IDEA GROUP PUBLISHING
701 E. Chocolate Avenue, Suite 200, Hershey PA 17033-1240, USA
Tel: 717/533-8845; Fax 717/533-8661; URL-http://www.idea-group.com
ITB12813

This paper appears in the book, *Emerging Trends and Challenges in Information Technology Management, Volume 1 and Volume 2* edited by Mehdi Khosrow-Pour © 2006, Idea Group Inc.

Gender Discrimination in IT Salary: A Preliminary Investigation

Jing 'Jim' Quan, Dept of Information & Decision Sciences, Perdue School of Business, Salisbury University, 1101 Camden Avenue, Salisbury, MD 21801, P (410) 543-6514, jxquan@salisbury.edu

Ronald Dattero, Dept of Computer Information Systems, Southwest Missouri State University, 901 South National Ave., Springfield, MO 65804, RonDattero@smsu.edu

Stuart D. Galup, Dept of Information Technology & Operations Management, Florida Atlantic University, Reubin O'D. Askew Tower, 220 SE 2nd Avenue, Fort Lauderdale, FL 33301, sgalup@fau.edu

ABSTRACT

Although over the past 25 years the gender pay gap for full-time workers has been dramatically narrowing, the gap remains wide in the IT industry. Why does such a gap persist and is the gap really gender related? A set of major factors for determining salary differentials has been identified by previous studies. Incorporating these variables in an integrated model that include a gender variable and various interaction terms, we examine whether wage discrimination based on gender for System Administrators exists. Our results indicate that after all major factors that may affect salary differentials are considered, gender is still a major significant factor in explaining such differentials.

INTRODUCTION

Over the past 25 years the gender pay gap for full-time workers has been dramatically narrowing, Blau and Kahn (2000). A recent survey on IT professionals by InformationWeek (2005), however, finds that the gender gap remains wide in the IT industry. The survey reveals that women, on average, receive about $9 for every $10 men earn in wages and bonuses. Why does such a gap persist? Is gender a significant contributing factor for explaining the gap? Or the gap can be explained by differences in other factors than gender such as education, experience, industry type and geographic locations alone? The answers to these questions are of great interest to not only academic researchers but companies' global competitiveness in the wake of the current labor shortage in the IT industry, Ahuja (2002).

Various studies have attempted to identify the drivers behind salary differentials between females and males in the IT field. Truman and Baroudi (1994) focused on senior Information Technology (IT) managers. They found that factors such as job level, age, education, and work experience were important in explaining the differentials. In a study conducted by Bertrand and Hallock (2001), the top 5 executives in 1,500 of the largest publicly traded firms tracked by Standard and Poor's were surveyed. Their analysis revealed that company size, age and seniority were the critical factors.

In addition to the factors identified by the previous studies, human capital theory (Mincer (1957, 1958, 1962), Schultz (1960, 1961), and Becker (1962, 1964) emphasizes two other factors: experience and education. It is obvious that a more experienced person would earn more than a less experienced one. For example, pay increases consistently with seniority. The human capital implications of education are a well-known and straightforward extension of Smith's idea of equalizing differences (Berndt 1991, p. 154). Educated workers are more productive than their less educated counterparts and thus are more likely to command higher wages. This also provides an economic explanation as to why a person will forego earnings and incur additional expenses to undertake an education, since their efforts will result in substantially more compensation in the long run.

Two other well known variables, although not well documented in academic research, are geographic location and industry type. In general, wages are vastly different across regions and industries. For example, the same InformationWeek (2005) survey reveals that IT wages increased in San Francisco, Portland (in Oregon), and Philadelphia while they fell in Houston, Washington, D.C., and Atlanta. Bernard et al. (2004) finds that relative wages vary considerably across regions of the United Kingdom and increases in the employment share of skill-intensive industries are greater in regions with lower initial skill premium.

In summary, a set of variables are identified by various studies as determinants for wages. As a natural extension, these variables can be used to study IT wages. The question remains whether the gender variable still plays a role after all factors are taken into consideration. If it does not, this would suggest that wage differentials between males and females can be explained by other factors than gender. If the gender variable is found significant, this would suggest the existence of discrimination by gender.

