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New Evidence on the Returns to Job Skills

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The typical Mincerian wage equation examines wages in relation to the education, potential experience, and other personal characteristics of job incumbents. These characteristics serve as proxies for the job holder's skill level, but do not indicate what specific skills are being rewarded. A number of recent papers make use of data on occupational skill requirements, which have proven useful for understanding shifts in labor demand (see, for example, David Autor, Frank Levy, and Richard Murnane 2003; Maarten Goos and Alan Manning 2007) as well as for understanding the relationship between wages and specific job skills (see, for example, Beth Ingram and George Neumann 2006; Autor and Michael Handel 2008). To the extent that the labor market does a good job of matching individuals to jobs for which they are well suited, such analyses can shed new light on how workers' job skills are valued in the labor market.

Studies that focus on job skills generally begin with data from the Current Population Survey (CPS) or another household survey that contains information on the detailed occupation in which people work. Information on required job skills is attached to the survey records according to reported occupation. There is considerable evidence, however, of significant errors in the coding of occupation in household survey data. Wesley Mellow and Hal Sider (1983) find disagreements between the occupation recorded in CPS data compared to that based on information supplied by individuals' employers for 19 percent of jobs at the major occupation level and 42 percent at the detailed occupation level. Nancy Mathiowetz (1992) reports similar findings for the employees of a large manufacturing firm. Comparisons of aggregate data on the number of jobs in each of 19 broad occupations from the Occupational Employment Statistics (OES) survey, a large employer survey, to comparable data from the CPS show large discrepancies.[1] Over the 2003–2004 period, the total number of private sector jobs averages just over 110 million in both surveys, but the CPS includes 4.6 million more management jobs, 1.1 million more "other professional" jobs, and 1.5 million more sales jobs; the OES includes 2.9 million more office and administrative jobs, 2.7 million more food preparation and serving jobs, and 1.5 million more production helper jobs.

To the extent that occupation is systematically mismeasured in household survey data, estimates of the returns to job skills based on these data also may be distorted. In particular, if lower-skilled jobs are systematically misclassified in occupations that require highly compensated skills, estimates of the returns to those skills are likely to be biased downward.

I. Data on Occupational Employment, Job Skills, and Wages

In this paper, we compare estimates of the returns to job skills based on CPS data for 2003 and 2004 to estimates for the same two years based on OES data. Both surveys provide data on employment and wages for nonagricultural wage and salary workers. For present purposes, we restrict our attention to private sector wage and salary jobs.

The CPS data we use are collected from the one-quarter of the CPS sample each month

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[1] See Abraham and Spletzer (2008) for a more detailed discussion of the CPS and OES data on occupational employment. The 19 broad occupations are management; business and financial operations; engineering; life, physical, and social science; computer and mathematical; health care practitioners; other professional and technical; sales and related; office and administrative support; protective service; food preparation and serving; building and grounds cleaning; all other services; production supervisors; installation and maintenance; construction and extraction; production; transportation, and moving; and production helpers.

that is in its fourth or eighth month in sample. Employed respondents are asked to report the occupation of their main job and of any second job; information on wages is collected only for the main job. Following Thomas Lemieux (2006), we focus on the hourly wage, which is reported directly for persons paid by the hour and defined as usual earnings divided by usual hours for those paid on some other basis.[2] In contrast to some previous studies, we retain observations for which the wage is imputed in order to preserve, insofar as possible, the observed distribution of employment across occupations. Top-coded earnings are multiplied by a factor of 1.4 before proceeding with the analysis. We do not trim wage outliers, but our findings are not sensitive to the exclusion of observations with wages below $1.00 per hour and above $100.00 per hour. Wages are missing for approximately 8.6 percent of CPS jobs, including the 3.9 percent that are second jobs and the 4.4 percent that are classified as self-employed incorporated jobs.

