

E C O N O M I C S B U L L E T I N

The Inter–Industry Wage Structure of U.S. Multinationals

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Abstract

Little is known about wage determination by multinationals, despite the much–discussed role of globalisation upon wage dispersion. Here we examine industry– and host–country–specific 1998 data on compensation of foreign affiliates of U.S. firms and compare that with U.S. labour–market data. We find substantial differences in employment distributions, that the inter–industry wage structure of US affiliates is less dispersed than the same structure in the U.S. and that the two industry wage premia are moderately correlated. We argue that these findings are consistent with the vertical model of FDI but less so with claims that multinationals increase wage inequality.

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1. Introduction

Not much is known about wage determination by multinational firms. However, the role of such firms in the world economy has been increasing significantly in the last two decades. For instance, according to UNCTAD (2000), the share of global GDP associated with international production increased from 5% in 1982 to 10% in 2000. More significantly, the ratio of world inward foreign direct investment (FDI) flows to global gross capital formation increased from 2% to 14% in the same period.

Other related changes, in particular the increasing flows of international trade, have led to important debates, both inside and outside academia, about the sign and magnitude of any possible impacts of globalisation upon wage dispersion. Indeed, trade, together with skill-biased technological change, have been suggested to be the main possible explanations of rising wage inequality, a phenomenon well documented, in particular for the U.S. during the 1980s and early 1990s. However, the analysis of the role of trade has not always considered its foreign direct investment dimension, since the focus has typically been placed instead on the international flows of goods and services.

This paper contributes to this wage inequality literature (and the role of international trade) by documenting on an aspect which, to the best of our knowledge, has not been addressed before: the inter-industry wage differentials of U.S. multinationals. By such differentials we mean the extent to which equivalent workers, in this case based outside the U.S., are paid different wage rates depending on their industry affiliation. While many authors have established the existence of sizeable industry differentials across the world, particularly since the seminal contributions of Krueger and Summers (1987, 1988), we know of no research that examines the wage practices of multinationals from this point of view.¹

There is, however, a large literature on the wage impacts of foreign ownership. See, among others, Aitken *et al.* (1996), Feenstra and Hanson (1997) and Aitken and Harrison (1999) for studies involving Mexico, the US and Venezuela. These papers, typically applying OLS on firm-level data, conclude that workers affiliated with foreign firms benefit from a wage premium when compared with similar workers affiliated with domestic firms.²

In this paper, our first goal is to assess to what extent the highly dispersed US inter-industry wage distribution is replicated abroad by US multinationals. Given the increasing role of FDI (and, in particular, U.S. FDI) in the world economy, and the large inter-industry wage differentials typically found in the U.S. economy, one may speculate that U.S. FDI is an important channel driving wage inequality levels *outside* the US. Indeed, since the pioneering work of Dunning (1958) that many authors discuss whether U.S. multinationals may have some role in moulding the wage structure of host countries.

Our second goal is to contribute to the characterisation of the nature of U.S. FDI in terms of the vertical, horizontal or knowledge-capital models, using data on the inter-industry wage structure of U.S. multinationals.³ The vertical model (Helpman, 1984) predicts a segmentation

¹ The only related topic we are aware of is that of international rent sharing: see Budd *et al.*, 2002

² This stylised fact is challenged in Martins (2004), who finds no significantly positive differences in wages when applying more robust econometric methods of controlling for differences between the two groups of workers and using a matched employer-employee panel data set.

³ Another FDI model is, of course, the OLI (Ownership-Location-Internalisation) paradigm of Dunning (1977). This framework argues that foreign firms hold advantages over domestic firms (e.g. ownership of special assets or

of production between the home and the host economies, as the multinational will exploit different intensities of skilled and unskilled labour (and the inherent factor cost differences) in the two areas. Conversely, the horizontal model (Markusen, 1984), which is based on the trade-off between trade costs and economies of scale, predicts a replication of host-economy activities in other countries. Finally, the knowledge-capital model (see Carr et al, 2001) combines the two frameworks, allowing for both the exploitation of factor-cost differences and for multiplant scale economies.

