Inter-industry and Firm-size Wage Differentials: New Evidence from Linked Employer-Employee Data

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Abstract

Two of the most pervasive and difficult to explain phenomena in economics are the persistence of inter-industry and firm-size wage differences. Some explanations predict that most of the variation is due to the persons employed in the industry or in firms of a particular size, whose opportunity wage rates are similarly high or low. Other explanations predict that most of the variation is due to differential firm or industry compensation policies that do not follow the individual from job to job. Economists' ability to distinguish among these explanations has been hampered by the lack of appropriate matched, longitudinal employer-employee data. Recent developments in Europe and in North America have allowed researchers access to this type of data. In this paper we use data from the State of Washington to decompose inter-industry wage differentials and firm-size wage differentials into components due to observable characteristics, personal heterogeneity, and firm heterogeneity. We provide an exact solution to the least squares identification and estimation of these effects. We show that person effects (net of observable non-time-varying characteristics) explain about half of the raw inter-industry wage differential (net of all observable characteristics) and about 30 percent of the firm-size wage differential. Firm heterogeneity accounts for half of the raw inter-industry wage differential and about 70 percent of the firm-size wage differential. The results for the State of Washington are compared to an identical analysis using French data. All raw differentials are much larger in the State of Washington than in France; however, the components due to personal and firm heterogeneity have large and similar correlations across the two data sources.

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1. Motivation

Two of the most pervasive and difficult to explain phenomena in economics are the persistence of inter-industry and firm-size wage differences. Some explanations predict that most of the variation is due to the persons employed in the industry or in firms of a particular size, whose opportunity wage rates are similarly high or low. Other explanations predict that most of the variation is due to differential firm or industry compensation policies that do not follow the individual from job to job. Economists' ability to distinguish among these explanations has been hampered by the lack of appropriate matched, longitudinal employer-employee data. Recent developments in Europe and in North America have allowed researchers access to this type of data. The arrival of this type of data has produced a resurgence of interest in problems that can be advanced by using data from both sides of the market: workers and firms. We have surveyed many of these applications elsewhere (Abowd and Kramarz, 1999a and 1999b). The recent book edited by Haltiwanger et al. (1999) provides many interesting applications of this kind of data from around the world.

What has not yet occurred is the routine application of statistical and economic modeling techniques that fully exploit the unique feature of these data: both the individual and the employer are identified in a manner that permits the research to follow the entities across time and to add external data from both sides of the market. On the theoretical side, this is understandable. Mortensen (2000) and Postel-Vinay and Robin (2000) developed their most recent search-based models to address the possibilities that linked data provide. The econometric modeling lag may be largely due to the lack of appropriate software even for linear models, which simply cannot be estimated properly using standard statistical programs like SAS or Stata. We address this issue directly in our 1999a paper, where we show the direct relation between linear statistical models used to analyze linked employer-employee data and models used in statistical genetics. By making direct application of algorithms developed for animal breeding (see, for example Robinson, 1991), we present in this paper the first statistically complete analysis of our linked data models.

An ideal application of longitudinal linked employer-employee data is the analysis of inter-industry wage differentials. Although this topic received a flurry of attention in the 1980s, when Krueger and Summers (1987, 1988) established the consistency of these differentials over time and across countries, the fundamental question remained unresolved: are these differentials due to individual or employer components. Individual factors stay with the worker from job to job, whereas employer differences affect any worker who has a job with the firm. Regardless of the economic model one considers, it is important to apportion the inter-industry differentials into these two parts. This can only be done using longitudinal linked employer-employee data, as our identification analysis shows. (Abowd and Kramarz, 2000).

Krueger and Summers stressed factors related to the employer, such as compensation policy, as the primary explanation of the inter-industry differentials although their analysis showed that such factors were, at best, an incomplete explanation. Murphy and Topel (1987), on the other hand, stressed individual unmeasured differences as the primary cause of the wage differentials, although, once again, their data were incomplete. Dickens and Katz (1987) tried to explain the inter-industry wage differentials using a variety of measured individual and firm characteristics aggregated to the industry level; hence, their analysis was very much in the spirit we propose but they could not control for the unmeasured differences that we stress below. Gibbons and Katz (1991) attempted to explain the differential based on unobserved individual heterogeneity. Brown and Medoff (1989) focused their attention on the firm-size wage differential. They attempted to distinguish between explanations based on individual heterogeneity and those based on firm level compensation policy. In related work Groshen (1991) examined the role of firm and establishment compensation policy heterogeneity on wage outcomes, generally.

In two related articles Abowd, Kramarz and Margolis (AKM, 1999) and Abowd, Finer and Kramarz (AFK, 1999) provided a basic statistical framework for decomposing inter-industry wage differentials and firm-size wage differentials into the sum of components due to individual heterogeneity (measured and unmeasured) and firm heterogeneity (measured and unmeasured). The first of these articles, AKM analyzes French data and finds that most of the inter-industry and the firm-size wage differentials are due to unmeasured individual heterogeneity. Goux and Maurin (1999) also find that most of the French inter-industry wage differential is due to individual heterogeneity using linked employer-employee data from the French Labor Force Survey (Enquête Emploi). The second of these articles, AFK, analyzes data from the State of Washington and finds that inter-industry wage differentials are due in equal proportions to individual and employer heterogeneity while firm-size wage differentials are due primarily to firm heterogeneity.

Both AKM and AFK used statistical approximations to estimate the decomposition of wage differentials into individual and employer components. In this article we apply new methods that permit us to use the exact solution to the estimation problem. We analyze the same American data as AFK whereas a companion paper, Abowd and Kramarz (2000) examines the same French data as AKM. We find that inter-industry wage differentials in the United States are due in approximately equal proportions to individual and firm heterogeneity in both samples. We find that firm-size wage differentials are due 70 percent to firm heterogeneity and 30 percent individual heterogeneity.

This paper is organized as follows. In section 2 we review the basic statistical model developed in AKM. Then, in section 3, we discuss the methods we used to identify and estimate the models without ancillary approximations. Section 4 discusses the inter-industry wage differential results. Section 5 discusses the firm-size wage differential results. Section 6 concludes.

2. Basic Statistical Model

The dependent variable is compensation, y_{it}, observed for individual i at date t and measured as a deviation from its grand mean μ_y. This variable is expressed as a function of individual heterogeneity, firm heterogeneity and measured time-varying characteristics

$$y_{it} - \mu_y = \theta_i + \psi_{\mathrm{J}(i,t)} + (x_{it} - \mu_x)\beta + \varepsilon_{it}. \tag{1}$$

There is no constant in the vector x_{it}. The function J(i,t) indicates the employer of i at date t. The first component is the individual effect, θ_i. The second component is the firm effect, $\psi_{\mathrm{J}(i,t)}$. The third component is the effect of measured time-varying characteristics, $(x_{i,t} - \mu_x)\beta$, stated as a deviation from the grand mean of x. The fourth component is the statistical residual, ε_{it} orthogonal to all other effects in the model.[1] For clarity in the derivations that follow, we note that x and y are expressed as deviations from their means. The dependent variable is employer reported gross employee earnings as defined by the State of Washington unemployment insurance system.

In all the statistical analyses that follow, we have used the decomposition of the individual effect into an observable component related to education and sex ($u_i\eta$) and an unobservable individual heterogeneity component (α_i), as in AKM.

$$\theta_i = \alpha_i + u_i\eta .$$

All results are reported using the unobservable component, α_i but the derivations below are done using the complete individual effect, θ_i, for simplicity and clarity.

Matrix Notation: Basic Statistical Model

In order to state the basic statistical relations more clearly, we restate equation (1) in matrix format. All vectors/matrices have row dimensionality equal to the total number of observations. The data are sorted by person identifiers and ordered chronologically for each person. This gives the following equation for the stacked system:

$$y = D\theta + F\psi + X\beta + \varepsilon \tag{2}$$

where D is the design matrix for the person effect: columns equal to the number of unique persons in the sample; F is the design matrix for the firm effect: columns equal to the number of unique firms; and X is the stacked matrix of time-varying characteristics.

