The Gender Earnings Gap Among the Less-Educated: The Effect of Occupational Characteristics

Job Market Paper

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Abstract

This research focuses on the role of occupational characteristics in the occupation-specific gender earnings gap for individuals whose highest level of education is less than a four-year college degree. Using data from the American Community Survey (ACS) and the U.S. Department of Labor's Occupational Information Network (O*NET), I identify occupational characteristics that are associated with an increasing or decreasing gender earnings gap within occupations. I find the importance, necessity, and frequency of cooperatively working with other individuals within an occupation is associated with a decreasing gender earnings gap within occupations, whereas the amount of responsibility a worker has within an occupation is associated with an increasing gender earnings gap. I also find evidence of a relationship between the gender earnings gap and the price of temporal flexibility within occupations, with the price of flexibility increasing in the amount of time pressure a worker faces and the regularity of work schedules.

1. Introduction

For many years, men outpaced women in educational attainment, job experience, skills, and other wage-determining factors. Due to this difference in marketable skills, men received higher compensation in the labor market. However, as women achieved higher levels of education and experience, the difference in wages for men and women contracted. The ratio of median women's earnings to men's earnings went from approximately 0.60 in the 1950s to nearly 0.70 by 1989. More recently, the earnings ratio has been relatively constant around 0.79 since 2000. In this research, I explore the effect of occupational characteristics, rather than individual characteristics, on the gender earnings gap within occupations.

In Claudia Goldin's Presidential Address at the 2014 meeting of the American Economic Association (Goldin 2014), she addressed the gender earnings gap and what must happen in "its last chapter" for gender equality in earnings to be achieved. A portion of her analysis examines the role of occupational characteristics and how they are contributing to the earnings gap for college-educated individuals in the top 95 highest paid occupations (as ranked by male income). Using data from the U.S. Department of Labor's Occupational Information Network (O*NET), she focuses on five occupational characteristics that capture the amount of temporal flexibility an individual has in their occupation. She finds occupations with less temporal flexibility have larger gender earnings gaps.

I use an analysis similar to Goldin's (2014) to examine the gender earnings gap among individuals who do not have a college degree. I identify a comprehensive set of occupational characteristics using O*NET and examine their role in the gender earnings gap among individuals whose highest level of education is either a high school diploma (or equivalent credential), an associate's degree, or some college completed, but with no degree. Using data from the American

Community Survey (ACS), I estimate occupation-specific gender earnings gaps and then estimate the effect of occupational traits on the earnings gap.

This work contributes to the literature by identifying what occupational characteristics, rather than human capital variables or individual characteristics, are associated with a gender earnings gap within occupations. By merging the O*NET occupation categories with the ACS occupation categories, I can study the gender earnings gap from an occupational perspective after using individual-level data to estimate the earnings gap. Moreover, this research provides a comprehensive study of the gender earnings gap of the less-educated population exclusively, whereas the majority of the gender wage inequality research focuses on the college-educated population.

I choose to study the less-educated population, which I define as the individuals whose highest level of education is a high school diploma or equivalent credential, some college experience without a degree, or an associate's degree, because they compose over half of the civilian workforce. Those with a high school diploma or equivalent credential account for approximately one quarter of the civilian labor force, while those with some college experience or an associate's degree compose nearly 28% (Bureau of Labor Statistics 2017, 1).

Furthermore, according to the 2016 Annual Social and Economic Supplement of the Current Population Survey, 27% of all households are headed by someone with a high school diploma and 29% by someone with some college experience. Considering only households headed by a single person with a high school diploma or some college experience (rather than a married couple), 68% and 74% of them, respectively, are headed by a woman (United States Census Bureau 2016). In 2014, nearly 31% of female-headed households were below the poverty line, while that was only true of 16% of male-headed households (DeNavas-Walt and Proctor 2015). Since the majority of

households that are headed by a single individual with either a high school diploma or some college experience are headed by a woman and these households are more likely to be below the poverty line, understanding any barriers to these women's success in the labor market is exceptionally important.

2. Literature Review

From the 1950s to the 1970s, the ratio of women's wages to men's wages stayed relatively constant at approximately 0.60 (Blau and Kahn 2006; 1994; O'Neill 2003; O'Neill and Polachek 1993). The ratio began increasing in 1979 and then experienced a rapid increase through the entire 1980s decade. By 1989, the ratio had reached nearly 0.70 and, in the following decade, the ratio increased by another 3.5 percentage points (Blau and Kahn 2006). The increase in the earnings ratio over this time is attributed to increases in women's experience (both quantity and quality) relative to men (O'Neill and Polachek 1993); increases in women's educational attainment (Blau and Kahn 2006); women shifting out of women-dominated occupations into male-dominated occupations (Blau and Kahn 1997); and evidence of declining discrimination against women or an increase in women's unobservable skills (Blau and Kahn 1997).

By 2010, the unadjusted earnings ratio increased to 0.79 and it only increased to 0.82 when adjusted for human capital controls, highlighting the lack of explanatory power human capital variables hold anymore. A Oaxaca-Blinder decomposition shows education and experience were responsible for 27% of the gender gap in 1980, but in 2010, they only accounted for 8%. When controls are added for union coverage, industry, and occupation the unadjusted ratio increases to 0.92 (Blau and Kahn 2017).

In an attempt to explain the earnings gaps within occupations, Goldin (2014) develops a simple theoretical compensating differentials framework examining hours worked and the penalty for

temporal flexibility. Occupations that value long work hours or working during certain hours impose a very heavy penalty for fewer hours worked or a change in the timing of work hours. For example, in certain occupations, a 60 hour work week will produce earnings greater than twice the earnings of a 30 hour work week, or working eight hours from 8am-4pm produces higher earnings than working eight hours from 8am-12pm and 4pm-8pm. Reduction of wages does not occur at a linear rate with respect to hours missed, which implies there is a convex earnings structure in these occupations. This large penalty may induce a worker to switch to an occupation or position where time flexibility is not as costly. Occupations that have a linear wage structure impose no additional consequence, other than reduced wages, for temporal flexibility. Fewer hours worked implies a reduction of wages at a linear rate, which does not induce workers to change occupations or positions within an occupation (Goldin 2014).

Goldin (2014) argues the substitutability between workers is the mechanism driving the linearity or nonlinearity of earnings in an occupation. When workers have the ability to substitute for one another easily with minimal transactions costs, earnings are linear with respect to hours worked, and in the case where workers are imperfect substitutes for one another, earnings are nonlinear. That is, when workers can easily substitute for one another in an occupation, flexibility is not met with a disproportionately large reduction in earnings because it imposes no costs on the firm. Conversely, when workers are imperfect substitutes, obtaining flexibility will cause earnings to be reduced by a larger amount.

To quantitatively model the degree of substitutability between workers within an occupation, Goldin (2014) uses data on five occupational characteristics from the Occupational Information Network (O*NET) that capture the degree of substitutability within an occupation[1]. A high average

[1] Goldin uses data on the following occupational characteristics: time pressure, contact with others, establishing and maintaining interpersonal relationships, structured vs. unstructured work, and freedom to make decisions.

O*NET value of the five occupational characteristics reflects little substitutability between workers in an occupation, which is thought to be due to factors such as a large amount of time pressure, or frequent contact with others. With little substitutability between workers, any change in the hours worked induces a disproportionally large change in earnings. In this case, the pay structure is thought to be nonlinear, which implies there is a large penalty to flexibility. Thus, a large O*NET average value for an occupation can be thought of as representing a nonlinear pay structure in that occupation, while a small O*NET value is representing a linear pay structure, where there is no penalty attached to flexibility.

Goldin (2014) estimates the occupation-specific gender earnings gaps for all occupations, while controlling for demographic variables, education, and hours and weeks worked. A regression of the occupation-specific earnings gap for the top 95 highest paid occupations of college-educated workers on the average value of the five occupational characteristics shows occupations with a lower degree of substitutability between workers have larger gender earnings gaps. This supports her argument that certain occupations have pay structures that penalize individuals who desire temporal flexibility. Assuming women want more flexibility than men, this desire for temporal flexibility and the penalty (i.e. compensating differential) associated with it may explain why we still observe a gender earnings gap within an occupation after controlling for human capital and demographic variables[2,3].

The data values are normalized, and Goldin calculates the average of the five normalized characteristic values for each occupation.

