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# Use of ACS to Improve Occupation Earnings Estimates[1]

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Abundant resources exist to measure the expected earnings of a given occupation down to the level of a local labor market. However, none of these resources consider the well-documented positive correlation between earnings and education or the continuing gap in earnings between males and females. This article utilizes the rich data offerings of the American Community Survey to generate cross-tabulations of occupational earnings delineated by gender and education.

The results reveal that earnings for the vast majority of occupations vary significantly depending upon the worker's education. Further, we[3] show that earnings for males consistently exceed those for females even when controlled for education and occupation. We provide tabulations for the nation and the largest metropolitan areas.

Vocational experts, economists, career theorists, and everyday job seekers frequently seek information on the typical earnings of a given occupation. With the advent of the internet, a never-ending list of potential sources exists, all claiming to satisfy this need. However, the number of tools offering reliable research and statistically sound projections remains rather stable. Perhaps the most widely used survey offering a reliable foundation is the Occupational Employment Statistics (OES) program from the U.S. Bureau of Labor Statistics (2017). This site offers earnings information on over 800 occupations in metropolitan and nonmetropolitan areas across the United States–all updated annually using consistent, established survey methodology.

However, neither the OES nor its competitors offer earnings within an occupation delineated by education. For example, consider the occupational category of "Accountants and Auditors." Depending upon the requirements of the employer, persons holding this position may have a wide range of educational attainment. Since research shows that earnings typically increase with education, one might expect that accountants and auditors with different levels of education would have different earnings on average. If so, is an earnings estimate for the occupation as a whole relevant?

Further, noting the attention given to differences in earnings by gender (the "Gender Gap"), one might wonder if and how occupation-specific earnings reflect these differences. Knowledge of any variance may be of importance in how the data are used.

This paper offers an alternative data source of earnings to measure the expected annual earnings of a person in a given occupation. This alternative is the American Community Survey (ACS) from the U.S. Census Bureau (2016). The ACS provides the benefit of a large annual sample size and the ability to combine multiple years' data to generate cross-tabulations of occupational earnings differentiated by gender and education. From the resulting data, we demonstrate continua in occupational earnings confirming significant education-driven differences. These continua exist as well in traditionally low-education (e.g., construction laborer) and high-education (e.g., mechanical engineer) occupations. Further, we demonstrate pervasively lower earnings for females than males, even when controlling for education and occupation. We provide tabulations of occupational earnings at the detail level nationally. We further offer data for the top 30 major metropolitan areas[4] to allow local application.

## OES v. ACS

Both the Occupational Employment Statistics (OES) survey and the American Community Survey (ACS) offer distinct advantages as annual surveys funded by the U.S. government using scientific sampling techniques to produce reliable results. For their respective purposes, both are recognized for their quality and integrity. However, because their purposes are not the same, the users of the resulting data need to be familiar with their relative advantages and disadvantages.

### Occupational Employment Statistics

According to the survey's website (Technical Notes, 2018), the OES ". . . is a semiannual survey measuring occupational employment and wage rates for wage and salary workers in nonfarm establishments in the United States." Funded and directed by the Bureau of Labor Statistics (BLS), the survey is a cooperative effort between the BLS and State Workforce Agencies (SWAs), who perform the data gathering activities.[5] The targets of the survey are more than 200,000 establishments (i.e., employers, not employees) spanning all states and the District of Columbia and encompassing more than 600 geographic areas (metropolitan and nonmetropolitan).

Other OES documentation (Survey Methods, 2018, p. 1) provides further detail, noting use of the 2010 Standard Occupational Classification (SOC) system to define 803 standard occupations. Employers use industry-specific survey forms (Survey Forms, 2018) which list all occupations typical for the industry and provide descriptions of the typical duties. Employers indicate how many of their employees fill each occupation, categorized by their *typical* earnings.

We fully accept that these typical earnings provide reliable measures in accordance with the survey's design. However, we suggest improvement in the estimates for use to measure a person's expected annual earnings given the following limitations:

- Although OES presents annual earnings for most of the occupations, these are merely the average hourly rate multiplied by 2,080 hours (52 weeks x 40 hours) (Survey Methods, 2018, p. 19). Earners may make significantly more (see below) or be part-time workers.
- By surveying only nonfarm employers, the OES excludes farm occupations and all self-employed individuals.[6]
- The earnings reported exclude bonuses, overtime, and premium pay (holidays, weekends, and shift differentials), which may be a normal part of earnings for a given position. (Frequently Asked Questions, 2018).

### American Community Survey

According to Census publication (What Researchers Need to Know, 2009, p. iv), the ACS ". . . is a nationwide survey designed to provide communities with reliable and timely demographic, social, economic, and housing data every year." Thus, information on occupations and earnings represents only a fraction of all the areas addressed in the annual survey. While the OES samples businesses, the ACS samples households statistically stratified to derive a representative sample of the population as a whole and within communities. Therefore, it captures persons in all occupations, including those associated with farming and self-employment.

Census releases the results of the ACS through multiple forms, including Public Use Microdata Sample (PUMS) files (ACS PUMS, 2016) containing more than 3 million observations each year. These files allow researchers to extract and cross-tabulate data across the broad array of topics addressed in the survey. Thus, a researcher can narrow the diverse topics addressed in the ACS questionnaire (U.S. Census Bureau, 2016) to the specific areas of interest–such as occupation and earnings. Further, Census encourages researchers to combine PUMS files from multiple years to improve sample size for smaller subpopulations.