In the 2003 and 2004 OES surveys, employers were asked to report the number of people employed, as of either May or November, by detailed occupation in each of the 12 wage intervals shown in Figure 1. The present analysis makes use of data for November 2003 and November 2004. The underlying unit of observation in the OES data is jobs at an establishment in a particular occupation paying a wage in a specified wage interval. Employers may report wages for full-time workers on either an hourly or an annual basis; wages for part-time workers are reported on an hourly basis. The conversion between the two reporting bases assumes 2,080 hours of work per year (40 hours per week for 52 weeks). Mean wages based on data from the National Compensation Survey (NCS) are assigned to each wage interval and used in subsequent calculations. Approximately 20 percent of sampled establishments do not respond to any given OES survey panel; data are imputed for these establishments.[3] All of the estimates reported here are weighted as described in Abraham and Spletzer (2008) to represent private sector jobs as of the reference dates.

The Standard Occupational Classification (SOC) system is used to classify occupations in both the CPS and the OES. Data are available for 486 distinct CPS occupations and 821 distinct OES occupations. Changes in the procedures for coding management occupations were introduced into the OES beginning in 1999. Both because these changes are a problem for the historical analysis planned in the next phase of our research and because we believe that they caused many people who should in fact have been categorized as managers to be coded as something else, we have reclassified about 1.5 million jobs each year into management (see Abraham and Spletzer 2008). We have no way to determine the specific type of management position held by those we reallocate into the management category; when job characteristics are assigned to these jobs, they are set at the management occupation average.

Information on the skills required for each of 733 six-digit SOC occupations is taken from Version 13.0 of the Occupational Information Network (O*NET), released in June 2008 (Employment and Training Administration 2008). The first version of O*NET was introduced in 1998 and the database is being filled in over time with information on occupational and worker requirements, largely collected from people working in those occupations. For most occupations, the O*NET worker sample is constructed by first sampling businesses and then sampling workers in the occupation at those businesses. We use O*NET information on the importance of various generalized activities by occupation. Job incumbents are asked to rate the importance of each of 41 activities to their job performance on a scale from 1 (not important) to 5 (extremely important). Average importance scores on this 1 to 5 scale (X) are converted to scores on a zero to 100 scale ($Y = 25*(X - 1)$) prior to analysis.

Among the 41 generalized activities, there are clusters of related activities that are highly correlated across occupations. For this analysis, we form three job activity measures which, based on an exploratory analysis of the data, seem to represent distinct activity dimensions. The first, intended to capture the importance of analytical skills, averages the responses to two questions about the importance of "making decisions and

[2] Missing hours were imputed using an algorithm developed by Lemieux based on advice from Anne Polivka of the Bureau of Labor Statistics. We thank Lemieux for sharing the SAS code to implement the algorithm with us.

[3] See Bureau of Labor Statistics (2008) for further details regarding the OES survey and estimation methods.

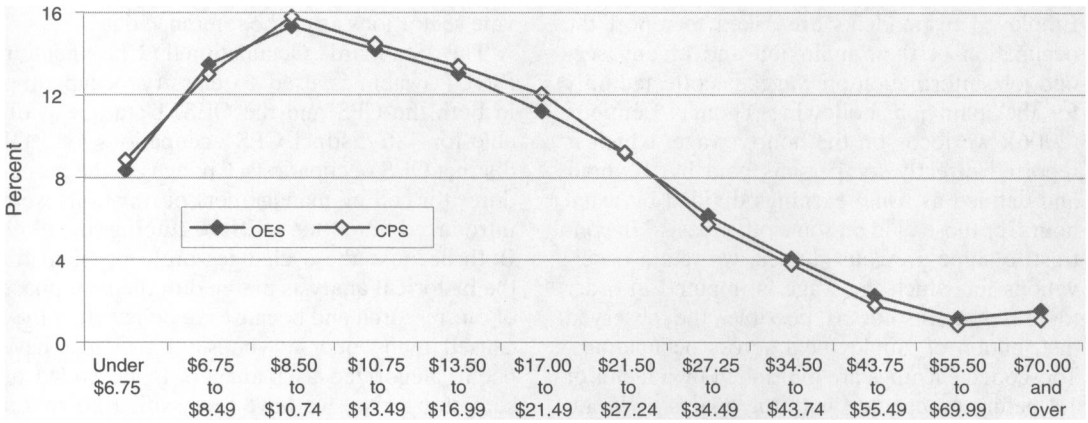

FIGURE 1. SHARE OF JOBS BY WAGE INTERVAL, CPS AND OES (2003–2004 AVERAGES)

solving problems" and "updating and using relevant knowledge" on the job; the second, intended to capture the importance of interpersonal skills, averages the responses to two questions about the importance of "establishing and maintaining relationships" and "resolving conflicts and negotiating with others"; and the third, a physical activities variable, is based on the responses to a question about the importance of "handling and moving objects."[4]

