It's Who You Are and What You Do: Explaining the IT Industry Wage Premium

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The investment in and use of information technology (IT) was undoubtedly an important contributor to the rapid growth of the U.S. economy during the 1990s. By one estimate the IT-producing sector was responsible for 1.4 percentage points of the nation's average annual real gross domestic product (GDP) growth of 4.6 percent between 1996 and 2000 (Economics and Statistics Administration 2003). But in 2001 the situation changed dramatically as business spending on IT equipment and services declined, and in 2002 IT-producing industries contributed only an estimated 0.1 percentage points to the 2 percent real GDP growth.

A recent paper by Hotchkiss, Pitts, and Robertson (2005) documents the wage outcomes for workers during and after the IT boom of the 1990s using a unique set of employer-employee matched earnings data for workers in Georgia. One of the paper's findings is that, after controlling for individual characteristics, workers in IT-producing industries have average earnings that are much higher than those in other industries. Workers in IT service industries, in particular, accrue a relatively large wage premium. Hotchkiss, Pitts, and Robertson speculate that these different wage outcomes may be related to the types of occupations IT workers hold across industries. Unfortunately, the data used in their paper do not contain information on a worker's occupation.

This article's main objective is to present evidence on the extent to which variation in average wages between IT-producing and non-IT industries can be accounted for by differences in wages paid to IT-related occupations.[1] If average industry wage differentials in IT-producing industries are substantially lower after controlling for IT occupation, this finding will reinforce the notion that occupation wage differentials are an important source of the observed wage premium accruing to workers in IT-producing industries.

The article first describes the data used in the analysis and then discusses the various estimates of the average industry wage differentials. The sample average wage differences across industries are compared with the differences obtained after

Table 1
IT-Related Occupations in the Current Population Survey

Billing, posting, and calculating machine operators	Electrical power installers and repairers
Broadcast equipment operators	Electronic repairers, communications and industrial equipment
Communications equipment operators, n.e.c.	Office machine operators, n.e.c.
Computer operators	Office machine repairers
Computer programmers	Operations and systems researchers and analysts
Computer systems analysts and scientists	Peripheral equipment operators
Data-entry keyers	Supervisors, computer equipment operators
Data processing and equipment repairers	Telephone installers and repairers
Electrical and electronic engineers	Telephone line installers and repairers
Electrical and electronic equipment assemblers	
Electrical and electronic technicians	

controlling for category of occupation and those obtained after controlling for occupation as well as individual and geographical characteristics. The article closes with some conclusions about the IT wage premium.

About the Data

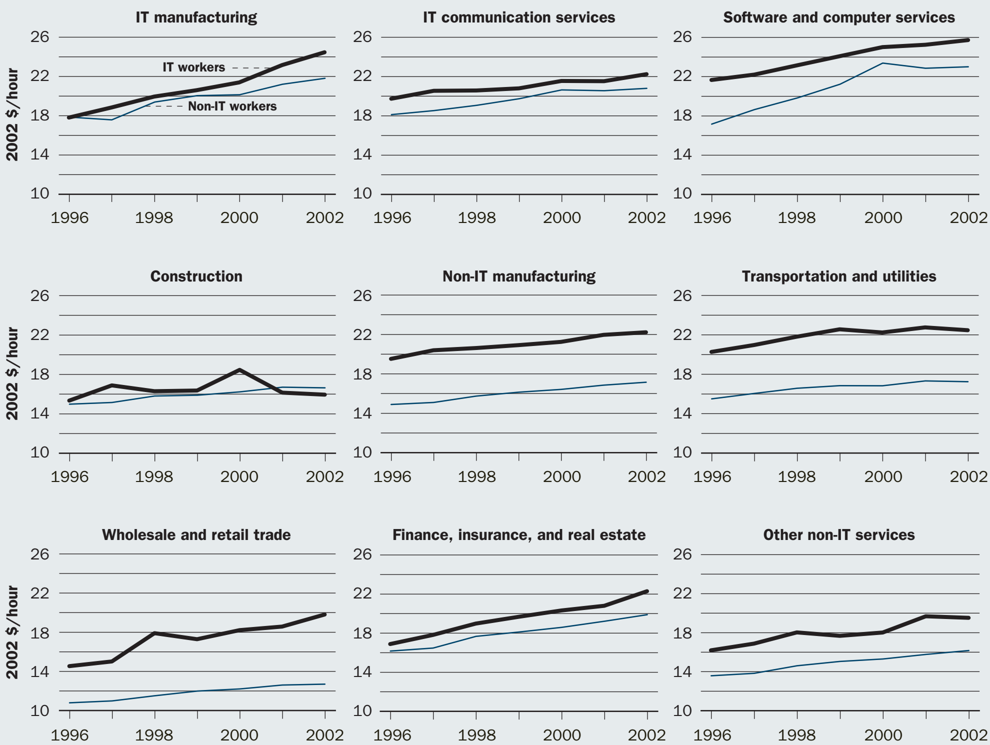
The data used in this study come from the Current Population Survey's Earner Study conducted by the Census Bureau and the Bureau of Labor Statistics. To incorporate variation in the IT industries associated with the employment boom of the late 1990s and the subsequent bust, data from surveys for 1996 to 2002 are used.[2]