This paper aims to answer this question by proposing an integrated model that includes all important wage determinants identified by previous research and a gender variable. We select one segment of the IT workforce: network and system administrators. The rational behind such a narrow focus is threefold. First, it is the most prevalent segment of the IT workforce. Second, the segment represents middle levels of IT management professionals. By focusing on a segment other than top IT management, we can contrast our results with those of the other research. Third, by selecting a sole occupation in the study minimizes the compounding factor of the crowding by occupation, Solberg (2005).

The remainder of this paper is organized as follows. First, the research model and hypotheses are presented. This is followed by the description of the data set and discussion of the estimation results. Finally, managerial implications and conclusion remarks are provided.

RESEARCH BACKGROUND AND FRAMEWORK

From the human capital theory point of view, the wage differences among workers are due to their differences in levels of education and experience. Human capital theorists believe that education represents an investment. By going to school, one has to incur both direct costs in the form of tuition and opportunity costs in the form of forgone earnings. In order to make up for the losses, workers that have attained additional education must be compensated, by the market, by sufficiently higher life-time earnings, Mincer (1957, 1958, 1962), Schultz (1960, 1961). This is validated by a 2004 census report released by the US Census Bureau stating that workers of 18 year old or older and with bachelors degrees earn an average of $51,206 a year, while those with a high school diploma earn $27,915. Workers with an advanced degree make an average of $74,602, and those without a high school diploma average $18,734, Census Bureau (2004).

Another human capital factor is experience. Experience from the general on-the-job training enables a worker to acquire extremely versatile skills that are equally usable or salable across firms and industries. This skill acquisition, in turn, increases the worker's productivity at any task. The competitive market dictates that she/he will be paid at a higher rate accordingly, Mincer (1957, 1958, 1962), Schultz (1960, 1961).

Of previous studies on gender discrimination, two are relatively significant. Using a survey on the top 5 executives in 1,500 of the largest publicly traded firms tracked by Standard and Poor's, Bertrand and Hallock (2001) showed that the fact that women managed smaller companies and were less likely to be CEO, Chair, or President of a large corporation can explain as much as 75% of the gender gap in salary for top corporate jobs. Adding other variables, such as age and seniority, to their model, the unexplained 25% gap fell further to only 5%.

In another study, Truman and Baroudi (1994) focused on the senior managerial ranks of the information systems (IS) occupation. Using data gathered by the Society for Information Management (SIM), they found that the average salary for women IT managers was considerably lower than males even when controlling for job level, age, education, and work experience. They concluded that IS may not be immune to the problems of gender discrimination.

In addition to the aforementioned factors, geographic locations of firms and industry types are found to play important roles in determining diversity in salaries by Bernard et al. (2004). In general, the divergence in price levels across different parts of the country determines the salary differentials. For example, an IT professional would make much more money in Silicon Valley than in Florida. According to a government estimate USDOL (2004), the average annual wages in 2004 for Computer and Mathematical Science Occupations were $57,960 in Florida and $74,060 in California. Industry types are also an important factor. For example, the average wage for computer programmers was $69,000 in Internet Services industry while $47,000 in Distributor/Wholesale industry according to a survey done by an online job site dice.com.

In summary, previous theories, studies, and surveys have indicated that education, experience, firm size, seniority, age, job rank, geographic location, and industry type are important wage differentiators. We propose our research question:

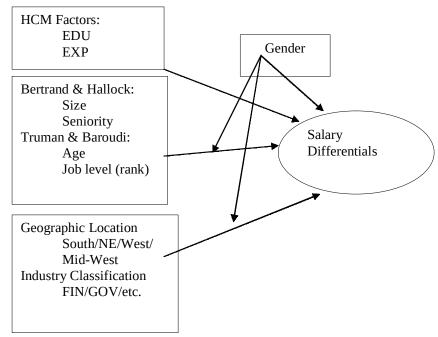
After taking into consideration all these variables, do a gender variable and its interaction with the other variables still have significant explanation power in determining wages?