The empirical analysis exploits data compiled by the Bureau of Economic Analysis from surveys filled in by multinational U.S. firms concerning the year of 1998. The data, although limited to industry- and country-specific cells, include information on the compensation and employment levels of foreign affiliates of U.S. firms, besides a set of other financial and operational variables. Data from the U.S. labour force - the Current Population Survey - is then used to compare the inter-industry wage dispersion levels found for the foreign affiliates with those of the U.S. labour market.

As to our results, we find that the industry employment structure outside the U.S. is biased towards low-skilled industries (with respect to the benchmark case of the U.S. labour market), that the industry wage structure of U.S. foreign affiliates is less dispersed than its home counterpart, and that the industry wage premia inside and outside the US are moderately correlated. We argue that these results are consistent with the vertical model of FDI while they are not easily reconcilable with claims that F.D.I. fosters wage inequality.

The structure of the rest of the paper is as follows. Section 2 briefly presents the methodology, Section 3 presents the two data sets and Section 4 analyses the results. Finally, Section 5 concludes.

2. Methodology

In this section we outline our approach in characterizing the nature of FDI from a comparison of home and host country data. In particular, we argue that, under the vertical model, we can make the following three testable predictions concerning inter-industry wage (and employment) structures: 1) U.S. foreign affiliates abroad will be relatively concentrated in low-skill intensive industries (with respect to the case of firms based in the US); 2) inter-industry wage differentials will be less dispersed in host markets than in the U.S.; and 3) inter-industry wage differentials abroad will be weakly correlated with the inter-industry wage differentials in the US.

A summary explanation of these predictions is as follows: Prediction 1 is due to production segmentation, a key characteristic of the vertical model. This leads to an over-representation of foreign affiliates in low-skill, low-wage industries/countries. Indeed, if multinationals decompose their production chains across different countries (as they do in the vertical model), they will naturally seek to set up low-skill affiliates in low-wage locations.

Prediction 2 is related to the search for host countries being driven by the host countries'

production technologies) that more than compensate for the costs involved in setting up in different countries. These characteristics also dictate their specific choice of location and entry mode (e.g. franchising vs. subsidiary) for their investments.

wage levels, as would be the case under the vertical model. We assume that the availability of an extended choice set over world locations where multinationals may invest will lead to lower levels of observed industry wage dispersion across the affiliates. This is because while high-wage countries would be over-represented with high-wage industries, low-wage industries would be concentrated in low-wage countries. The decrease in industry dispersion in host countries would therefore be particularly acute when one controls for each country's wage levels.

Finally, prediction 3 – of a weak correlation between industry wage dispersion inside and outside the U.S. – is related to prediction 2 as lower dispersion of industry differentials abroad must imply a weaker correlation with industry differentials at home. Another aspect behind this prediction follows from our implicit assumption throughout the paper that industry wage differentials reflect the payment of rents and not compensating differentials or unobserved heterogeneity. Therefore, since U.S. multinationals have more freedom concerning where to invest with respect to the situation those and other U.S. firms face in the U.S., then one may expect that multinationals will be less likely to engage in rent sharing abroad. This would then generate lower wage dispersion and correlations.⁴

Under the horizontal model, one obtains similar types of predictions, but of opposite signs: 1) U.S. foreign affiliates will exhibit a similar employment distribution (with respect to firms based in the U.S.); 2) inter-industry wage differentials will be as dispersed abroad as at home; and 3) inter-industry wage differentials abroad will be strongly correlated with the same differentials in the U.S.. The explanations for these predictions follow immediately from the characteristics of horizontal investments.

Finally, under the knowledge-capital model, we expect some combination of the predictions of both models. Given its hybrid nature, we regard this model as a residual category to be considered if the data do not fit well any one of the previous two models.