True Industry Effect Model

An industry effect is defined, following AKM, as a characteristic of the firm. Thus, the *true* industry effect is an aggregation of the firm effects in the model. What remains of the firm effects is the deviation of the firm effect from the industry effect:

$$y_{it} = \theta_i + (\psi_{\mathrm{J}(i,t)} - \kappa_{\mathrm{K}(\mathrm{J}(i,t))}) + \kappa_{\mathrm{K}(\mathrm{J}(i,t))} + x_{it}\beta + \varepsilon_{it} . \tag{3}$$

The function K(j) indicates the industry of firm j. The first component of equation (3) is the person effect. The second component is the firm effect net of the true industry effect. The third

[1] See Abowd and Kramarz (1999a and 1999b) for a more complete discussion of the exogeneity assumption for the residual.

component is the true industry effect, $\kappa_{\mathrm{K}(\mathrm{J}(i,t))}$, an aggregation of firm effects since industry is a property of the employer. The fourth component is the measured characteristics. The fifth component is the statistical residual.

We put equation (3) into matrix form as:

$$y = D\theta + FA\kappa + (F\psi - FA\kappa) + X\beta + \varepsilon \qquad (4)$$

The matrix A is the classification matrix that takes firms into industries. Thus, the matrix FA is the design matrix for the true industry effect. The true industry effect κ can be expressed as

$$\kappa = (A'F'FA)^{-1} A'F'F\psi ,$$

which is just the appropriately weighted average of the firm effects within the industry.

Raw Industry Effect Model

For comparison we show what equations (3) and (4) become when both individual and firm effects are, incorrectly, excluded from the model. We refer to such estimates as "raw" effects. They are equivalent to the regression-adjusted inter-industry wage differentials analyzed by the authors cited in the introduction.

$$y_{it} = \kappa^{**}_{\mathrm{K}(\mathrm{J}(i,t))} + x_{it}\beta^{**} + \varepsilon_{it} \qquad (5)$$

The first component of equation (5), $\kappa^{**}_{\mathrm{K}(\mathrm{J}(i,t))}$, is the raw industry effect. The second component is the effect of measured time-varying characteristics. The third component is the statistical residual. The raw industry effect is an aggregation of the appropriately weighted average person and average firm effects within the industry, since both have been excluded from the model. The true industry effect is only an aggregation of the appropriately weighted average firm effect within the industry, as shown above.

Industry Effects Adjusted for Person Effects Model

When only firm heterogeneity is inappropriately excluded from equation (1) we have:

$$y_{it} = \kappa^{*}_{\mathrm{K}(i,t)} + \theta^{*}_{i} + x_{it}\beta^{*} + \varepsilon_{it} \qquad (6)$$

The first component of equation (6), $\kappa^{*}_{\mathrm{K}(\mathrm{J}(i,t))}$, is the industry effect adjusted for person effects. The second component is individual effect (with firm effects omitted). The third component is the effect of measured time-varying characteristics. The fourth component is the statistical residual. The industry effects adjusted for person effects are also biased (not equal to κ) because the rest of the firm effect has been excluded. (See AKM for the relevant formula.)

Relation: True and Raw Industry Effects

AKM provide a full analysis of the relation between the three industry effects defined above. For completeness we show their basic formulas for the decomposition of the raw inter-industry wage differential into two forms. First, the formula showing the classic omitted variable bias:

$$\kappa^{**} = \kappa + (A'F'M_X FA)^{-1} A'F'M_X (M_{FA} F\psi + D\theta) \tag{7}$$

where all data have been stacked into matrices as defined in equation (2). The vector κ^{**} of industry effects can be expressed as the true industry effect κ plus a bias that depends upon both the person and firm effects. The matrix M is the residual matrix (column null space) after projection onto the column space of the matrix in the subscript, X, say:

$$M_X \equiv I - X(X'X)^{-1} X'$$

AKM decompose the raw inter-industry wage effect into the sum of the industry-average person effect and the industry-average firm effect, both conditional on X:

$$\begin{aligned} \kappa^{**} &= (A'F'M_X FA)^{-1} A'F'M_X D\theta \\ &\quad + (A'F'M_X FA)^{-1} A'F'M_X F\psi \end{aligned} \tag{8}$$

Thus, the vector κ^{**} of raw industry effects can be expressed as a matrix weighted average of the person effects θ and the firm effects ψ. The matrix weights are related to the personal characteristics X, and the design matrices for the person and firm effects (see AKM). Equation (8) is exact if the values of θ and ψ. are known. AKM show that if least squares estimates of these two sets of effects are used, then equation (8) provides a consistent estimate of the decomposition for the sample. In the analysis presented below we use equation (8) with exact least squares estimates of the two sets of effects (estimated simultaneously). The equation is essentially exact for our sample because the two components are estimated with great precision for each industry.

All results derived in this section also hold for firm-size wage differences. We use size categories to classify the firms into groups of similar size. The size-category classification matrix plays the role of the matrix A above. Thus, FA is the design of the firm-size effect.

3. Identification and Estimation by Fixed-effect Methods

Least Squares Normal Equations

The full least squares solution to the basic estimation problem for equation (2) solves the following normal equations for all identified effects.

$$\begin{bmatrix} X'X & X'D & X'F \\ D'X & D'D & D'F \\ F'X & F'D & F'F \end{bmatrix} \begin{bmatrix} \beta \\ \theta \\ \psi \end{bmatrix} = \begin{bmatrix} X'y \\ D'y \\ F'y \end{bmatrix} \tag{9}$$

In our estimation sample, the cross-product matrix on the left-hand side of equation (9) is too high dimensional to use conventional algorithms.[2] AKM present a set of approximate solutions to (9) based on the use of different conditioning effects, *Z*. In this paper we present a method for identifying effects in (9) and estimating all identifiable effects. Our methods are similar to those used in statistical genetics.[3]

Identification of Individual and Firm Effects

Use of the decomposition formula for the industry (or firm-size) effect in equation (8) requires a solution for the identified person, firm and characteristic effects. The conventional technique of eliminating singular row/column combinations from the normal equations does not work when the least squares problem is solved directly, as we do in this paper. Identification of the person and firm effects in order to estimate using the exact least squares estimator requires finding the conditions under which equation (9) can be solved for some subset of the person and firm effects. In this sub-section we ignore the problem of identifying the coefficients β because in practice this is never difficult. The problem one encounters for the person and firm effects is the necessity that some workers be mobile among the firms. To state precisely how much mobility is required, we use a concept from graph theory connected groups. A group of workers and firms is connected if the group contains all the workers who ever worked for any of the firms in the group and all the firms at which any of the workers were ever employed. From an economic perspective, connected groups of workers and firms show the realized mobility network in the economy. From a statistical perspective, connected groups of workers and firms block diagonalize the normal equations and permit the precise statement of identification restrictions on the person and firm effects.

We first show the algorithm that constructs *G* connected groups from the *N* workers in *J* firms.

1. Firm 1 is in group $g = 1$.
2. Repeat until no more persons or firms are added:
   Add all persons employed by a firm in group 1 to group 1
   Add all firms that have employed a person in group 1 to group 1
3. For $g = 2, ...,$ repeat until no firms remain:
   The first firm not assigned to a group is in group *g*.
   Repeat until no more firms or persons are added to group *g*:
      Add all persons employed by a firm in group *g* to group *g*.

[2] Conventional algorithms solve equation (9) using methods that can automatically detect a singularity in the system. They then remove the singular effect and continue trying to solve the equation. These methods are very memory-intensive. Sparse algorithms are required for large systems like ours. Such algorithms are not available in general-purpose statistical software, even if the analyst wishes to compute only the solution for β.
[3] See Abowd and Kramarz 1999a for a longer discussion.

Add all firms that have employed a person in group g to group g.

At the conclusion of step 3, the persons and firms in the sample have been divided into G disjoint groups where every pair of workers in a given group shares at least one common employer and every pair of employers in the group shares at least one common employee. Abowd and Kramarz (2000) demonstrate that, once the persons and firms have been divided into G groups, exactly $N + J - G$ person and firm effects are identified (estimable).

Characteristics of the Groups

Table 1 shows the results of applying our grouping algorithm to the State of Washington data. Notice that the largest group in our data contains the overwhelming majority of all the identifiable person and firm effects. We could apply our methods directly to group 1 alone without much change in the statistical results. We cannot, however, use conventional methods to estimate the person and firm effects group by group because the cross-product matrix for group 1 is essentially the same size as the full set of normal equations (9).

