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Abstract

A vast literature has sought to assess the magnitude of inter-industry differences in pay and explain why they exist. The measurement of inter-industry pay differentials and the resulting use of this information to assess the empirical relevance of different labor market theories have been hampered, however, by the fact that measures of total compensation -- as opposed to just wages and salaries -- are not available in the datasets traditionally used. To our knowledge, we are the first to use compensation microdata in a study of inter-industry pay differentials. Because nonwage compensation can easily exceed 40 to 50 percent of wages, its inclusion has the potential to alter measured industry pay differences, either diminishing or amplifying them. We find that the inclusion of benefits increases industry dispersion, as measured by the standard deviation of inter-industry differentials, by 16 percent when no controls are included and by an even greater 30 percent when controls are included.

Keywords: inter-industry wage structure, compensation

JEL Classification: J3

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1. Introduction

Are equivalent workers doing similar work paid more in some industries than in others? This question has been an important one in labor economics for many decades. Slichter (1950) was among the first to address it, noting the differing wage rates for unskilled laborers in manufacturing industries. In the 1980s, spurred in part by the increasing availability of microdata that enabled controls for individual characteristics, there was a revival of interest in this area (Krueger and Summers 1987, 1988; and Dickens and Katz 1987a, b). Though the expanding availability of employer-employee matched databases has helped shift focus away from industry and towards individual employers (Abowd and Kramarz, 1999), work in this area continues (Gibbons, Katz, Lemieux, and Parent, 2005; Gittleman and Pierce, 2011).

It is well known that large inter-industry wage differentials remain even after attempts have been made to control for a wide array of individual characteristics. Groshen (1991) offers a taxonomy for models seeking to explain this finding. Such differentials may arise because: 1) employers sort workers by ability; 2) compensating differentials lead to a variation of wages across industries; 3) there are random variations in pay, perhaps generated or perpetuated by costly information; 4) firms may pay efficiency wages to increase effort, reduce turnover and improve worker morale; and 5) there may be rent sharing. Distinguishing among these competing theories is important because they have different implications for policies in a number of different areas, including foreign trade, unemployment insurance and industrial policy. In addition, differences in wages by industry and, more generally, by employer have implications for understanding and addressing differences in pay by demographic group.

The measurement of inter-industry pay differentials and the resulting use of this information to assess the empirical relevance of different labor market theories have been hampered by the fact that measures of total compensation -- as opposed to just wages and salaries -- are not available in the datasets traditionally used by labor economists, such as the Current Population Survey (CPS) in the U.S. To our knowledge, we are the first to use compensation microdata in a study of inter-industry pay differentials. Compensation is clearly preferable to wages, given that it measures the actual willingness to pay on the demand side by companies and is what, in competitive labor market models, is being equated to the value of marginal product. Almost without exception, studies prior to this one have used wages and salaries to measure pay, thus omitting an important and growing portion of compensation, noncash benefits. Because nonwage compensation can easily exceed 40 to 50 percent of wages, its inclusion has the potential to alter the industry differences noted.

It is possible, for instance, that inter-industry differences are overstated by wages and that including benefits would diminish such differences. For example, health insurance and legally required employer costs like unemployment insurance can have fixed cost attributes that reduce measured percentage differentials across groups of workers. Or, tradeoffs between wage and nonwage forms of compensation could manifest along industry lines. On the other hand, there are a number of reasons to think that the exclusion of noncash compensation has led to an understatement of inter-industry differences. For a variety of reasons, higher benefits tend to go with higher wages. First, some benefits -- for example, health insurance and defined contribution pensions -- are tax-advantaged, making them relatively cheaper for workers with higher marginal tax rates. Second, benefits demands tend to be very income-elastic (Woodbury, 1983). Third, higher-wage individuals tend to have other characteristics such as being older or being married that correlate with greater benefits demand.

To determine the direction of this effect, this study makes use of a dataset that contains both wage and nonwage compensation, the Employer Costs for Employee Compensation (ECEC) data produced by the U.S. Bureau of Labor Statistics. We find that the inclusion of benefits increases industry dispersion, as measured by the standard deviation of inter-industry differentials, by 16 percent when no controls are included and by an even greater 30 percent when controls are included.