3. Data

The main source of information in this paper is the 1998 Financial and Operational data on affiliates of U.S. firms, as compiled by the Bureau of Economic Analysis – U.S. Department of Commerce. The version of this data which is available publicly and which is used here is disaggregated into twelve industries and 58 countries.⁵ The variables considered are compensation of employees, employment, and sales. All variables are reported in industry-country cells and measured in millions of 1998 U.S. dollars, with the exception of employment, which is measured in thousands of workers.⁶ Obviously, the aggregate data on

⁴ This prediction is also about the extent to which U.S. multinationals mould the wage structure abroad. Such moulding can be argued to be weaker under production segmentation (vertical model) than under the case of production replication in different countries (horizontal model), at least to the extent that multinationals' choice of locations is driven by wage costs in different host countries.

⁵ The economies covered are: Canada, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, UK, Argentina, Brazil, Chile, Colombia, Ecuador, Peru, Venezuela, Costa Rica, Guatemala, Honduras, Mexico, Panama, Bahamas, Barbados, Bermuda, Dominican Republic, Jamaica, Netherlands Antilles, Trinidad and Tobago, UK Caribbean, Egypt, Nigeria, South Africa, Israel, Saudi Arabia, United Arab Emirates, Australia, China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, New Zealand, Philippines, Singapore, Taiwan, and Thailand. The data set is available at www.bea.doc.gov.

⁶ Some cells are not reported, due to confidentiality restrictions. We coded these cells as missing observations.

wages used in this study is not ideal, although they are divided at the industry and country levels. Micro data, especially including some key human capital controls typically used in wage equations would be preferable but are not available.

The second data set used is the 1998 Current Population Survey, March supplement. This is the main U.S. labour force survey and we use it for the purpose of comparing the results of the foreign affiliates of U.S. multinationals with the results for workers based in the U.S. The information obtained from this data set is the standard set of variables used in the estimation of wage equations: earnings, human capital and geographical variables and industry affiliation, restricting our analysis to workers aged 18-65. The industry coding in the two data sets was also made compatible, by following the BEA industry coding in the CPS data.

Table 1 describes the BEA data, in particular the employment and compensation levels across the different industry-country cells available. It is found that the average compensation per worker is 34,200 1998 U.S. dollars per year. This ranges between 2,200 dollars (Services, Ecuador) and 130,000 dollars (Services, Bahamas). The largest industry-country cell, with 311,900 workers is Other Industries in Canada. It can also be seen that the distribution of workers across the industries is somewhat asymmetric. It ranges between 2.6% and 2.8% (metals and petroleum) and 17.2% (other industries). An average of 138,420 workers per country (and a total of 8.03 million workers) is covered in the data.

Table 2 presents descriptive statistics about the CPS data. A first result is that the distribution of workers across industries is very different in the two data sets. It should be stressed that, in order to be able to compare the two data sets, we impose the BEA industry structure on the CPS data. This implies that, for instance, across the workers based in the U.S., we find that five industries in the BEA classification have employment shares lower than 2%. Other five industries have employment shares ranging between 2% and 8%. The remaining two industries have employment shares above 32% each (Services and Other Industries). Overall, the industries under-represented in BEA data are: Services, Other Industries, and Finance. All others industries, particularly Petroleum, Food, Chemicals, Electronics, Machinery, and Transport Equipment, have higher shares of employment abroad than in the U.S.

This comparison clearly suggests that an over-representation of the foreign affiliates of U.S. multinationals in low-skill industries, when compared to the benchmark case of the U.S. domestic labour market. For instance, while Finance and Services, which are likely to be relatively skill-intensive industries, take 8% and 38% of the labour force in the U.S., respectively, the same industries take only 3% and 13% abroad. Conversely, Food, Electronics, Machinery, and Transport Equipment, take much higher employment shares abroad (between 7% and 10%) than in the U.S. (between only 1% and 2%). This first finding is therefore consistent with the first prediction of the vertical model of FDI.

4. Results

The main empirical implementation of this paper involves estimating industry wage premia inside the U.S. and of the U.S. affiliates abroad. The amount of dispersion of each premia can then be computed and compared. In a second stage, we examine the correlation of the

two industry premia. Following the predictions and assumptions presented in Section 2, these steps allow us to clarify the nature of FDI according to the vertical and horizontal models. Moreover, this approach also allows us to make a preliminary assessment about the scope for U.S. multinationals to shape the wage distributions abroad.