[2] Cha and Weeden's (2014) empirical results are consistent with Goldin's (2014) argument of a nonlinear earnings structure. They also find that the incidences of "overwork" (defined as working a minimum of 50 hours per week) play a role in the gender earnings gap from 1979-2009. They find an earnings premium is associated with overwork and that men are more likely to overwork. Thus, overwork increases men's earnings relative to women's earnings.

[3] This is similar to the idea of occupational segregation. Polachek (1981) argued women are more likely to enter occupations where the wage penalty for time out of the labor force is low. He finds there is a higher probability that women will enter clerical, sales, craft, operative, or service occupations relative to professional occupations, where the loss of earnings potential is greatest.

I expand the research of the role of occupational characteristics in perpetuating the gender earnings gap within occupations by identifying specific occupational characteristics that are associated with an increasing or decreasing gender earnings gap within occupations. Goldin (2014) shows the average value of occupational characteristics that reflect the level of temporal flexibility is related to the gender earnings gap within occupations, but the effect of each characteristic individually is unknown. Moreover, I focus exclusively on the less-educated population in this study, which will allow me to see whether Goldin's (2014) theory and results generalize to a very different group of individuals.

The models I estimate are models of compensating differentials, rather than models of human capital, which have historically dominated the literature on the gender earnings gap. However, instead of estimating the effect of occupational characteristics on earnings (e.g. the effect of job riskiness on earnings), I estimate the effect of occupational characteristics on the gender earnings gap within occupations. Furthermore, I focus on characteristics of an occupation that reflect the typical duties and tasks workers face in an occupation (e.g. the necessity of working with a group) rather than characteristics that reflect more obvious occupational traits, such as job safety. Nearly all studies in the literature find a gender earnings gap after controlling for wage-determining variables, such as human capital characteristics, occupation choice, time worked, etc. Therefore, the remaining earnings gap can plausibly come from some characteristics that are inherent to a profession, such as the time constraints, tasks, or responsibilities faced by the worker.

3. Data & Methodology

3.1 Data

I use two sources of data, the American Community Survey (ACS) and the U.S. Department of Labor's Occupational Information Network (O*NET). The ACS is a national survey that is

administered on an annual basis by the United States Census Bureau. It is sent to approximately 3.5 million households asking detailed questions regarding demographic information, education, income, occupation, fertility, military status, citizenship, etc. O*NET is a comprehensive database that provides occupational information for nearly 1,000 jobs. It provides data on hundreds of job and worker characteristics based on survey responses from individuals employed in each of the jobs. The O*NET database serves as the replacement for the U.S. Department of Labor's Dictionary of Occupational Titles (DOT).

3.1.1 American Community Survey

I use ACS data for 2012-2014. Because I am examining the gender earnings gap for less-educated individuals in the civilian population, only individuals with a high school diploma or equivalent credential (e.g. GED)[4], an associate's degree, or some college experience but no degree are included in the sample. As previously mentioned, this group of individuals composes over half of the civilian workforce. Those with a high school diploma or GED account for approximately one quarter of the civilian workforce, while those with some college or an associate's degree account for nearly 28% (Bureau of Labor Statistics 2017, 1).

In addition to the education restrictions, I restrict the sample to persons of prime working age, which I define as 22-55 years of age, who have positive wage or salary income reported and work full-time year-round. I choose to use workers 22 years or older to avoid including students who are working while attending school, and I exclude workers over 55 to avoid individuals who retired

[4] Three exams in the U.S. can be used to obtain a high school equivalency credential: the General Educational Development test (GED), the Test Assessing Secondary Completion (TASC), and the High School Equivalency Test (HiSET) (Educational Testing Center 2017). States can also offer additional options to obtain a high school equivalency credential. For example, Pennsylvania offers a "30 College Credit Option", which awards a high school equivalency credential to a PA resident who has completed a minimum of 30 semester hours at an accredited postsecondary institution (Pennsylvania Department of Education 2016). For the sake of brevity, any high school equivalency credential will be referred to as GED for the remainder of this paper.

from a previous occupation and choose to work in a different, often less arduous, occupation in retirement. To be considered a full-time, full-year worker, an individual must work a minimum of 35 hours per week and 40 weeks per year. I choose 40 weeks per year because the next cutoff would be 48 weeks per year, which may be too restrictive. Lastly, I only use individuals who work in an occupation with 1) a minimum of 25 men and 25 women employed in the occupation, and 2) a minimum of 10% of all workers in the occupation falling into the education restrictions.

From the ACS data, I use data on individuals' annual earnings (wage or salary), education, occupation, working time (hours and weeks), and demographic information. I choose to use an individual's wage or salary income for the past 12 months over alternative earnings measures (e.g. total earnings) because I am focusing solely on the compensation individuals are receiving for their work in the labor market. For the same reason, I do not consider self-employment income.

Table 1 provides descriptive statistics of the sample. Column (1) shows the average income in the sample is roughly $45,000. The average number of hours worked per week is 43 and the average number of weeks worked in a year is approximately 51. The distribution of individuals' highest education level is also shown. Individuals who have a high school diploma as their highest education credential account for the largest proportion of the sample and those with a GED account for the smallest fraction.

In columns (2) and (3), the descriptive statistics are decomposed by gender. A comparison of columns (2) and (3) shows that, on average, men earn more than women and work slightly more hours in a typical week. Within the sample, the average man earns nearly $13,000 (or 34%) more than the average woman annually. The education distributions show that, generally speaking, women are more educated than men in this sample. Nearly 22% of women hold an associate's

degree, while that is true of only 15% of men. Similarly, 40% of men hold a high school diploma as their highest level of education compared to 32% for women[5].

Table 1: *Descriptive Statistics for Full-Time, Full-Year Workers Aged 22-55 Without a College Degree*

	(1) All Workers		*(2)* Male		*(3)* Female	
Variable	Mean	SD	Mean	SD	Mean	SD
Annual Wage or Salary Income	44,593	34,048	50,035	37,908	37,269	26,306
Usual weekly hours worked	43.46	7.98	44.87	8.83	41.56	6.17
Weeks worked	50.61	1.60	50.62	1.58	50.61	1.61
Age	40.35	9.82	39.93	9.79	40.91	9.84
White	0.78		0.80		0.76	
Black	0.11		0.10		0.14	
Amer. Ind/Alaska Native	0.01		0.01		0.01	
Asian	0.03		0.03		0.03	
Hawaiian/Pac. Island	0.002		0.002		0.002	
Other Race/Multiple Races	0.06		0.06		0.06	
HS Diploma	0.37		0.40		0.32	
GED (or alt. cred)	0.06		0.07		0.05	
Some Col. <1 yr	0.12		0.12		0.13	
Some Col. >1 yr	0.27		0.26		0.29	
Associate's degree	0.18		0.15		0.22	
Female	0.43					
N	1,210,371		694,411		515,960	

Source: American Community Survey 2012-2014

Notes: The sample includes all individuals who have positive income reported, whose highest level of education is either a high school diploma, GED, some college experience without a degree, or an associate's degree, and works in an occupation with a minimum of 25 men and women where at least 10% of all workers in the occupation fall within the education restrictions. Full-time (FT) is defined as working a minimum of 35 hours per week, and full-year (FY) is defined as working a minimum of 40 weeks per year

[5] I address the potential concern of the education distribution shifting systematically over the three ACS years informally by examining the education distribution across years. There is no evidence of systematic shifts occurring: For each respective education level, the percentage of the sample earning that credential stays within one percentage point over the course of the three years. I also verify that the education distribution across genders is not systematically changing over time by examining the education distributions across years by gender and I can draw the same conclusion for each gender.

3.1.2 Occupational Information Network

O*NET provides data on occupational characteristics for 974 occupations. For each occupation, O*NET provides 227 characteristics, which are classified into 6 broad categories: worker characteristics, worker requirements, experience requirements, occupational requirements, workforce characteristics, and occupation-specific information. Within each of these categories, there are additional subcategories. For example, under the occupational requirements category, there are 5 subcategories: generalized work activities (41 descriptors), intermediate work activities, detailed work activities, organizational context, and work context (57 descriptors). Since this research is concerned with the importance of occupational factors instead of individual factors, most relevant factors will come from the occupational requirements category.