**Occupations**. The reader should recall that the OES samples businesses, asking them to match their workers to standard occupational definitions. Because the ACS samples the general population, it does not assume familiarity with these definitions or present a list of potential jobs. Rather, in questions 45 and 46 of the survey (ACS Questionnaire, 2016, p. 11), the respondent provides open-ended responses on the type of work and duties performed. Through automated coding, with Census staff intervention where necessary (2016 Subject Definitions, 2016, pp. 102-5), Census identifies the appropriate occupation using the same 2010 SOC coding structure employed by the OES.

In its recent content review, Census documented dozens of applications of the ACS occupation data by federal agencies alone (American Community Survey Handbook of Questions and Current Federal Uses, 2014, pp. 139–143). These include use by the Department of Labor to analyze the educational attainment of workers by occupation (similar to the application in this paper) and by the EEOC to identify potential under-representation in job categories under the Civil Rights Act of 1964.

**Earnings.** The definition of earnings under the ACS also differs from that used by OES. Question 47 of the ACS questionnaire (U.S. Census Bureau, 2016, p. 11) asks about earnings in the past twelve months, including the subcategories of earning from employment and from self-employment.[7] Thus, the earnings captured by the ACS include farming, self-employment, overtime, bonuses, and shift premiums–all of which are excluded in the OES. Further, as we discuss in ACS Extraction Methodology, we limit the earnings examined to persons who answer other questions that indicate full-time employment.

## Comparison

Figure 1 presents a comparison of some key attributes of both surveys. Most either need no explanation or were already explained. However, the entries for "Detail occupations" and "Geographic areas" bear some discussion.

Although OES and ACS share the same SOC coding foundation, ACS's application is more limited.

*Figure 1. Comparison of OES and ACS*

| | OES | ACS |
|---|---|---|
| Source | BLS | Census |
| Detail occupations | 803 | 474 |
| Geographic areas | 655 | Limited |
| Farm workers | No | Yes |
| Self-employed | No | Yes |
| Full-time | Limited | Yes |
| Education levels | No | Yes |

The 2014 OES provides earnings data for 803 detailed occupations. The ACS PUMS files provide only 474, excluding military codes.[8] The differences arise from one major source–Census's duty to protect the confidentiality of the ACS respondents. Census avoids publishing enough information on the individual respondents in the PUMS files that would allow identification of a specific respondent. Thus, for occupations with limited likely respondents, Census will merge the occupation with other similar occupation(s) to protect the respondent's identity.

Included with this article are spreadsheets (see Earnings Tabulations) that list the 474 ACS occupations tabulated for this paper, grouped by 32 summary levels. The difference between the ACS and OES categories requires merging of some SOC codes into single ACS codes. As an example, OES contains codes for Floral Designers, Designers, Fashion Designers, and Graphic Designers. ACS merges

all of these (plus a couple of others) into a single occupation of Designer (2016 Code List, 2016, pp. 80-94). The merger involving the most SOC codes is for the ACS title of Postsecondary Teachers, which combines 50 separate SOC postsecondary teaching categories (by discipline).

When providing employment areas for localities, OES generates tabulations for all states, all officially defined metropolitan areas, and several nonmetropolitan areas (Survey Methods, 2018, p. 1). This results in 655 sets of data within the fifty states in the 2017 survey (including the nation as a whole).[9] Through the extraction process described in Appendix B, ACS data can be tabulated into all of these areas and more. However, given the purpose of this paper to subdivide occupation samples by education and gender, the results for smaller areas would be extremely limited. Therefore, our discussion will focus only on the nation as a whole and the largest metropolitan areas, as discussed in more detail in Local Occupation Earnings.

## ACS National Occupation Earnings

For the study of earnings by occupation, the goal of this paper is to consider how the trends depicted in Figure 2 impact a given occupation. As shown, earnings in the United States have a strong positive correlation with the level of educational attainment.[10] Further, this chart also depicts significant differences by gender at all levels of education. Since most occupations include persons of either gender and multiple levels of education, the analyses that follow attempt to quantify to what degree these relationships exist within a specific occupation.

### ACS Extraction Methodology

We extract the data for our tabulations from the 2011–2016 PUMS files (ACS PUMS, 2016) using the criteria identified in Appendix A. This methodology is consistent with a paper we presented to the ACS Data Users Conference (Gibson, Use of ACS to Estimate Lifetime Loss of Earning Capacity as a Result of Disability, 2015). We note some important considerations encompassed in these criteria:

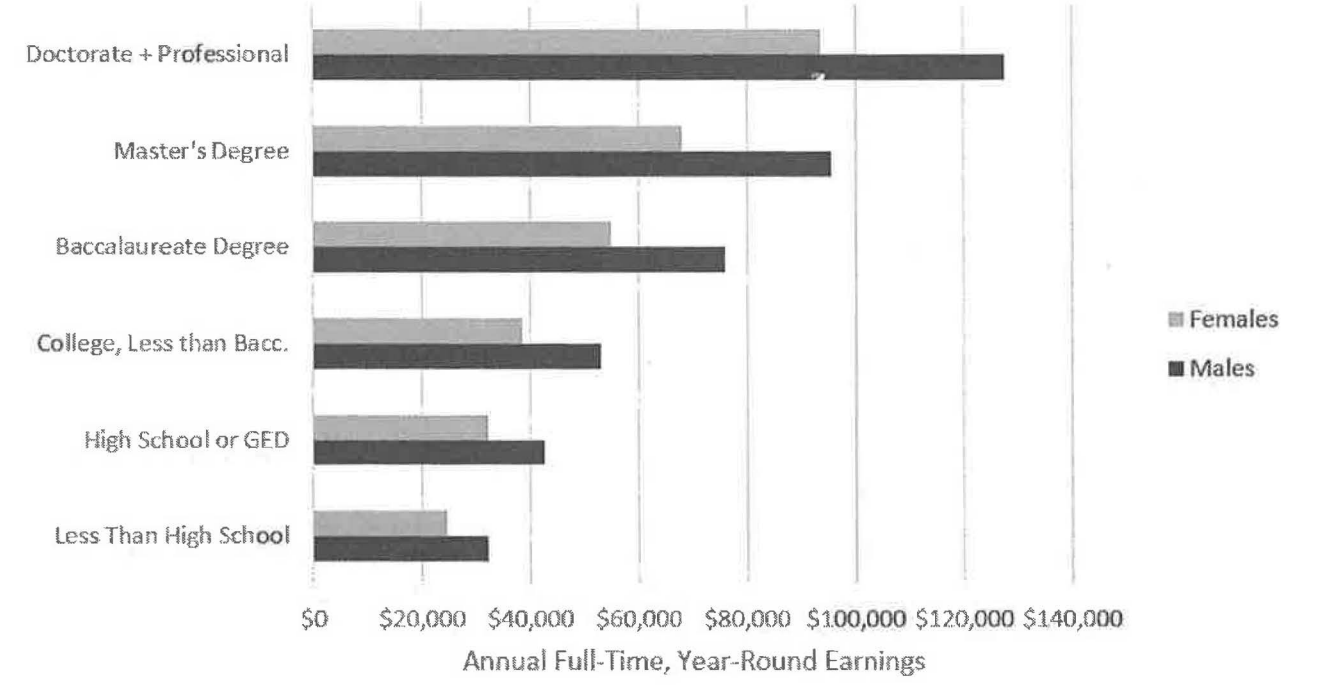


Figure 2. Median Full-Time Earnings by Gender & Education [22]

- We limit the sample to those working full-time (at least 35 hours per week), year-round (at least 50 weeks per year), or *FTYR* for short.
- We also limit the sample to persons in the prime working years of 25 through 64 to avoid distortion by those in the early exploration or later decline periods.
- For brevity of the paper and simplicity of the figures we present, we limit the education levels to the six presented in Figure 2.[11]
- We state earnings as medians.[12]

We believe these considerations, along with those noted earlier for self-employment, earnings premiums, and farm workers, improve the results. However, they also reduce the ability to compare the results directly to values from the OES. That said, we note that our earlier working paper (Gibson, 2015) demonstrates any variance is within expectations.

Figure 3 presents the resulting sample size and estimated population.

## Results by Education

*Figure 3. Extracted Sample Size*

| Education Level | Sample Size (n) | Estimated Population (000) |
|---|---|---|
| Less Than High School | 357,730 | 7,097 |
| High School or GED | 1,234,637 | 21,946 |
| College, Less than Bacc. | 1,607,073 | 28,123 |
| Baccalaureate Degree | 1,233,385 | 21,516 |
| Master's Degree | 541,432 | 8,981 |
| Doctorate + Professional | 236,369 | 3,799 |

The accompanying spreadsheets (see Earnings Tabulations) contain our results detailed by gender, education, occupation, and summary occupation groupings. Figure 4 extracts the results for the five major occupations groups as identified in ACS documentation (2016 Code List, 2016, p. 58). This figure includes prevalence percentages in each cell, indicating what fraction of the jobs in the respective occupation group persons at each level of education hold.

Note that the progression of earnings by level of education depicted earlier in Figure 2 holds true with each occupation group. Also note that only the "Management, Business, Science, and Arts" group is held in the majority by persons with a baccalaureate and above. It thus has the highest level of earnings. However, even those with lower levels of education earn more in this group than they do in any other.

Of course, job seekers obtain employment in a specific occupation, not by major grouping. The detail for all 474 occupations provided in the companion spreadsheets (see Earnings Tabulations) can be a bit daunting to review and make general observations. However, Figure 5 presents an extract of eleven of the most common occupations,[13] sorted in decreasing order of prevalence. From Figure 5, we offer the following observations:

- The trend of increasing earnings by level of education generally holds true within specific occupations. Use of earnings for the occupation as a whole (All Levels) for any occupation is rarely an accurate predictor compared to education-specific earnings. Thus, education, presumably through the addition of skills and training, makes a significant impact on earnings within a common occupation.