Table 1
Results of Applying the Grouping Algorithm to the State of Washington

	Largest group	*Second largest group*	*Average of all other groups*	*Total of all groups*	*Identified effects*
Observations	3,999,598	276	15.0	4,036,171	
Persons	292,945	33	1.6	296,801	296,800
Firms	81,107	3	2.0	85,864	83,436
Groups	1	1	2,426	2,428	

Notes: Largest and second largest groups are based on the number of persons in the group. Sources: Authors' calculations based on State of Washington UI data.

Estimation by Direct Solution of Least Squares

Once the grouping algorithm has identified all estimable effects, we solve for the least squares estimates by direct minimization of the sum of squared residuals. This method, widely used in animal breeding and genetics research, produces a unique solution for all estimable effects, including estimates of all identifiable individual and firm effects.[4]

4. Inter-industry Wage Differentials

Summary of Data Sources

The State of Washington data are derived from unemployment insurance wage records, which are employer reports. We use a 1/10th sample of State of Washington employment with the individual and the taxable employing entity identified for the years 1984-1993 (quarterly).

[4] We use a conjugate gradient method to solve the least squares equations. Algorithm details are available in Abowd and Kramarz (2000). The algorithm was developed and implemented by Robert Creecy at the Unites States Bureau of the Census.

There are 293,000 individuals, 80,000 firms, and 4.3 million observations used. The time varying characteristics consist of labor force experience (quartic) and time period (annual and quarter) both fully interacted with sex and race. The non-time-varying personal characteristics consist of educational attainment (years), again fully interacted with sex and race. See AFK for a full description of the methods used to create the data and for summary statistics.

Main Results for Inter-industry Wage Differentials

Table 2 presents the results, by two-digit industry, for the analysis of inter-industry wage differentials for the State of Washington. In order to facilitate the discussion of the American results, we also provide equivalent results for France in Table A.1 of Appendix A, which uses the same data as AKM but the new estimation techniques developed for the present paper.

The column labeled "Raw industry effect" is the estimate of $\kappa^{**}_{\mathrm{K}(\mathrm{J}(i,t))}$ from equation (5). The column labeled "Industry effect given persons" is the estimate of $\kappa^{*}_{\mathrm{K}(\mathrm{J}(i,t))}$ from equation (6). The column labeled "Industry average person effect" is the estimate of $(A'F'M_X FA)^{-1}A'F'M_X D\theta$ from equation (8). The column labeled "Industry average firm effect is the estimate of $(A'F'M_X FA)^{-1}A'F'M_X F\psi$ from equation (8). The sum of the last two columns is theoretically equal to the first column. The estimated version of equation (8) for both data sets had an R^2 in excess of 0.98 and coefficients of 1.0 on the industry average person and firm effects. Thus, the estimates of the inter-industry wage differentials are sufficiently precise to permit a very accurate decomposition. In the discussion below, we use the term high-wage individual to mean a person whose individual effect is greater than the economy-wide average of zero. We use the term high-wage firm to mean an employer whose employer effect is greater than the economy-wide average of zero.

Table 2
(appears at the end of the paper)

Figures 1 and 2 show the relation between raw industry effects and industry average person and firm effects, respectively, for the State of Washington.[5] The figures show that either person or firm effects could be used to predict the raw inter-industry wage differentials with considerable precision. Note that the figures are quite symmetric with respect to the origin, inter-industry differences being as important in the high-wage labor market as they are in the low-wage labor market, which is the direct result of the low levels of wage floors in the United States.

[5] Figures 3 and 4 are essentially identical to the results in AFK because the approximate and exact solutions are very highly correlated.

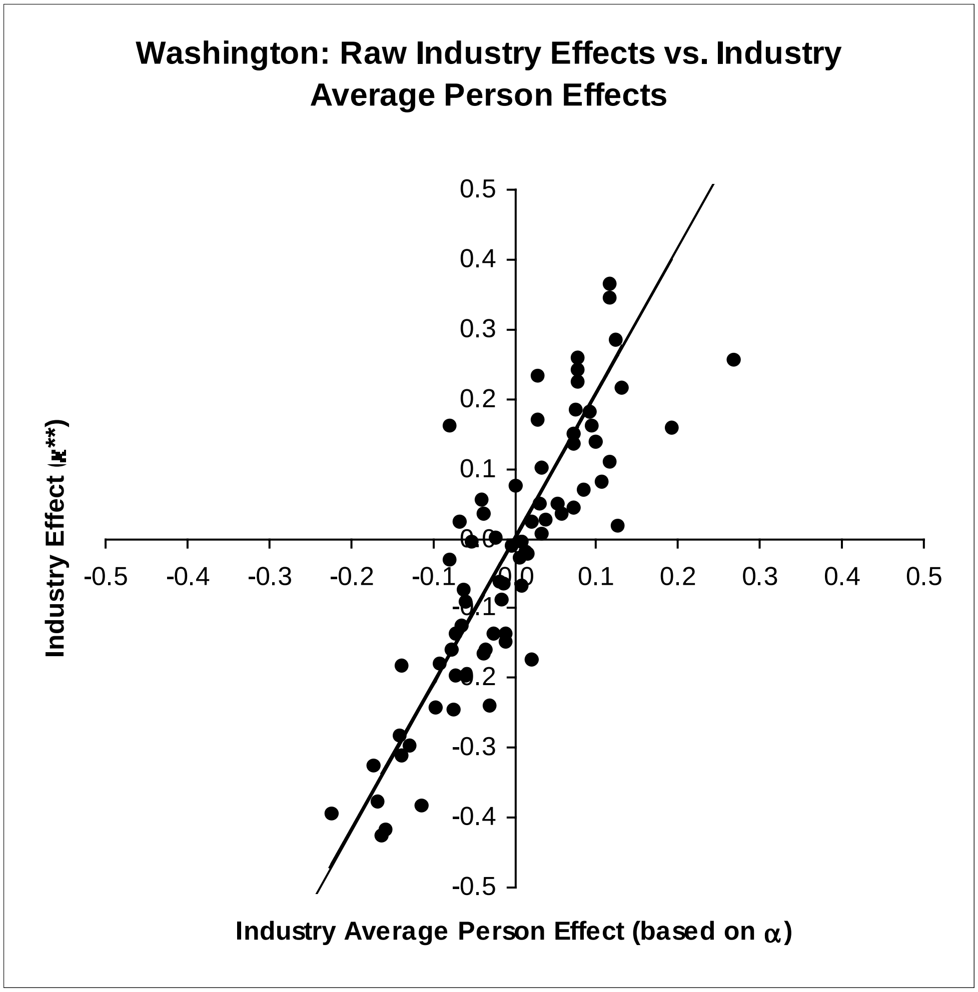
Washington: Raw Industry Effects vs. Industry Average Person Effects
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.5 -0.4 -0.3 -0.2 -0.1 0.0 0.1 0.2 0.3 0.4 0.5
Industry Effect (κ**)
Industry Average Person Effect (based on α)

