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INFORMATION TECHNOLOGY WORKFORCE STRUCTURE AND COMPENSATION: IMPLICATIONS FOR OUTSOURCING

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Abstract

Some literature on information technology outsourcing has argued that the rise of outsourcing can be tied to IT labor market conditions. The purpose of this research is to investigate how IT workforce characteristics influence the distribution of workers between IT services (ITS) firms and non-ITS firms and the associated compensation. IT outsourcing literature points out that due to the economies of scale and scope and specialization in IT, ITS firms may have an advantage in hiring, retaining, and motivating highly skilled IT workers by providing better career opportunities and better compensation due to higher productivity. On the other hand, non-ITS firms may have to compensate IT workers better because they need to make specific investments in non-IT skills and, as a result, may have some hold up power over other employees. This study reports early results from an analysis of the U.S. Department of Labor's Current Population (CPS) Survey from 1983-2001 and the U.S. population census for 2000. These results show that IT workers employed by ITS firms are better educated, younger, and proportionally more are male. The wage regression results show that holding other factors constant, ITS firms pay more than non-ITS firms for a given type of worker. However, there may be other factors, such as finer differentiation in worker qualification or job intensity, unobservable from our dataset that may influence the wage. Further research is suggested.

Keywords: IT workers, IT outsourcing, labor market, wage regression

Introduction

Literature on outsourcing has argued that the rise of IT outsourcing can be tied to IT labor market conditions. Specifically, increasing technological and environmental turbulence such as the diffusion of client-server and network technologies in the 1990s made hiring permanent employees prohibitively expensive (Ang and Slaughter 2001; Slaughter and Ang 1996). This brought about conflicting demands on firms. On the one hand, firms needed to stay flexible and be able to focus on their core businesses, while, on the other hand, they were facing an IT skill market characterized by skill deterioration and advanced-skills shortages (NRC 2001). In this situation, long-term commitments to permanent employees became problematic, leading to the use of contingent workers for jobs requiring advanced technical skills. Yet, a significant amount of outsourcing was and is provided by specialized

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IT services (ITS) firms, which engage permanent IT workers in a traditional employment relationship. Through the specialization in IT services, these firms may be better able to recruit, retain, and motivate high-quality IT workers. This paper investigates two related research questions:

1. How do IT workers (characterized by their demographics and human capital) working for specialized ITS firms differ from IT workers working in other industries?
2. Do IT workers in ITS firms get paid the same, higher, or lower wages for the same kinds of qualifications as IT workers working in other industries?

This investigation offers a richer understanding of the IT outsourcing phenomenon, which thus far has been explained primarily through transaction cost economics and production economies lenses (Ang and Straub 1998) and core competency-based arguments (Levina and Ross 2003) without an in-depth investigation of the labor market factors. The deeper investigation proposed here helps bridge the gap between academic and practitioner accounts of outsourcing, which emphasized that firms tend to outsource IT to get access to superb technical expertise (Casale 2003; ITAA 2002; Quinn 1999). For example, even for a network administrator job, which is associated with stable and predictable demand, practitioners argued that outsourcing offered “the ability to have top-level support that we couldn’t hire internally” (cited in Casale 2003). This rationale assumes that specialized ITS firms have advantages in hiring high-skilled IT labor even for stable demand jobs. While Slaughter and Ang’s (1996) work provides an explanation for the firm’s side of the problem, this work explores the worker’s side as well.

Background Literature and Theory

There have been relatively few studies of the IT labor market on an economy level especially when it comes to the distinctions between ITS vs. non-ITS firms. Slaughter and Ang’s (1996) study along with practitioner accounts suggest that workers with more advanced skills are more likely to be hired by IT firms than non-IT firms because the former can pull demand across clients. In addition, large IT service providers often have system outsourcing, integration, and development lines of service. The diversification into complementary areas allows the provider to offer its employees good promotion and learning opportunity (Levina and Ross 2003). Smaller more focused IT firms often attract employees by offering opportunities to work with the latest technology and with likeminded coworkers (Levina 2001; Swart et al. 2003). Specialized ITS firms are also more likely to invest in software process improvement techniques to improve worker’s productivity as well as to use them as credentials with clients (Levina and Ross 2003). Such investments are complementary to IT workers’ skills (Harter and Slaughter 2003). Hence we hypothesize:

H1: Workers with higher human capital endowment (such as years of education) are more likely to work for specialized ITS firms.