*Figure 4. Median Earnings by Occupation Group and Education*[23]

| | < High School | HS or GED | College. < Bacc. | Bacc. | Master's | Ph. D. /. /Profess. | All Levels |
|---|---|---|---|---|---|---|---|
| All Occupations | 29,500 (8%) | 38,000 (24%) | 44,500 (31%) | 63,500 (23%) | 79,500 (10%) | 106,000 (4%) | 51,000 |
| Management, Business, Science, and Arts | 44,000 (1%) | 49,000 (9%) | 56,000 (24%) | 72,000 (37%) | 81,000 (20%) | 112,000 (9%) | 69,000 |
| Nat. Resources, Constr., & Maintenance | 32,000 (19%) | 46,000 (41%) | 53,000 (32%) | 56,000 (6%) | 61,000 (1%) | - | 46,000 |
| Production, Transport., and Material Moving | 31,000 (19%) | 40,000 (41%) | 45,000 (32%) | 53,000 (6%) | 62,000 (1%) | - | 40,000 |
| Sales and Office | 30,000 (4%) | 37,000 (28%) | 41,000 (40%) (40%) | 55,000 (23%) | 70,000 (4%) | 76,000 (1%) | 42,000 |
| Service | 23,000 (16%) | 28,000 (34%) | 34,000 (36%) | 44,000 (12%) | 53,000 (2%) | 54,000 (1%) | 31,000 |

*Figure 5. Median Earnings by Occupation and Education–Sample Occupations*[24]

| | < High School | HS or GED | College. < Bacc. | Bacc. | Master's | Ph. D. /. /Profess. | All Levels |
|---|---|---|---|---|---|---|---|
| Misc mgrs, incl postmasters. | 50,000 (2%) | 57,000 (14%) | 69,000 (26%) | 94,000 (36%) | 115,000 (18%) | 133,000 (3%) | 84,000 |
| First-line supervisors retail sales workers | 34,000 (5%) | 40,000 (30%) | 44,000 (39%) | 55,000 (22%) | 62,000 (4%) | 85,000 (1%) | 44,000 |
| Driver/sales workers and truck drivers | 41,000 (17%) | 46,000 (50%) | 48,000 (28%) | 47,000 (4%) | 48,000 (1%) | | 46,000 |
| Secretaries and admin. assistants | 33,000 (2%) | 38,000 (28%) | 40,000 (49%) | 44,000 (18%) | 46,000 (3%) | | 40,000 |
| Elementary & middle s school teacher | | | 30,000 (4%) | 49,000 (43%) | 61,000 (49%) | 65,000 (4%) | 55,000 |
| Registered nurses | | 55,000 (1%) | 64,000 (40%) | 72,000 (48%) | 86,000 (9%) | 79,000 (2%) | 70,000 |
| Accountants and auditors | | 45,000 (4%) | 49,000 (16%) | 71,000 (56%) | 85,000 (21%) | 97,000 (2%) | 69,000 |
| Retail salespersons | 27,000 (6%) | 33,000 (30%) | 39,000 (37%) | 53,000 (23%) | 57,000 (3%) | 50,000 (1%) | 39,000 |
| Customer service representatives | 28,000 (3%) | 34,000 (26%) | 36,000 (44%) | 47,000 (22%) | 55,000 (4%) | | 38,000 |
| Janitors and building cleaners | 25,000 24%) | 31,000 (46%) | 34,000 (25%) | 34,000 (4%) | 34,000 (1%) | | 30,000 |
| Construction laborers | 29,000 (32%) | 37,000 (41%) | 43,000 (21%) | 46,000 (5%) | 54,000 (1%) | | 35,000 |

- Workers with less education than might typically be assumed necessary for an occupation (e.g., elementary and middle school teachers with less than a baccalaureate) are noted in multiple positions. However, their earnings are typically far below those with higher levels of education. Identification of education thus allows isolation of the outliers.
- Conversely, workers with a higher level of education than might typically be expected (e.g., construction laborers with baccalaureate or master's degrees) are also frequently noted. However, even in these positions, persons with higher levels of education command significantly higher earnings than the occupation median. It is unlikely that employers for these positions are offering higher rates of pay merely because the employee has higher education. Rather, it is more likely that education is a signal of increased human capital that makes these employees more valuable for their respective positions.

From the "Estimated Population" column of Figure 3, we note that the distribution of FTYR employees falls (approximately) evenly into three groups: high school diploma or less, college less than baccalaureate, and baccalaureate and above. Let us refer to the first group as "Lower Education" and the last group as "Higher Education." We further classify occupations held by at least two-thirds of one of these two groups as either "Lower Education Occupations" or "Higher Education Occupations," and offer the graphs shown in Figure 6 and Figure 7.

These graphs share the following components.

- The columns depict the median earnings by level of education. To read the value of these earnings, reference the vertical axis on the left side of the graph.
- The two lines depict the median earnings as a percentage of a given standard. To read the value of these lines, reference the vertical axis on the right side of the graph.
- The solid lines show the earnings as a percentage of the median of all higher or lower education occupations, respectively.