Figure 1

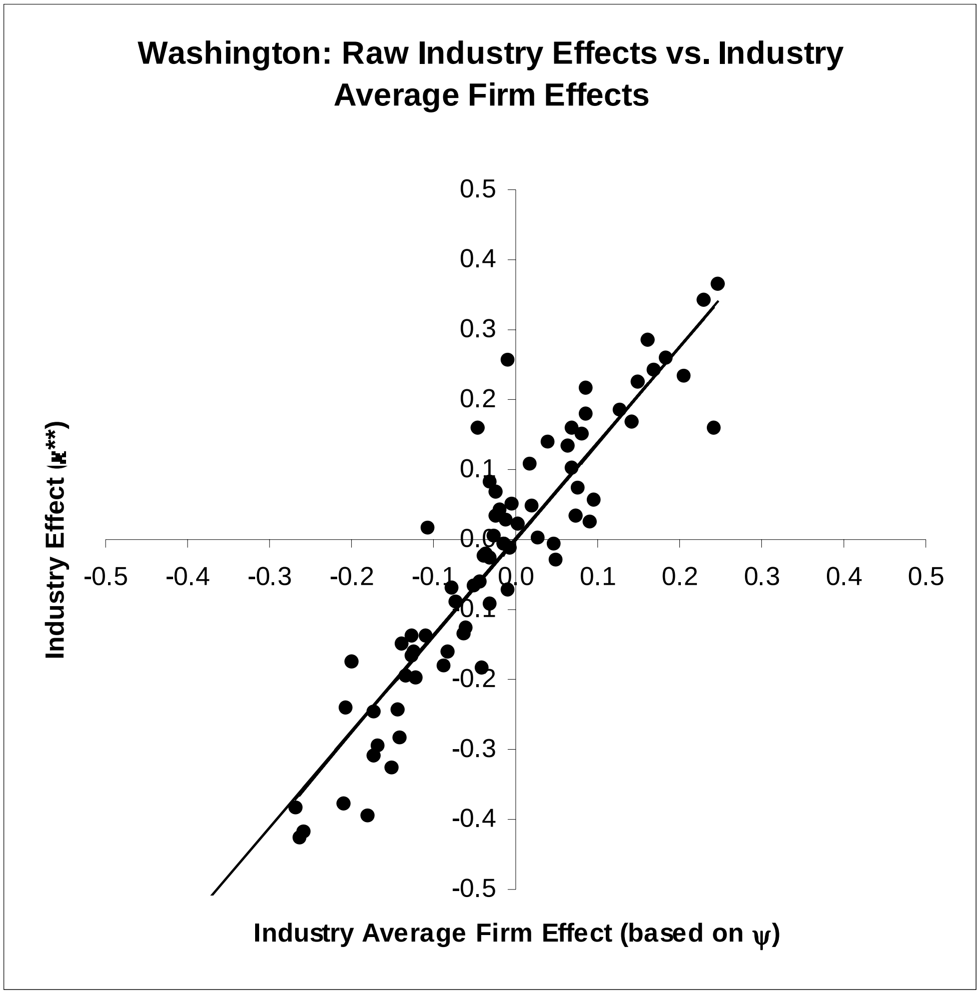

Figure 2

Tabular Summary of Inter-industry Wage Results

Table 3 presents a summary of the main results for inter-industry wage differentials. The exact percentage decomposition is based on equation (8):

$$\text{Part due to individual effects} = (A'F'M_X FA)^{-1} A'F'M_X D\theta / \kappa^{**}$$
$$\text{Part due to firm effects} = (A'F'M_X FA)^{-1} A'F'M_X F\psi / \kappa^{**}$$

The table shows that for the State of Washington 50% of inter-industry wage differentials is due to unmeasured individual heterogeneity and 50% is due to unmeasured firm heterogeneity based on the results in Table 2. For France these proportions are 55% individual and 45% firm, based on the estimates used to produce Table A1. The table also presents the wage differential variance statistic developed by Krueger and Summers (1988). Krueger and Summers calculated the weighted variance of the inter-industry wage differentials, which is 0.0344 for Washington and 0.0107 for France. They also estimated the weighted variance for the inter-industry wage differences given person effects, which is 0.0098 for Washington and 0.0004 for France. Given the estimates in Table 3, Krueger and Summers would have argued that most of the effect is due to individual differences because very little variation remains after controlling for person effects. Krueger and Summers reached exactly the opposite conclusion. That may be due to differences in the longitudinal data they used (the Current Population Survey, which has only two years of longitudinal data) as compared to our own, which has up to 10 years of quarterly data per person.[6] Once controls for both individual and employer heterogeneity are included in the estimating equation, one must decompose the variance into three parts: the part due to person effects, the part due to firm effects and the part due to the covariation between the two, as shown in the last three columns of Table 3. Because there substantial covariation between the industry-average person and industry-average firm effects, it is not possible to answer the original question about the share of these wage differences due to individual vs. firm heterogeneity using the Krueger-Summers measure. Our exact measure provides a complete answer.

Table 3
Summary of Inter-industry Wage Differential Sources

Data Source	***Raw Industry Effect***	***Industry Effect Given Persons***	***Industry Average Person Effect***	***Industry Average Firm Effect***	***Covariance between Person and Firm Effects***
Washington					
Exact Percentage Decomposition			50%	50%	
Krueger-Summers Variance Decomposition	0.0344	0.0098	0.0055	0.0163	0.0126
France					
Exact Percentage Decomposition			55%	45%	
Krueger-Summers Variance Decomposition	0.0107	0.0004	0.0030	0.0037	0.0040

The exact percentage decomposition is based on equation (8) in the text. The Krueger-Summers variance decomposition is based on their 1988 statistic (corrected for sample estimation). Their model did not permit estimation of the covariance between effects.

One way to assess the quality of the estimated inter-industry wage effects is to examine the workers who ever moved. If the workers who moved between, as well as within industries, are in sufficient number and "representative" enough, then this should guarantee precise and reasonable estimation results. Statistics on movers are presented in the Table 4. Most workers who moved changed industries as well as employers, that is, they moved to an employer in a different industry. Analysis of their pay structure shows that movers had rather low wages even though their person effects are close to zero. Those who stayed in the same industry worked for low-wage firms.

Table 4
Summary Statistics for Individuals Who Change Employers (Period of Move)

Worker Category	Number of observations	Average earnings	Average person effect	Average firm effect
Ever Moved	141,731	-0.0930	-0.0161	-0.0248
Ever Moved (same industry)	27,508	-0.0421	0.0327	-0.0833
Ever Moved (new industry)	114,223	-0.1036	-0.0262	-0.0126

Notes: Authors' calculations. Total observations: 4,036,171; total individuals: 296,801.

[6] Krueger and Summers adjusted their results for measurement error in the industry, which is not an issue with our data since we use employer reported industry which has been edited by the State of Washington's Employment Security Division (for Washington) and official employer reports edited by INSEE (for France).

Our evidence shows that our inter-industry wage effects are well estimated. However, we cannot offer an interpretation of their economic significance based solely upon the statistical evidence. In particular, we need a way to assess the origin of the person effects or of the firm effects. The debate between Krueger and Summers (1987, 1988), Murphy and Topel (1987), Dickens and Katz (1987), and Gibbons and Katz (1991) seems to show that person effects are generally associated with unobserved worker quality whereas firm effects are generally associated with firm specific compensation policies such as efficiency wage considerations or rent-sharing.

To provide an economic interpretation, we compare the American decomposition of the inter-industry effects (Table 2) with the French decomposition (Table A.1). The comparison of the structure of these effects between countries with different, and sometimes opposite, institutions will add economic variation to the statistical evidence. This extra variation allows us to identify the nature of the inter-industry effects. We first demonstrate that the inter-industry structures are comparable in the two countries. Krueger and Summers (1987) have shown that raw inter-industry wage effects are highly correlated between these two countries. Table 5 shows that the industry-average person effects and the industry-average firm effects are also highly correlated. Our estimated correlation is slightly lower than the one given in Krueger and Summers (1987), 0.7; however, our results are computed from 2-digit industries whereas theirs were computed for 1-digit industries. Despite very different institutional arrangements, both person and firm-effects are highly correlated. Therefore, a detailed analysis of the similarities and of the differences in inter-industry effects across the two countries should give insights into their economic origins.

Table 5
Correlation of the Inter-industry Wage Effects
(State of Washington vs France)

	US Weights	French Weights
Raw Industry Effects	0.5470	0.4321
Person Effects	0.5722	0.4766
Firm Effects	0.5080	0.4708

In the State of Washington, sectors that pay high wages primarily because of high-wages firms are the fishing (SIC09), coal mining (SIC12), chemicals (SIC26), paper (SIC28), transportation equipment manufacture (SIC37), water transportation (SIC44), and communication (SIC48) industries. The petroleum industry (SIC29) has both high-wage persons and high-wage firms. In France, sectors with high wages due to high-wage firms are electricity (NAP06), tobacco (NAP42), and railroad transportation (NAP68). In addition, French sectors that have high-wage persons and high-wage firms are the coal mining (NAP04), petroleum (NAP05), office and accounting machines (NAP27), aircraft manufacturing (NAP33), and air transportation (NAP72) industries. In France large firm effects are (almost) always associated with the presence of large state monopolies or large state-owned companies: Electricité de France (EDF) in the electricity sector; SEITA, the “Gauloises” State-owned tobacco producer; SNCF (Societé Nationale des Chemins de Fers) in railroad transportation; ELF in the petroleum industry, BULL in the office machine sector; Airbus or Aérospatiale in the aircraft manufacturing sector; and Air France in the air transportation industry. Evidently, the large firm effects come from a strong union presence with a large bargaining power together with large rents due to the lack of competition.[7] In the State of Washington, transportation equipment, fishing, coal mining, and chemicals are all examples of largely unionized industries or in which some large firms may enjoy strong competitive advantages.