In addition to human capital endowment, demographic worker characteristics such as age, gender, and family status are also likely to be unequally distributed across firms. Because IT services jobs are likely to require more travel and longer working hours, older workers, women, and workers with family are less likely to work in those jobs. Younger workers are also more likely to work for specialized IT firms because those firms tend to invest more in training and mentorship and provide better advancement opportunities within the firm (Levina and Ross 2003). Those workers are also more likely to welcome adoption of software process improvement methods and benefit from them to build their development and management skills (Harter and Slaughter 2003; Levina and Ross 2003). Based on the data from National Science Foundation (NSF) on technical degree graduates, proportionally more of the younger (under 40) workers with a bachelor’s or higher degree tended to work for the IT industry, but the situation reversed for older workers (NRC 2001; p. 67). Younger, single workers also have different attitudes toward job stability and entrepreneurial orientation of the firm (Agarwal et al. 2001). They are more likely to work for ITS firms, which tend to be more entrepreneurial and have more stock sharing and option plans as part of compensation packages (Yang et al. 2003).

H2a: Proportionally younger workers are likely to work for specialized ITS firms.

H2b: Proportionally more male workers are likely to work for specialized ITS firms.

H2c: Proportionally more unmarried workers are likely to work for specialized ITS firms.

H2d: Workers with fewer children under 18 are more likely to work for specialized ITS firms.

Finally, geographic location also matters in workforce distribution. Intellectual capital workers tend to benefit from collocation (Saxenian 1996). Non-specialized firms may need to choose locations in areas that are close to natural resources or transportation.

H3: Workers in ITS firms are more likely to be located in metropolitan areas.

Relating to our second research question on compensation, to date, the most comprehensive study of IT compensation was conducted by Ang et al. (2002) and found that for Singaporean IT workers, compensation was directly determined by the education and experience of workers (human capital endowment). Studies of the U.S. labor force also show that education and experience yield higher compensation (Wills 1999). It is also well known that female and minority workers tend to earn less in a given position and with a given human capital, while married people tend to earn more than their unmarried counterparts. We expect those trends to be supported for IT workers across industries. A more interesting question becomes whether ITS firms pay differently from other firms for the same type of worker (same human capital endowment, demographics, and geography).

Specific to industry distinctions, Anderson et al. (2000) studied the differences among executives' total compensation in IT vs. non-IT firms and found that, after controlling for performance and other factors, the pay in the IT industry was not higher than in other industries. However, executive compensation is often driven by factors other than regular employee compensation, so it is not clear if the results generalize to the labor force at large. The study by Ang et al. distinguished between information intensive firms (IT, finance, and insurance) and others. This distinction did not have a direct effect on the compensation level, but had a moderating effect with information intensive firms paying more to IT professionals with more education and/or IT-specific education. While the studies above suggest that we should hypothesize no difference in pay using economic considerations, such as total worker's utility from the job and worker's marginal productivity, different factors and theories have contradictory implications in this regard. Table 1 outlines different arguments assuming that worker characteristics, geographical location, and firm size remain constant.

While factors outlined in Table 1 can be observed and studied individually, for the initial investigation we are more interested in the general movement of wages and only test for Hypothesis 4 and 5. In addition, prior studies (Agarwal et al. 2001; Ang et al. 2002) suggested that there may be interaction effects between worker's human capital endowment, demographics, and geography and firm's characteristics such as size and industry. For example, younger workers with higher education may prefer to take highly intense, but less stable, jobs with good career progression and learning opportunities in smaller ITS firms and get higher pay as a result. These interaction effects are important, but fall beyond the scope of this initial investigation.