The wage equation we consider takes the standard format, including industry dummies. (We implement robust regressions weighted by cell size.) Table 3 presents the first set of results, concerning U.S. multinationals abroad. In specification 1 (which does not include extra controls besides the industry dummies), a ranking of industries in terms of their pay can be established. In decreasing order of the premiums, the ranking is: Finance, Wholesale Trade, Petroleum, Services, Chemicals, Machinery, Other Manufacturing, Metals, Transportation Equipment, Food, Other Industries, and Electronics.⁷

The regression presents a moderately high level of fit, given by an adjusted R^2 of 24%. More importantly, the null hypothesis that all industry coefficients are equal is strongly rejected (F-statistic of 16.8 and a p-value below 0.001). Finally, the WASD (Weighted Average Standard Deviation) statistic, the standard measure of dispersion of wage premia, is very high at .289. This compares with previous results for the U.S. of about .15 or less (see Krueger and Summers, 1988). The second specification presented in the table control for log sales per worker, which may proxy for some relevant worker characteristics that vary by industry. It is found that the WASD statistic increases to .35 and the null of equal premia is always clearly rejected too.⁸

A possible interpretation of these results is that the dispersion of industry premiums found may be due to the location of high-wage industries in high-wage countries (and vice-versa). In order to address this concern, we include country dummies to the previous specification.⁹ The last two columns of Table 3 present the results under this extended specification.

It is found that the country dummies substantially increase the adjusted R^2 statistics (from .24 to .91 in the first specification, for instance) but the null hypothesis of equality of industry dummies is still strongly rejected in all specifications. Additionally, the null hypotheses of equality of country dummies are also strongly rejected in both specifications. The dispersion of the premia, as measured by the WASD statistic, falls however only marginally as country dummies are included (from .289 to .285) in the specification without sales, although the decrease is substantial (from .35 to .12) when the control for sales is included.

Having computed some estimates of the inter-industry wage structure of the foreign affiliates of U.S. multinationals, we now characterise the same structure in the U.S. labour market. Here we draw on the CPS data described before, but using the same industry classification as that considered in the BEA data. We find that, when considering our first specification, the level of inter-industry wage dispersion measured by the WASD statistic is of .378 – see Table 4. When human capital and other controls are included, this figures drops to .316.¹⁰

⁷ The latter industry is also the one which is dropped, in order to avoid the perfect multicollinearity dummy trap.

⁸ It should be mentioned that the specifications are not strictly comparable as the addition of the control for sales (not present for all country-industry cells) changes the sample used.

⁹ The dropped country is Mexico.

¹⁰ It should also be pointed out that the inclusion of controls in the CPS data does not substantially change the industry premiums, as their correlation is about .93. This result is in line with previous findings, including Krueger and Summers

These figures are again very high and, in particular, they are higher than those typically found for the U.S. when using a standard industry classification, not the industry classification which is imposed by the set which is specific to foreign affiliates. More interestingly, we find that the wage structure for the U.S. labour market is, in general, more dispersed than the wage structure for foreign affiliates. Following the discussion above, this is evidence that we consider consistent with the vertical model of FDI (prediction 2).

Finally, we assess the correlations of industry premia with CPS data and with BEA data. We find – see Table 5 – that these correlations exhibit some variability, ranging between .31 and .71 (standard correlations) and between .42 and .60 (Pearson correlations), depending on the specification considered. For instance, while CPS premia with human capital controls exhibit a standard correlation of .31 with the BEA premia without country controls, the same CPS premia have a correlation of .71 with the BEA premia with country controls.

This variability means that it is difficult to relate the evidence to any one of the three FDI models described. Being the correlations in all cases less than .71, one may argue that there is again evidence consistent with the vertical model: high-wage industries for U.S. affiliates are not necessarily also high-wage industries in the U.S. labour market.