In the State of Washington, industries that pay high wages primarily because they employ high-wage persons are financial industries (SIC62 and SIC67), air transportation (SIC45), and the petroleum industry (SIC29). These are all industries that also employ high-wage employees in France. The financial sectors are largely deregulated in most countries in the world and this shows up in the absence a sizeable industry average firm effect in both countries (see NAP76 and NAP89 for France). But, as for air transportation, because of the intense competition in the United States the average firm effect is small (even negative) whereas in France, as noted above, Air France is a State-owned company. So, in both countries airlines need high-wage workers as reflected in the average person effect but the rents that exist in France and accrue to the workers do not exist any more in the United States. (See, for instance the analysis of Card, 1986, on airline mechanics.)

Finally, if we focus on the low-wage industries we see that these industries are roughly similar in the two countries: apparel (SIC23 and NAP47), leather (SIC31 and NAP45), food retailing (SIC54 and NAP62), eating and drinking places and hotels (SIC58 and 70 and NAP67), personal and social services (SIC72 and 83 and NAP82 and 85). But the magnitude of the effects is much larger in the United States, reflecting the low minimum wage in those years. Indeed, in absolute values the negative effects are larger than the positive ones in the State of Washington, the reverse being true in France.

If we believe that competition explains part of the inter-industry differentials, we can use our data to measure the concentration as reflected in the employment variables. We construct the Herfindahl index of employment[8] and the employment share of the three largest firms for each industry. We use these measures to try to explain our estimated inter-industry effects. The results are presented in Table 6. We see that the average firm effect is, as was apparent from the above discussion, related to the monopoly power – as measured by the employment share of the three largest firms - prevailing in the industry. The average person effect is only mildly negatively related to the Herfindahl index.

[7] The period of analysis, 1976-1987, for the French data includes the "nationalizations" that occurred in 1981 after François Mitterrand's election.

[8] The Herfindahl index of employment share was computed as the unweighted average of the squared employment shares within the two-digit SIC. Thus, it varies from $(1/N)^2$ to 1, where N is the number of firms in the SIC.

Table 6
Explanation of the Inter-Industry Wage Effects in Washington

Effect	Industry Effect Coefficient (StErr)	Average Person Effect Coefficient (StErr)	Average Firm Effect Coefficient (StErr)
Employment Share of the 3 Largest Firms	0.1866 (0.1152)	0.0102 (0.0464)	0.1761 (0.0788)
Herfindahl Index on Employment	-1.1468 (0.7092)	-0.4774 (0.2858)	-0.5746 (0.4850)
Constant	-0.1040 (0.0693)	-0.0042 (0.0279)	-0.0999 (0.0474)
R^2	0.0288	0.0098	0.0426
Number of Observations	82	82	82

5. Firm-Size Wage Effects

Figure 3 summarizes the results for firm-size wage differentials for the State of Washington. The figure shows the firm size on the horizontal axis (logarithmic scale) and the wage differential on the vertical axis. This figure shows the familiar (Oi and Idson, 1999, and Brown and Medoff, 1989) quadratic relation between log firm size and wage differentials—increasing at a decreasing rate. The solid portion of the bar indicates the part due to the firm-size average person effect while the open part of the bar is the portion due to the firm-size average firm effect, again according to the decomposition in equation (8). Therefore, for the State of Washington, 70% of the raw firm-size wage effect is due to the firm-size average firm effect with the remainder being due to the firm-size average person effect.

These results strengthen Oi and Idson's (1999) claim that most of the firm-size wage differential is a firm-effect. While personal heterogeneity clearly plays a role (30% of the differential is not trivial), the search for explanations of this phenomenon should clearly favor models that relate the firm-size to the firm's structural compensation decisions (as, for example, in Ichniowski, Shaw, and Prennushi, 1997, and Groshen, 1991).

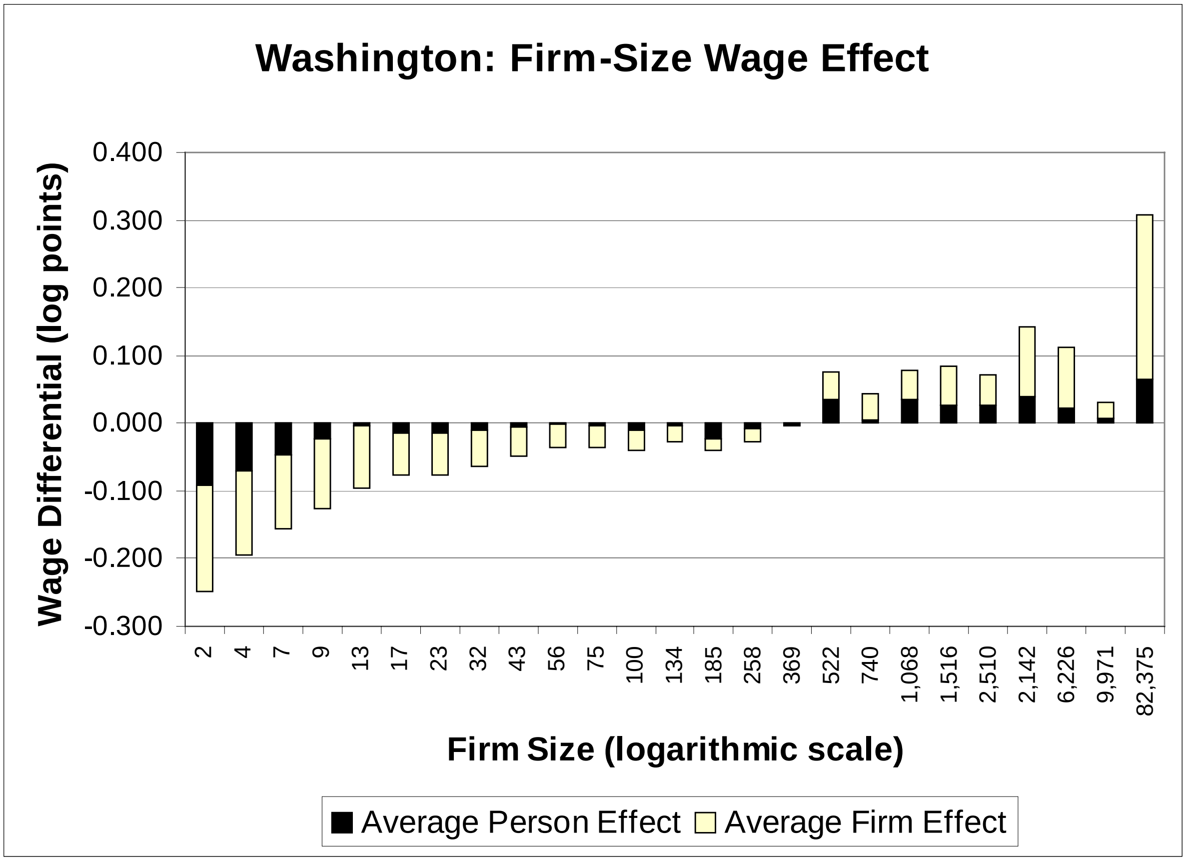

Figure 3

6. Conclusions

For the State of Washington, raw inter-industry wage variation is well explained by either the inter-industry variation in the weighted average person effects or weighted average firm effects. The sum of the two exactly explains the differential as the relation in equation (8) shows. Furthermore, the raw inter-industry wage variation is essentially 50% person effect and 50% firm effect. In the State of Washington, firm effects are more important than person effects for explaining the firm-size wage effect (70% firm v. 30% person).

By examining precisely the industries that were employing high-wage workers or comprising high-wage firms (low-wage, respectively) and comparing the structure of inter-industry differences in the United States with those observed in France, we were able to derive several conclusions. All components of inter-industry differences, the raw effect, the average person effect and the average firm effects are highly correlated between the two countries, showing that explanations of these differences have to be similar in the two countries. However, in the State of Washington the variance of inter-industry differentials is greater than in France. Indeed, in the United States dispersion across high-wage sectors appears to be roughly equal to dispersion across low-wage sectors, whereas, in France, collective bargaining agreements eliminate or greatly reduce wage differentials for low to mid-wage workers. Even though the low-wage sectors are almost identical in the two countries, this is not so always so for the high-wage industries. The structure of competition on the product market seems to be an important component of any explanation of high average firm effects. In the United States, an explanation would be unionization and a lack of intense competitive pressure. In France, all such industries include large State monopolies. In addition, industries with high average person effects are very similar in the two countries. Most face intense international competition.