An affirmative answer to the above question confirms existence of gender discrimination. If none of the gender related variables is significant, however, one can conclude that all the wage divergence is explained by variables other than gender. Therefore, wage differences cannot be attributed to gender.

Based on the discussion above, we present our research framework in Figure 1.

In the framework above, we include not only a gender variable but interaction terms between gender and location, industry type, firm size, employee's age, seniority and rank. The rational for the inclusion of the interaction terms is to discern any location- and industry-related gender discrimination. Specifically, even if the gender variable is found insignificant overall, wage discrimination based on gender can still be found in different regions and/or industries. In addition, such an inclusion helps

Figure 1. Research framework



answer questions such as whether older or higher ranked female workers are discriminated and whether female employees are better off working for large firms or small ones.

DATASET

The dataset we use in our analysis is from a voluntary web-based survey on salary and skills of IT workers that was conducted by Dice Incorporated, one of the largest on-line job placement companies. The time period is from June 7, 2000 to April 13, 2001. Among the 38 different job titles, we selected Network Manager and Systems Administrator to test our model. After any problematic data was removed (see appendix for data treatment), our sample size is 2,103.

Since technical experience is reported in levels rather than in years, it is scaled as follows: (1) 0.5 for less than 1 year, (2) 1.5 for 1-2 years, (3) 3.5 for 3-5 years, (4) 7.5 for 6-10 years, (5) 12.5 for 11-14 years, and (6) 17.5 for more than 15 years. By the same principal, the highest education level attained is scaled into education in years as follows: (1) 12 for High School, (2) 14 for Military, (3) 14 for Vocational/Tech School, (4) 14 for Some College, (5) 16 for College Grad, (6) 18 for Master's Degree, (7) 20 for Doctoral Degree, and (8) 20 for Professional Degree (MD, JD).

MODEL

Human capital theory suggests that the earning function is concave in experience with earnings peaking somewhere in midlife. It is also suggested that instead of using annual salaries, the hourly salary rate should be employed, Berndt (1991). We calculate the hourly salary based on the reported annual salary and average number of hours worked per week.

Hence, we propose our model as follows:

$$\log Y = \alpha + \beta_1(edu) + \beta_2(exp) + \beta_2(exp)^2 + \Sigma\pi(dummy) + \Sigma\rho(interactions) + \varepsilon \quad (1)$$

where dummy variables include:

- Gender: female;
- Industry: Finance, IT, Government, Manufacturing, Medical, Retail/Wholesale, Transportation. Others are used as the base;
- Age: younger than 40;
- Size: small (1-99) and medium (100-999). Large (>1000) is used as the base;
- Seniority: less than 5 years in the current position;
- Geographic locations: West, Mid-West and Northeast. South is used as the base.

Interaction terms are between gender and all other indicative variables.

RESULTS

Table 1 reports the estimation results. The model fits well with the human capital theory. As expected, the signs for Edu and Exp are positive and the sign for Exp^2 is negative. The estimated coefficients for these three variables are 0.036, 0.047 and -0.002, respectively, and all are significant at the 1% level. Of the estimates coefficients for industries, the ones for Manufacturing, Medical, Retail/Wholesale and Transportation are not significant. The ones for IT and Finance are significant at the 1% level while the one for Government is at the 5% level. When compared to other industries, Network and System administrators are paid the most in IT (0.140), next in Finance (0.106) while making less in Government (-0.076). Firm size is also important in determining Network and System administrators' pay. They are better off working for large organizations. They are paid less (-0.065) in medium companies and even worse (-0.128) in small ones. Both estimates are significant at the 1% level. For those who are in their current positions for 5 years or less, they are paid less (-0.088) than those who have more seniority. This estimate is significant at the 1% level. Our findings in terms of size and seniority are consistent with those by Bertrand and Hallock (2001). In terms of geographical locations, the West (0.115) and Northeast (0.105) regions are better places for Network and System administrators than the South. Both estimates are significant at the 1% level. Meanwhile, the Mid-West region is not significantly different from the South. None of the interaction terms are found significant.

After all the possible causes for explaining salary differentials are considered, the gender variable is still found negative (-0.142) and significant at the 10% level (p=0.0887). This suggests that gender itself is responsible for explaining some of the wage gender gap when controlling the other factors. Hence we conclude that it is likely that gender discrimination exists. That is, all things being equal female Network and System administrators are paid less than their male counterparts.