The sample includes U.S. workers aged eighteen to sixty-four who are not self-employed, who work in private industries not based on natural resources, who have positive wages that do not exceed $150 per hour in 2002 dollars, and for whom no data are missing. The resulting sample is a set of seven annual cross sections with a total of 845,045 observations. All observations within a year represent unique individuals.

An individual's industry and occupation cohort is defined according to the individual's primary job. The categories used to define cohorts reflect the type of occupation, IT-related or non-IT-related, and nine industry or sector groups. The twenty job descriptions that identify a worker as having an IT-related occupation (listed in Table 1) are based on those used by the Economics and Statistics Administration (1999). The definition of the IT-related occupation category includes a broader array of jobs than what might be considered "core" IT jobs such as computer scientists, engineers, programmers, and system analysts. Specifically, the category also includes jobs deemed important to maintaining the infrastructure of the IT-producing industries—for example, data-entry keyers, telephone installers, and equipment repairers.

The industry groupings are taken from the 1990 Census of Population Industrial Classification System (Census Bureau), with the IT-producing sector defined as in Economics and Statistics Administration (1999). To focus on IT-producing industries in more detail and to make them comparable to the IT industry classification used in Hotchkiss, Pitts, and Robertson (2005), we divide the IT-producing sector into three components: (1) the manufacturing of IT equipment or components, (2) communication services, and (3) software and computer services. The non-IT industries are con-

Figure
Wages by Industry and Occupation



Source: CPS Earner Study

struction; non-IT manufacturing; transportation and utilities; wholesale and retail trade; finance, insurance, and real estate; and miscellaneous non-IT services. The combination of industry and occupation makes up eighteen industry/occupation cohorts.

The figure presents the time path of average real wages across the nine industries over the 1996–2002 period for IT and non-IT occupations. The charts show that the average wage of IT occupations is greater than for non-IT occupations irrespective of industry.[3] The average wage of IT occupations across all industries is $20.62, and the average for non-IT occupations is $15.02.

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1. Comparing relative wage outcomes for transitioning workers after controlling for occupation is left to future research.
2. Because of changes in occupational and industry classifications associated with the shift from Standard Industrial Classification to the North American Industrial Classification System definitions, data for years after 2002 are not directly comparable to earlier years and so are excluded from the analysis.
3. The charts also show that the occupation wages vary by industry. For instance, the average wage of IT workers is $22.08 in the IT-producing sector as a whole but only $19.26 in non-IT industries. At the same time, occupational wage differentials tend to vary across industry. For instance, a large wage gap separates IT and non-IT occupations in the non-IT manufacturing industry, but only a relatively small wage difference appears in IT manufacturing. Separate regression analysis shows that controlling for these sources of variation by interacting occupation and industry does not change the basic findings regarding the industry wage differentials.