The results presented in this paper are a major challenge to theories of the labor market. Such theories must provide a role for both individual differences (wage variation that is carried from job to job) and firm differences (consistent payment of wage differentials to individuals with the same observed and unobserved characteristics) in a framework where both the labor market and the product market matter.

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Table 2
Inter-industry Wage Differentials for the State of Washington

SIC	Industry (1987 SIC)	Raw Industry Effect	(SE)	Industry Effect Given Persons	(SE)	Industry Average Person Effect	(SE)	Industry Average Firm Effect	(SE)
01	Agriculture-crops	-0.417	(0.002)	-0.185	(0.006)	-0.159	(0.002)	-0.258	(0.001)
02	Agriculture-livestock	-0.296	(0.004)	-0.099	(0.007)	-0.127	(0.004)	-0.169	(0.002)
07	Agricultural services	-0.243	(0.003)	-0.079	(0.006)	-0.097	(0.002)	-0.145	(0.001)
08	Forestry	-0.073	(0.008)	0.036	(0.009)	-0.061	(0.007)	-0.011	(0.004)
09	Fishing	0.170	(0.005)	0.076	(0.007)	0.028	(0.004)	0.141	(0.002)
10	Metal mining	0.276	(0.014)	0.181	(0.015)	0.044	(0.012)	0.236	(0.006)
12	Bituminous coal mining	0.344	(0.008)	0.176	(0.018)	0.115	(0.007)	0.229	(0.004)
13	Oil and gas extraction	0.198	(0.021)	0.077	(0.017)	0.256	(0.018)	-0.053	(0.010)
14	Nonmetal mineral mining	0.075	(0.007)	0.059	(0.008)	0.000	(0.006)	0.076	(0.003)
15	Building contractors	0.151	(0.002)	0.061	(0.006)	0.072	(0.002)	0.080	(0.001)
16	Heavy construction	0.259	(0.002)	0.124	(0.006)	0.077	(0.002)	0.182	(0.001)
17	Special trade contractors	0.136	(0.001)	0.057	(0.006)	0.072	(0.001)	0.063	(0.001)
20	Food and tobacco manufacturing	-0.029	(0.001)	0.052	(0.006)	-0.079	(0.001)	0.050	(0.001)
22	Textile mill products	-0.181	(0.007)	-0.046	(0.009)	-0.139	(0.006)	-0.042	(0.003)
23	Apparel	-0.325	(0.003)	-0.107	(0.007)	-0.172	(0.003)	-0.152	(0.002)
24	Lumber and wood	0.025	(0.001)	0.076	(0.006)	-0.067	(0.001)	0.089	(0.001)
25	Furniture and fixtures	-0.160	(0.004)	-0.043	(0.007)	-0.076	(0.004)	-0.084	(0.002)
26	Paper and allied products	0.243	(0.002)	0.098	(0.006)	0.076	(0.001)	0.167	(0.001)
27	Printing and publishing	-0.011	(0.002)	-0.025	(0.006)	-0.003	(0.002)	-0.008	(0.001)
28	Chemicals and allied products	0.225	(0.002)	0.019	(0.006)	0.077	(0.002)	0.150	(0.001)
29	Petroleum and coal products	0.365	(0.005)	0.204	(0.010)	0.116	(0.004)	0.246	(0.002)
30	Rubber and plastics	-0.126	(0.003)	-0.037	(0.006)	-0.064	(0.003)	-0.061	(0.001)
31	Leather	-0.393	(0.011)	-0.112	(0.011)	-0.223	(0.009)	-0.180	(0.005)
32	Stone, clay and glass	0.035	(0.003)	0.059	(0.006)	-0.039	(0.002)	0.074	(0.001)
33	Primary metals	0.161	(0.002)	0.211	(0.006)	-0.080	(0.002)	0.241	(0.001)
34	Fabricated metals	0.003	(0.002)	0.018	(0.006)	-0.024	(0.002)	0.026	(0.001)
35	Machinery, except electrical	-0.005	(0.002)	0.016	(0.006)	0.008	(0.002)	-0.014	(0.001)
36	Electric and electronic equipment	-0.065	(0.002)	-0.034	(0.006)	-0.014	(0.002)	-0.051	(0.001)
37	Transportation equipment	0.275	(0.001)	0.156	(0.006)	0.058	(0.001)	0.217	(0.000)
38	Instruments and related products	0.161	(0.002)	0.012	(0.006)	0.094	(0.002)	0.068	(0.001)
39	Miscellaneous manufacturing	-0.136	(0.003)	-0.028	(0.007)	-0.071	(0.003)	-0.063	(0.001)
40	Railroad transport	-0.189	(0.042)	0.209	(0.038)	-0.353	(0.036)	0.169	(0.019)
41	Local and interurban passenger transport	0.056	(0.003)	0.028	(0.007)	-0.040	(0.002)	0.096	(0.001)

Table 2
Inter-industry Wage Differentials for the State of Washington

SIC	Industry (1987 SIC)	Raw Industry Effect	(SE)	Industry Effect Given Persons	(SE)	Industry Average Person Effect	(SE)	Industry Average Firm Effect	(SE)
42	Trucking and warehousing	-0.005	(0.002)	0.042	(0.006)	-0.052	(0.002)	0.047	(0.001)
43	US postal service	-0.163	(0.016)	0.062	(0.013)	-0.008	(0.014)	-0.236	(0.007)
44	Water transportation	0.284	(0.002)	0.060	(0.007)	0.123	(0.002)	0.162	(0.001)
45	Air transportation	0.017	(0.002)	-0.033	(0.006)	0.125	(0.002)	-0.108	(0.001)
46	Pipelines, except natural gas	0.234	(0.043)	0.350	(0.037)	-0.130	(0.037)	0.364	(0.020)
47	Transportation services	-0.068	(0.003)	-0.053	(0.006)	0.009	(0.002)	-0.078	(0.001)
48	Communication	0.233	(0.002)	0.067	(0.006)	0.029	(0.001)	0.205	(0.001)
49	Electric, gas and sanitary services	0.217	(0.002)	0.063	(0.006)	0.132	(0.001)	0.085	(0.001)
50	Wholesale trade-durable goods	0.007	(0.001)	-0.012	(0.006)	0.032	(0.001)	-0.026	(0.000)
51	Wholesale trade-nondurable goods	-0.027	(0.001)	-0.017	(0.006)	0.006	(0.001)	-0.032	(0.001)
52	Building materials and garden supplies	-0.196	(0.002)	-0.084	(0.006)	-0.072	(0.002)	-0.121	(0.001)
53	General merchandise stores	-0.179	(0.001)	-0.073	(0.006)	-0.090	(0.001)	-0.088	(0.001)
54	Food stores	-0.195	(0.001)	-0.125	(0.006)	-0.061	(0.001)	-0.134	(0.001)
55	Automobile dealers and service stations	-0.137	(0.001)	-0.108	(0.006)	-0.011	(0.001)	-0.126	(0.001)
56	Apparel and accessory stores	-0.090	(0.002)	-0.054	(0.006)	-0.059	(0.002)	-0.031	(0.001)
57	Furniture and home furnishing stores	-0.159	(0.002)	-0.096	(0.006)	-0.035	(0.002)	-0.123	(0.001)
58	Eating and drinking places	-0.427	(0.001)	-0.230	(0.006)	-0.161	(0.001)	-0.265	(0.001)
59	Miscellaneous retail	-0.246	(0.002)	-0.124	(0.006)	-0.074	(0.001)	-0.172	(0.001)
60	Banking	-0.020	(0.001)	-0.018	(0.006)	0.014	(0.001)	-0.035	(0.001)
61	Credit agencies other than banks	0.044	(0.003)	-0.033	(0.006)	0.071	(0.002)	-0.019	(0.001)
62	Security, commodity, brokers and services	0.258	(0.004)	-0.005	(0.007)	0.268	(0.003)	-0.010	(0.002)
63	Insurance carriers	0.050	(0.002)	0.012	(0.006)	0.031	(0.001)	0.018	(0.001)
64	Insurance agents and brokers	0.035	(0.003)	0.000	(0.006)	0.058	(0.002)	-0.024	(0.001)
65	Real estate	-0.164	(0.002)	-0.086	(0.006)	-0.037	(0.002)	-0.127	(0.001)
66	Combined real estate and insurance	-0.041	(0.037)	-0.077	(0.023)	0.025	(0.032)	-0.063	(0.017)
67	Holding and other investments	0.160	(0.005)	-0.001	(0.006)	0.191	(0.004)	-0.046	(0.002)
70	Hotel and lodging services	-0.377	(0.002)	-0.181	(0.006)	-0.167	(0.002)	-0.210	(0.001)
72	Personal services	-0.283	(0.002)	-0.110	(0.006)	-0.142	(0.002)	-0.141	(0.001)
73	Business services	-0.060	(0.001)	-0.046	(0.006)	-0.017	(0.001)	-0.043	(0.001)
75	Auto repair services and garages	-0.137	(0.002)	-0.086	(0.006)	-0.026	(0.002)	-0.111	(0.001)
76	Miscellaneous repair	-0.088	(0.003)	-0.040	(0.006)	-0.015	(0.003)	-0.072	(0.002)
78	Motion pictures	-0.384	(0.006)	-0.261	(0.007)	-0.115	(0.005)	-0.269	(0.003)
79	Amusement and recreation services	-0.239	(0.003)	-0.153	(0.006)	-0.030	(0.002)	-0.208	(0.001)