The data from O*NET is unique and advantageous because it quantifies a large number of various occupational characteristics that are not obvious. The O*NET data has information on day-to-day responsibilities, tasks, pressures, and working conditions faced in an occupation. For example, O*NET provides information on how frequently a job uses different types of communication methods, such as public speaking or email. It also provides data on a worker's freedom to make decisions, responsibility for others, contact with others (in person or otherwise), and their consequences if an error is made. It also provides information on more obvious job characteristics, such as exposure to hazardous materials, likelihood of injury, and working conditions (e.g. indoor/outdoor, hot/cold, etc.).

One disadvantage of the O*NET data is the inconsistency of the measurement scales used. Unfortunately, the occupational characteristics are measured using multiple scales so they are not directly comparable. For example, some characteristics are measured on a scale from 1-5, while others are measured on a scale of 0-7. To remedy this, I normalize all the occupational data from

O*NET. Each occupational characteristic is normalized to have mean zero and standard deviation one.

Since O*NET provides data on approximately twice the number of occupations than are included in the ACS, I have to collapse multiple O*NET occupations to map to a single census occupation. Since the O*NET classification system is based on the Standard Occupation Classification system (SOC) and O*NET provides a crosswalk linking the two different systems, I first map O*NET occupations to SOC occupations. Then using a crosswalk published by the Bureau of Labor Statistics, I map SOC occupations to ACS occupations. If multiple SOC occupations map to a single ACS occupation, I weight each SOC occupation by the number of individuals employed in that occupation relative to the total number of individuals employed in the ACS occupation. Once the O*NET occupations and the ACS occupations are made compatible and have a one-to-one correspondence, 405 occupation categories fall into the sample restrictions.

As mentioned previously, O*NET provides data for more than 200 occupational characteristics. I do not use data on all of the occupational characteristics, especially the more obvious ones. It is well-known that hazardous or dangerous occupations have greater compensation compared to safe occupations to account for the increased risk workers face (see, among others, Smith (1979), Olson (1981), and Leeth and Ruser (2003)). I am more interested in a small set of occupational characteristics that capture the nuances of a worker's day-to-day activities and responsibilities.

Within the occupational requirements category, O*NET provides data on what are called "Structural Job Characteristics", "Work Context", and "Generalized Work Activities". The structural job characteristics reflect "the relationship or interactions between the worker and the structural characteristics of the jobs", while the work context variables reflect the "physical and

social factors that influence the nature of work". Generalized work activities are "activities that are common across a very large number of occupations" (National Center for O*NET Development). Table 2 lists the variables I use from each category and their respective descriptions.

While O*NET provides data on additional aspects of an occupation, I choose the 21 variables listed in Table 2 because they capture various aspects of the work that could be done on a typical day by workers in many occupations. Specifically, the O*NET characteristics I use attempt to capture, within an occupation, i) the importance (and necessity) of working with others; ii) the amount of responsibility a worker has; iii) the importance of leadership roles; iv) the type of work; and v) the work environment.

I include multiple characteristics that highlight the importance of working cooperatively with other individuals, including coworkers, workers in other firms, and the public, because interacting with others is shown to be a valuable skill for workers (Deming 2017; Borghans, ter Weel, and Weinberg 2014; Weinberger 2014; Bacolod and Blum 2010). From the selected characteristics in Table 2, the following characteristics capture the importance of working with others within an occupation: the frequency of face to face discussions; the frequency of being in contact with others (in person, by phone, email, etc); the importance of working with a group or team; the importance of working with external customers or the public; the importance of communicating with persons outside the organization; and the importance of establishing and maintaining interpersonal relationships. These characteristics reflect the importance and frequency with which workers must work together as well as with individuals outside of their firm.

I also include characteristics that reflect the level of responsibility and influence a worker has within an occupation since these characteristics are usually associated with an earnings premium

(e.g. see Fleming (2015)). The amount of responsibility a worker has within an occupation is reflected by: the amount of freedom a worker has to make decisions without supervision and the frequency in which he/she does so; the consequence of an error; and the level of responsibility a worker has for the outcomes of the work completed as well as for the health and safety of others. These characteristics reflect the accountability of a worker along with the amount of discretion a worker can use in his/her daily life. I include two characteristics, the importance of coordinating the work of others and the importance of staffing organizational units, to capture the importance of leadership roles and responsibilities.

I attempt to capture the type of work done within an occupation with the following six characteristics: the degree of automation; the importance of being exact or accurate; how structured or unstructured the work is; the importance of processing information; the importance of thinking creatively; and the importance of organizing, planning, and prioritizing work. Lastly, the level of competition and the frequency of conflict situations are two characteristics I include to reflect the work environment within an occupation.

Table 2: *Occupational Characteristics and their O*NET Description, 2016*

O*NET Occupational Characteristic	O*NET Characteristic Description
Structural Characteristics	
Consequence of Error	How serious would the result usually be if the worker made a mistake that was not readily correctable?
Frequency of Decision Making	How frequently is the worker required to make decisions that affect other people, the financial resources, and/or the image and reputation of the organization?
Freedom to Make Decisions	How much decision making freedom, without supervision, does the job offer?
Degree of Automation	How automated is the job?
Importance of Being Exact or Accurate	How important is being very exact or highly accurate in performing this job?
Structured versus Unstructured Work	To what extent is this job structured for the worker, rather than allowing the worker to determine tasks, priorities, and goals?
Level of Competition	To what extent does this job require the worker to compete or to be aware of competitive pressures?
Work Context	
Face-to-Face Discussions	How often do you have to have face-to-face discussions with individuals or teams in this job?
Contact with Others	How much does this job require the worker to be in contact with others (face-to-face, by telephone, or otherwise) in order to perform it?
Work with Work Group or Team	How important is it to work with others in a group or team in this job?
Deal with External Customers	How important is it to work with external customers or the public in this job?
Responsible for Others' Health and Safety	How much responsibility is there for the health and safety of others in this job?
Responsibility for Outcomes and Results	How responsible is the worker for work outcomes and results of other workers?
Frequency of Conflict Situations	How often are there conflict situations the employee has to face in this job?
Generalized Work Activities	
Processing Information	Compiling, coding, categorizing, calculating, tabulating, auditing, or verifying information or data.
Thinking Creatively	Developing, designing, or creating new applications, ideas, relationships, systems, or products, including artistic contributions.
Organizing, Planning, and Prioritizing Work	Developing specific goals and plans to prioritize, organize, and accomplish your work.
Communicating with Persons Outside Organization	Communicating with people outside the organization, representing the organization to customers, the public, government, and other external sources. This information can be exchanged in person, in writing, or by telephone or e-mail.
Establishing and Maintaining Interpersonal Relationships	Developing constructive and cooperative working relationships with others, and maintaining them over time.
Coordinating the Work and Activities of Others	Getting members of a group to work together to accomplish tasks.
Staffing Organizational Units	Recruiting, interviewing, selecting, hiring, and promoting employees in an organization.

Source: O*NET Database 21.0, released August 2016

3.2 Methodology

I use the ACS data to estimate earnings equations. I begin by estimating a basic earnings equation where I control for only demographic variables, education level, and time worked (hours per week and weeks per year). Then controls for occupation and the interaction terms of occupation and female are added successively. The occupation controls consist of 404 occupation dummies. Recall, there are 405 occupation categories, but I drop one (maids and housekeepers) so the model is not over-identified. The following model, which includes occupation controls and the interaction terms of occupation and female, is estimated using Ordinary Least Squares (OLS) and produces the occupation-specific gender earnings gap for the 404 occupation categories included in the model.

$$\log(earnings_i) = \beta_0 + \beta_1 female_i + \beta_2 age_i + \beta_3 race_i + \beta_4 hisp_i + \beta_5 \log(hrs_i) + \beta_6 \log(wks_i) + \beta_7 educ_i + \sum_{k=1}^{404} \gamma_k occ_i + \sum_{k=1}^{404} \theta_k (occ_i \times female_i) + \Phi_t + \varepsilon_i \quad (1)$$

In the model, $female_i$ is a dummy variable that takes the value of 1 if individual i is a woman. age_i is the age of individual i, which I will enter in the model as a quartic following Goldin (2014). $earnings_i$ represents individual i's annual earnings from wage or salary income in the past 12 months. $race_i$ represents a set of dummy variables that includes the following categories: African-American; American Indian or Alaska native; Asian; Native Hawaiian or other Pacific Islander; and some other race or the combination of two or more races (white is the omitted group). I include a Hispanic dummy variable, $hisp_i$, to control for different ethnic backgrounds as well.