Methods

Our investigation is based on understanding the IT labor market from the labor economics perspective (Wills 1999). Thus we seek to get an estimation of both supply (worker) and demand (firm) sides of the market. To estimate the supply side of the market, we analyze 19 years (1983 through 2001) of data from the U.S. Department of Labor's Current Population Survey (CPS). The data was collected by interviewers who visited a random sample of 5 percent of the U.S. workforce (77,594 workers on average per year). While the data on IT workers has been collected since 1971, the sample size before 1983 was very small. Using data since 1983, our sample resulted in 1,225 IT workers on average per year. In our analysis, IT worker occupations included computer system analysts and scientists, computer programmers, supervisors, computer equipment operators, and data processing equipment repairers. In the final analysis we only include full-time, full-year employees who constituted 75 to 83 percent of the sample depending on the year. Self-employed workers constituted a maximum of 3.6 percent of the IT workforce in any given year and there were virtually no unemployed IT workers. We dropped these choices from the final analysis.² All the industry and occupations specific data in the analysis refers to the last year (this choice provided the cleanest data in the CPS sample).

Based on the literature on IT workers, we define worker type using occupational group, years of education, age, gender, number of children in the family under 18 years of age, marital status, and location. The government data did not have workers' years of experience or the type of education. Our proxy for experience is age – education - 6. The square of this variable was used as well following the standard labor economic arguments (nonlinear returns to experience).

²We recognize that contingent workers employed by staffing firms may be reported as permanent workers and not self-employed workers despite the qualitative difference between them and permanent workers in ITS firms.

Table 1. Factors Influencing Wages in ITS vs. Non-ITS Firms

<i>H4: ITS firms pay less than non-ITS firms keeping all other factors constant</i>	
Firm-specific skills lock-in	Non-ITS firms may need to pay more because they have greater need to retain their IT workers because there is a greater amount of firm or industry-specific skills that workers need to acquire as compared to ITS firms, where many skills are occupation-specific, but transferable across firms (NRC 2001).
Job satisfaction	ITS firms offer an ability to learn new skills through training and mentorship, task challenge, respect and influence associated with being a line worker as opposed to staff worker, and interaction with other IT workers (Levina and Ross 2003; Swart et al. 2003). Thus, they may be able to hire for lower wages.
Technical field career objectives	Technically as well as managerially oriented IT workers (Agarwal et al. 2001) have better career ladders in ITS firms due to the scope and scale of operations and may be willing to accept lower wages (Levina and Ross 2003).
Stock options	ITS firms are younger and have more entrepreneurial orientation, which leads to the use of stock options instead of wages for pay (Yang et al. 2003).
<i>H5: ITS firms pay more than non-ITS firms keeping all other factors constant</i>	
Worker’s marginal productivity	ITS firms may obtain higher marginal productivity from the same IT worker due to economies of scale and scope, investment in complementary organizational practices, and experience gained from specialization (Harter and Slaughter 2003; Levina and Ross 2003). In a tight labor market, IT firms would pass some of their productivity gains to workers and pay more.
Job intensity	ITS firms often pay more because they require their workers to work longer hours, learn new skills at a greater pace, and do more traveling.
Job stability	ITS firms are more prone to be affected by changing IT demand. For example, they showed greater job loss in the last 3 years (ITAA 2002).
Internal labor market conflicts	Pay equity issues have put pressure on non-ITS firms to keep IT salaries in line with others, but IT salaries grew substantially more than most other occupations during 1990s due to shortages (ITAA 2002; NRC 2001).
Non-technical field career objectives	Non-ITS firms may pay less to IT workers if IT workers see their IT job growth as limited and want to transfer into non-IT career paths. This trend was observed among Singaporean IT workers (Lee 2000).
Hiring clients’ workers	Many outsourcing arrangements require that ITS firms make offers to the client’s IT workers. If the offer is below what the non-ITS firm offered, adverse selection is likely to result in only poor workers staying.

At this point in time, our demand side analysis is limited to distinguishing among ITS vs. non-ITS firms. In the CPS sample, we treat ITS firms as those practicing in Computer and Data Processing Services—SIC code 732 (1992-2001) and 740 (1983-1991). In the CPS data, there was no way to distinguish between ITS firms (e.g., EDS) and IT product firms (e.g., Microsoft) because the government used the same code. Indeed many firms (e.g., Oracle) have several lines of business. To address these limitations, we have included data analysis from the U.S. census in 2000, where ITS industry includes data processing services (679), computer systems design and related services (738), and management, scientific, and technical consulting services (739), but excludes software publishing (649). To analyze worker differences between ITS vs. non-ITS firms (H1 through H3), we used descriptive statistics and z-test for independent samples in the CPS data. We report early results in this paper.