Table 1. Estimation results

Coefficient	Estimate	Pr > |t|
Intercept	2.350[a]	<.0001
Edu	0.036[a]	<.0001
Exp	0.047[a]	<.0001
Exp^2	-0.002[a]	<.0001
Female	-0.142[c]	0.0886
Industry Indicators		
Finance	0.106[a]	0.002
IT	0.139[a]	<.0001
Government	-0.075[b]	0.0268
Manufacturing	0.016	0.6491
Medical	0.059	0.1803
Retail/Wholesale	-0.011	0.8118
Transportation/Utilities	0.069	0.2097
Age: Under 40 Years Old	0.013	0.5825
Firm Size Indicators		
Small (1-99)	-0.128[a]	<.0001
Medium (100-999)	-0.065[a]	0.0009
Tenure: Less than 5 Years in Current Position	-0.088[a]	<.0001
Region Indicators		
West	0.115[a]	<.0001
Midwest	0.025	0.3409
Northeast	0.105[a]	<.0001
Industry Interaction Terms with Female		
Finance	-0.011	0.9093
IT	0.075	0.3118
Government	0.077	0.4071
Manufacturing	0.024	0.8180
Medical	-0.141	0.2236
Retail/Wholesale	0.198	0.1355
Transportation/Utilities	0.234	0.2011
Age Interaction Term with Female	-0.038	0.5096
Firm Size Interaction Terms with Female		
Small	0.047	0.5160
Medium	-0.004	0.9534
Tenure Interaction Term with Female	0.0568	0.3039
Region Interaction Terms with Female		
West	0.060	0.3754
Midwest	0.036	0.6212
Northeast	0.088	0.2507

Overall model p-value < .0001
Adj. R^2 = 0.174

Notes:
a Significant at the 1% level
b Significant at the 5% level
c Significant at the 10% level

DISCUSSION AND CONCLUSIONS

This paper aims to develop a generalized model that can be used to determine whether salary differentials are based on gender. This model includes all possible variables identified by previous research as contributing factors to the wage gap. We estimate the model using data on one of the most predominant jobs in the IT field: Network and System administrators, obtained from an internet job placement website. Our results reveal that that after all major factors that may affect salary differentials are considered, gender is still likely a contributing factor.

Our results are consistent with findings by Truman and Baroudi (1994) that IS may not be immune to the problems of gender discrimination. This poses a serious challenge for management. In order to create and maintain diversity in working environments, managers must pay attention to the needs of all different groups of employees, including females. Management can address this issue in terms of both access and treatment. It is imperative to draw more women to the IT profession by making efforts to eliminate the stereotype of IT jobs being "techie" and create a female friendly image in the IT profession. Once at work, these new female workers should be assured that they feel welcomed in the IT community. A number of psychological studies indicate "through experience, people come to share beliefs about the extent to which tasks are linked to gender" (Vancouver and Ilgen 1989). Management can also define better career paths for women and constantly monitor their progress.

The directions for future research include a comparison of gender diversity between Network and System administrators and other IT management ranks. If divergence is found among different type of IT jobs, then different management policy implications can be drawn according.

REFERENCES

Ahuja, MK. (2002). "Women in the Information Technology Profession: a Literature Review, Synthesis and Research Agenda," *European Journal of Information Systems*, 11, 20-34.

Becker, G.S. (1961) "Investment in Human Capital: A Theoretical Analysis," *Journal of Political Economy* 70(5), Part 2, pp. S9-S49.

Becker, G.S. (1964) *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*, National Bureau of Economic Research.

Bernard, A. B., Redding, S., Schott, P. K. and Simpson H. (2004). "Relative Wage Variation and Industry Location." *The Centre for Economic Performance Publications Unit*, http://cep.lse.ac.uk

Berndt, E.R. (1991). *The Practice of Econometrics: Classic and Contemporary*, Addison-Wesley.