I control for the time worked by individual i by including the usual hours worked per week (hrs_i) and the number of weeks worked in the past year (wks_i); both hours and weeks enter the model as log values. $educ_i$ represents a set of dummy variables for the highest level of educational attainment of individual i, including GED, some college but less than one year, more than one year of college but no degree, and associate's degree (high school diploma is the omitted

group). I use dummy variables for the highest grade completed so the effect of education can vary by education level.

I control for the occupation in which individual i is employed by using 404 occupation dummies and allow the effect of occupation to vary by gender (or, equivalently, allow the gender effect to vary by occupation) by including the interaction terms of occupation and female. The interaction of female and occupation captures the differential effect of being a woman in a given occupation. Lastly, Φ_t represents two year dummy variables to control for the different years of ACS data, and ε_i is the error term.

In this specification, $\widehat{gap_k} \equiv \widehat{\beta_1} + \widehat{\theta_k}$ is the occupation-specific gender earnings gap for occupation *k* adjusted for demographic information, education level, and time worked (or equivalently, the adjusted gender earnings gap within occupation *k*). 404 occupation categories are included in the model, so I estimate 404 occupation-specific gender earnings gaps. By estimating within-occupation earnings gaps, I avoid the issue of women selecting into women-dominated occupations, which are often lower-paying occupations compared to male-dominated occupations. Additionally, the distribution of women across occupations is no longer the main problem (Goldin 2014). The earnings gap is primarily stemming from differences in earnings between men and women within the same occupation.

Combining the data from O*NET with the estimation results from (1), I identify the occupational characteristics that are associated with the earnings difference between genders within occupations by regressing the estimated occupation-specific gender earnings gap on the normalized occupational characteristic values. By doing so, I can identify how certain characteristics of occupations affect the gender earnings gaps within occupations.

Using the comprehensive group of occupational characteristics listed in Table 2 and, following Goldin's (2014) approach, I estimate the following univariate models[6]:

$$\widehat{gap_k} = \beta_0 + \beta_1 ONETcharacteristic_k + \epsilon_k \quad (2)$$

Recall, $\widehat{gap_k}$ is the vector of estimated occupation-specific gender earnings gaps from the estimation of equation (1). $ONETcharacteristic_k$ represents one of the 21 normalized O*NET occupational characteristics (listed in Table 2) in occupation *k*. I choose to use 21 univariate regressions as opposed to a single multivariate regression that includes the 21 occupational characteristics. The characteristics are highly correlated so multicollinearity would be a problem in a multivariate regression. The results of a univariate regression show the effect of the occupational characteristic in the regression as well as everything it is correlated with. With these models, I am not aiming to estimate causal effects. Rather, in this "horserace" approach, I want to see the effect (and its magnitude) of each characteristic individually.

The characteristic descriptions in Table 2 show exactly what each O*NET characteristic measures. As discussed previously, the characteristics in Table 2 can be categorized into 5 aspects of an occupation: i) the importance of working with others (which includes $facetoface_k, contactothers_k, group\_team_k, external\ cust_k, outside\ person_k,$ $interpersonal_k$); ii) the amount of responsibility a worker has ($conseq\ error_k, outcomes_k,$ $othershealth_k, freq\ decision_k, free\ decision_k$) ; iii) the importance of leadership roles ($coordinate_k$, $staff\ units_k$); iv) the type of work ($automation_k$, $exact_k$, $processinginfo_k$, $thinkcreatively_k$, $org\ work_k$, $structured_k$); and v) the work environment ($competition_k$, $freq\ conflict_k$).

[6] Goldin uses data for only five characteristics that capture temporal flexibility. In her model, she aggregates the five characteristics and regresses the estimated occupation-specific gender earnings gap on the average of the five occupational characteristics.

Estimation of these 21 univariate models will allow me to identify what occupational characteristics, if any, rather than human capital differences, are contributing to the earnings difference between genders. Since I control for human capital and demographic variables as well as time worked in the estimation of the earnings gaps, the remaining difference in earnings can plausibly stem from occupational features.

4. Results & Discussion

4.1 The Gender Earnings Gap Within Occupations

Table 3 displays the estimation results for different specifications of the earnings equation (where the dependent variable is the natural log of annual earnings) for full-time, full-year workers aged 22-55. Column (1) shows the results for the most basic earnings equation, controlling for only demographic variables, education, and time worked. Column (2) adds 404 controls for occupation. Column (3) subsequently adds interaction terms of female and occupation and column (4), which will be discussed below, adds the interaction terms of occupation and hours[7].

In each specification, earnings are increasing with education. According to the most basic specification in column (1), relative to someone with a high school diploma (the omitted group), an individual with some college experience earns 11-16% more annually. The return to an associate's degree is greater still, with earnings being nearly 25% larger. Conversely, those with a GED earn approximately 8% less than individuals who have a diploma. The returns to education are approximately halved once controls for occupation are added with the exception of the penalty to a GED, which stays relatively constant in all specifications. This suggests that some of the returns to education come in the form of access to better-paying occupations.

[7] The full estimation results for the specifications in columns (2), (3), and (4) are available upon request.

Earnings are also increasing in the time worked (hours and weeks). Similar to education but less dramatic, the returns to hours and weeks worked fall once occupation controls are added, implying the effect of time worked is partially dependent on occupation. After controlling for occupation, earnings increase by approximately 17% if the number of weeks worked in a year increases by 10%, as shown in column (2). A 10% increase in the number of hours worked in a typical week would yield a 6% increase in earnings according to the specification in column (2). The latter result appears to be at odds with Goldin's (2014) result, which is that many occupations have a convex wage schedule, meaning a given increase in the number of hours worked would be met with an even larger increase in earnings. However, that result is based on the occupation-specific earnings elasticity with respect to hours worked, whereas the current results show the overall effect across all occupations.

The specification in column (3) produces 404 occupation-specific (or within occupation) log gender earnings gaps that are adjusted for demographic variables, education, and time worked. The occupation-specific log gender earnings gap for a given occupation is the sum of the coefficient on the female term and the coefficient on the interaction term of occupation and female. Figure 1 shows the distribution of the estimated occupation-specific log gender earnings gaps.

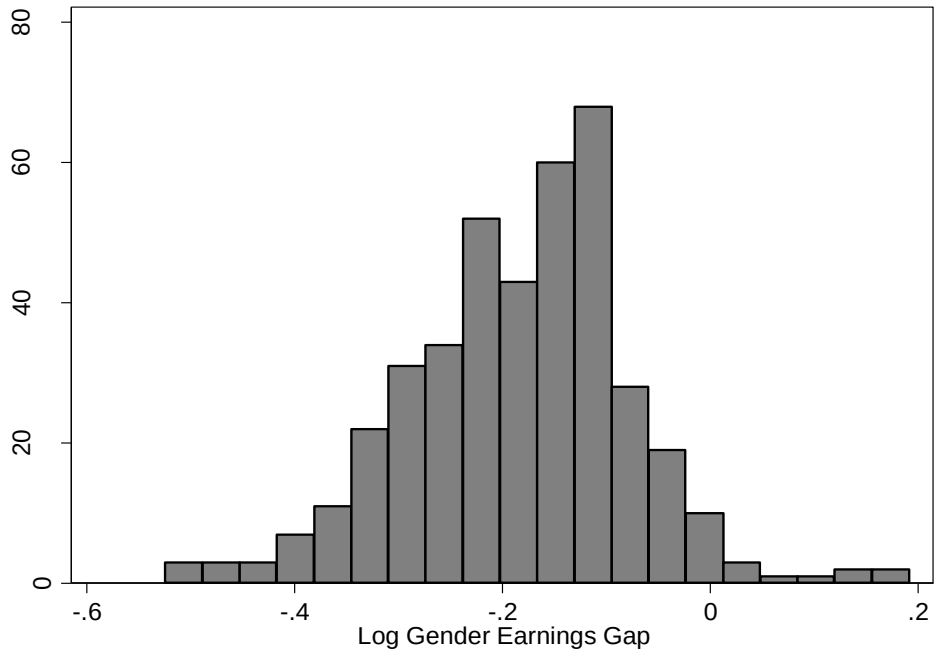
Table 3: *Estimation Results of Annual Earnings for Full-Time, Full-Year Workers Without a College Degree, 2012-2014*