2. Data

Though ECEC data have not been used previously for an analysis of inter-industry pay differences, they have been used in more general studies of compensation inequality (Pierce 2001, 2010). In addition, the sample for the ECEC is a subset of the sample for the National Compensation Survey (NCS) of the U.S. Bureau of Labor Statistics, and wage data from the NCS have been used together with data from the CPS in a study of inter-industry wage differentials (Gittleman and Pierce, 2011). The ECEC measures the cost to employers for wages and salaries and benefits per employee hour worked. [1]

The scope of the ECEC is the civilian economy, including private industry and State and local government. Excluded from private industry are the self-employed and farm and private household workers. Federal government workers are excluded from the public sector. The ECEC sample is a probability-sample of establishments (not firms). Jobs are sampled proportional to employment in the job, but, when weighted, the data represent the average worker and not the average job. The number of jobs selected generally ranges from 4 to 8 depending on establishment size. In contrast to the case of the microdata traditionally used in inter-industry wage analysis, the unit of analysis is a job rather than an individual.

[1] See US DOL, undated, for further details.

Jobs are defined using the employer's most narrow occupational classification. Job-specific information includes a Standard Occupational Classification (SOC) code along with indicators for union coverage, full-time status, and whether the pay is tied, at least in part, to commissions, piece rates, production bonuses, or other incentives based on production or sales. Earnings data are collected and converted into average hourly wage rates using work schedule information common to all workers in the sampled job.

One major use to which NCS data are put is to enable the President's Pay Agent – which consists of the Secretary of Labor and the Directors of the Office of Management and Budget and the Office of Personnel Management – to compare rates of pay under the General Schedule (GS) to non-Federal rates of pay. As a step in doing so, the NCS collects information on job duties. We use these data elements (or "factors") describing job duties, each of which is an ordinal variable with a number of possible levels, as proxies for skill in our analysis below. As a practical matter, much of the explanatory power of these data keys off of the *Knowledge* factor, which is meant to capture skills related to schooling, training, and experience. *Guidelines* captures the extent to which policies and rules direct the job tasks. *Complexity* describes the intricacy of tasks. *Scope and Effect* describes the importance of the job to the organization as a whole. *Supervision Received* captures how directed the job is. The *Personal Contacts* and *Purpose of Contacts* variables capture the amount and importance of interpersonal communications that are not in the supervisory chain. The variables collected in this process have been shown to be of great use in controlling for skill differences across jobs (Gittleman and Pierce, 2011). [2]

[2] During the period of our data, the job duty fields were simplified by combining some factors. *Knowledge* was maintained, the two contacts variables were collapsed into one (*Contacts*) and the remaining four factors were aggregated into a single factor called *Job controls and complexity*. For additional details on these job duty elements, see US DOL, 2003.

In the ECEC, earnings are defined to include incentive pay but exclude premium pay for overtime, holiday, and weekend work; shift differentials; bonuses not directly tied to production; payments by third parties such as tips; and payment in kind such as room and board. The ECEC also measures the following types of benefits: paid leave—vacations, holidays, sick leave, and personal leave; supplemental pay—premium pay for work in addition to the regular work schedule (such as overtime, weekend, and holiday work) and for shift differentials, and nonproduction bonuses (such as yearend, referral, and attendance bonuses); insurance benefits—life, health, short-term disability, and long-term disability insurance; retirement and savings benefits—defined benefit and defined contribution plans; and legally required benefits—Social Security, Medicare, Federal and State unemployment insurance, and workers' compensation. The ECEC data are converted to a cost per hour worked and averaged over the incumbents within a job.

As is detailed in Pierce (2010), there are caveats to be kept in mind when considering these data. First, as the name implies, the data refer to employer costs, which will differ from employee valuations due to a number of considerations including taxes, the fact that the same benefits are being provided to a large group, and to any divergence between an employer's price for a benefit and what an employee would have to pay as an individual (Famulari and Manser, 1989). Second, there is a certain amount of measurement error involved in getting job-specific data for some of the components of the ECEC because respondents are sometimes able to report data only for a broader group than the job incumbents, such as the average for all white-collar workers or for all workers.