5. Conclusions

This paper contributes to two key topics in the current literature about Foreign Direct Investment: 1) understanding the nature of FDI, in terms of which model describes it best (vertical, horizontal or capital- knowledge models); and 2) the role of FDI in shaping wage dispersion in host countries.

Our approach involves comparing data about employment and compensation of employees of U.S. multinationals in different countries and industries and similar data for the U.S. labour market. We obtain three results: 1) the employment structure abroad (i.e. US affiliates in host countries) is more concentrated on industries that are typically associated with low-skill workers; 2) the inter-industry wage structure abroad is less dispersed than that in the US; and 3) the correlation between the premia in each wage structure (inside and outside the US) is never very high.

Given our simple methodological discussion, we conclude that our results are more consistent with the vertical model of FDI than other competing models. This conclusion, which stands in opposition to most of the literature (e.g. Brainard, 1997), is driven by our findings that employment abroad is concentrated in low-skill industries, that industry premia abroad are less dispersed and that premia in the US and abroad are only moderately correlated.

Finally, since the industry premia abroad are less dispersed than those in the US and that the correlation between those premia is not very large, we also believe our results are not easily

(1988). It is also interesting to compare the ranking of industry premiums, using this data. In decreasing order of pay premiums (and considering the specification without other controls), the industries are: Petroleum, Chemicals, Transport Equipment, Electronics, Machinery, Finance, Wholesale, Metals, Services, Other Manufacturing, Other Industries and Food.

reconcilable with the claim that (U.S.) FDI fosters wage inequality.

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Table 1 - Descriptive statistics - BEA data (country-industry cells)

Variable	Obs/Share	Mean	Std. Dev.	Min	Max
Total compensation	551	338,8	848,3	0,0	8876,0
Total employment	696	11,5	26,2	0,0	311,9
Compensation per worker	464	34,2	22,3	2,2	130,0
Log compensation per worker	464	3,27	0,80	0,80	4,87
Log sales per worker	377	5,40	1,04	1,71	8,91
Petroleum	2,8%	3,88	6,32	0	37,5
Food	8,2%	11,38	24,56	0	160,4
Chemicals	7,1%	9,79	14,43	0	60,1
Metals	2,6%	3,55	6,97	0	33,7
Electronics	7,3%	10,15	18,99	0	94,6
Machinery	9,5%	13,18	26,13	0	150
Transport Equipment	9,9%	13,76	33,16	0	150
Other, Manufacturing	12,8%	17,70	31,49	0	150
Wholesale	6,8%	9,38	14,29	0	66,4
Finance	3,0%	4,18	9,84	0	63,7
Services	12,7%	17,64	36,65	0	207,9
Other Industries	17,2%	23,82	47,88	0	311,9

Units: Total compensation, sales are in millions of dollars.
Total employment is in thousands of employees.

Notes:

The statistics refer to industry-country cells and were computed by the authors from data assembled by the Bureau of Economic Analysis, US Department of Commerce. The figures for industries refer to employment across the 58 countries covered.

Table 2 - Descriptive statistics - CPS data

Variable	Mean	Std. Dev.	Min	Max
Log hourly wage	1,883	0,627	0,693	7,411
Female	0,460	0,498	0	1
Schooling	13,353	2,598	0	18
Experience (Mincer)	20,162	11,434	0	58
Log hours	3,667	0,359	0	5,159
Petroleum	0,6%	0,075	0	1
Food	1,5%	0,123	0	1
Chemicals	1,1%	0,105	0	1
Metals	1,9%	0,135	0	1
Electronics	2,2%	0,146	0	1
Machinery	1,8%	0,132	0	1
Transport Equipment	2,1%	0,143	0	1
Other, Manufacturing	7,2%	0,259	0	1
Wholesale	4,1%	0,199	0	1
Finance	7,6%	0,264	0	1
Services	38,3%	0,486	0	1
Other Industries	31,7%	0,465	0	1

Notes:

Other human capital regressors considered are four regions, four race dummies and a quadratic on experience. 45,105 observations used.