Dependent Variable: ln(annual earnings)				
Independent Variable	*(1)*	*(2)*	*(3)*	*(4)*
Female	-0.241*	-0.193*	-0.207*	-0.209*
	(0.001)	(0.001)	(0.016)	(0.016)
African American	-0.165*	-0.090*	-0.089*	-0.087*
	(0.002)	(0.002)	(0.002)	(0.002)
American Ind./Alaska Native	-0.139*	-0.092*	-0.092*	-0.092*
	(0.005)	(0.004)	(0.004)	(0.004)
Asian	-0.083*	-0.013*	-0.010*	-0.008*
	(0.003)	(0.003)	(0.003)	(0.003)
Hawaiian/Pacific Islander	-0.051*	-0.012	-0.012	-0.011
	(0.011)	(0.010)	(0.010)	(0.010)
Other race/Combination	-0.037*	-0.012*	-0.011*	-0.010*
	(0.002)	(0.002)	(0.002)	(0.002)
Hispanic	-0.093*	-0.049*	-0.048*	-0.047*
	(0.002)	(0.002)	(0.002)	(0.002)
GED	-0.078*	-0.067*	-0.066*	-0.066*
	(0.002)	(0.002)	(0.002)	(0.002)
Some College < 1 yr.	0.113*	0.050*	0.050*	0.049*
	(0.002)	(0.002)	(0.002)	(0.002)
Some College >1 yr.	0.159*	0.075*	0.075*	0.074*
	(0.001)	(0.001)	(0.001)	(0.001)
Associate's Degree	0.244*	0.098*	0.097*	0.097*
	(0.001)	(0.001)	(0.001)	(0.001)
ln(hours)	0.720*	0.597*	0.593*	0.418*
	(0.003)	(0.003)	(0.003)	(0.052)
ln(weeks)	2.121*	1.725*	1.720*	1.722*
	(0.015)	(0.014)	(0.014)	(0.014)
Intercept	-6.935*	-4.370*	-4.323*	-3.630*
	(0.172)	(0.158)	(0.158)	(0.249)
Occupation Controls	No	Yes	Yes	Yes
Occupation*Female Interactions	No	No	Yes	Yes
Occupation*Hours Interactions	No	No	No	Yes
R^2	0.2159	0.3411	0.3433	0.3463
F value	17543.15	1480.84	764.49	520.30
Pr >F	0.0000	0.0000	0.0000	0.0000
Sample Size	1,210,371	1,210,371	1,210,371	1,210,371

Notes: *, **, *** indicate significance at the 1%, 5%, and 10% level, respectively. Standard errors are shown in parenthesis. Controls for age and year are included, but are not reported for the sake of brevity. "Occupation Controls" are 404 occupation dummy variables and "Occupation*Female Interactions" are 404 interaction terms of the occupation dummy variables and the female dummy variable. The "Occupation*Hours Interactions" are 404 variables where the occupation dummy variables are interacted with ln(hrs). The full estimation results that include the additional indicator variables for occupation, female and occupation, and hours and occupation are available upon request. The estimation results are for full-time (defined as working 35 hours or more per week), full-year workers (defined as working a minimum of 40 weeks per year) who are 22-55 years old.

The average log gender earnings gap within occupations (weighted by the number of women in each occupation) is -0.176, which corresponds to an earnings ratio of 0.839. The median log gender earnings gap of -0.171 is larger than the mean and more mass lies to the left of the distribution's central tendency, giving the distribution a slight negative skew. The largest gender earnings gap in an occupation corresponds to the minimum log gender earnings gap of -1.569, which translates to an earnings ratio of 0.208, and belongs to the occupation drywall installers, ceiling tile installers, and tapers. This observation is an outlier, which is excluded from Figure 1 so as to not distort the distribution; the next largest log gender gap is -0.524.

Figure 1: *Frequency Distribution of the Occupation-Specific Log Gender Earnings Gaps of Full-Time, Full-Year Workers Without a College Degree*



Source: Author's calculations using the American Community Survey 2012-2014.

Notes: The occupation-specific log gender earnings gaps are calculated using the estimated coefficients from column (3) in Table 3 (i.e. $\widehat{\beta_1} + \widehat{\theta_k}$ in equation (1) in section 3.2 where $\widehat{\beta_1}$ is the coefficient on $female_i$ and $\widehat{\theta_k}$ is the coefficient on $occ_i \times female_i$). The occupation-specific earnings gaps are adjusted for demographic variables, education, and time worked. The unadjusted mean and standard deviation are -0.188 and 0.128, respectively.

The maximum log gender earnings gap of 0.192 shows women in this occupation (gaming cage workers) earn approximately $0.21 more per $1 than men. Women earn a premium relative to men in only 13 occupations (3.22% of all occupations). In the remaining 391 occupations, women earn less than men even after controlling for time worked, demographic variables, and education level. The earnings ratio in over 80% of the occupations is less than or equal to 0.90 (which corresponds to a log gender earnings gap of -0.1 or below), meaning that in over 80% of the occupations (333 to be exact) women earn $0.90 or less per $1 men earn. In the majority of occupations (278 occupations or 69% of all occupations), women earn between $0.74 and $0.90 per $1 men earn.

4.2 The Effect of Occupational Characteristics on the Gender Earnings Gap

Figure 1 shows the earnings gap varies greatly across occupations. This suggests that something must be happening within occupations to cause this variation. To investigate this possibility, I estimate 21 univariate regressions of the occupation-specific gender earnings gap of full-time, full-year workers aged 22-55 on 21 occupational characteristics from O*NET. Table 4 shows the results of the 21 estimations. When interpreting the results in Table 4, it is important to keep in mind that the dependent variable is the occupation-specific log gender earnings gap estimated in equation (1). Since a negative estimated coefficient decreases the log gender gap (i.e. makes it a larger negative value), variables that have a negative estimated coefficient are associated with an increasing gender earnings gap (and vice versa). As previously mentioned, I do not estimate a single multivariate regression with the 21 characteristics because the occupational characteristics are correlated, and thus, multicollinearity may lead to erroneous and imprecise estimates of the effect of each characteristic. Since I estimate 21 univariate regressions, the estimated coefficient in each regression captures the effect of the occupational characteristic in the

regression as well as everything it is correlated with. My goal here is not to estimate causal effects but to get a "horserace" sense of the magnitudes of the effect of each characteristic individually.

The regressors in the first six models reflect the importance, necessity, and frequency of working with others within an occupation. Five of them have a significant estimated effect on the occupation-specific gender earnings gap, with four of them being significant at the 1% level. They all have a positive estimated effect, meaning they are associated with a decreasing gender earnings gap. Additionally, the magnitudes of the estimated effects are largest for these characteristics that reflect the importance and frequency of working with others compared to all other occupational characteristics included in this study. A one standard deviation increase in the importance of developing interpersonal relationships, communicating with persons outside the firm, working with the public or external customers, or the amount of contact a worker must have with others is associated with a 0.02-0.03 fall in the occupation-specific log gender earnings gap, which corresponds to an 0.02-0.03 increase in the earnings ratio. The effect of a one standard deviation increase in the importance of working with a group is slightly smaller and less significant.

Similar to these results, Borghans, ter Weel, and Weinberg (2014) find people skills are associated with a decreasing gender earnings gap. They find the importance of people tasks and the premium associated with them increased from 1970-2002. Moreover, there is a positive and significant correlation between women and interpersonal tasks (Borghans, ter Weel, and Weinberg 2008), and occupations where people skills are important tend to favor women (Borghans, ter Weel, and Weinberg 2014). This implies women should make gains in their earnings relative to men due to the importance of having people skills in the labor market, which is the result they find. The current results support this: In occupations where working with others is important and necessary, the earnings gap is decreasing.

