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Firm Level Evidence of Efficiency Wages and Labor Turnover in Colombia's Manufacturing Industry

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Abstract

Working on data of 1241 incumbent firms of the Colombian manufacturing industry this paper tests the hypothesis proposed in models relating turnover and efficiency wage theory. We find evidence of a substantial number of firms paying wages above the industry average and its effect on turn over in firms employment.

JEL Classification: E24, J63, J64.

Key words: Efficincy wages, labor turn over, Colombia's manufacturing industry, microdata.

Resumen

Trabajando con datos de 1241 empresas permanentes de la industria manufacturera de Colombia, el artículo pone a prueba la hipótesis de modelos que relacionan la rotación laboral con salarios de eficiencia. Encontramos evidencia de un número sustancial de empresas que pagan salarios por encima del promedio de su industria y su efecto en la rotación del empleo al interior de las firmas.

Clasificación JEL: E24, J63, J64.

Palabras claves: salarios de eficiencia, rotación laboral, industria manufacturera colombiana.

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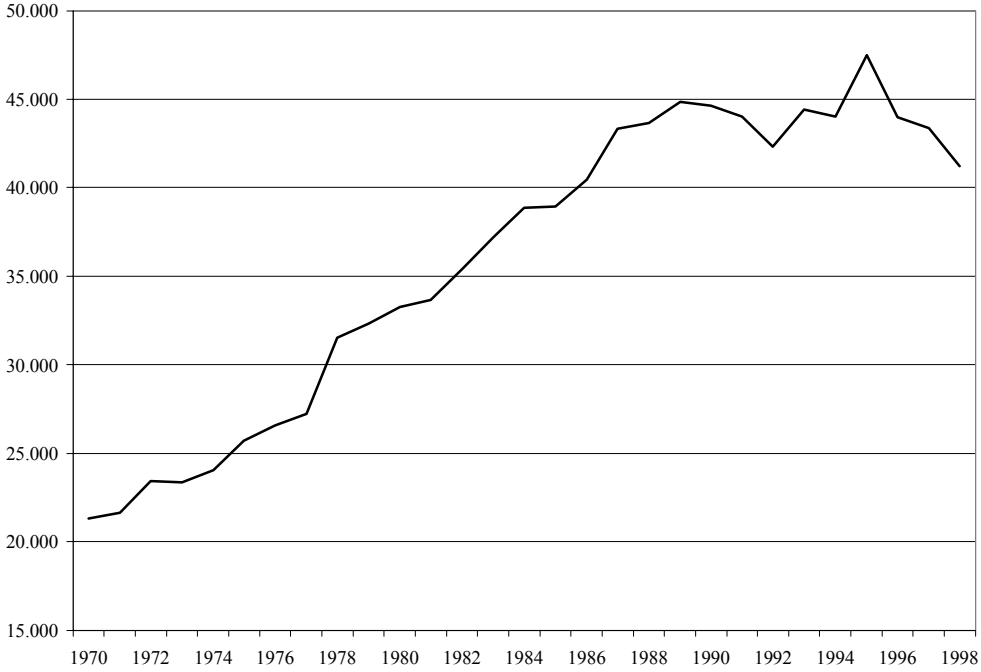
Introduction

Wage rigidity is characteristic of real wages in the Colombia's manufacturing industry, as can be seen in Figure 1. Real wages have kept an increasing pace for fifteen years from 1974 to 1989. The following ten years show an steady behavior and only after 1995 real wages have taken a downward tendency. The steady behavior in the 90s decade can be a result from the general changes in Colombia's economy, following a generalized tendency towards openness, export led development, changes in the role of the government in the economy, and specially a clear break in the role of the central bank towards reducing the inflation rate. This new environment clearly has had impact on the economy' wages. The starting fact used in this paper is a non-decreasing tendency on real wages for a period of almost twenty years, from 1974 up to 1995.

