 | −25.23 | 0.00 |
| M/F ratio, worked 15–34 Hrs/week, 50–52 weeks | 3509.31 | 0.18 | 11.65 | 0.00 |
| Diff, male–female, management, business, science & art | −0.12 | −0.09 | −5.69 | 0.00 |
| R-value | 0.601 | | | |
| R square | 0.361 | | | |
income whereas doctoral degrees for males and females both, and lower degrees for females (no-high-school diploma, with high-school diploma or some college/associates)—all have negative B-coefficients. This result is surprising in that the highest degree of doctorate may not necessarily associate with higher median-earnings for females. This is the sad reality for females in USA. Females’ higher education does not necessarily translate into greater earnings, except in select cases where women have professional education. (Table 3A) also suggests that for male/female ratios in work-status (did not work at all, worked for 15–34 h/week, and for those working more than 35 h/week, and fulltime workers at 50–52 weeks/year), the B-coefficients were strong and negative. This means that when the ratio of male versus females in these work-categories increase, they associate negatively with female median earnings. This makes sense because these patterns reflect negative work-status for women and hence lowered earnings. This model had an R-square of 0.463, which is quite good.

The R-square value for female median earnings for women who worked full-time, however, has far greater predictability with R-square of 0.632 (Table 3B). The positive B-coefficient for females with Master’s degree (B = 48,970.18) was missing in the model predicting female median earnings for overall women. This model better captures the earnings for fulltime working women and is more informative as the Bachelor’s level specializations come out as significant for male/female ratios in the sub-disciplines of science/engineering, science & engineering related fields and in business—fields deemed masculine in the larger society. This suggests need for strategic policies for including women in science & engineering disciplines, which can prepare them with skills that are valued in the new economy.

Female (dis)parity in earnings across us counties, 2019

Finally, concerning gender parity in earnings, Tables 4(A & B) illustrate the variables that serve as the best predictors for female versus male ratios in median earnings (for fulltime employed, Table 4A) as well as gaps (difference) in female and male median earnings for fully employed. Model-A only explains 14.1% variance in female/male earnings ratio; however, the B-coefficients on several education variables provide meaningful insights. With larger shares of females with higher education such as Masters, professional and doctorate degrees, the female/male earnings ratio increases, whereas higher share of females with high-school diploma has negative association. As expected, male/female ratios in science/engineering, science & engineering-related disciplines as well as those in arts/humanities/others—all associate with negative B-coefficients. This implies that higher ratio values (male vs female) associate with lower female median earnings.

Male/female ratio (worked 35 h/more, full year) has negative B-coefficients, suggesting that this category of work-status (fulltime, employed for whole year) has a negating effect on female/male earnings parity. This is quite concerning because one would expect better earnings with fuller employment for females. However, this can also be interpreted differently as this finding, indeed, hints at the culture of low-wage inertia. Currently, the female/male ratios in earnings—a measure of female earnings parity—is low because the number/share of women working fulltime, throughout the year is low, which does not give them enough bargaining power. This might pose a negating influence on the labor-market for women who are currently working fulltime. This also suggests a need for strategic steps toward creating facilities and opportunities (e.g., day care, maternity benefits, dependent care, and the like) that can enable more women to participate fully in the labor market such that their larger numbers in the labor-market can empower them to command better wages.

Regarding gender parity in earnings, Table 4B, with R-square of 36.1%, is a better model and suggests that higher shares of low-educated males (no-high school, with high-school, and some college/associate degrees), higher shares of well-educated females (professionals and doctorates) and higher male/female ratios with Bachelor’s level education-major—a field largely considered feminine—are all associated with greater earnings parity for women. This is interesting in that it provides progressive pathways toward becoming teachers and educations—which is still considered a feminine occupation.

Conclusions, policy implications and future research

This analysis hoped to explain why and how females suffer from earnings disadvantage compared to men
in the US. My aim was to explore how might the easy-fix socio-economic determinants such as human capital skills—proxied here by educational attainments, and labor-market attributes such as fulltime versus parttime work-status by gender and gender-based under/over representation in occupations might be associated with earnings differentials and gender (dis)parity. This analysis finds complex processes at play that create economic marginalization for women. Despite educational attainment, not all women are able to achieve earnings parity, and much of it is hidden in the cultural and societal constraints embedded in the labor market.

This analysis finds that male/female ratio by work-status for fulltime employed has a negating effect on female/male earnings parity. This, however, also points out the hidden truths in the larger society. The female/male ratios in earnings—a measure of female earnings parity/equity—is low because of a smaller percentage of women working fulltime, making them susceptible to labor market discrimination as they are unable to bargain for better wages. Thus, there is a need to create facilities and opportunities (e.g., day-care, dependent care, maternity benefits, flexible work hours, and the like) which will attract more women to work fulltime. This may eventually empower them to command better wages and negotiation power. Greater and fuller participation in the labor market will also empower them to strengthen their own human capital skills to stay competitive in the market—especially in the sub-specialties of science/engineering, science & engineering-related fields and business. Lack of enough women in science & engineering and in STEM disciplines associates with higher earnings disparity. Men enjoy higher earnings because of their over-representation in the masculine sub-disciplines of science & engineering, and related disciplines as well as in business—all of which provide better opportunities for men. The inability women to be fully engaged in the labor market further aggravates the cyclic effects of disadvantage in earnings.

This analysis also finds that three occupations—management, service, and sales/office—all associate with lower female median earnings, lower female/male ratios in earnings and greater male advantage in earnings (overall and fulltime employed); these relationships change for the masculine occupations (natural resources/construction and production/transportation/material moving). This also speaks of the feminization of specific occupations, because the above three occupations (management services and sales/office) have far greater representation of women. This speaks highly of the institutional and occupational sexism inherent in USA and elsewhere in the world wherein the occupations/industries that employ largely women have lower wages than the masculine jobs, even though the latter requires lower education (Coe et al., 2012; Glynn, 2018; Sharma, 2021a). This research also finds that both genders have lower earnings when they have lower levels of education—no schooling, no high school diploma, with high school diploma and/or some college/associate degree. Interestingly though, in terms of earnings parity, the female/male ratio in median earnings ger r-values (positive & significant) when both males and females both have no schooling at all. These, indeed, are indicative of a socially polarizing society in the new economy era wherein for those with low-skills, income differentials are not significant.

On the brighter side, though, professional degrees by females associate with higher earnings, and higher shares of females with Masters, professional and doctoral degrees associate with greater earnings parity with men. There is a need to improve the human capital skills for females, especially in the sciences & engineering and STEM disciplines so that more women can work in these well-paid professions. The finding that greater earnings parity occurs for better educated females (professional and/or doctoral degrees) and with higher ratios of male/female with education-major—a field that is largely considered feminine field—also provides an interesting and progressive pathway to break the cultural barriers regarding human capital attainment. In short, creating opportunities for women’s engagement in STEM disciplines and legislatively creating inclusive environments to facilitate fuller participation by women in the labor market is critical toward a more sustainable and economically equitable society.

This detailed analysis opened a pandora box for several new lines of inquiry. Ageing is inherent in labor market, regardless of gender. However, how does ageing in different occupation-types impact gendered-earnings, especially in different types of educational categories? This could be an interesting line of future inquiry. This analyses also illustrated various counties (e.g., the Mississippi Delta and the
Mountain states) with specific industry-specialization where gendered earnings and educational attainments showed distinct patterns. This needs to be pursued further. There is a need to pursue how women in STEM disciplines have changed in the last two decades or so, and how do they compare again male participation and earning differences—something that I would like to pursue in my immediate future.

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