Table 4: *Estimation of the Effect of Occupational Characteristics on the Occupation-Specific Gender Earnings Gap of Full-Time, Full-Year Workers Without a College Degree*

	Dependent Variable: ln (Occupation-Specific Gender Earnings Gap)			
	Independent Variable	*Coefficient Estimate*	*Model Statistics*	
Working with Others	Face-to-face discussions	0.004	R^2	*0.0012*
		(0.006)	*F value*	*0.47*
			Pr >F	*0.4936*
	Contact with others	0.023*	R^2	*0.0323*
		(0.006)	*F value*	*13.42*
			Pr >F	*0.0003*
	Work with a group or team	0.012***	R^2	*0.0086*
		(0.006)	*F value*	*3.48*
			Pr >F	*0.0630*
	Deal with external customers	0.030*	R^2	*0.0545*
		(0.006)	*F value*	*23.17*
			Pr >F	*0.0000*
	Communicate with outside persons	0.027*	R^2	*0.0451*
		(0.006)	*F value*	*19.00*
			Pr >F	*0.0000*
	Interpersonal relationships	0.028*	R^2	0.0470
		(0.006)	*F value*	19.82
			Pr >F	0.0000
Amount of Responsibility	Freedom to make decisions	-0.005	R^2	0.0017
		(0.006)	*F value*	0.69
			Pr >F	0.4053
	Frequency of decision making	0.004	R^2	0.0011
		(0.006)	*F value*	0.44
			Pr >F	0.5085
	Consequence of error	-0.004	R^2	0.0010
		(0.006)	*F value*	0.40
			Pr >F	0.5255
	Responsible for outcomes	-0.014**	R^2	0.0118
		(0.006)	*F value*	4.79
			Pr >F	0.0292
	Responsible for others' health	-0.012***	R^2	0.0082
		(0.006)	*F value*	3.32
			Pr >F	0.0690
Leadership Roles	Coordinate the work of others	0.001	R^2	0.0001
		(0.006)	*F value*	0.03
			Pr >F	0.8662
	Staff organizational units	0.013**	R^2	0.0102
		(0.006)	*F value*	4.14
			Pr >F	0.0426

Type of Work	Degree of automation	-0.005 (0.006)	R^2 *F value* *Pr >F*	0.0017 0.70 0.4046
	Importance of being exact	0.004 (0.006)	R^2 *F value* *Pr >F*	0.0010 0.39 0.5320
	Structured vs. Unstructured	0.0001 (0.006)	R^2 *F value* *Pr >F*	0.0000 0.00 0.9861
	Processing information	0.014** (0.006)	R^2 *F value* *Pr >F*	0.0125 5.09 0.0246
	Thinking creatively	0.004 (0.006)	R^2 *F value* *Pr >F*	0.0009 0.37 0.5437
	Organizing/planning work	0.011*** (0.006)	R^2 *F value* *Pr >F*	0.0072 2.90 0.0895
Work Environment	Frequency of conflict situations	0.015** (0.006)	R^2 *F value* *Pr >F*	0.0146 5.97 0.0150
	Level of competition	-0.004 (0.006)	R^2 *F value* *Pr >F*	0.0009 0.35 0.5558

Notes: *, **, *** indicate significance at the 1%, 5%, and 10% level, respectively, and standard errors are shown in parenthesis. The reported coefficients are from 21 univariate regressions that are each estimated with an intercept term where the dependent variable is the log occupation-specific gender earnings gap for full-time, full-year workers aged 22-55. The sample size is 404 in each regression.

The next five regression coefficients capture the level of responsibility or the amount of influence a single worker has in an occupation. Of these five occupational characteristics, only two have a significant estimated effect on the gender earnings gap. Interestingly, the two characteristics that have a significant estimated effect are the characteristics that directly measure the amount of responsibility a worker has in an occupation. The occupation-specific gender earnings gap is increasing in the amount of responsibility a worker has for outcomes of the work done/the results of others, and the earnings gap is also increasing in the amount of responsibility a worker has for the health and safety of others. A one standard deviation increase in the amount of responsibility for the outcomes of the work done (for the health and safety of others) is associated with a 0.014

(0.012) decrease in the earnings ratio. That is, if the earnings ratio of women's earnings to men's earnings within an occupation is 1, a one standard deviation increase is associated with a fall in the earnings ratio to 0.986 (0.988).

These two characteristics that directly measure the amount of responsibility a worker has in an occupation are the only occupational characteristics significantly associated with an increasing gender earnings gap. This suggests that in occupations where workers are directly responsible for the work outcomes/results of others or for the health and safety of other individuals, such as in managerial or supervisory positions, the gender earnings gap is larger than it would be in other occupations. The data supports this notion. The 20 occupations with the largest values for the responsibility for outcomes and results are various managers or first-line supervisors, and the average log gender earnings gap in these 20 occupations is -0.225 (with an unweighted average of -0.215), which is substantially larger than the overall average occupation-specific gender earnings gap of -0.176.

The results of a study of the U.S. hospitality industry are consistent with this result. Across the entire U.S. hospitality industry women are paid less than men, losing out on approximately 5.5% of the average income. However, female managers are the most disadvantaged within this industry, missing out on nearly 22% of the mean income of managers in the hospitality sector (Fleming 2015).

Of the next ten models, which have characteristics that reflect leadership roles, the type of work, and the work environment, only four characteristics have a significant estimated effect on the occupation-specific gender earnings gap. The importance of staffing organizational units, processing information, organizing/planning work, and the frequency of conflict situations are all significantly associated with a decreasing gender earnings gap. The magnitudes of the estimated

effects of these characteristics are very similar as well. A one standard deviation increase in any of these characteristics is associated with a decrease in the gender earnings gap of 0.011-0.015.

Finding the frequency of conflict situations is significantly associated with a decreasing gender earnings gap is surprising. I would expect occupations with frequent conflicts to be male-dominated, and male-dominated occupations are typically higher paid. The occupations with some of the highest values for the frequency of conflict situations include police officers, supervisors of police and detectives, and supervisors of correctional officers, where 88%, 85%, and 75%, respectively, of all workers in each job are men. However, for the ten occupations with the highest frequency of conflict situations the average gender earnings gap is -0.164 (with an unweighted average of -0.150), which is smaller than the overall average gender earnings gap of -0.176. Even though men are more likely to work in conflict-riddled occupations, it appears greater frequency of conflict situations in an occupation is associated with greater gender equality in earnings.

Similarly, Baker and Cornelson (2016) find men are more likely to work in an occupation with a high level of competitive pressure. However, it appears the level of competition is unrelated to the gender earnings gap within occupations. That is not to say that occupations that have competitive pressures do not have a gender earnings gap, but the gender earnings gaps in those occupations are not related to the amount of competitive pressures in the occupation.

The lack of significance of regressors still provides important information. For example, the severity of a mistake and the freedom and frequency of making decisions, while reflecting different types of responsibilities just like the characteristics that directly measure the amount of responsibility a worker has in an occupation, do not appear to affect the gender earnings gap in an occupation. This implies that not all responsibilities in an occupation are equal in influencing the gender earnings gap. Similarly, the importance of processing information, which includes

requiring workers to compile, code, and categorize data, and the importance of a worker prioritizing his/her work to accomplish goals are associated with a decreasing gender earnings gap, whereas the importance of thinking creatively, which requires workers to design and/or create new ideas or products, appears to be unrelated to the earnings gap in an occupation. This implies only certain occupational tasks are associated with the earnings gap within occupations.

In regards to how the type of work done in an occupation influences the gender earnings gap, the degree of automation, the importance of being exact, and how structured or unstructured the work is are not significant in the estimation of the gender earnings gap. If substitutability between workers decreases the gender earnings gap as Goldin (2014) hypothesizes, I would expect each of these characteristics to be significantly associated with a decreasing gender earnings gap. Instead, their estimated effects are insignificant and nearly zero. In occupations where being exact in production is important, production is highly automated, and/or the tasks are not structured for a specific individual (meaning another worker can easily replace that worker), workers should have the ability to easily substitute for one another. If substitutability between workers is easy, there should be no transaction costs (or minimal costs) of substituting, implying reduced hours or a change in the timing of hours should impose no cost and earnings should move towards equality in such occupations. However, these characteristics are not significant in the estimation of the gender earnings gap and their lack of significance does not support this substitutability argument.

Similarly, I find strong evidence that working with others (in a variety of different capacities) is associated with a decreasing gender earnings gap, which is at odds with Goldin's (2014) theory about the substitutability of workers. She argues that working in an occupation that requires personal relationships can make workers imperfect substitutes for each other, which can contribute to the gender earnings gap by making flexibility costly. However, she never isolates the effect of

working with others empirically. Instead, she finds the average of five occupational characteristics that reflect working with others, among other things, increases the occupation-specific gender earnings gap.