To test H4 and H5, we rely on the income from wage and salary variable reported in the CPS and the census. We also control for the difference in benefits (pension plan and health insurance availability, but not size) in the CPS data. From the the CPS and the census data sets, it is impossible to fully analyze all the supply and demand movements, but it is possible to analyze the satisfied demand and supply which includes both worker preferences and firms’ willingness to pay. We use wage regression (below) to understand which factors shape the wages:

$$\ln W_{it} = \text{IND}_{it} \alpha + X_{it} \beta + Y_{it} \gamma_d + \varepsilon_{it}$$

where W_{it} is a wage, X_{it} is a vector of individual characteristics (human capital endowment and demographics), Y_{it} is employer characteristics (metropolitan area indicator, firm size, and benefits availability), and IND_{it} is industry (ITS vs. non-ITS indicator), within the range of uncertainty parameter ϵ_{it} for individual i in year t . As a first step, we use ordinary least square (OLS) estimates. We conducted the analysis for all IT workers and for each occupational group controlling for each year.

Our next step is to gather and analyze additional data to estimate the demand. The Occupational Employment Survey (OES), which asks employers to describe jobs, educational requirements, and pay scales, is another source of demand estimation provided by the government. Demand shocks can also be estimated by analyzing changes in IT budgets and the growth of IT industry in relation to U.S. GDP. Since there is a potential for unmet demand, shortage data from ITAA (2002) may prove valuable. We will seek other statistical models (e.g., logistic regression, structural equation modeling, etc.) to address limitations of the current analysis method.

Early Findings

The CPS data (1983-2001) show that the percentage of IT workers working for ITS firms grew from about 10 percent in the mid-1980s to 33 percent in 2001 with the most rapid growth in the mid- to late 1990s. Indeed, we found significant differences among IT workers working for ITS vs. non-ITS firms. Table 2 summarizes key findings. Detailed statistics are not reported due to space limitations.

Table 2. Hypotheses 1, 2, and 3 Results Using z-Test with 95 Percent Confidence Interval

Hypothesis	Support Years
H1 (education)	Supported – All Years
H2a (age)	Supported in 10 years (1987, 1989, and 1994-2001)
H2b (male)	Supported in 17 years (1983, 1984, 1986-1997, 1999-2001)
H2c (married)	Not significant differences.
H2d (children)	Supported in 4 years (1989, 1994, 1995, and 2001)
H3 (location)	Supported in 14 years (1983, 1984; 1986, 1988-1997, 1999)

The data shows that age differences (H2a) have been increasing since 1991. Metropolitan location differences show a trend decreasing to zero (H3a), potentially because after 1990 more non-ITS firms (both in metropolitan and non-metropolitan areas) began to adopt IT.

The wage regression results are reported in Table 3 and show significant differences.

Human capital and demographic variables show the usual characteristics of U.S. wages at large (Wills 1999). In Table 3, columns 1 and 5 indicate the overall industry effects, columns 2, 6, and 7 include worker variables, columns 3 and 4 includes benefits, and column 4 also includes firm size variables. For example, controlling for each year in the CPS sample, for computer system analysts and scientists, return to education was 5.90 percent per year; female workers earned 13.14 percent less; married people earned 9.46 percent more; and African-Americans earned 7.08 percent less. Similarly to the NRC study, we find that workers in metropolitan areas received 18.46 percent more in high-skilled occupations (computer system analysts and scientists – code 64).

Controlling for all of the worker and location variables, we found ITS firms pay 7.71 percent more on average across all years than non-ITS firms for a given occupation (code 64) supporting Hypothesis 5 and not supporting Hypothesis 4. The results from the CPS dataset are confirmed by results from the census 2000 dataset. When controlling for health insurance availability (which showed no significant difference between ITS vs. non-ITS firms) and pension plan availability (which was offered more often by non-IT firms), ITS firms still paid significantly higher wages.

