Occupational Sex Segregation and Wages in the United States: Devaluation, Human Capital, or Knowledge Requirement?

EXTENDED ABSTRACT

Over the past 30 years, the devaluation of women's work in the United States has received much attention in the literature on gender inequality. The debate on whether there is a true devaluation effect remains unsettled. Merging a new occupational database with a nationally representative survey, this study demonstrates that the knowledge requirement in engineering and technology explains why female-dominated occupations are poorly paid.

Criticizing the neoclassical economic perspective, Paula England has shown an inter-occupational wage gap between male and female occupations (England et al. 1988; Levanon, England and Allison 2009) and argues that sexism affects wages via discrimination in hiring and wage settings. Her work serves as the base for advocating pay equity.

Nevertheless, Tam (1997) and Tomaskovic-Devey and Skaggs (2002) show that the effect of occupational percent women on wages disappears when training time, or specialized human capital, is included in the model. This poses a challenge to the devaluation perspective because researchers rely on the negative wage coefficients of occupational percent women to argue that discrimination exists in labor market.

In response to Tam's finding, England, Hermsen and Cotter (2000) point out that general human capital is absent in Tam's models and the devaluation is restored after controlling for general and specialized human capital. In his rebuttal, Tam (2000) points out that the difference in sex composition estimates results from the serious measurement error in general educational development (GED), an indicator of general human capital in the *Dictionary of Occupational Titles* (DOT). Although Tam (2000) claims that the restoration of devaluation results from noisy GED variable, he provides no direct evidence to substantiate his argument. It is still uncertain whether occupational percent female has true effect on wages.

Regardless of their theoretical positions, most previous studies do not include any occupational knowledge requirement. There are two reasons why this knowledge requirement is important: (1) some knowledge, such as engineering and technology, is more remunerative than other knowledge (Freeman and Hirsch 2008); (2) women are less likely to possess the remunerative knowledge because of horizontal segregation in postsecondary education (Gerber and Cheung 2008). In other words, the wage return of female occupations is lower because women are less likely to invest in the knowledge in engineering and technology. Nevertheless, this supply-side mechanism is missing in previous studies because of the data limitation.

This study merges the January 2012 Current Population Survey (CPS) with Occupational Information Network (O*NET) 17.0. I select this particular CPS because it contains data on worker tenure with current employer and respondents' occupations are coded according to the 2010 Census Occupational Codes. Tenure is important because the gender difference in tenure is

substantial (see Hollister and Smith (2014) for recent trend analysis). The crosswalk between 2010 Census Codes and O*NET codes is much straightforward than other occupational coding schemes.

The dependent variable is the natural logarithm of hourly wage, which is the ratio of weekly earnings and usual weekly hours. Four core explanatory variables in this study are: (1) Occupational percent women (SC): a variable calculated from sex ratio of each occupation in the 2011 American Community Survey. (2) Required level of education (RLE): an O*NET element that indicates the level of education required to perform a job. (3)On the job training (OJT): an O*NET element that signifies the amount of on the job training required to perform a job. (4) Knowledge in engineering and technology (ENGINE): a factor score of 5 O*NET elements (computers and electronics, engineering and technology, design, building and construction, and mechanical) classified under the knowledge domain of engineering and technology.

While the scale of OJT is similar to specific vocational preparation (SVP) in the *DOT*, RLE, which indicates the occupational requirement of general human capital, is far more precise than the GED. It has 12 ordered levels in its scale, ranging from "less than a high school diploma" to "post-doctoral training". This precise indicator resolves the dilemma of including an important yet erroneous measure of general human capital.

Knowledge is defined as "a collection of discrete but related facts and information about a particular domain" (Costanza, Fleishman and Marshall-Mies 1999, p. 71) in O*NET. This study uses only knowledge in engineering and technology because gender segregation in acquiring this knowledge is well-documented (England and Li 2006; Jacobs 1995). Such segregation may explain why female occupation is poorly paid, as the return of engineering and technology knowledge is positive across the years (Liu and Grusky 2013).

[INSERT TABLE 1 ABOUT HERE]

Table 1 shows the OLS regression coefficients of log hourly wages for men and women, controlling for all variables in the model specification of Tam (1997). Column (1) shows that women working in female occupations (SC) receive higher wage penalty, a result that is in line with England et al. (1988)'s finding.

As shown in column (2), the effect of general human capital on devaluation is gendered: it increases the penalty for men but reduces more than half of the penalty for women. As general human capital is positively related to one's wages, the correlation between SC and RLE is positive for men but negative for women. Such gendered path is not documented in previous studies and may worth further examination in future.

Column (3) shows that specialized human capital, measured by OJT, explains part of the devaluation: 39.0% for men and 24.5% for women. Similar to the results in England, Hermsen and Cotter (2000), the coefficient of SC remains statistically significant.

Results from column (4) are encouraging: The knowledge in engineering and technology explains nearly all the devaluation for women (83.3%) and more than half devaluation (52.4%) for

men. The effect of SC is no longer significant at 0.05 level for both sexes, controlling for general human capital.