Many of the CPS occupations are a direct match for the occupations included in O*NET Version 13.0. In other cases, the O*NET data are more detailed than the CPS data, and the activity variable scores for the more detailed O*NET occupations can be aggregated up to the broader CPS occupation using OES employment weights. In a few cases, we could find no match for the CPS occupation in the O*NET data. About 2 percent of CPS employment was excluded from our regressions of wages on job skills for this reason. Our final dataset includes data for 465 CPS occupations. For comparability, the OES data were aggregated up to the same 465 occupations. About 5 percent of OES employment was in occupations that we could not match to the O*NET data and was excluded from our wage regressions.

II. Occupational Wages in the CPS and the OES

We begin by looking at the distribution of hourly wages in the CPS and the OES. Data on wages are missing for 9.5 million of the 110.2 million CPS jobs. As can be seen in Figure 1, based on the CPS jobs for which we have wage information, the overall distribution of wages in the two surveys across wage intervals is fairly similar. The share of jobs in the top three wage intervals is slightly higher in the OES than in the CPS—5.0 versus 3.7 percent—but the differences in the two distributions are not visually striking.

Somewhat surprisingly, given the apparent similarity of the two wage distributions, the overall mean OES wage, calculated using the mean NCS wage for each interval, is nearly a dollar higher than the overall mean CPS wage calculated using the CPS interval means ($17.75 versus $16.82). A simple decomposition shows that more than 90 percent of this difference can be attributed to the larger share of OES jobs in the top three wage intervals.[5]

[4] We experimented with other ways of creating the analytical, interpersonal, and physical activity variables, and obtained qualitatively similar results concerning the relationship between wages and job skills. In future work, we plan to carry out a more formal factor analysis to identify distinct activity dimensions.

[5] More than 120 percent of the difference can be attributed to the larger share of OES jobs in the top five wage intervals, with offsetting effects due to the larger share of CPS jobs in lower wage intervals. Using CPS employment shares and NCS wage interval means yields an estimated mean wage of $16.90, very close to the original CPS mean.

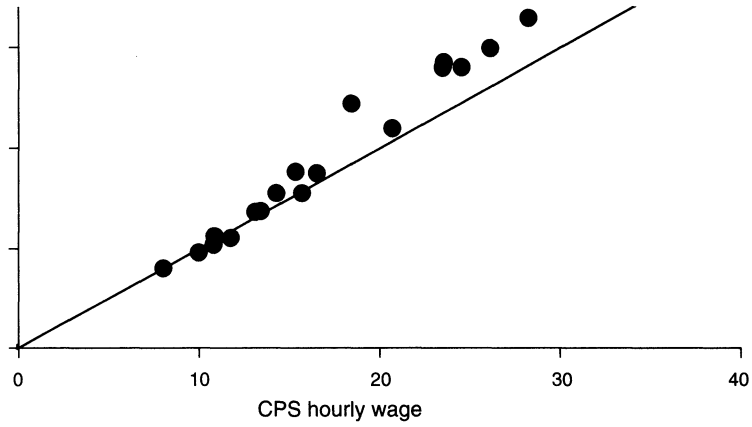

FIGURE 2. MEAN HOURLY WAGE BY OCCUPATION, OES VERSUS CPS (2003–2004 AVERAGES)

One possible explanation for the difference in mean hourly wages between the two surveys is that, for salaried workers, the CPS hourly wage is calculated as the ratio of earnings to hours worked and hours worked may exceed hours paid, producing a lower estimated hourly wage. We repeated our CPS calculations with all salaried workers treated as having worked a 40-hour week; this raised the estimated mean CPS wage from \$16.82 to \$17.40, closing much of the OES-CPS gap. Another contributing factor may be that CPS workers for whom we do not observe a wage are disproportionately highly paid.