Table 3. Wage Regression Results (p < 0.01*; p < 0.05**)**

CPS Data 1983-2001							
Variables	All IT workers				Computer System Analysts and Scientists	Census 2000 All IT workers	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Years of Education		0.0847***	0.0804***	0.0788***		0.0573***	0.07589***
Experience Years		0.0338***	0.0311***	0.0293***		0.0312***	0.03528***
Experience-squared		-0.0006***	-0.0005***	-0.0005***		-0.0006***	-0.00059***
Female (1=yes)		-0.2287***	-0.2177***	-0.1946***		-0.1409***	-0.13994***
Married (1=yes)		0.0854***	0.0863***	0.0944***		0.0866***	0.09705***
African-American (1=yes)		-0.0806***	-0.0903***	-0.0960***		-0.0734***	-0.09715***
Metropolitan Area (1=yes)		0.1768***	0.1747***	0.1956***		0.1694***	0.32386***
Employer Pays for Health Ins			0.1035***	0.1022***			
Employer Pays for Pension Plan			0.1224***	0.0855***			
Firm Size 50-99				0.0105			
Firm Size 100-499				0.0413**			
Firm Size 500-999				0.0580***			
Firm Size >=1000				0.1183***			
IT industry over non-IT industry	0.1687***	0.0932***	0.1101***	0.1425***	0.0792***	0.0743***	0.09226***
Control for years (1983-2001)	All years	All years	All years	1989-2001	All years	All years	Year 2000
R ²	25.39%	46.92%	49.71%	42.23%	18.74%	33.67%	20.67%
N	18028	16765	14347	10711	6601	6296	18519

Discussion, Limitations, and Research Implications

Early analysis indicates that indeed ITS firms employ different kinds of workers (better educated, younger, and more male) and pay differently. This supports (but does not prove) the proposition that ITS firms were able to attract qualified workers and pay them more during the time of IT labor shortage. However, it is not clear if the difference in pay was associated with higher labor productivity or with other factors (listed in Table 1). To further explore this phenomenon, we propose classifying workers into different types (e.g., highly educated younger male workers, highly educated older female workers, low education older male workers, etc.) and studying which factors influence the match between worker types and their employee’s line of business and affect compensation levels. From the literature on IT careers, the variables that play a role in the employment relationship include job intensity, job satisfaction, job stability, career opportunities, and location. On the other hand, factors influencing firm’s job design and compensation policy include firm’s age and size, internal labor market dynamics, job’s contribution to firm’s production function, need for firm-specific vs. profession-specific skills, and institutional pressures. Structural equation modeling may be a useful technique in testing such a model. To fully address the question of whether ITS firms had an employment relationship advantage requires a study of IT worker preferences (and not just satisfied demand) as well as the analysis of the demand side shock.

Even within our investigation of satisfied demand, we found the CPS and the census data sets rather coarse. For example, the data on benefits was not specific enough to construct the full compensation package. Similarly, stock option data was not available. However, since ITS firms tend to offer more options, this data is likely to provide further support for our current findings. The data on hours worked available in the CPS data set had too many missing values. On the other hand, we were able to analyze

which kinds of people were transitioning from ITS to non-ITS industry and vice versa. Early results provided further support for findings reported in this paper.

Although our initial research motivation was to examine the role of the IT labor market as it shaped IS outsourcing, we realize that compensation of IT workers may have significant differences across non-ITS industries. For example, IT intensity, operationalized as firms in the finance and insurance industries, has been related to compensation. However, this is a limited definition of IT intensity. Our future studies will investigate the relationship between IT intensity (the amount of IT investment compared to total investment) and IT workers' pay.

Our initial investigation concludes that if ITS firms indeed have advantages in delivering IT services, they did not come from offering lower wages. Not only were these firms offering higher wages and potentially delivering at lower cost, but they were also making a nice profit in the 1990s. Proponents of economic theory would argue that higher pay would be associated with higher productivity of these workers. However, advocates of political and institutional views on outsourcing (Hu et al. 1997; Lacity and Hirschheim 1993) may offer a different argument. Once firms outsourced their IT due to internal and external pressures in the 1990s, they gave up some of their value adding activities to service providers. The latter succeeded in hiring more qualified workers at the time of the IT labor market shortage by sharing some monetary rewards with workers. This made it even harder for non-ITS firms to find qualified workers, reducing their ability to provide good service and increasing internal and external pressures to outsource. Potentially, the ITS industry was able to create a need for its services without any specific productivity gains.

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