Figure 1

Real wages

Colombia's manufacturing industry



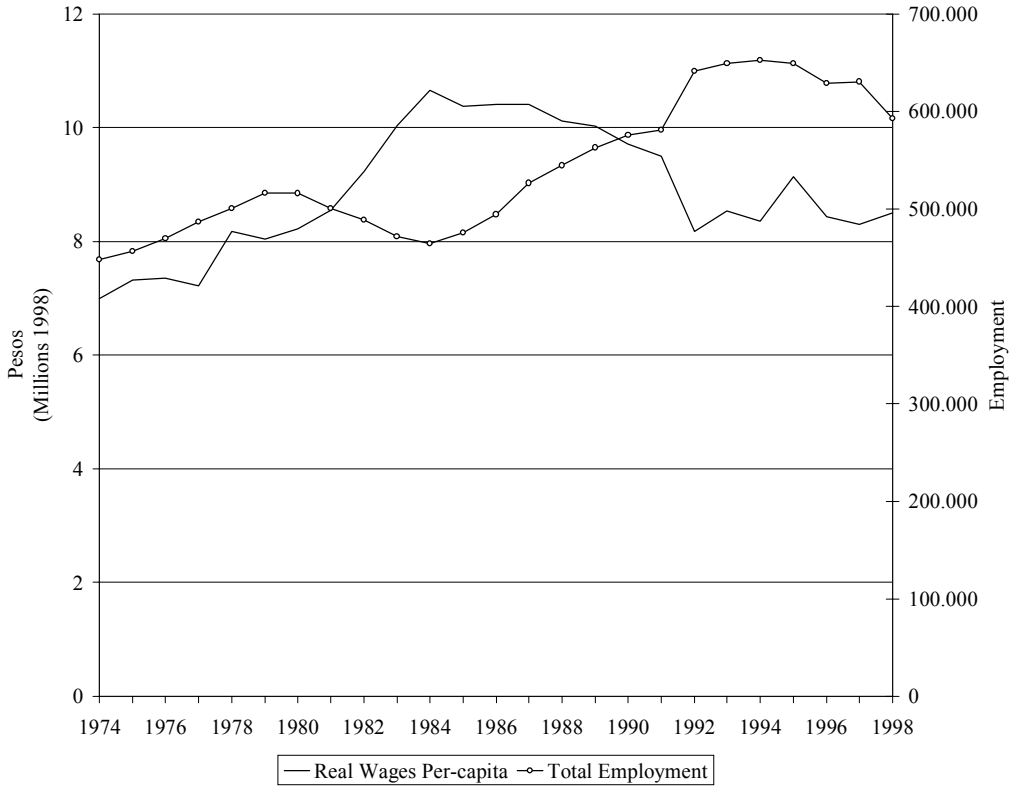
Note: Deflated with CPI. Base 1998.
Source: Annual Manufacturing Industry Survey. Authors calculations

Examining per-capita real wages show a behavior which responds strictly to labor dynamics and not wages. Figure 2 graphs the real per-capita wages and total employment for the manufacturing industry. The data on real per-capita wages takes an increasing behavior from 1974 up to the mid 80's, afterwards the real per-capita wages seems to decrease steadily. But conversely in the periods of increasing real wages there is less employment and in decreasing real wages the industry labor force is bigger. Leaving all the behavior of real per-capita wages to movements of the amount of workers employed in the industry.

FIGURE 2

REAL PER-CAPITA WAGES AND EMPLOYMENT

COLOMBIA'S MANUFACTURING INDUSTRY



Note: Deflated with CPI. Base 1998.
Source: Annual Manufacturing Industry Survey. Authors calculations

Finally the recent behavior of the unemployment rate in Colombia has not been satisfactory, unemployment rates rose from 8 percent in 1994 to around 21 per cent in 2000, Arango and Posada (2001a) and, Arango and Posada (2001b) provide a careful description and explanations of its recent behavior. Recent estimations of a NAIRU such as the provided by Julio (2001) show an increasing NAIRU, most probably driven by the slowdown of the Colombian economy in the last five years of the 90s decade. Efficiency wages is one of the explanations used to rationalize the existence of a NAIRU. In Colombia there is no evidence of the existence of efficiency wages and its contribution to a natural rate of unemployment. To undercover and understand the formation of efficiency wages becomes an important task in order to provide empirically explanations for wage rigidity and a non long run decreasing rate of unemployment.[1]

Labor markets literature give to wage rigidity a role on the impossibility of labor markets to clear or reach a non unemployment equilibrium and formation of a natural rate of unemploy-

[1] We should acknowledge that the most recent behavior of the unemployment rate in Colombia has shown a decreasing tendency correspondingly primarily to a slight improvement in GDP growth.

ment. Theories of wage rigidity are well explained as a failure of the Walrasian labor market to reduce wages given that a worker would be willing to work for less than the industry average wage. Labor market behavior such as implicit contracts theory, insiders-outsiders models, search and matching models, turnover theory and efficiency wages are the standard explanations for wage rigidity.