Table 2
The Share of Workers in IT-Related Occupations by Industry

	Percent of IT workers	Total number of workers
IT manufacturing	31.8	21,270
Communication services	33.0	16,360
Software and computer services	43.5	21,775
Construction	1.2	55,039
Non-IT manufacturing	3.8	146,172
Transportation and utilities	5.3	46,787
Wholesale and retail trade	1.2	196,711
Finance, insurance, and real estate	6.6	66,807
Miscellaneous non-IT services	2.8	274,124

Source: CPS Earner Study

Table 2 presents the average share of workers in IT-related occupations by industry and the total number of workers. In the sample, 32 percent of the workers in IT manufacturing, 33 percent of those in communication services, and 44 percent of those in software and computer services are in core IT occupations. For the non-IT industries the concentration of IT workers is much lower, ranging from 7 percent of workers in finance, insurance, and real estate to 1 percent of workers in construction and in wholesale and retail trade.

Analysis of the Data: Industry Wage Differentials

The primary focus of the analysis is on the average wage differentials across industries and whether these differences can be accounted for by occupation over and above other worker characteristics. The sample average industry wage differentials presented in the first column of Table 3 are obtained from a regression of the logarithm of the real hourly wage on a set of dummy variables that identify the worker's industry of employment (using non-IT manufacturing as the reference industry).[4] As in Hotchkiss, Pitts, and Robertson (2005), the highest average earnings are in the IT-producing sector. The average wage in the software and computer services industry is 27.4 percent higher than that for non-IT manufacturing while in communication services and IT manufacturing the wage gap is 21.4 and 17.3 percent, respectively. Average wages in finance, insurance, and real estate; transportation and utilities; and construction are 7.0, 4.5, and 0.5 percent higher than in non-IT manufacturing, respectively. In contrast, workers in the wholesale and retail trade sector earn an average 32.8 percent less, and average wages in miscellaneous non-IT service industries are 11.9 percent less than in non-IT manufacturing.

Controlling for occupation. The fact that workers in the IT sector have high average wages is not surprising. The figure shows that workers in IT-related occupations earn more on average than non-IT workers while Table 2 shows that IT industries have a large concentration of workers in IT-related occupations.

To estimate the industry wage differentials after controlling for IT occupations, the logarithm of real hourly wage is regressed on a dummy variable equal to 1 for an IT occupation and 0 otherwise in addition to the set of dummy variables for industry of employment. The estimation results are presented in the second column of Table 3.

Table 3
Average Occupation and Industry Wage Differentials

	Unconditional	Controlling for occupation	Controlling for individual characteristics	Controlling for occupation and individual characteristics
IT occupation		0.1884		0.0925
		(0.0031)		(0.0026)
IT manufacturing	0.1732	0.1204	0.0656	0.0404
	(0.0043)	(0.0043)	(0.0036)	(0.0036)
Communication services	0.2143	0.1593	0.1041	0.0777
	(0.0048)	(0.0049)	(0.0040)	(0.0041)
Software and computer services	0.2741	0.1993	0.1051	0.0697
	(0.0042)	(0.0044)	(0.0036)	(0.0037)
Construction	0.0047	0.0096	0.0458	0.0484
	(0.0029)	(0.0029)	(0.0024)	(0.0024)
Transportation and utilities	0.0450	0.0421	0.0007	–0.0005
	(0.0031)	(0.0031)	(0.0026)	(0.0026)
Wholesale and retail trade	–0.3279	–0.3231	–0.1682	–0.1663
	(0.0020)	(0.0020)	(0.0017)	(0.0017)
Finance, insurance, and real estate	0.0702	0.0649	0.0276	0.0251
	(0.0027)	(0.0027)	(0.0023)	(0.0023)
Miscellaneous non-IT services	–0.1192	–0.1174	–0.0848	–0.0842
	(0.0019)	(0.0019)	(0.0017)	(0.0017)

Note: These percent average wage differentials are relative to workers in non-IT manufacturing. The numbers in parentheses are standard errors.