Table 2
Inter-industry Wage Differentials for the State of Washington

SIC	*Industry (1987 SIC)*	*Raw Industry Effect*	*(SE)*	*Industry Effect Given Persons*	*(SE)*	*Industry Average Person Effect*	*(SE)*	*Industry Average Firm Effect*	*(SE)*
80	Health services	-0.023	(0.001)	-0.027	(0.006)	0.015	(0.001)	-0.038	(0.000)
81	Legal services	0.139	(0.002)	0.037	(0.006)	0.099	(0.002)	0.040	(0.001)
82	Educational services	0.024	(0.001)	0.030	(0.006)	0.021	(0.001)	0.003	(0.000)
83	Social services	-0.310	(0.002)	-0.114	(0.006)	-0.137	(0.001)	-0.173	(0.001)
84	Museums, botanical, zoological gardens	-0.173	(0.011)	-0.146	(0.013)	0.021	(0.010)	-0.199	(0.005)
86	Membership organizations	-0.148	(0.002)	-0.089	(0.006)	-0.010	(0.002)	-0.138	(0.001)
87	Engineering, accounting, research services	0.181	(0.001)	0.040	(0.006)	0.091	(0.001)	0.084	(0.001)
88	Private households	-0.761	(0.004)	-0.417	(0.007)	-0.225	(0.004)	-0.535	(0.002)
89	Miscellaneous services	0.110	(0.003)	-0.025	(0.006)	0.115	(0.003)	0.018	(0.002)
91	Executive, legislative and general	0.102	(0.001)	0.094	(0.006)	0.033	(0.001)	0.068	(0.000)
92	Justice, public order	0.069	(0.003)	0.088	(0.007)	0.085	(0.002)	-0.023	(0.001)
93	Finance, taxation and monetary policy	0.082	(0.007)	0.064	(0.010)	0.108	(0.006)	-0.031	(0.003)
94	Administration of human resources	0.029	(0.002)	0.075	(0.006)	0.037	(0.002)	-0.013	(0.001)
95	Environmental quality and housing	-0.004	(0.004)	0.042	(0.007)	0.008	(0.003)	-0.016	(0.002)
96	Administration of economic programs	0.051	(0.003)	0.050	(0.007)	0.053	(0.003)	-0.004	(0.001)
97	National security	-0.580	(0.004)	-0.399	(0.006)	-0.293	(0.003)	-0.219	(0.002)
	Weighted adjusted standard deviation	0.1855		0.0988		0.0740		0.1278	
	Weighted adjusted variance	0.0344		0.0098		0.0055		0.0163	

Appendix A

The French data are based on a collection of employer payroll reports called the Déclaration annuelles des données sociales. These consist of a $1/25^{th}$ sample of the French workforce with the individual and employing firm identified for the years 1976-1987 (1981 and 1983 are not available). There are 1.2 million individuals, 500,000 firms and 5.3 million observations. The time varying characteristics consist of labor force experience (quartic), time period (annual), region of France all fully interacted with sex. The non-time-varying personal characteristics consist of eight indicator variables for educational attainment, again fully interacted with sex. See AKM for a full description of the methods used to create the data and for summary statistics.

Table A.1
Inter-industry Wage Differentials for France

SIC	***Industry (Translation of the NAP-100)***	***Raw Industry Effect***	***(SE)***	***Industry Effect Given Persons***	***(SE)***	***Industry Average Person Effect***	***(SE)***	***Industry Average Firm Effect***	***(SE)***
04	Coal mining	0.297	(0.006)	0.172	(0.014)	0.141	(0.005)	0.156	(0.004)
05	Crude petroleum and natural gas extraction	0.358	(0.003)	-0.009	(0.006)	0.226	(0.003)	0.130	(0.002)
06	Electricity production and supply	0.203	(0.002)	-0.060	(0.004)	0.053	(0.002)	0.155	(0.001)
08	Water and city-heating supply	0.137	(0.004)	-0.007	(0.008)	0.091	(0.004)	0.045	(0.003)
10	Iron and steel foundries	0.097	(0.002)	0.016	(0.005)	-0.006	(0.002)	0.100	(0.001)
11	Primary metal manufacturing	-0.011	(0.003)	-0.007	(0.006)	-0.039	(0.003)	0.029	(0.002)
13	Primary nonmetallic manufacturing	0.106	(0.003)	-0.023	(0.005)	0.023	(0.002)	0.084	(0.002)
14	Miscellaneous mineral production	0.049	(0.008)	0.029	(0.012)	-0.005	(0.007)	0.049	(0.005)
15	Cement, stone, and concrete products	-0.037	(0.002)	0.004	(0.003)	-0.029	(0.002)	-0.010	(0.001)
16	Glass and glass products	0.123	(0.003)	0.000	(0.005)	0.023	(0.002)	0.098	(0.002)
17	Basic chemical manufacture	0.201	(0.002)	-0.001	(0.004)	0.086	(0.002)	0.114	(0.001)
18	Allied chemical products, soaps, cosmetics	0.122	(0.002)	0.004	(0.003)	0.063	(0.002)	0.056	(0.001)
19	Pharmaceuticals	0.156	(0.003)	-0.021	(0.004)	0.048	(0.002)	0.111	(0.002)
20	Foundries and smelting works	0.010	(0.002)	0.044	(0.004)	-0.016	(0.002)	0.019	(0.002)
21	Metal works	0.003	(0.001)	-0.002	(0.002)	0.000	(0.001)	0.003	(0.001)
22	Farm machinery and equipment	-0.007	(0.003)	0.000	(0.005)	-0.044	(0.003)	0.034	(0.002)
23	Metalworking machinery manufacture	0.060	(0.003)	0.026	(0.004)	0.023	(0.002)	0.032	(0.002)
24	Industrial machinery manufacture	0.055	(0.001)	0.003	(0.002)	0.029	(0.001)	0.025	(0.001)
25	Material handling machines and equipment	0.061	(0.003)	0.019	(0.004)	0.000	(0.002)	0.056	(0.002)
26	Ordnance	0.093	(0.008)	-0.035	(0.012)	0.033	(0.007)	0.068	(0.005)
27	Office and accounting machines	0.333	(0.003)	0.012	(0.005)	0.138	(0.003)	0.190	(0.002)
28	Electrical machinery equipment	0.046	(0.001)	0.022	(0.003)	0.005	(0.001)	0.037	(0.001)
29	Electronic computing equipment	0.071	(0.001)	-0.007	(0.003)	0.018	(0.001)	0.053	(0.001)
30	Household appliances	-0.001	(0.003)	0.004	(0.005)	-0.048	(0.003)	0.046	(0.002)
31	Motor vehicles, trains, land transport man.	0.058	(0.001)	0.040	(0.003)	-0.023	(0.001)	0.075	(0.001)
32	Ship and boat building	0.105	(0.003)	0.032	(0.006)	0.034	(0.003)	0.067	(0.002)
33	Aircraft and parts manufacture	0.220	(0.002)	0.014	(0.005)	0.104	(0.002)	0.115	(0.001)
34	Professional and scientific equipment man.	0.034	(0.002)	0.016	(0.004)	0.020	(0.002)	0.012	(0.001)
35	Meat products	-0.019	(0.002)	-0.002	(0.004)	0.017	(0.002)	-0.034	(0.002)
36	Dairy products	0.053	(0.003)	0.013	(0.005)	0.005	(0.002)	0.044	(0.002)
37	Canned and preserved products	-0.038	(0.004)	0.000	(0.005)	-0.050	(0.003)	0.013	(0.002)
38	Bakery products	-0.082	(0.002)	0.000	(0.004)	-0.011	(0.002)	-0.069	(0.001)
39	Grain mill and cereal products	0.038	(0.003)	0.023	(0.005)	-0.015	(0.002)	0.050	(0.002)
40	Miscellaneous food preparations	0.073	(0.003)	0.006	(0.004)	-0.019	(0.002)	0.090	(0.002)