Efficiency wage models focus in establishing a relationship between productivity and wages, and firm costs and wages; explaining why firms would be willing to pay wages above the market clearing level, generating downward wage rigidity and involuntary unemployment. An alternative way to understand the concept is to see that a firm can find costly to pay lower wages, establishing a direct link between higher wages and high productivity labor efficiency.

Efficiency wage models which relate productivity and wages are the shirking, loyalty and screening models. The model which relate costs and wages is the turnover costs model which is also a model of insider-outsider theory since firms would accept the workers demands of keeping the existing staff in order to reducing possible costs of hiring and training. Good literature reviews in this area are Katz (1988) and Yellen (1984). The objective of this paper is to find empirical evidence of the hypothesis of the turnover costs model, where efficiency wages are paid to reduce turnover costs. If firms bear turnover costs and turnover costs are a decreasing function of wages, firms will pay higher wages to reduce these costs. That is: relative high (low) wages will reduce (increase) the labor turnover rate of individuals to other firms and sectors of the economy.

Empirical evidence of efficiency wage models is scarce. Krueger and Summers (1988) focus its work on the importance of efficiency wages, examining wage differentials among industries in United States. Campbell and Kamlani (1997) carried out a survey with specific questions to understand the behavior and validity of wage rigidity theories; among the efficiency wage theories they tested are the shirking, loyalty and screening models. Konings and Walsh (1994) test the efficiency wage hypothesis relating employees and firms rent sharing behavior, postulating a different kind of efficiency wage model keeping the idea of higher wages paid by firms. Using the same concept Teal (1995) shows satisfactory results for efficiency swage theories in Ghana manufacturing industry. Campbell (1993), using data from a special survey conducted in 1980 among 5000 firms in United States finds that firms with higher turnover costs pay higher wages supporting the efficiency wage model predictions, he takes advantage of an existing data series of turnover costs by ISIC sub sectors.

Our model and results resembles the model of wage growth and turnovers used by Munasinghe (2000) who proposes a negative correlation between wage growth and job turnover. Specifically his model states that once the worker have chosen a high wage-growth job there will be fewer switches to jobs with different wage-growth prospects. Its model comes along with our proposal of efficiency wages given that a firm offers a higher wages to retain its workers in order to reduce its turnover costs.

The sole empirical evidence of efficiency wages theories in Colombia is Hernandez, et al. (2001), they analyze wage differentials among industry sectors not associated with ability or labor conditions; they approach the hypothesis of testing wage differentials as industry characteristics and also test the hypothesis of workers rent sharing to explain those differentials. They

find that wage differentials are explained by rent sharing rather than by human capital or ability and industry's characteristics.

Our paper differs from Hernandez, et al. (2001) in the testing of a the turnover model to undercover the existence of efficiency wages in the Colombia's industrial labor market. We use a better data base using firm level information for incumbent firms for 25 years (1972 - 1998). This data provide us with wages and employment levels for white and blue collar workers. The relationship of higher wages with low turnover of employment is tested, in the middle of this relationship are the turnover costs, unobservable in the data.

Our main econometric results show the existence of a negative relationship between wages differentials for different sectors of the economy and turnover employment in firms. A general specification for white and blue collar workers in our model fits a fixed effects specification; after spliting our sample in output quartiles and employment halfs the fixed effects specification stands only for the lowest levels; the upper output and employment levels show no difference among firms in its turnover rate due to wage differentials.

The next section develops a simple model of wage rigidity due to turnover costs, the third section shows empirical results and the last section summarize some conclusions.

A TURNOVER COSTS MODEL

The model developed in this section follows closely the one of Stiglitz (1974). We modify the conditions of rural and urban wage differentials to firm and industry wage differentials, doing so is possible to estimate relative high or low wages and to establish a relationship with turnover rates.

Labor costs are defined as wages (w) plus specific training and hiring costs (T). Training and hiring costs are function of the rate of turnover of employees (q). The turnover rate (q) is a function of the wage differential among the wage paid in the firm i belonging to industry j with the average wage paid in the industry j; and with the average wage paid in the industry k; the unemployment rate of the economy; and the growth of the output of the firm i and the industry j.

$$q_i = q\left(\frac{w_{ij}}{\overline{w}_j}; \frac{w_{ij}}{\overline{w}_k}; u; \Delta Q_i; \Delta Q_j\right) \tag{1.1}$$

Where: q_i is the turnover rate in firm i

w_{ij} is the wage of firm i of industry j.