The substitutability theory may not hold in this study since I am examining the less-educated population. Goldin (2014) argues that substitutability between workers can decrease the gender earnings gap within occupations for college-educated workers in the top 95 highest-paid occupations. In those occupations, workers are highly educated and highly skilled, making them hard to replace. In this study, workers have less than a four-year college degree, and they work in occupations that are less specialized and require less training and education. For that reason, the ability to substitute one worker for another may not be difficult and may play no role in the gender earnings gap within occupations where the less-educated population works.

However, while it appears the substitutability between workers does not have a direct effect on the gender earnings gap for the less-educated population, there is not enough evidence to completely dismiss Goldin's (2014) substitutability theory. Goldin (2014) argues in jobs where workers are imperfect substitutes for one another, a penalty for flexibility exists, which can contribute to the earnings gap. Thus, it is possible the degree of substitutability between workers may affect the earnings gap through its role in determining the price of temporal flexibility, and I explore this possibility below.

5. The Role of Temporal Flexibility and Working Hours in the Gender Earnings Gap

Following Goldin's (2014) work, which emphasizes how temporal flexibility and the penalty associated with it influences the gender earnings gap, I investigate the role of temporal flexibility and working hours in perpetuating the gender earnings gap within occupations. Furthermore, I aim to identify the characteristics of an occupation that cause earnings to be sensitive to changes in the number of hours worked.

The pursuit of flexibility can lead to workers sorting across occupations, which is consistent with the theory of occupational segregation, but it can also lead to workers sorting across jobs (or niches) within occupations. Since multiple studies show the increasing importance of occupation when considering the gender earnings gap (Goldin 2014, Blau and Kahn 2017, Baker and Cornelson 2016, Goldin et al. 2017), this research focuses on what is happening within occupations.

Because flexibility is typically regarded as a desirable job amenity it will, according to the theory of compensating differentials, come at the price of lowered earnings. Within an occupation, a job offering a high level of temporal flexibility is expected to have lower earnings than a comparable job in the same occupation that does not offer the same amount of temporal freedom. For example, an individual who is employed as a legal secretary must prepare legal documents (among other tasks), often having to meet strict deadlines and work long hours to do so, whereas a secretary in a different environment, such as a school, is responsible for more typical secretarial duties like scheduling appointments, maintaining student records, and greeting visitors. Both individuals work in the occupation of "secretaries and administrative assistants", but a legal secretary is likely to have less flexibility due to the strict deadlines he/she must meet. As a result, earnings of legal secretaries are greater than earnings of other types of secretaries who have more flexibility. The median annual earnings for legal secretaries in 2016 was $44,180, while the median annual earnings of secretaries and administrative assistants excluding legal, medical, and executive assistants was $34,820 (Bureau of Labor Statistics).

Since different individuals place different values on flexibility, the price, in terms of forgone earnings, an individual is willing to pay for flexibility varies. An individual who strongly desires flexibility is willing to forego a nontrivial amount of earnings in order to obtain flexibility, whereas

an individual who does not value flexibility is not willing to sacrifice earnings for flexibility. If women desire flexibility more than men, the gender earnings gap within occupations may stem from the different desire for and price of temporal flexibility.

Since the price of temporal flexibility is hard to quantify, I use the elasticity of earnings with respect to hours worked within an occupation as a proxy for it. Goldin (2014) uses the earnings-hours elasticity to look at the role of working hours in the occupation-specific gender earnings gap. The earnings-hours elasticity captures how responsive earnings are to a change in the number of hours typically worked in a week. When the elasticity is large, earnings are sensitive to any small change in the number of hours worked. Thus, a large earnings elasticity represents a high price of temporal flexibility (and vice versa). In an occupation with a high earnings-hours elasticity, individuals who desire temporal flexibility will be adversely affected. Their earnings will be significantly lower than the earnings of an individual who does not want flexibility, since they have to pay a high price for the flexibility they desire. If the individuals who desire flexibility are women, the within-occupation gender earnings gap may be stemming from the high price of temporal flexibility.

I begin by estimating the occupation-specific earnings elasticity with respect to hours worked by adding an interaction term of log hours and occupation to the basic earnings equation:

$$\log(earnings_i) = \beta_0 + \beta_1 female_i + \beta_2 age_i + \beta_3 race_i + \beta_4 hisp_i + \beta_5 \log(hrs_i) + \beta_6 \log(wks_i) + \beta_7 educ_i + \sum_{k=1}^{404} \gamma_k occ_i + \sum_{k=1}^{404} \theta_k \, (occ_i \times female_i) + \sum_{k=1}^{404} \delta_k \, (occ_i \times log(hrs_i)) + \Phi_t + \varepsilon_i \quad (3)$$

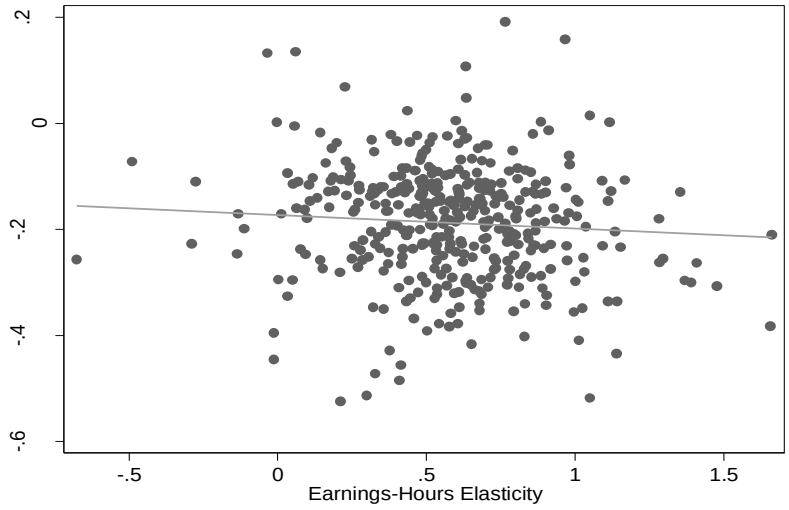
In this model, $\widehat{\beta_5} + \widehat{\delta_k} \equiv \widehat{\eta_{eh_k}}$ is the estimated occupation-specific earnings-hours elasticity. Column (4) of Table 3 shows a subset of the estimation results when the interaction effect is added.

While the earnings-hours elasticity can capture the responsiveness of earnings with respect to a change in the number of weekly hours worked, it does not provide any information on the

responsiveness of earnings with respect to the timing of the hours worked. That is, the number of hours worked is only part of the flexibility story. Flexibility can also be achieved through the timing of work hours, but due to data constraints, the change in earnings due to a change in the timing of working hours cannot be found. Thus, I will focus on flexibility in terms of the number of working hours.

A simple plot (Figure 2) of the occupation-specific earnings-hours elasticity estimated in equation (3) against the occupation-specific gender earnings gap estimated in equation (1) shows that occupations with a large earnings-hours elasticity have a large gender earnings gap. That is, in occupations where flexibility is costly, the gender earnings gap is large.

Figure 2: *The Occupation-Specific Gender Earnings Gap and Earnings-Hours Elasticity of Full-Time, Full-Year Workers Without a College Degree*



Notes: Quantitatively, the relationship between the gender earnings gap and the earnings-hours elasticity within an occupation is given by: $\widehat{gap_k} = -0.173 - 0.026\widehat{\eta_{eh_k}}$, with the standard error of the slope estimate being 0.021.

Because of this, it would be extremely valuable to identify what features of an occupation are associated with a high price of temporal flexibility. Isolating the occupational characteristics that contribute to a large earnings elasticity within an occupation will have important implications in achieving gender equality in earnings as well as providing insight as how to lower the price of

flexibility within occupations. To do this, I use data on 10 occupational characteristics and estimate the following model using OLS.

$$\widehat{\eta_{eh\,k}} = \beta_0 + \beta_1 interpersonal_k + \beta_2 free\ decision_k + \beta_3 time\ pressure_k + \beta_4 contactothers_k + \beta_5 structured_k + \beta_6 work\ sched_k + \beta_7 duration_k + \beta_8 pace\_equipment_k + \beta_9 group\_team_k + \beta_{10} time\ management_k + \epsilon_k \quad (4)$$

The characteristic descriptions in Table 5 identify exactly what each characteristic measures. The first five characteristics in the model are the characteristics Goldin (2014) identifies as influencing temporal flexibility, and the latter five characteristics I identify as likely influencing flexibility.