Table 3 - Wage equations (different specifications)
 Dependent variable: Log annual compensation per worker

	No Country Controls		Country Controls	
	(1)	(2)	(3)	(4)
Petroleum	0,959	-0,529	1,029	0,356
	(0.001)**	(0.018)*	(0.000)**	(0.037)*
Food	0,207	0,095	0,39	0,179
	(0,608)	(0,575)	(0.001)**	(0.097)+
Chemicals	0,801	0,243	0,618	0,337
	(0.000)**	(0.095)+	(0.000)**	(0.001)**
Metals	0,618	0,412	0,32	0,19
	(0.005)**	(0.002)**	(0.004)**	(0.043)*
Machinery	0,769	0,146	0,379	0,157
	(0.001)**	(0,293)	(0.005)**	(0,217)
Transportation Equipment	0,333	-0,116	0,304	0,038
	(0,464)	(0,747)	(0.012)*	(0,805)
Other, Manufacturing	0,62	0,476	0,247	0,131
	(0.015)*	(0.001)**	(0.034)*	(0.094)+
Wholesale Trade	1,08	-0,141	0,639	0,197
	(0.000)**	(0,462)	(0.000)**	(0.083)+
Finance	1,265	0,274	0,748	0,475
	(0.000)**	(0,186)	(0.000)**	(0.009)**
Services	0,909	0,968	0,326	0,395
	(0.001)**	(0.000)**	(0.005)**	(0.000)**
Other Industries	0,16	0,281	0,011	0,005
	(0,562)	(0,145)	(0,929)	(0,951)
Log sales per worker		0,806		0,329
		(0.000)**		(0.000)**
Log income per worker				
Log assets per worker				
Constant	2,727	-1,231	1,895	0,643
	(0.000)**	(0.011)*	(0.000)**	(0.034)*
Observations	464	326	464	326
Adjusted R-squared	0,24	0,678	0,909	0,927
F-statistics of equality of:				
Industry dummies	16,81	37,87	21,33	8,58
(p-values)	0	0	0	0
Country dummies			8651,1	1528,92
(p-values)			0	0
WASD	0,289	0,349	0,285	0,116

Notes:

Robust p values in parentheses

+ significant at 10%; * significant at 5%; ** significant at 1%

Weighted regressions, cluster analysis

Industry controls (57 dummies) are included in (3) and (4) but not reported.

Table 4 - Wage equations (different specifications, CPS data set)

Dependent variable: Log hourly compensation per worker

	No HC controls	HC controls
	(1)	(2)
Petroleum	0,143	0,110
	0,001	0,004
Food	-0,281	-0,135
	0,000	0,000
Chemicals	0,112	0,041
	0,002	0,175
Metals	-0,097	-0,051
	0,265	0,052
Machinery	-0,033	-0,044
	0,009	0,086
Transport Equipment	0,078	0,028
	0,000	0,271
Other, Manufacturing	-0,214	-0,135
	0,000	0,000
Wholesale	-0,096	-0,112
	0,083	0,000
Finance	-0,042	-0,028
	0,000	0,178
Services	-0,158	-0,187
	0,000	0,000
Other Industries	-0,262	-0,196
	0,000	0,000
Constant	2,052	1,051
	0,000	0,000
Observations	45.105	45.105
Adjusted R-squared	0,021	0,275
F-statistics of equality of:		
Industry dummies	66,23	90,74
(p-values)	0	0
WASD	0,378	0,316

Notes:

p-values are indicated below the coefficients in smaller print.

Table 5 - Correlations of Industry Coefficients

Standard Correlations	(2)	(3)	(4)
(1)	0,932	0,443	0,671
(2)		0,314	0,709
(3)			0,725
Pearson Correlations	(2)	(3)	(4)
(1)	0,929	0,509	0,536
(2)		0,415	0,597
(3)			0,773

Notes:

Specifications (1) and (2) refer to industry coefficients from regressions using CPS data without and with human capital controls, respectively.

Specifications (3) and (4) refer to industry coefficients from regressions using BEA data without and with country dummies, respectively (and, in both cases, without controls for sales).