$\overline{w}_j$ is the average wage of industry j.

$\overline{w}_k$ is the average wage of industry k.

u is the general unemployment level of the economy.

ΔQ_i is the growth in output of firm i.

ΔQ_j is the growth in output of industry j.

The logic behind this formulation is the following. The turnover rate of the firm will increase if firms' wages are below the average wage of the industry or an alternative industry. Workers will be willing to change its job if they observe the wage differential, on the other hand firms want to minimize their turnover rates to reduce the associated costs. Following this mechanics we expect to find the efficiency wage hypothesis behind the turnover rates, firms will be eager to pay higher wages to induce its workers no to quit for alternative job and so reduce their turnover costs (T).

The turnover rate will decrease if the general level of unemployment increases, workers will not risk its job position facing an increasing rate of unemployment no matter the wage differential, therefore there is an inverse relation with the turnover rate. The inclusion of firm and industry output growth is a proxy for firm and industry unemployment dynamics, decreasing output would lead to higher unemployment levels reducing the turnover rate, assuming workers will not quit in such a case. However firms facing a decreasing demand of its output would find less damaging lay off workers increasing the turnover rate. The net effect of this variable is ambiguous but it should be considered as a variable of the turnover rate.

Total labor costs are expressed as a function of:

w_{ij}^* the total labor cost per employee on industry j.

L_{ij} the number of workers of firm *i* of industry *j*.

T the training and hiring costs

$$w_{ij}^* L_{ij} = w_{ij} \times L_{ij} + q \times T \times L_{ij} \tag{1.2}$$

$$w_{ij}^* = w_{ij} + q \times T \tag{1.3}$$

Replacing equation (1.1) in (1.3), we have:

$$w_{ij}^* = w_{ij} + q\left(\frac{w_{ij}}{\overline{w}_j}; \frac{w_{ij}}{\overline{w}_k}; u; \Delta Q_i; \Delta Q_j\right) \times T \tag{1.4}$$

Firms want to minimize (1.4), the first order condition for its control variable w_{ij} is:

$$\frac{\partial w_{ij}^*}{\partial w_{ij}} = 1 + \left[\frac{\partial q}{\partial\left(w_{ij}/\overline{w}_j\right)} \times \frac{1}{\overline{w}_j} + \frac{\partial q}{\partial\left(w_{ij}/\overline{w}_k\right)} \times \frac{1}{\overline{w}_k}\right] \times T = 0 \tag{1.5}$$

The equilibrium condition for the job market for firms and industries requires that firm's wages be equal to wages paid in its industry (j) and the alternative industry (k), this condition would eliminate the turnover variables associated to wage differentials and leaves all turnover effects to exogenous variables like unemployment and business cycles:

$$w_{ij} = \overline{w}_j = \overline{w}_k \tag{1.6}$$

Replacing (1.6) in (1.5), and leaving w_{ij} as dependent variable we have:

$$w_{ij} = -T\left[\frac{\partial q}{\partial\left(w_{ij}/w_j\right)} + \frac{\partial q}{\partial\left(w_{ij}/w_k\right)}\right] \tag{1.7}$$

Solution (1.7) show us the condition for an optimizing firm which wants to offset effects on wages coming from wage differentials through the turnover rate. The negative relationship show us the expected sign for our econometric exercise.

The unemployment relationship enter the quit rate in the following way. Unemployment discourages any job change among firms and industries, but its effect over the turnover rate q can be ambiguous depending on the wage structure. If there are wage differentials favoring job changes a low unemployment rate will foster job changes and a high quit rate, on the other hand high unemployment would offset any effect over the quit rate coming from the wage differential. In this way the unemployment rate comes as an exogenous variable on our formulation and firm output variations come as an appropriate proxy.

THE DATA

The data used for our estimation is a sub sample of 1217 incumbent firms of Colombian Annual Manufacturing Survey (AMS) for 25 years (1974-1998), making a final balanced panel data of 30425 observations. We have selected incumbent firms given that their wage setting behavior is the one of a long run profit maximizing firm, adjusting to the one of our model. The wage policy of a new or about to close firm would be different. Survival theory of the firm suggests that new firms in the industry may have even higher wages to attract good workers that help to accomplish their recent entry into the industry and closing firms might be reducing their pool of workers and wages faster than usual.