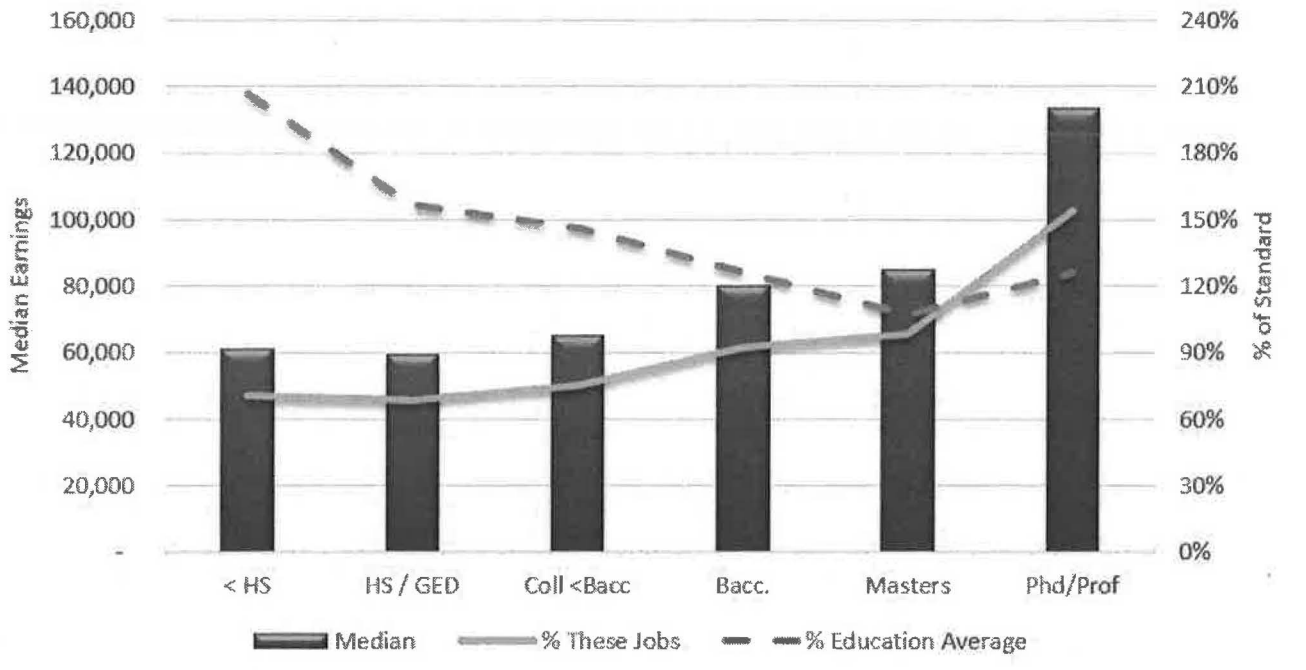


Figure 6. Earnings in Higher Education Occcupations

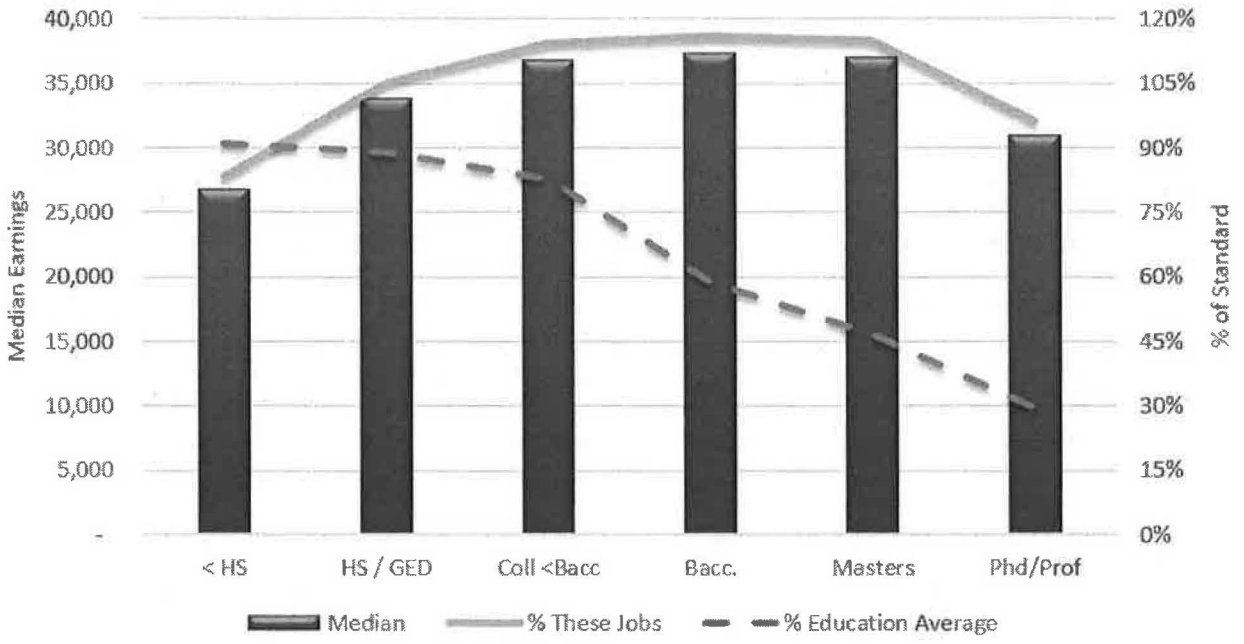


Figure 7. Earnings in Lower Education Occupations

- The dashed lines show the earnings as a percentage of earnings at each level of education for all occupations combined, as shown in Figure 4.

Let us focus first on the higher education occupations depicted in Figure 6.

- First, note that consistent with our review of the results for individual occupations, this shows increasing earnings with increasing education.
- Despite the fact that this graph summarizes occupations dominated (at least two-thirds) by persons with at least a baccalaureate, employees with lower levels of education occupy a significant number of positions. Noting that the dashed line indicates these employees earn 150% to 200% of what other workers with similar levels of education earn, one may presume their presence in these occupations is indicative of human capital they possess beyond their formal education.
- The dashed line remains above 100% for all education levels. This indicates that earnings at all levels of education are generally maximized when working in more highly skilled occupations.

Next, consider the lower education occupations in Figure 7. Recall that this summarizes all occupations held predominantly by persons with a high school diploma or lower.