The estimated IT occupation differential is 18.8 percent. That is, given the industry of employment, someone in an IT-related occupation is expected to earn 18.8 percent more than someone in a non-IT occupation. Because the share of IT workers in the IT sector is much greater than in non-IT industries, including the occupation identifier lowers the average wage differential in IT industries much more than in non-IT industries. Nonetheless, average IT-industry wage premiums remain quite large (12.0 percent in IT manufacturing, 15.9 percent in communication services, and 19.9 percent in software and computer services), suggesting that factors other than simply identifying the worker as having an IT-related occupation are important.

Controlling for individual characteristics. Individual worker characteristics not accounted for by IT occupation may explain some of the remaining wage variation across industries. For instance, the relatively high average pay of workers in the software and computer services industry might be attributable to the fact that all workers in this industry are disproportionately more highly educated and that a general wage premium exists for more education.[5]

4. All the regressions in this section also include a set of dummy variables that identify the year to control for covariation over time.
5. See, for example, Hellerstein, Neumark, and Troske (1999) for some recent evidence on the relative importance of individual characteristics for wage differences across industries.

Table 4
Individual Characteristic Estimation Results

	Controlling for industry	Controlling for industry and occupation
Age	0.0501 (0.0003)	0.0500 (0.0003)
Age squared	–0.0005 (0.0000)	–0.0005 (0.0000)
Less than high school education	–0.1951 (0.0019)	–0.1941 (0.0019)
Some college, no degree	0.1205 (0.0013)	0.1191 (0.0013)
College degree or higher	0.4466 (0.0015)	0.4446 (0.0015)
Female	–0.1850 (0.0012)	–0.1831 (0.0012)
Black	–0.1773 (0.0019)	–0.1770 (0.0019)
Hispanic	–0.1803 (0.0020)	–0.1798 (0.0020)
Other race	–0.1114 (0.0025)	–0.1143 (0.0025)
Part-time	–0.1810 (0.0015)	–0.1802 (0.0015)
Union	0.1332 (0.0019)	0.1333 (0.0019)
Midwest	–0.0088 (0.0016)	–0.0087 (0.0016)
South	–0.0200 (0.0016)	–0.0200 (0.0016)
West	0.0170 (0.0016)	0.0174 (0.0016)
Nonmetro area	–0.2006 (0.0016)	0.1995 (0.0016)
Metro size 100,000–249,999	–0.1457 (0.0024)	–0.1450 (0.0024)
Metro size 250,000–499,999	–0.1237 (0.0022)	–0.1232 (0.0022)
Metro size 500,000–999,999	–0.0980 (0.0020)	–0.0974 (0.0020)
Metro size 1,000,000–2,499,999	–0.0765 (0.0017)	–0.0763 (0.0017)
Metro size 2,500,000–4,999,999	–0.0216 (0.0024)	–0.0220 (0.0024)
Adjusted R-squared	0.3590	0.3600

Note: The first column of estimates refers to the model without the occupation control. The second column of estimates refers to the model with the occupation control included. The numbers in parentheses are standard errors.

To control for the effect of individual characteristics on wages, the logarithm of the real hourly wage is regressed on the industry dummy variables and a set of individual characteristics: age, educational attainment, gender, race, geographical location, union status, and part-time work status. The estimated wage differentials are reported in the third column of Table 3.

The estimated coefficients on the individual characteristics are quite consistent with standard human capital theory. For example, the coefficients on age and age squared show that earnings increase with experience but at a decreasing rate. At the sample mean age of 37.99, holding other factors constant, an extra year of age adds 1.2 percent to expected wages. More important to earnings than age is educational attainment. Workers with at least a college degree earn 44.7 percent more than those with a high school diploma, other factors held constant. Female workers earn 18.5 percent less than male workers, and black and Hispanic workers each earn about 18 percent less than white workers. Union workers earn 13.3 percent more than nonunion workers. Part-time workers earn 18.1 percent less than full-time workers, and workers in the South and the Midwest earn 2 and 0.9 percent less than those in the Northeast, respectively, while those in the West earn 1.7 percent more than those in the Northeast.