We use employment and wages for permanent workers, these variables are divided for white and blue collar workers. Blue collar workers are all the employed force used in the production process itself, the data brought by the AMS allow us to classify raw workers, technicians and apprentices as blue collar workers. While white collar workers are the labor force employed in administrative, sales and management duties.

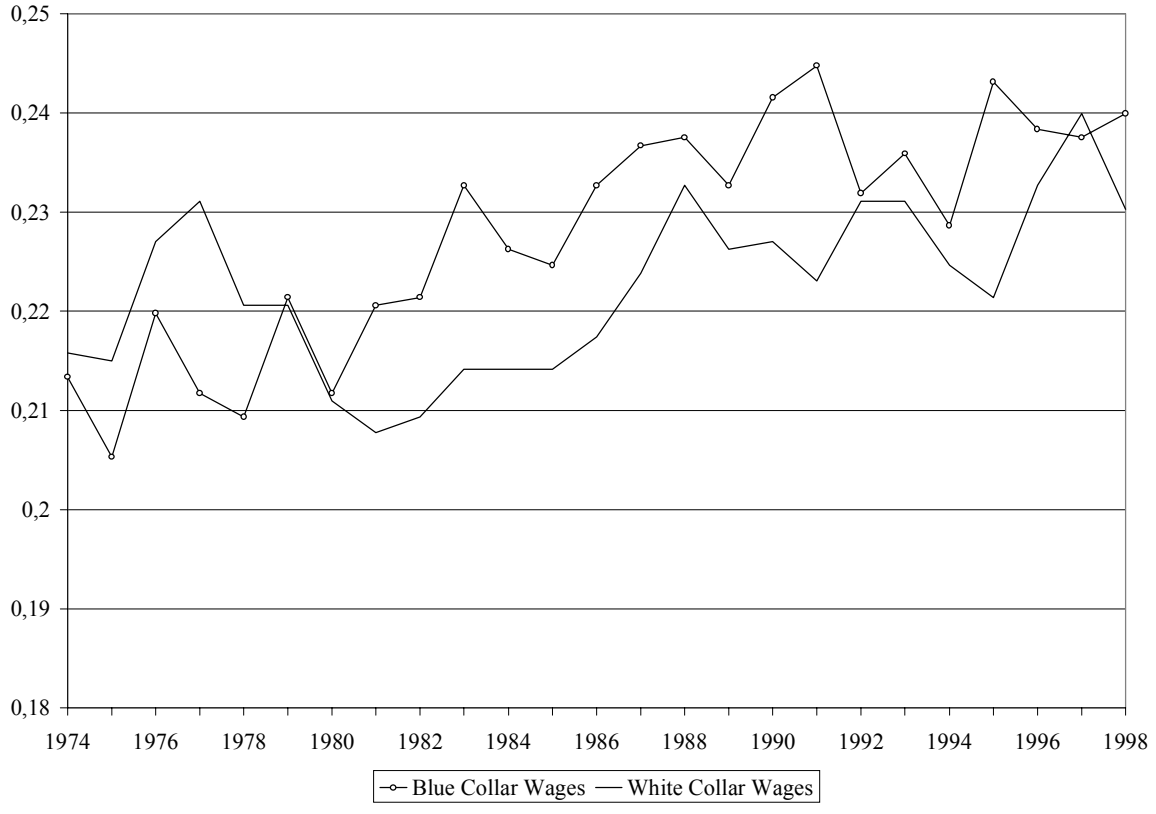
White and blue collar wages are directly extracted from our database, other income related to work is also available. Other income for workers come from social security and legal and extra-legal liabilities in favor of workers, such as: one or more extra-wages in each year (this is

13 or 14 montly wages paid in a year), paid vacations, savings for retirement and interests paid over those savings. In Colombia legal and extra-legal liabilities come from legislature usually favoring workers and from private arrangements between unions and employers. Output is the value of production and value added is the usual calculation of output minus intermediate consumption. All wages, income and production value variables were deflated using the consumer price index (CPI) for 1998=100.