We look next at mean wages in the two surveys for each of the same 19 broad occupations referenced above. For comparability between the two surveys, mean wages by occupation in the CPS are computed using "intervalized" data, though this has very little effect on the calculations. Average wages for all 19 occupations are plotted in Figure 2. In broad occupations that pay below the overall average wage, CPS and OES wages match fairly closely. In higher-wage occupations, however, OES wages often exceed CPS wages, in some cases by a considerable amount. Managers are paid an hourly wage of \$39.39 in the OES versus just \$27.68 in the CPS. Other occupations with large hourly wage gaps are production supervisors (\$24.39 versus \$18.47), health care practitioners (\$28.43 versus \$23.58), engineers (\$32.81 versus \$28.30), and business and financial operations (\$27.94 versus \$23.53).

Part of the discrepancy between OES and CPS wages by occupation may be attributable to the use of hours worked in the CPS and hours paid in the OES. Mean CPS wages by occupation calculated with all salaried workers treated as working a 40-hour week tend to be closer to mean OES wages, but substantial gaps remain. For managers, the adjusted CPS mean wage with the 40-hour adjustment rises to \$30.74, still considerably below the OES mean wage of \$39.39. A second factor may be that, in some occupations, those with missing CPS wages have higher earnings than those with reported wages. Wages are missing in the CPS for 17 percent of managers, many of whom seem likely to be business owners.

Another plausible explanation for higher mean OES wages in occupations at the upper end of the wage distribution is that, in the CPS, there are a significant number of people assigned to these occupations who in fact work in lower-paid jobs. This last explanation would lead us to expect the within-occupation variation of wages to be higher in the CPS than in the OES, even after the CPS wages have been "intervalized" in the same way as OES wages. The within-occupation standard deviation of the interval ln(wage) averages 0.4470 across the 465 detailed occupations for which we have

Similarly, using OES employment shares and CPS wage interval means yields an estimated overall mean wage of \$17.68, very close to the original OES mean.

TABLE 1—RELATIONSHIP OF EARNINGS TO JOB ACTIVITIES, CPS AND OES (2003–2004)

	CPS wages	CPS interval wages	OES interval wages
Analytic	0.0221	0.0215	0.0274
	(0.0010)	(0.0009)	(0.0012)
Interpersonal	−0.0043	−0.0037	−0.0021
	(0.0011)	(0.0011)	(0.0015)
Physical	−0.0044	−0.0042	−0.0036
	(0.0006)	(0.0006)	(0.0008)

Notes: OLS regression coefficients from models with ln(wage) as dependent variable; standard errors in parentheses corrected for fact that job activity measures do not vary by occupation; see Brent Moulton (1990). All wages converted to November 2004 dollars using CPI-U deflator.

data in the CPS and 0.3791 across the same occupations in OES. Further, when the within-occupation standard deviation of the ln(wage) is regressed on the mean of the ln(wage) for the occupation, the coefficient on the mean ln(wage) is considerably larger in the CPS data than in the OES data. While not definitive, this seems consistent with what one would expect if recorded occupations are less homogeneous in the CPS than in the OES, and occupational status commonly is exaggerated in the CPS responses.

III. Returns to Skill in the CPS and the OES

The major question we seek to answer is how the different job activities for which we have information—analytical activities, interpersonal activities, and physical activities—are related to earnings. To answer this question, we fit ln(wage) models in which these job activity measures serve as independent variables. Consistent with the larger reported share of higher-wage occupations in the CPS, the average value of the analytic skills measure is higher in the CPS, while the average value of the physical activity measure is lower.[6]