Table 5: *Occupational Characteristics that Influence Flexibility and their O*NET Description, 2016*

O*NET Occupational Characteristic	O*NET Characteristic Description
Structural Characteristics	
Work Schedules	How regular are the work schedules for this job?
Duration of Typical Work Week	Number of hours typically worked in one week.
Freedom to Make Decisions	How much decision-making freedom, without supervision, does the job offer?
Time Pressure	How often does this job require the worker to meet strict deadlines?
Structured versus Unstructured Work	To what extent is this job structured for the worker, rather than allowing the worker to determine tasks, priorities, and goals?
Pace Determined by Speed of Equipment	How important is it to this job that the pace is determined by the speed of equipment or machinery? (This does not refer to keeping busy at all times on this job.)
Work Context	
Work with Work Group or Team	How important is it to work with others in a group or team in this job?
Contact with Others	How much does this job require the worker to be in contact with others (face-to-face, by telephone, or otherwise) in order to perform it?
Generalized Work Activities	
Establishing and Maintaining Interpersonal Relationships	Developing constructive and cooperative working relationships with others, and maintaining them over time.
Cross-Functional Skills	
Time Management	Managing one's own time and the time of others.

Source: O*NET Database 21.0, released August 2016

I argue each of these characteristics affects the amount of flexibility a worker has in an occupation, either through the freedom (or lack thereof) to change the timing or quantity of working hours (the latter five characteristics in the model) or through the substitutability of workers (the first five characteristics in the model). In occupations where workers have little

freedom to alter their working hours or are imperfect substitutes for one another, flexibility is more expensive, meaning the earnings-hours elasticity will be increasing. These characteristics may drive the gender earnings gap through their role in making temporal flexibility an expensive job amenity. The estimation results of (4) are shown in Table 6.

Two occupational characteristics, the amount of time pressure a worker faces and the regularity of work schedules, are significantly associated with an increasing occupation-specific earnings-hours elasticity[8]. That is, a higher frequency in which workers must meet deadlines and regular working schedules are both associated with an increasing price of flexibility in occupations. One of these characteristics captures the importance of the timing of working hours and the other makes workers imperfect substitutes for one another. Specifically, in occupations where schedules are set and workers follow an established routine, the price of flexibility is higher than in a comparable occupation where that is not the case. This implies that earnings are sensitive to the timing of the hours worked, but the lack of significance of the estimated effect of the duration of a typical work implies the price of flexibility is not sensitive to the number of hours worked. The positive relationship between the elasticity of earnings and the amount of time pressure a worker faces in an occupation is consistent with Goldin's (2014) theory about the substitutability between workers. Goldin (2014) argues that within occupations where workers must meet deadlines frequently, workers become imperfect substitutes for each other, which can cause earnings to be sensitive to any time away from the workplace. According to the results above in section 4.2, it appears substitutability between workers does not directly influence the gender earnings gap within occupations, but according to the current results, it appears to have a negative relationship with

[8]The occupation-specific earnings-hours elasticity is increasing in the regularity of work schedules because a lower value for the regularity of work schedules indicates a more regular schedule within an occupation.

the price of flexibility. That is, the price of flexibility appears to be increasing as the substitutability between workers in an occupation decreases.

Table 6: *Estimation of the Occupation-Specific Earnings-Hours Elasticity of Full-Time, Full-Year Workers Without a College Degree Using Occupational Characteristics*

Dependent Variable: Occupation-Specific Earnings-Hours Elasticity	
Independent Variable	
Interpersonal relationships	0.035
	(0.025)
Freedom to make decisions	0.012
	(0.026)
Time Pressure	0.060*
	(0.021)
Contact with others	0.002
	(0.023)
Structured vs. Unstructured	-0.029
	(0.029)
Regularity of work schedules	-0.028***
	(0.015)
Duration of typical work week	0.011
	(0.022)
Pace determined by equipment	0.023
	(0.020)
Work with a group or team	0.005
	(0.022)
Importance of time management	-0.062*
	(0.023)
Intercept	0.581*
	(0.015)
R^2	0.0641
F value	2.24
Pr >F	0.0149
Sample Size	404

Notes: *, **, *** indicate significance at the 1%, 5%, and 10% level, respectively. Robust standard errors are shown in parenthesis. The dependent variable is the estimated occupation-specific earnings-hours elasticity for full-time, full-year workers aged 22-55.

The importance of time management is the only characteristic that is significantly associated with a decreasing earnings-hours elasticity within occupations. This relationship may be reflecting reverse causality. Occupations where time management is important may be able to offer temporal flexibility at a lower price, rather than time management skills causing the price of flexibility to

fall[9]. That is, if a worker can manage time well and complete all necessary work in a timely manner in such an occupation, flexibility is not met with an additional penalty.

The results in Table 6 provide evidence that the price of flexibility is influenced by the timing of work hours and the degree of substitutability, but the evidence is not very strong. While the estimated coefficients that are insignificant maintain each of their respective expected signs[10], the lack of significance by the majority of regressors limits the conclusive power of this analysis.

To summarize, it appears the price of flexibility within an occupation is influenced by the timing, but not the duration, of work hours and the ease of substitutability between workers. Identifying these occupational traits and their impacts is important because the evidence in Figure 2 suggests the gender earnings gap within an occupation is related to the price of flexibility in that occupation. If occupations can make earnings less sensitive to the timing of work hours and find ways for workers to be better able to substitute for one another, flexibility will come at a lower price and the gender earnings gap within occupations may decrease. While making flexibility more accessible at a lower price will help close the gender earnings gap within occupations, that in and of itself is not the entire solution.

6. Conclusion

[9] The results shown in Table 6 are largely unchanged if 10 univariate regressions are estimated with the occupational characteristics and the occupation-specific earnings-hours elasticity (as I do in Table 4 with the occupation-specific gender earnings gap). Two additional characteristics become significant in the estimation of the univariate models, structured vs. unstructured work and the importance of the pace being determined by equipment, but their estimated effects are very similar to those shown in Table 6.

[10] An increase in the importance of interpersonal relationships, the amount of freedom to make decisions, the amount of contact with others, and how structured the work is to a specific worker (where a large value means less structured and a small value means more structured) should make workers imperfect substitutes for one another, making the price of flexibility costly. An increase in the duration of a typical work week, the importance of working with a group or team, and the pace of work being determined by equipment should make changing the quantity and timing of work hours difficult, which would increase the price of flexibility.

In this research, I show occupation-specific (or within occupation) gender earnings gaps of various magnitudes exist for the less-educated population, which is defined as the group of individuals who have less than a four-year college degree but a minimum of a high school diploma, after controlling for wage-determining variables such as education, time worked, and demographic information. Within a majority of the 404 occupations included in this analysis, women earn $0.90 or less per $1 men earn, and women earn a premium relative to men in only 13 occupations.

I find the importance, necessity, and frequency in which workers must work cooperatively with others within an occupation is associated with a decreasing occupation-specific gender earnings gap. That is, occupations that require workers to work with others have smaller gender earnings gaps than occupations that do not require cooperative working relationships. Conversely, occupations where workers are held responsible for work outcomes or for the health and safety of others have larger gender earnings gaps than occupations where this is not the case.

I also find suggestive evidence that the earnings gap within occupations is related to the price of temporal flexibility. Moreover, the price of flexibility within occupations is increasing in the amount of time pressure a worker faces as well as the regularity of work schedules. More specifically, the price of flexibility is increasing in occupations that require workers to frequently meet deadlines and/or follow regulated work schedules.

This research shows that factors other than the typical wage-determining characteristics may be contributing to the gender earnings gap within occupations. Some inherent traits of occupations may be partially to blame, either directly or through their role in making flexibility an expensive job amenity, for the persistent gender earnings gaps observed within occupations. Further research may be able to shed light on how best to restructure occupational requirements in order for flexibility to come at a lower price and to achieve gender equality in earnings within occupations.

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