The turnover rate of employment is the variation of employment of each firm year to year for the two employment categories explained above. The wage differential is calculated as in equation (1.1) the ratio of wages in firm i, of industry j, over average wage in the respective j industry and the average wage of the alternative industry k, this calculation by itself is an indicator of efficiency wage payments procedures, paying overhead wages to attract, or retain workers, creating downward wage rigidities. Figures 3 and 4 respectively plot the evolution of the percentage of firms paying wages above its industry average (this is the number of wages that comply with $w_{ij} > \overline{w_j}$), and firms paying a total income above its industry average, both for blue and white collar workers.

FIGURE 3

PERCENTAGE OF FIRMS PAYING WAGES ABOVE INDUSTRY AVERAGE



Source: Annual Manufacturing Industry Survey

FIGURE 4

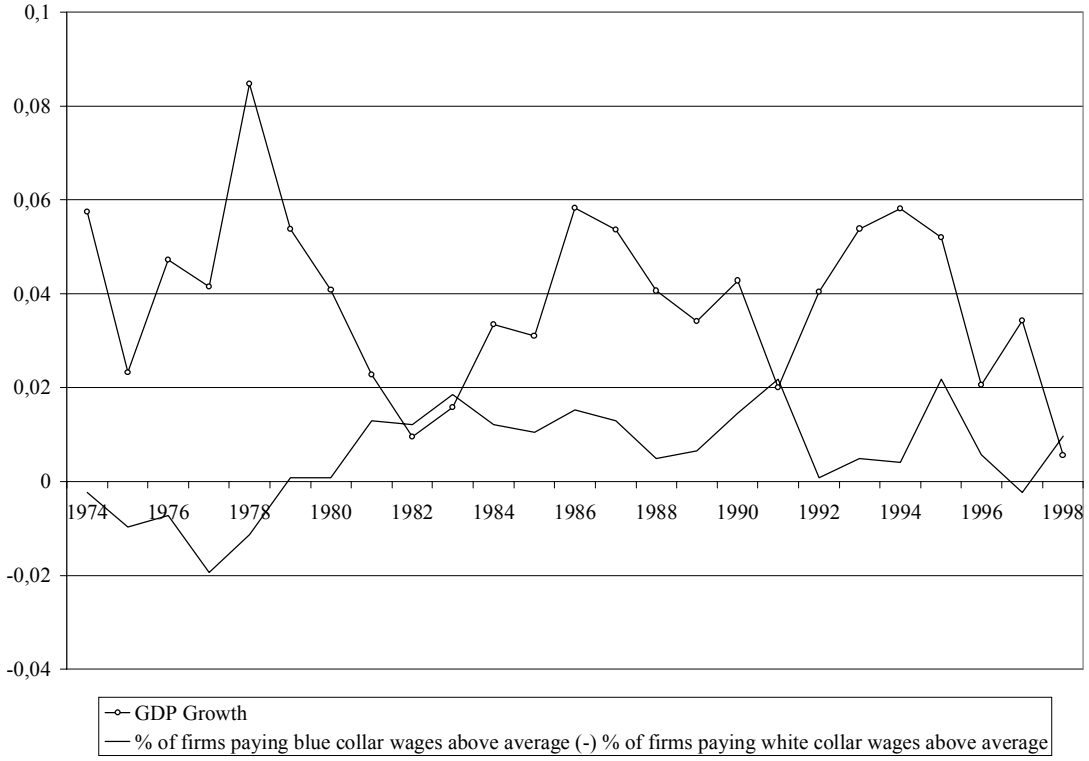
PERCENTAGE OF FIRMS PAYING TOTAL INCOME ABOVE INDUSTRY AVERAGE

Source: Annual Manufacturing Industry Survey. Authors calculations

From Figure 3 we find that around 23% of the firms pay wages above its industry average, with an increase in the percentage of firms from 1980 to 1988 for both white and blue collar wages. Also is worth noting that usually more firms pay blue collar workers wages above its industry average, than for white collar workers. The same behavior can be observed in Figure 4 for total income. An interesting pattern appears among the data for white and blue collar worker's wages. Whenever there is a peak in the percentage of firms paying blue collar wages above the average, there seems to be a trough in the percentage of firms paying white collar wages above the average. Subtracting the percentage for white collar from the percentage of blue collar wages and plotting these difference against the GDP growth, it is easy to observe a counter-cyclical behavior (Figure 5).