- Although the columns depicting the median earnings do not demonstrate a pronounced step-like progression, the solid line demonstrates that persons with higher levels of education usually earn more than the median for these occupations. (i.e., The line is above 100%.) Thus, the human capital of these workers, who are likely overqualified in formal education, leads to greater value to their employers.
- Despite the above observation, the dashed line indicates that earnings in these positions are significantly below what workers with their respective levels of education typically earn.

Thus, the overall results of segregating occupation earnings by highest level of educational attainment shows great promise. Consistent with overall findings that higher levels of education result in

higher earnings, our extraction shows that occupation earnings estimates are greatly improved by considering the significant impact of diversifying these estimates by level of education.

## Results by Gender

The "Gender Gap," or observed differences in overall earnings between men and women, has been a hot topic of analysis, discussion, and debate for several decades now. Many researchers have offered valuable insight into the causes and composition of the gap. More articles exist than we can possibly detail on this topic. However, we note work by Blau and Kahn (1999), Olivetti and Petrongolo (2014) and the American Association of University Women (2018) as a start. These and other articles note there may be explainable drivers of the differences that are nondiscriminatory, including the following:

- Do the wage earners have the same education levels? This paper controls for this variable. In fact, the graph in Figure 2 shows significant variation across all levels of education.
- Are the wage earners performing similar work? This paper controls for comparability of job titles.
- Are the results from the same quantity of work? We control for this by considering only earnings from full-time, year-round (FTYR) employment.
- Do the wage earners have similar training (outside of formal education) and experience? Exploration of these variables is beyond the scope of the ACS, and therefore they are not controlled in our analyses. The user must consider this limitation when contemplating the discussion below.

Using the gender-specific values for the five major non-military occupation categories, we offer the summary in Figure 8. Here, the "% Female" column presents the percentage of FTYR jobs held by females. The remaining values show the gap as the decrease in male to female FTYR earnings as a percentage of male earnings.[14]

- Note that the gap for the All Occupations row is relatively constant over the six education categories at 23%-29%. However, for the "All Levels" category, the value is significantly less: 18%. This decrease from the education-specific gaps results from the fact that the female FTYR population as a whole is more highly educated,[15] resulting in higher earnings. Thus, the overall gap of 18% masks the difference in distribution, and we must use caution measuring the gap for any occupation without controlling for education.

*Figure 8. Gender Earnings Gap by Occupation Group*

| | % Female | < High School | HS or GED | College. < Bacc. | Bacc. | Master's | Ph. D. /. /Profess. | All Levels |
|---|---|---|---|---|---|---|---|---|
| All Occupations | 43% | 23% | 25% | 27% | 28% | 29% | 27% | 18% |
| Management, Business, Science, and Arts | 49% | 24% | 28% | 24% | 28% | 30% | 27% | 28% |
| Nat. Resources, Constr., & Maintenance | 4% | 33% | 26% | 19% | 11% | -2% | | 24% |
| Production, Transport., and Material Moving | 20% | 29% | 30% | 29% | 22% | 20% | | 32% |
| Sales and Office | 59% | 21% | 19% | 22% | 32% | 39% | 39% | 27% |
| Service | 50% | 16% | 22% | 33% | 35% | 33% | 37% | 27% |

- Only the Natural Resources, Construction, & Maintenance group shows gaps approaching 0%.[16] However, this group has only 4% of the sample as female.

Of course, measurement at the major occupation group level is insufficient to form conclusions on the gender gap since the distribution can differ significantly among the more skilled occupations within a group. However, perusal of the results in the accompanying spreadsheets should reveal pervasive differences throughout the occupations at each level of education. In fact, Figure 9 presents a tabulation of the education-specific (excluding the "All Levels" category) cells from the spreadsheet (see Earnings Tabulations).

- The first row shows that in occupations where males and females each represent at least 10% of the weighted sample, 95% of all cells have male earnings more than those of females. The disparity exceeds 10% in 75% of the cells, and exceeds 20% in 36% of the cells.
- The next two rows focus on whether the occupations are dominated (at least 67%) by one of the genders.
- Examples of male-dominated occupations include computer programmers, butchers, couriers, and barbers. The observed rates where male earnings exceed those of females are somewhat higher than for the general population.
- Examples of female-dominated occupations include social workers, registered nurses, flight attendants, court clerks, and hairdressers. Even controlling for these occupations does little to improve the percentage of cells where male earnings significantly exceed those for females.

Thus, we can conclude that the gender gap is pervasive across occupations and education. Further, we know that it has persisted for decades despite scrutiny by the press and government agencies. The question remains on how to use the results when using the earnings to predict the future potential for any given individual:

- Should we ignore the gender-specific results and focus only on the "Both Genders" values?
- Should we assume that the gap will eventually close and ignore it?
- Should we assume the gap is permanent or representative of what is likely in the long term, and use only gender-specific values?
- Should we consider the gender-specific values in the evaluee's specific context and make a case-by-case decision on the appropriate value to use?

We do not prescribe any standard approach for all professionals to apply. We merely offer the results in the accompanying spreadsheet combined with the above analysis for consideration.

## Local Occupation Earnings

Although earnings at the national level may be informative and appropriate for use in many cases, users generally seek data specific to a given geographic area. As we noted earlier, the ACS is designed to collect and tab ulate data at the community level–down to communities significantly smaller than the 655 areas (Figure 1) reported by the OES. However, the sample size is strained by delineating community-level data by 474 ACS occupations, 2 genders, and 6 education levels. Thus, we must restrict our study to larger metropolitan areas.