Table A.1
Inter-industry Wage Differentials for France

SIC	Industry (Translation of the NAP-100)	Raw Industry Effect	(SE)	Industry Effect Given Persons	(SE)	Industry Average Person Effect	(SE)	Industry Average Firm Effect	(SE)
41	Beverage industries	0.112	(0.003)	-0.009	(0.005)	0.012	(0.003)	0.100	(0.002)
42	Tobacco products manufacture	0.238	(0.007)	-0.046	(0.020)	0.055	(0.007)	0.181	(0.005)
43	Knitting mills, threads and artificial fibers	0.073	(0.007)	0.015	(0.012)	-0.063	(0.006)	0.137	(0.004)
44	Textile products	-0.076	(0.001)	0.013	(0.003)	-0.066	(0.001)	-0.011	(0.001)
45	Leather products except footwear	-0.109	(0.004)	0.019	(0.006)	-0.048	(0.003)	-0.064	(0.002)
46	Footwear	-0.081	(0.003)	0.006	(0.006)	0.001	(0.002)	-0.081	(0.002)
47	Apparel, clothing and allied products	-0.115	(0.001)	0.002	(0.003)	-0.056	(0.001)	-0.057	(0.001)
48	Lumber mills	-0.110	(0.002)	0.005	(0.004)	-0.069	(0.002)	-0.040	(0.001)
49	Furniture and fixtures manufacture	-0.096	(0.002)	0.006	(0.004)	-0.035	(0.002)	-0.060	(0.001)
50	Pulp and paper mills and packaging prod.	0.078	(0.002)	0.003	(0.004)	0.022	(0.002)	0.054	(0.001)
51	Printing and publishing	0.125	(0.001)	-0.011	(0.003)	0.064	(0.001)	0.061	(0.001)
52	Rubber products	0.034	(0.002)	0.044	(0.004)	-0.015	(0.002)	0.040	(0.001)
53	Plastic products	0.003	(0.002)	-0.001	(0.003)	-0.016	(0.002)	0.019	(0.001)
54	Miscellaneous manufacturing industries	-0.071	(0.002)	0.000	(0.003)	-0.047	(0.002)	-0.024	(0.001)
55	Construction	-0.122	(0.001)	0.006	(0.002)	-0.049	(0.001)	-0.074	(0.000)
56	Waste product management	-0.116	(0.005)	0.010	(0.006)	-0.083	(0.004)	-0.035	(0.003)
57	Wholesale food trade	-0.024	(0.001)	-0.004	(0.002)	-0.006	(0.001)	-0.019	(0.001)
58	Wholesale non-food trade	0.005	(0.001)	-0.023	(0.002)	0.018	(0.001)	-0.008	(0.001)
59	Inter-industry wholesale trade	0.052	(0.001)	-0.012	(0.002)	0.047	(0.001)	0.008	(0.001)
60	Commercial intermediaries	0.084	(0.003)	-0.026	(0.004)	0.086	(0.002)	0.005	(0.002)
61	Retail food and supermarkets	-0.051	(0.002)	0.018	(0.003)	-0.019	(0.002)	-0.033	(0.001)
62	Retail specialty and neighborhood food	-0.110	(0.001)	0.012	(0.002)	-0.045	(0.001)	-0.066	(0.001)
63	Retail general merchandise and non food	-0.044	(0.002)	0.004	(0.004)	-0.008	(0.002)	-0.036	(0.002)
64	Retail specialty non food trade	-0.074	(0.001)	-0.019	(0.002)	-0.015	(0.001)	-0.056	(0.001)
65	Automobile dealers, auto parts and repair	-0.043	(0.001)	-0.001	(0.002)	0.004	(0.001)	-0.048	(0.001)
66	Miscellaneous repair services	-0.095	(0.005)	-0.034	(0.006)	-0.021	(0.004)	-0.060	(0.003)
67	Hotels, motels, bars and restaurants	-0.151	(0.001)	-0.004	(0.002)	-0.087	(0.001)	-0.060	(0.001)
68	Railroad transportation	0.090	(0.001)	-0.010	(0.005)	-0.046	(0.001)	0.134	(0.001)
69	Bus, taxicab and other urban transit	-0.039	(0.001)	-0.021	(0.002)	-0.010	(0.001)	-0.025	(0.001)
70	Inland water transportation	0.005	(0.013)	0.051	(0.017)	-0.084	(0.012)	0.081	(0.008)
71	Marine transport and coastal shipping	0.203	(0.007)	0.021	(0.012)	0.110	(0.006)	0.086	(0.005)
72	Air transportation	0.309	(0.003)	-0.035	(0.007)	0.107	(0.003)	0.200	(0.002)
73	Allied transportation and warehousing	0.069	(0.004)	-0.009	(0.006)	0.032	(0.003)	0.037	(0.002)
74	Travel agencies	0.018	(0.002)	-0.010	(0.003)	0.004	(0.002)	0.014	(0.001)

Table A.1
Inter-industry Wage Differentials for France

SIC	***Industry (Translation of the NAP-100)***	***Raw Industry Effect***	***(SE)***	***Industry Effect Given Persons***	***(SE)***	***Industry Average Person Effect***	***(SE)***	***Industry Average Firm Effect***	***(SE)***
75	Telecommunications and postal	0.019	(0.008)	-0.021	(0.010)	0.080	(0.007)	-0.039	(0.005)
76	Financial holding companies	0.282	(0.006)	0.005	(0.006)	0.226	(0.006)	0.055	(0.004)
77	Advertising and consulting services	0.028	(0.001)	-0.024	(0.002)	0.032	(0.001)	0.003	(0.001)
78	Brokers, credit agencies, and insurance	0.083	(0.003)	-0.001	(0.005)	0.070	(0.003)	0.012	(0.002)
79	Commercial real estate development, sales	-0.069	(0.002)	-0.029	(0.003)	-0.028	(0.002)	-0.032	(0.001)
80	Nonresidential goods rental services	0.038	(0.004)	-0.002	(0.004)	0.023	(0.003)	0.014	(0.002)
81	Real estate renting and leasing	-0.096	(0.003)	0.004	(0.003)	-0.029	(0.002)	-0.070	(0.002)
82	Commercial education services	-0.160	(0.005)	-0.052	(0.006)	-0.051	(0.005)	-0.094	(0.003)
83	Commercial research services	0.174	(0.007)	0.022	(0.008)	0.121	(0.006)	0.039	(0.004)
84	Commercial health services	0.050	(0.001)	-0.015	(0.002)	0.029	(0.001)	0.021	(0.000)
85	Commercial social services	-0.119	(0.002)	0.027	(0.003)	-0.091	(0.002)	-0.036	(0.001)
86	Commercial entertainment and recreation	0.079	(0.003)	-0.031	(0.004)	0.011	(0.002)	0.074	(0.002)
87	Miscellaneous commercial services	-0.252	(0.001)	-0.029	(0.003)	-0.112	(0.001)	-0.135	(0.001)
88	Insurance carriers	0.112	(0.002)	0.019	(0.003)	0.079	(0.002)	0.030	(0.001)
89	Banks and financial institutions	0.214	(0.001)	0.037	(0.003)	0.180	(0.001)	0.030	(0.001)
90	Public Administration	-0.023	(0.001)	0.020	(0.002)	0.002	(0.001)	-0.028	(0.001)
	Weighted adjusted standard deviation	0.104		0.020		0.055		0.061	
	Weighted adjusted variance	0.01073		0.00039		0.00303		0.00373	