Figure 5

Difference of percentage of firms paying wages above industry average for white and blue collar against GDP growth



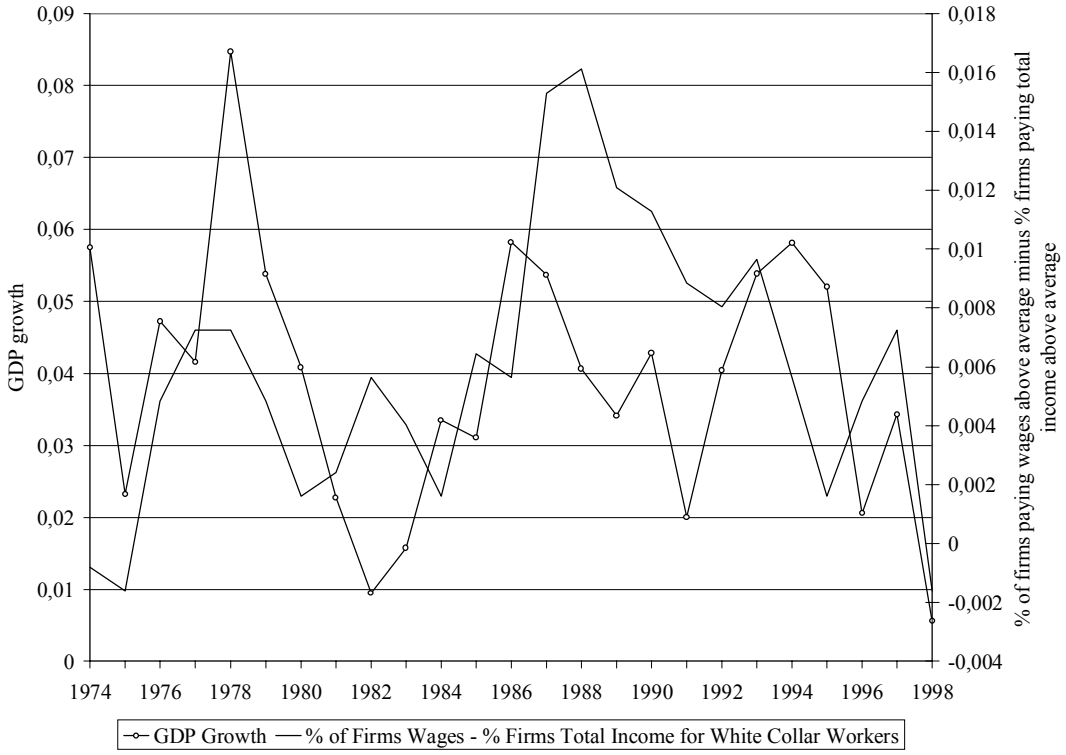
Source: Annual Manufacturing Industry Survey. Authors calculations

The logic behind this finding is the following. When firms are facing a healthy and growing economy more firms pay higher than average salaries for white collar workers than for blue collar workers, this behavior can be characterized as rent sharing biased toward white collar workers. And, whenever there is a slowdown in the economy, more firms pay wages above the average for blue collar workers, this insight though bizarre can be associated to insider-outsider models or strong union agreements. To summarize in the Colombian manufacturing sector, in good macroeconomic performance years more firms pay higher wages to white collar workers, and in bad macroeconomic environment more firms pay higher wages to blue collar workers, or less firms pay higher wages to its white collar workers which might be less unionized than blue collar workers and face faster changes in its salary. What we have here seems to be a fast adjustment in the white collar job market and a slow one in the blue collar job market, resembling the idea of segmented labor markets within firms.

An additional feature observed using this information emerges in the evolution of the percentage of firms paying a wages above the industry average minus the percentage of firms paying total income above the industry average. This difference is graphed in Figure 6 against GDP growth.

FIGURE 6

DIFFERENCE OF PERCENTAGE OF FIRMS PAYING WAGES ABOVE INDUSTRY AVERAGE TO PERCENTAGE OF FIRMS PAYING TOTAL INCOME ABOVE AVERAGE FOR WHITE COLLAR WORKERS AGAINST GDP GROWTH



Source: Annual Manufacturing Industry Survey. Authors calculations

The first feature to note after this calculation is that more firms pay wages above average than firms paying total income above average, this suggests that firms change wages but not much the companion income described above. Secondly there is a co-movement in the variables, whenever the GDP grows the number of firms that pay wages above average also grow over the number of firms that pay a total income above the average; confirming the insight stated before of some rent-sharing behavior for white collar workers, but this time our analysis suggests that is through wages and not other income that the rent-sharing transfer is done.[2] [3]

Some other characteristics of our data are described in the remaining of this section. The size plant of our data, measured on ranges of production determined by DANE, mostly aggregates on higher percentiles. Table 1 summarize this information. Around 60% of the firms studied have production higher than six thousand 1994 million pesos.