Bertrand, M. and Hallock, K.F.(2001). "The gender gap in top corporate jobs," Industrial & Labor Relations Review, vol. 55, no. 1, pp. 3-21.

Blau, F.D. and Kahn, L.M. (2000). "Gender Differences in Pay." *Journal of Economic Perspectives*, 14(4), pp. 75-99.

Census Bureau (the US) (2004). "Educational Attainment in the United States: 2004, http://www.census.gov/population/www/socdemo/education/cps2004.html

Darity, D. and Mason, P. (1998). "Evidence on Discrimination in Employment: Codes of Color, Codes of Gender (in Symposium: Discrimination in Product, Credit and Labor Markets)," The Journal of Economic Perspectives, vol. 12, no. 2, pp. 63-90.

Greenhaus, J., Parasuraman, S., and Wormley, W. (1990). "Effects of race on organizational experiences, job performance evaluations, and career outcomes," Academy of Management, vol. 33, no. 1, pp. 64-86.

InformationWeek (2005). "Fair Or Not, Men Earn More Than Women In IT." April 25, http://www.informationweek.com/showArticle.jhtml?articleID=161500639.

Keith, K. and McWilliams, A. (1999). "The Return to Mobility and Job Search by Gender," Industrial and Labor Relations Review, vol. 52, no. 3, pp. 460-477.

Kulik, L. (2000). "A Comparative Analysis of Job Search Intensity, Attitudes Toward Unemployment, and Related Responses," Journal of Occupational and Organizational Psychology, vol. 73, pp. 487-500.

Lage, E. (1991). "Boys, girls, and microcomputing," European Journal of Psychology in Education, vol. 6, pp.29-44.

Levitin, T., Quinn, R.P., and Staines, G.L. (1971). "Sex Discrimination Against the American Working Women," American Behavioral Scientist, vol.15, no. 2, pp. 238-254.

Mincer, J. *A Study of Personal Income Distribution*, unpublished Ph.D. dissertation, Columbia University, Department of Economics, 1957.

Mincer, J. "Investment in Human Capital and Personal Income Distribution," *Journal of Political Economy* (66:4), August 1957, pp. 281-302.

Mincer, J. "On-the-Job Training: Costs, Returns, and Some Implications," *Journal of Political Economy* (70:5 Part 2), October 1962, pp. S50-S79.

Mincer, J. *Schooling, Experience and Earnings*, Columbia University Press for the National Bureau of Economic Research, 1974.

Moyes, G., Williams, P., Quigley, B. (2000). "The relation between perceived treatment discrimination and job satisfaction among African-American accounting professionals," Accounting Horizons, vol. 14, no.1, pp. 21-49.

Panteli, A., Stack, J. and Ramsay H. (1999). "Gender and Professional Ethics in the IT Industry," Journal of Business Ethics, vol.22, pp. 51-61.

Roy, A. (1950). "The Distribution of Earnings and of Individual Output," Economic Journal, vol. 60, no. 3, pp. 489-505.

Schultz, T.W. (1960). "Capital Formation by Education," *Journal of Political Economy*, 68(6), pp. 571-583.

Schultz, T.W. (1961). "Investment in Human Capital," *American Economic Review*, 51(1), pp. 1-17.

Smith, A. (1937). The Wealth of Nations (reprinted edition), Random House.

Solberg, E.J. (2005). "The Gender Pay Gap by Occupation: a Test of the Crowding Hypothesis," *Contemporary Economic Policy*, 23 (1), pp. 129-148.

Truman, G. and Baroudi, J. (1994). "Gender Differences in the Information Systems Managerial Ranks: An Assessment of Potential Discriminatory Practices," Management Information Systems Quarterly, vol. 18, no. 2, pp. 129-141.

USDOL (2004). "State Occupational Employment and Wage Estimates," *Occupational Employment Statistics*, U.S. Department of Labor, Bureau of Labor Statistics. http://www.bls.gov/oes/current/oessrcst.htm

Vancouver, J.B. and Ilgen, D.R. (1989). "Effects of Interpersonnal Orientation and the Sex-Type of the Task on Choosing to Work Alone or in Groups," *Journal of Applied Psychology*, vol. 74, no. 6, pp. 927-934.