Even after human capital differences and differences that arise across occupations are controlled for, workers in IT-producing industries still enjoy a wage premium over workers in other sectors.

A comparison of the third column of Table 3 with the first and second columns shows that controlling for individual characteristics reduces the estimated average industry wage differentials across all industries. Further, for IT-producing industries, the reduction is by more than would be seen by simply controlling for occupation. For IT manufacturing the estimated average wage premium is 6.6 percent. For software and computer services the premium is 10.5 percent, and for communication services, 10.4 percent.

Controlling for occupation and individual characteristics. The remaining question is whether controlling for IT occupation results in a further reduction in the average industry wage differentials after controlling for individual characteristics. To control for individual characteristics as well as occupation, the logarithm of the real hourly wage is regressed on the IT occupation dummy variable, the industry dummy variables, and the set of individual characteristics. The estimated occupation and wage differentials are reported in the fourth column of Table 3.

The estimated coefficients on the individual characteristics are similar to those obtained when occupation is excluded from the regression and are reported in Table 4. Comparing the fourth and second columns of Table 3 shows that controlling for individual characteristics reduces the size of the IT-occupation wage premium from 18.8 percent to 9.3 percent.

Comparing the fourth and third columns in Table 3 shows that including the occupation identifier does matter for the average industry wage differentials in the IT-producing sector but does not matter as much as do the individual characteristics. Specifically, including occupation reduces the average industry wage differentials in the IT-producing industries by between 2.5 and 3 percentage points. Across industries, the average industry wage differentials are all less than 10 percent except for the wholesale and retail trade sector; however, the largest premiums still accrue to workers in IT-producing industries.[6]

Conclusions

Working in an IT industry is associated with higher-than-average wages. Both IT and non-IT workers in the IT-producing sector (as broadly defined in this article) are paid more on average than their counterparts in the various non-IT sectors.

Part of the reason for the high wages in IT-producing industries appears to be that the average wage of IT occupations is greater than for non-IT occupations, and IT-producing industries have a disproportionately large share of their workforce in IT-related occupations. In other words, the IT industry wage differentials are partly attributable to occupation wage differences.

Controlling for individual worker characteristics such as gender, race, education, part-time status, and location is also very important and substantially lowers the average industry wage premium across all industries. However, accounting for individual characteristics reduces, but does not eliminate, the IT occupation effect on IT industry wages and further reduces the wage premium in IT-producing industries. These findings are broadly consistent with those in Hotchkiss, Pitts, and Robertson (2005) and suggest that workers in IT-producing industries generally have high levels of human capital. But even after human capital differences (through inclusion of individual characteristics) and differences that arise across occupations are controlled for, workers in IT-producing industries still enjoy a wage premium over workers in other sectors.

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6. The IT occupation grouping used here is too coarse to capture the effect on wages of differences in the distribution of IT occupations across industries. For example, an examination of the distribution of the twenty IT-related occupations in the communication services industry shows that the most populous occupation is telephone installer and repairer (36 percent of IT workers versus 9.8 percent for the IT sector overall). Interestingly, these workers are much older than average for IT workers (40.8 years versus 37.8 years), but they have much less formal education (only 10.7 percent have a college degree compared with 39.9 percent for the IT sector as a whole) and are more unionized (51.7 percent versus 9.6 percent) than other IT workers in the IT-producing sector. This observation suggests that blue-collar IT service workers, perhaps because of the need for long-term, on-the-job training such as apprenticeships, receive a wage premium that is not adequately accounted for by the broad IT-occupation categorization. An extension of the wage model used here would be to control for blue-collar versus white-collar IT occupations.

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