Nonetheless, we believe the ECEC to be the best compensation microdata that are available in the U.S. They come from a representative sample, comprehensively cover the benefit spectrum and are derived from employer and administrative records. While we do not have demographic information, we have high-quality job content information, which, along with other information about the job and the establishment, enable a comparison of jobs across industries.[3]

3. Prior Literature

While the literature on inter-industry *wage* differentials is vast, articles on inter-industry *compensation* differentials are scarce. Two studies have tried to circumvent the lack of availability of nonwage compensation data by linking CPS hourly wage data with data on total compensation from the National Income and Product Accounts (NIPA). Krueger and Summers (1988) multiplied hourly wages in the May 1984 CPS by the ratio of compensation to wages in NIPA for the corresponding industry. They found that including nonwage compensation tends to increase rather than reduce cross-industry differentials. In a similar exercise with the same NIPA data, Katz and Summers (1989), also find that consideration of fringe benefits expands inter-industry differences. While these results are suggestive, the assumption these authors were forced to make -- that benefits as a share of compensation do not vary within industry -- is at odds with reality. Pierce (2001) has shown that the share of compensation devoted to benefits tends to increase as compensation rises. Given this and other reasons for within-industry variation in compensation, it seems probable that, after accounting for other regressors, compensation microdata would allow for more accurate inter-industry differential estimation. Another motivation for the present study is that the aforementioned results used data from more than 25 years ago, when benefits composed a smaller share of total compensation.

4. Results

[3] As shown in Gittleman and Pierce (2011), R-squareds in wage regressions including the factors underlying work level reach about 0.8, much higher than the comparable wage regressions using the CPS.

Before turning to our main results, we present some descriptive statistics on wages and benefits in Table 1. Wages in the 2009 ECEC averaged $20.81 per hour, or 69.3 percent of total compensation. Benefits averaged $9.23 per hour, or 30.7 percent of total compensation, with the most important categories being health, retirement, and leave.

The multivariate analysis consists of a series of regressions of the form

$$Y = X\beta + Z\alpha + \varepsilon \tag{1}$$

where Y is either the log hourly wage or the log hourly compensation, Z is a set of indicator variables representing 47 industries, and X is a set of other covariates. There are two regressions for each dependent variable, the first where X is only a constant, the second where the other covariates are a series of variables measuring job duties or content, the log of establishment employment, along with indicators for full-time status, union status, incentive pay, two-digit occupation, Census division, and presence in a metropolitan area.

As shown near the bottom of Table 2, industry affiliation alone explains a substantial amount of the variation in wages (33 percent) and compensation (38 percent). When other controls are added, the R-squared reaches nearly 0.8, much higher than in comparable regressions using household data. The primary explanation for this is that the job content variables explain a lot more pay variation than their counterparts in the CPS, education and experience. Additionally, the NCS may more accurately measure wages, occupation and industry.

Table 2 also displays the industry wage premia in detail. There are two sets of premia for wages and for compensation, one with no controls and one with controls. In all cases, industry premia are log differentials measured relative to the sample average, so weighted averages of the premia equal zero by construction. In addition to the detailed industry premia, the table displays as summary measures the weighted standard deviations of the industry premia, in the final row. Because sampling variation in the coefficient estimates artificially inflates the standard deviation measure, we make an adjustment as in Haisken-DeNew and Schmidt (1997).

In the first column, the raw industry wage differentials range from a high of 0.583 log points for Internet service providers and data processing services to a low of -0.811 log points for Food services and drinking places, with a standard deviation of 0.341. When controls are added, industry differentials shrink greatly -- all raw industry differentials above 0.10 in absolute value shrink toward zero -- with the standard deviation declining by 69 percent. Despite the narrowing of the differentials, industries that were high-paying before controls are added tend to be high-paying afterwards, as the hours-weighted employment correlation between the two sets of wage differentials is 0.84.

Before turning to the main focus of the paper, inter-industry compensation differentials, it is useful to compare the inter-industry wage differentials from the ECEC to those from the more familiar Current Population Survey (CPS), shown in Table3. Both sets of differentials, with and without controls, are highly correlated with their counterpart in the other dataset. Without controls, the standard deviation is higher for the ECEC, 0.341 to 0.251 in the CPS, owing in part to more accurate industry reporting in establishment surveys. With controls, however, the order is reversed, as the explanatory power of the skill variables in the ECEC leads to a greater narrowing of the standard deviation in that dataset than in the CPS.

We now turn to the measurement of compensation differentials (column 3 of Table 2), and note that the highest raw differential is now one of 0.723 points for petroleum and coal products manufacturing, and the lowest is that for Food services and drinking places at -0.958 points. The greater range is indicative of increased dispersion, as the standard deviation has risen to 0.394, up 16 percent from that for the raw wage differentials. In other words, rather than offsetting the differentials, the inclusion of compensation has expanded them, with the two sets being very highly correlated (0.99).