Using the methodology detailed i n Appendix B, we were able to extract sufficiently delineated results for metropolitan areas of at least 400,000 in population. This encompasses 308 combined (CSA) or stand-alone (CBSA) metropolitan areas.[17] The accompanying spreadsheets for this article include the results for the top 30 areas in population according to the 2010 census. A review of these spreadsheets will reveal that the trends by gender and education noted at the national level hold true within each metropolitan area.[18]

*Figure 9. Analysis of Education-Specific Cells with Gender Earnings Differences*

| | # of Cells | > 0% | > 10% | > 20% |
|---|---|---|---|---|
| All occupations (at least 10% female and 10% male) | 1,340 | 95% | 75% | 36% |
| Male-dominated (at least 10% female and 67% male) | 417 | 97% | 78% | 41% |
| Female-dominated (at least 67% female and 10% male) | 272 | 94% | 63% | 20% |

## Earnings Tabulations

For practical application of this research, one would naturally need the detailed earning information discussed throughout this article. However, given the enormity of the tabulations, they cannot be printed as part of the article itself. Rather, the detail is provided in two spreadsheets stored on the author's website.

- **Median Occupation Earnings**–this spreadsheet contains the median earnings by occupation, gender, and education for the United States, as well as for the top 30 metropolitan areas. Readers may access the data at:
  http://davegibson.net/articles/rehabpro26_1/MedianOccupationEarnings.xlsx
- **Detail Occupation Earnings**–for all of the same cells in the Median Occupation Earnings spreadsheet, this spreadsheet provides sample sizes, estimated populations, standard errors, and earnings at multiple percentile levels. Readers may access the data at:
  http://davegibson.net/articles/rehabpro26_1/DetailOccupationEarnings.xlsx

## Summary

This article provides earnings at the detail occupation level nationally and for the thirty largest metropolitan areas. These tabulations provide a rich source of information on the relationship of earnings by gender and education within these categories.

Our discussion and analyses focused on three key areas of occupational earnings estimates: survey composition differences between the OES and ACS, the impact of specific education identification, and the impact of gender. We believe that in each of these areas, the ACS offers distinct advantages that can lead the user to more informed projections of earnings for a given individual in a target occupation.

Although the OES is a well-administered and controlled source offering some distinct advantages over the ACS, we believe the composition of wage and self-employed earnings merged with the ability to isolate an occupation more specifically makes the ACS a superior tool. In some cases, where the OES provides a more specific occupation level or geography than the ACS, use of both surveys through imputation may be appropriate.

Variation of earnings by education level, as demonstrated in the accompanying spreadsheets consistently confirms that even within a specific occupation, the expected earnings tend to increase with education. Given these results, it is difficult to support use of an occupation-wide measure of central tendency as a one-size-fits-all measure.

Finally, the gender gap is a political hot potato for which this paper provides analyses and data to support the reader's decision on appropriate measures of occupation earning. The results overwhelmingly demonstrate pervasive earnings for males above those for females controlled for education, full-time employment, and occupation. Although we fall short in providing a definitive method in how these results should be applied when projecting the earnings for a given candidate in a specific occupation, we believe the paper provides a foundation that must be considered for the application.

# Appendix A
# Earnings Extraction Criteria

Figure 10 identifies the variables from the 2011–2016 PUMS files and the related values used to extract the earnings summarized in this paper. Earnings are stated as medians in terms of 2018 dollars (see below) and rounded to the nearest thousand to simplify the summarization process. This is consistent with the methodology in our presentation to the ACS Users Committee (Gibson, 2015).

## Earnings Restatement to Current Dollars

To state the earnings from the six years of extracted PUMS data in common-year terms, we applied the methodology identified in "Restating Earnings in Common-Year Terms When Combining Multiple ACS PUMS Files" (Gibson, 2017). This approach weights the observed change in FTYR earnings by education using the most current education distribution. As a result, the earnings from the 2011-2016 PUMS files were increased by 14.7%, 13.7%, 11.1%, 9.6%, 8.1%, and 5.3% respectively to reflect their values in 2018 dollars.

# Appendix B
# Metropolitan Area Extraction Process

The PUMS files released by Census provide geographic identification at the lowest level of Public Use Microdata Areas (PUMA).[19] PUMAs are logically segregated areas within a state that contain a population of at least 100,000 persons. Although Census certainly has the information to identify specifically where the respondent lives, it restricts the data released to the public via PUMS files to these geographic areas to protect the respondent's identity. Thus, to tabulate our occupation data at the

*Figure 10. Earnings Extraction Criteria*

| Variable | Description | Use |
|---|---|---|
| AGEP | Age | Select all respondents in the primary working ages of 25 through 64 |
| SCHL | Educational attainment | See Figure 11 in the on-line appendix |
| ESR | Employment status | Civilians: use 1, 2, 3, or 6 |
| SEX | Gender | 1 for males, 2 for females |
| PWGTP | Weight | Use weight to determine median |
| WKHP | Usual hours worked per week in past 12 months | >= 35 for full-time |
| WKW | Weeks worked in past 12 months | >= 50 for year-round |
| ADJINC | Seasonal adjustment factor | Multiplied by PERNP |
| OCCP | Occupation recode | Provides a Census occupation code that translates to SOC occupations |
| PERNP | Total earnings (wage & self-employment) | Use as earnings value, multiplied by ADJINC and adjusted to current year as discussed on page 22. |
| TYPE | Household variable to indicate type of house | 1 to exclude group quarters |

*Figure 11. Education Level Classification*[25]

| SCHL Values | Education Level |
|---|---|
| 0 – 15 | Less than high school |
| 15 – 16 | GED or High school graduate |
| 17 – 20 | College, less than baccalaureate[xxvi] |
| 21 | Baccalaureate degree |
| 22 | Master's degree |
| 23 – 24 | Professional or doctorate degree |

metropolitan area level, we must add two variables–state and PUMA–to the criteria identified in Appendix A.