For the first model estimated using the CPS data, the ln(wage) dependent variable uses the continuous wage constructed for individual observations; the second uses a wage that has been "intervalized" to correspond to the information available in the OES data. The results of the two models are virtually identical. In both, jobs that require more analytical activity pay significantly higher wages, while jobs that require more interpersonal activity or more physical activity pay lower wages. The last column of the table reports the corresponding model estimated using the OES data. Although the general pattern of the estimated coefficients is broadly similar, the estimated coefficient on the analytical activities variable is significantly larger in the OES equation. For someone who is one standard deviation above the occupational average with respect to the importance of analytical activities, rather than one standard deviation below (based on either the CPS or the OES occupational distribution), the estimated OES coefficients imply an effect on earnings that is roughly 15 percentage points larger than the effect implied by the estimated CPS coefficients. The differences between the estimated returns to analytic skills are reduced but not eliminated in models using a CPS wage variable calculated on the assumption that all salaried workers work 40 hours per week (which reduces the gap by about 15 percent) and in models that exclude imputed data (which reduces the gap by about 45 percent).

Our findings are consistent with biased reporting of occupation and resulting bias in measures of the job activities performed by CPS respondents. In particular, to the extent that there is a systematic tendency for CPS respondents to be assigned to occupations in which highly rewarded analytical skills are more important than in the jobs they actually perform, it is not surprising that the estimated returns to analytical skills should be biased downward.

[6] The explanatory variable means are 62.47 (CPS) and 60.23 (OES) for analytic skills; 58.07 and 56.65 for interpersonal skills; and 45.32 and 46.92 for physical skills. The corresponding standard deviations are 13.77 and 13.70 for analytic skills; 13.10 and 12.38 for interpersonal skills; and 21.32 and 20.92 for physical skills.

IV. Conclusion

This paper describes an exploratory analysis of estimated returns to job skills in data from the OES as compared to data from the CPS. Much of what is known about the determinants of earnings in the US labor market is based on CPS data. There has been growing interest in the rewards to different job skills, and other research has discussed the growing demand for skills similar to those captured by our analytical skills measure. We find that estimates of returns to analytical job skills based on CPS data in fact understate the extent to which those skills are rewarded in today's labor market.

In future work, we plan to carry out a more formal factor analysis to identify job skill dimensions and then to examine how the job skill dimensions identified through the factor analysis are rewarded in the labor market. We also plan to extend our cross-sectional analysis to look at changes in the returns to job skills over time as measured using OES versus CPS data.

REFERENCES

Abraham, Katharine G., and James R. Spletzer. 2008. "Are the New Jobs Good Jobs?" Unpublished.

Autor, David H., and Michael J. Handel. 2008. "Variation in Job Tasks: Measurement, Interpretation and Relationship to Earnings." Unpublished.

Autor, David H., Frank Levy, and Richard J. Murnane. 2003. "The Skill Content of Recent Technological Change: An Empirical Exploration." *Quarterly Journal of Economics*, 118(4): 1279–1333.

Bureau of Labor Statistics, US Department of Labor. 2008. "Occupational Employment and Wages, 2007." United States Department of Labor 08–0620. http://www.bls.gov/news.release/pdf/ocwage.pdf.

Employment and Training Administration, US Department of Labor. 2008. "O*Net Data Collection Program." Office of Management and Budget Clearance Package and Data Collection Instruments. http://www.onetcenter.org/dataCollection.html.

Goos, Maarten, and Alan Manning. 2007. "Lousy and Lovely Jobs: The Rising Polarization of Work in Britain." *Review of Economics and Statistics*, 89(1): 118–33.

Ingram, Beth F., and George R. Neumann. 2006. "The Returns to Skill." *Labour Economics*, 13(1): 35–59.

Lemieux, Thomas. 2006. "Increasing Residual Wage Inequality: Composition Effects, Noisy Data, or Rising Demand for Skill?" *American Economic Review*, 96(3): 461–98.

Mathiowetz, Nancy. 1992. "Errors in Reports of Occupation." *Public Opinion Quarterly*, 56(3): 352–55.

Mellow, Wesley, and Hal Sider. 1983. "Accuracy of Response in Labor Market Surveys: Evidence and Implications." *Journal of Labor Economics*, 1(4): 331–44.

Moulton, Brent R. 1990. "An Illustration of a Pitfall in Estimating the Effects of Aggregate Variables on Micro Unit." *Review of Economics and Statistics*, 72(2): 334–38.