How do the compensation differentials look after controlling for skill and other variables? As with the wage differentials, they contract, though not by quite as much (by 65 percent, as measured by the standard deviation). When these adjusted compensation differentials are compared to the wage differentials, however, a different picture emerges. The standard deviation of 0.139 is 30 percent higher than that for wage differentials, confirming that wage differentials do understate the extent of inter-industry differences. While neither Krueger and Summers (1988) nor Katz and Summers (1989) presented a measure of change for raw dispersion, their increases in dispersion after controls were on the order of 26 and 28 percent, respectively.

Thus, the incorporation of benefit costs clearly expands rather than offsets measured inter-industry differentials. This pattern emerges for a variety of possible reasons, including: tax-advantaged benefits are relatively cheaper for workers with higher marginal tax rates; benefits demands are very income-elastic; and, higher-wage individuals tend to have other characteristics (such as being older or married) that correlate with greater benefits demand. These explanations do not require that inter-industry differentials reflect ability, only that firm and worker choices regarding wage-benefits packages act to magnify inter-industry differences. For example, rent capture by workers could generate greater benefit demand (via income or tax-price effects), or, unionized bargaining environments may stress noncash compensation.

5. Concluding Remarks

The vast literature measuring inter-industry differentials has almost without exception focused on wage premia and excluded nonwage compensation, an important and growing portion of total compensation. The inclusion of fringe benefits has the potential to either offset measured differentials or expand them. We find that the inclusion of compensation increases industry dispersion, as measured by the standard deviation, by 16 percent when no controls are included and by 30 percent when controls are included. An interesting avenue for future research would be to see if this finding holds at other points in time and for other countries.

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Table 1. Employer Costs per Hour Worked and as a Percentage of Compensation

Compensation Component	Average Cost per Hour Worked ($/hr)	Percent of Compensation
Wages and Salaries	20.81	69.3
Total Benefits	9.23	30.7
Health Insurance	2.47	8.2
Retirement and Savings	1.32	4.4
Paid Leave	2.14	7.1
Other Benefits	3.30	11.0

Notes. Estimates are based on employer costs from the 2009 ECEC sample, and are hours-weighted statistics. Other Benefits include overtime pay and shift differentials, nonproduction bonuses, life insurance, short- and long-term disability benefits, and all legally required benefits.

Table 2. Industry Wage and Compensation Premia, 2009 ECEC

Industry	Wages: Without Controls	Wages: With Controls	Compensation: Without Controls	Compensation: With Controls
Mining	0.329	0.305	0.433	0.404
Construction	0.124	0.115	0.120	0.103
Nonmetallic mineral product manufacturing	-0.043	0.056	0.013	0.089
Primary metals and fabricated metal products	0.002	0.052	0.062	0.088
Machinery manufacturing	0.115	0.063	0.172	0.093
Computer and electronic product manufacturing	0.401	0.078	0.459	0.114
Electrical equipment, appliance manufacturing	0.023	0.108	0.103	0.146
Transportation equipment manufacturing	0.326	0.145	0.441	0.193
Wood products	-0.239	-0.025	-0.249	-0.038
Furniture and fixtures manufacturing	-0.155	0.047	-0.158	0.038
Miscellaneous and not specified manufacturing	-0.055	0.028	-0.015	0.054
Food manufacturing	-0.222	-0.008	-0.140	0.023
Beverage and tobacco products	0.180	0.170	0.305	0.226
Textile, apparel, and leather manufacturing	-0.240	-0.006	-0.238	-0.006
Paper and printing	0.061	0.115	0.095	0.125
Petroleum and coal products manufacturing	0.576	0.344	0.723	0.430
Chemical manufacturing	0.318	0.207	0.398	0.257
Plastics and rubber products	-0.149	0.042	-0.100	0.067
Wholesale trade	0.058	0.082	0.066	0.102
Retail trade	-0.354	-0.124	-0.419	-0.144
Transportation and warehousing	0.020	0.089	0.077	0.111
Utilities	0.510	0.262	0.641	0.343
Publishing industries (except internet)	0.256	0.035	0.258	0.042
Motion picture and sound recording industries	0.082	0.125	0.007	0.088
Broadcasting	0.217	0.029	0.231	0.050
Telecommunications	0.443	0.145	0.528	0.185
Internet service providers & data processing services	0.583	0.077	0.594	0.090
Other information services	0.041	-0.146	0.063	-0.098
Finance	0.212	0.058	0.270	0.135
Insurance	0.276	0.107	0.324	0.156
Real estate	0.025	0.038	0.009	0.050
Rental and leasing services	-0.076	0.007	-0.095	0.013
Professional and technical services	0.469	0.122	0.439	0.117
Management of companies and enterprises	0.458	0.139	0.480	0.144