Given the PUMA target size of 100,000 or more and the fact that our extraction focuses only on metropolitan areas of at least 400,000, we must combine multiple PUMAs to measure each area. To do this, we rely upon a valuable service from the Missouri Census Data Center (MABLE, 2014) which provides cross-references of PUMAs [20] to multiple types of metropolitan areas. We focus our collection at two different levels, either of which may cross state boundaries.[21]

- Core-Based Statistical Areas (CBSA) – also referred to as Micropolitan Statistical Area. This is the most common form of identifying a metropolitan area.
- Combined Statistical Areas (CSA) – Contiguous CBSAs may be combined into CSAs. Most of the major metropolitan areas in the United States have related CSAs. As an example, the Chicago CSA combines the CBSAs of Chicago, Kankakee, Michigan City-La Porte, and Ottawa-Peru.

Using this translation and extracting data for all states and metropolitan areas (of either of the above types) with a population of at least 400,000 in the 2010 Decennial Census, we computed values for almost 650,000 occupation /education combinations. Reporting the results for all of these is beyond the scope of this paper. However, the accompanying spreadsheets provide the results for the top 30 metropolitan areas.

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## Endnotes

[1] This paper is an expansion and update of a presentation given to the 2014 American Community Survey Data Users Conference (Gibson, 2014) and a working paper presented to the 2015 IARP Annual Conference (Gibson, Use of ACS to Improve Occupation Earnings Estimates, 2015).

[2]David S. Gibson, MBA, MRC, is a Senior Analyst for Vocational Economics, Inc. in Chicago, Illinois.

[3] This paper adopts an editorial "we" to refer to the author, who is solely responsible for the content.

[4] Further detail is tabulated and available from the author.

[5] Many of the SWAs publish similar data to the OES on their respective state websites. These data usually emanate from the OES survey process.

[6]According to the 2016 ACS, more than 500,000 people work in farm occupations on a full-time, year-round basis; and more than 7 million full-time earners had earnings from self-employment. (ACS PUMS, 2016).

[7] omits others that deal with passive income or earnings unassociated with an occupation.

[8]This quantity is accurate for the 2012–2016 PUMS. The data for 2011 included 540 categories, with the difference of 66 categories merged with others in the most recent PUMS. Therefore, we recoded these earlier PUMS to the 2012 definitions to enable combination with the later years.

[9]Given sample size limitations in some of the smaller markets, earnings data may not exist for several occupations.

[10]The education levels shown here and used throughout this paper are a collapsed subset of all of those available through the ACS. We limit them to the six levels in Figure 2 to keep the analyses and charts that follow to a minimum size.

[11] The spreadsheets accompanying the article have some more detail. Further detail is available from the author.

[12] The medians are rounded to the nearest thousand to simplify the extraction process.

[13]This includes the top ten by national prevalence, plus construction laborers to assure all five of the major occupation groups are represented.

[14] Computed as 1–(F/M), where F is FTYR female earnings, and M is FTYR male earnings.

[15] Per our extracted sample (ACS PUMS, 2016), only 28% of FTYR females have a high school diploma or less, versus 36% of males. Conversely 39% of females have a baccalaureate or higher, versus 35% of males.

[16] In fact, female earnings are slightly higher at the Master's degree level, although the difference is not statistically significant.

[17]As discussed in Appendix B, metropolitan areas are defined at multiple levels, of which we use two: CBSAs, and CSAs. As a result, there is some duplication in the areas included. For example, the Chicago CBSA qualifies as over 400,000 individually, and the Chicago CSA that combines the Chicago CBSA with smaller neighboring CBSAs also qualifies.

[18] We have not yet attempted to study the degree to which education or gender is more or less important for each metropolitan area, but leave this as a topic for future research.

[19]These acronyms provide a source of confusion for many persons new to the ACS data. PUMS (Public Use Microdata Sample) should not be confused with PUMA, which is a geographic designation.

[20] Note that the PUMA definition changed in the 2012 ACS. When using the MABLE cross-references, we relied upon the "PUMA 2012" values for the 2012 and 2013 ACS files, and the "PUMA 2000" values for the 2011 ACS files.

[21] The hierarchy of codes is confusing. We refer the reader to the web page "Geography" (Missouri Census Data Center, 2016) for more detail.

[22] Extracted from the 2016 ACS (ACS PUMS, 2016) and restated to 2018 dollars as documented in Appendix A.

[23] Values are suppressed where a cell represents less than 0.5% of the weighted population size of a given occupation.

[24] Values are suppressed where a cell represents less than 0.5% of the weighted population size of a given occupation.

[25]The education levels encompass all the SCHL values tracked by the ACS. We collapse them to these six categories only for the brevity of our analyses and exhibits.

[26] This includes those with associate degrees.