As shown in column (5), the devaluation effect is fully explained by human capital and knowledge in engineering and technology for women. Some devaluation effect can still be found for men, but its *p*-value is far above the significance level.

In sum, this study not only retests the devaluation perspective with better human capital measures, but also shows that the knowledge requirement in engineering and technology, as a supply-side factor, is the key to explain why workers in female occupations receive lower wages. Nevertheless, this study cannot determine how the knowledge requirement can explain the devaluation. Two possible mechanisms are : (1) SC has true effect on wages and ENGINE fully mediates such effect; (2) the relationship between SC and wages is spurious: a confounding factor, such as cultural beliefs about gender (Ridgeway 2011), is present between SC and ENGINE. Future research can use panel data to test these two competing hypotheses.

Table 1. OLS Regressions of Log Hourly Wages on Sex Composition, Required Level of Education, On the Job Training, Knowledge in Engineering and Technology

	(1)	(2)	(3)	(4)	(5)
Men (N=5,241)					
SC	–0.154***	–0.187***	–0.114**	–0.089	–0.058
	(0.040)	(0.040)	(0.041)	(0.048)	(0.048)
RLE		0.070***	0.062***	0.067***	0.060***
		(0.005)	(0.005)	(0.005)	(0.005)
OJT			0.071***		0.064***
			(0.011)		(0.011)
ENGINE				0.046***	0.029*
				(0.012)	(0.012)
R^2	0.425	0.454	0.459	0.456	0.460
Women (N=5,275)					
SC	–0.210***	–0.102**	–0.077*	–0.017	0.003
	(0.036)	(0.034)	(0.036)	(0.042)	(0.043)
RLE		0.088***	0.085***	0.086***	0.084***
		(0.005)	(0.005)	(0.005)	(0.005)
OJT			0.034		0.030
			(0.018)		(0.018)
ENGINE				0.057***	0.056***
				(0.017)	(0.017)
R^2	0.393	0.442	0.442	0.443	0.443

Source: January 2012 CPS. $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.

Unstandardized regression coefficients with SEs in parentheses.

SC = Occupational percent women; RLE = Required level of education; OJT = On-the-job training; ENGINE = Factor score of occupational knowledge requirement in engineering and technology.

All models control for regions (South, West, Midwest), SMSA, veteran, union, school, experience and its square, tenure and its square, full-time, and 22 industries.

REFERENCES

Costanza, David P., Edwin A. Fleishman, and Joanne Marshall-Mies. 1999. "Knowledges." Pp. 71-90 in *An occupational information system for the 21st century: the development of O*NET*, edited by Norman G. Peterson, Michael D. Mumford, Walter C. Borman, P. Richard Jeanneret, and Edwin A. Fleishman. Washington, D.C.: American Psychological Association.

England, Paula, George Farkas, Barbara Stanek Kilbourne, and Thomas Dou. 1988. "Explaining Occupational Sex Segregation and Wages: Findings from a Model with Fixed Effects." *American Sociological Review* 53(4):544-58.

England, Paula, Joan M. Hermsen, and David A. Cotter. 2000. "The Devaluation of Women's Work: A Comment on Tam." *American Journal of Sociology* 105(6):1741-51.

England, Paula, and Su Li. 2006. "Desegregation Stalled: The Changing Gender Composition of College Majors, 1971-2002." *Gender & Society* 20(5):657-77.

Freeman, James A., and Barry T. Hirsch. 2008. "College majors and the knowledge content of jobs." *Economics of Education Review* 27(5):517-35.

Gerber, Theodore P., and Sin Yi Cheung. 2008. "Horizontal Stratification in Postsecondary Education: Forms, Explanations, and Implications." *Annual Review of Sociology* 34(1):299-318.

Hollister, Matissa N., and Kristin E. Smith. 2014. "Unmasking the Conflicting Trends in Job Tenure by Gender in the United States, 1983–2008." *American Sociological Review* 79(1):159-81.

Jacobs, Jerry A. 1995. "Gender and Academic Specialties: Trends among Recipients of College Degrees in the 1980s." *Sociology of Education* 68(2):81-98.

Levanon, Asaf, Paula England, and Paul Allison. 2009. "Occupational Feminization and Pay: Assessing Causal Dynamics Using 1950–2000 U.S. Census Data." *Social Forces* 88(2):865-91.

Liu, Yujia, and David B. Grusky. 2013. "The Payoff to Skill in the Third Industrial Revolution." *American Journal of Sociology* 118(5):1330-74.

Ridgeway, Cecilia L. 2011. *Framed by gender: how gender inequality persists in the modern world*. New York: Oxford University Press.

Tam, Tony. 1997. "Sex Segregation and Occupational Gender Inequality in the United States: Devaluation or Specialized Training?" *American Journal of Sociology* 102(6):1652-92.

—. 2000. "Occupational Wage Inequality and Devaluation: A Cautionary Tale of Measurement Error." *American Journal of Sociology* 105(6):1752-60.

Tomaskovic-Devey, Don, and Sheryl Skaggs. 2002. "Sex Segregation, Labor Process Organization, and Gender Earnings Inequality." *American Journal of Sociology* 108(1):102-28.