Table 2 (continued)

Administrative and support services	-0.268	-0.064	-0.369	-0.151
Waste management and remediation services	0.226	0.093	0.293	0.133
Educational services	0.369	0.010	0.405	0.015
Hospitals	0.202	-0.028	0.263	-0.003
Health care services, except hospitals	0.074	0.025	0.051	0.025
Social assistance	-0.268	-0.119	-0.290	-0.128
Arts, entertainment, and recreation	-0.340	-0.067	-0.410	-0.115
Accommodation	-0.509	-0.151	-0.518	-0.183
Food services and drinking places	-0.811	-0.224	-0.958	-0.310
Repair and maintenance	-0.055	-0.041	-0.144	-0.103
Personal and laundry services	-0.399	-0.082	-0.500	-0.138
Membership associations and organizations	0.125	0.027	0.109	0.044
Public administration	0.209	-0.026	0.352	0.043
R-squared	0.332	0.760	0.383	0.778
Standard Deviation of Premia	0.341	0.107	0.394	0.139
(Standard Error)	(0.006)	(0.005)	(0.006)	(0.005)

Notes. The final row gives the weighted standard deviation of industry wage premia, where weights are proportionate to total hours worked in the industry. The standard deviations are corrected for sampling error in the premia estimates; their standard errors are shown in parentheses (Haisken-DeNew and Schmidt, 1997). Controls are the job content variables, ln(establishment employment), and indicators for full-time status, union status, incentive pay, two-digit occupation, Census division, and presence in a metropolitan area.

Table 3. Industry Wage Premia, 2009 CPS

Industry	Wages: Without Controls	Wages: With Controls
Mining	0.275	0.365
Construction	0.040	0.109
Nonmetallic mineral product manufacturing	0.002	0.114
Primary metals and fabricated metal products	0.019	0.114
Machinery manufacturing	0.160	0.177
Computer and electronic product manufacturing	0.418	0.173
Electrical equipment, appliance manufacturing	0.188	0.132
Transportation equipment manufacturing	0.294	0.199
Wood products	-0.180	0.004
Furniture and fixtures manufacturing	-0.126	0.042
Miscellaneous and not specified manufacturing	0.093	0.066
Food manufacturing	-0.194	-0.011
Beverage and tobacco products	0.155	0.149
Textile, apparel, and leather manufacturing	-0.254	-0.107
Paper and printing	0.014	0.102
Petroleum and coal products manufacturing	0.470	0.430
Chemical manufacturing	0.344	0.243
Plastics and rubber products	-0.071	0.074
Wholesale trade	0.061	0.106
Retail trade	-0.281	-0.132
Transportation and warehousing	0.000	0.106
Utilities	0.336	0.256
Publishing industries (except internet)	0.171	0.034
Motion picture and sound recording industries	0.153	0.073
Broadcasting	0.161	0.077
Telecommunications	0.319	0.170
Internet service providers & data processing services	0.178	0.034
Other information services	-0.010	-0.085
Finance	0.252	0.124
Insurance	0.234	0.123
Real estate	-0.005	-0.031
Rental and leasing services	-0.148	-0.027
Professional and technical services	0.410	0.156
Management of companies and enterprises	0.362	0.174
Administrative and support services	-0.249	-0.080
Waste management and remediation services	-0.051	0.112
Educational services	0.088	-0.107
Hospitals	0.215	0.031
Health care services, except hospitals	-0.060	-0.050

Table 3 (continued)

Social assistance	-0.303	-0.243
Arts, entertainment, and recreation	-0.214	-0.058
Accommodation	-0.358	-0.188
Food services and drinking places	-0.557	-0.214
Repair and maintenance	-0.207	-0.067
Personal and laundry services	-0.435	-0.146
Membership associations and organizations	-0.043	-0.151
Public administration	0.157	0.032
R-squared	0.195	0.514
Standard Deviation of Premia	0.251	0.132
(Standard Error)	(0.001)	(0.002)

Notes. The final row gives the weighted standard deviation of industry wage premia, where weights are proportionate to total hours worked in the industry. The standard deviations are corrected for sampling error in the premia estimates; their standard errors are shown in parentheses (Haisken-DeNew and Schmidt, 1997). Controls are for five education groups, a quartic in experience, full-time status, union status, two-digit occupation, Census division, and presence in a metropolitan area.