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[2] The same manipulation was carried out for blue collar workers providing no significant results for discussion in this section.

[3] This calculations were also performed for the median, instead of the mean, to use a different measure of central tendency, for all the calculations the median seems to have been too low defining a very stable group of firms, around 50% for all ISIC sectors, paying higher wages without any characteristic for white or blue collar workers.

Table 1

Percentage of firms for ranges of Gross Product

Gross Product range *	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0 - 80	0,0048	0,0008	0,0008	0,0008	0,0008	0,0008	0,0008	0,0024	0,0008	0,0032	0,0016	0,0008	0,0016
81 - 250	0,0032	0,0024	0,0008	0,0008	0,0000	0,0000	0,0000	0,0153	0,0113	0,0129	0,0121	0,0153	0,0129
251 - 500	0,0081	0,0072	0,0056	0,0000	0,0000	0,0000	0,0000	0,0258	0,0370	0,0290	0,0274	0,0282	0,0266
500 - 830	0,0161	0,0121	0,0072	0,0072	0,0000	0,0000	0,0000	0,0403	0,0370	0,0443	0,0451	0,0395	0,0386
830 - 1650	0,0588	0,0370	0,0233	0,0105	0,0097	0,0064	0,0008	0,0709	0,0692	0,0757	0,0660	0,0717	0,0588
1650 - 3300	0,0427	0,0491	0,0322	0,0185	0,0064	0,0032	0,0048	0,0507	0,0531	0,0483	0,0467	0,0403	0,0507
3300 - 6600	0,1490	0,1369	0,1192	0,0886	0,0596	0,0403	0,0282	0,1449	0,1490	0,1417	0,1353	0,1385	0,1272
6600 - 12400	0,2069	0,2126	0,2021	0,1876	0,1675	0,1409	0,1224	0,2045	0,1997	0,1997	0,1973	0,1900	0,1908
12400 - 24800	0,2818	0,2882	0,3140	0,3430	0,3543	0,3535	0,3486	0,2673	0,2576	0,2585	0,2754	0,2786	0,2858
Bigger than 25000	0,2287	0,2536	0,2947	0,3430	0,4018	0,4549	0,4944	0,1779	0,1852	0,1868	0,1932	0,1973	0,2069

Gross Product range *	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	
0 - 80	0,0016	0,0008	0,0016	0,0016	0,0024	0,0016	0,0016	0,0016	0,0016	0,0016	0,0016	0,0016	
81 - 250	0,0177	0,0145	0,0153	0,0113	0,0089	0,0121	0,0121	0,0121	0,0121	0,0121	0,0121	0,0121	
251 - 500	0,0193	0,0153	0,0233	0,0266	0,0225	0,0274	0,0274	0,0274	0,0274	0,0274	0,0274	0,0274	
500 - 830	0,0386	0,0531	0,0378	0,0354	0,0395	0,0451	0,0451	0,0451	0,0451	0,0451	0,0451	0,0451	
830 - 1650	0,0636	0,0491	0,0483	0,0507	0,0507	0,0660	0,0660	0,0660	0,0660	0,0660	0,0660	0,0660	
1650 - 3300	0,0403	0,0395	0,0499	0,0435	0,0523	0,0467	0,0467	0,0467	0,0467	0,0467	0,0467	0,0467	
3300 - 6600	0,1272	0,1127	0,1159	0,1264	0,1240	0,1353	0,1353	0,1353	0,1353	0,1353	0,1353	0,1353	
6600 - 12400	0,1940	0,2013	0,1908	0,1812	0,1755	0,1973	0,1973	0,1973	0,1973	0,1973	0,1973	0,1973	
12400 - 24800	0,2778	0,2842	0,2890	0,2874	0,2907	0,2754	0,2754	0,2754	0,2754	0,2754	0,2754	0,2754	
Bigger than 25000	0,2198	0,2295	0,2279	0,2359	0,2335	0,1932	0,1932	0,1932	0,1932	0,1932	0,1932	0,1932	

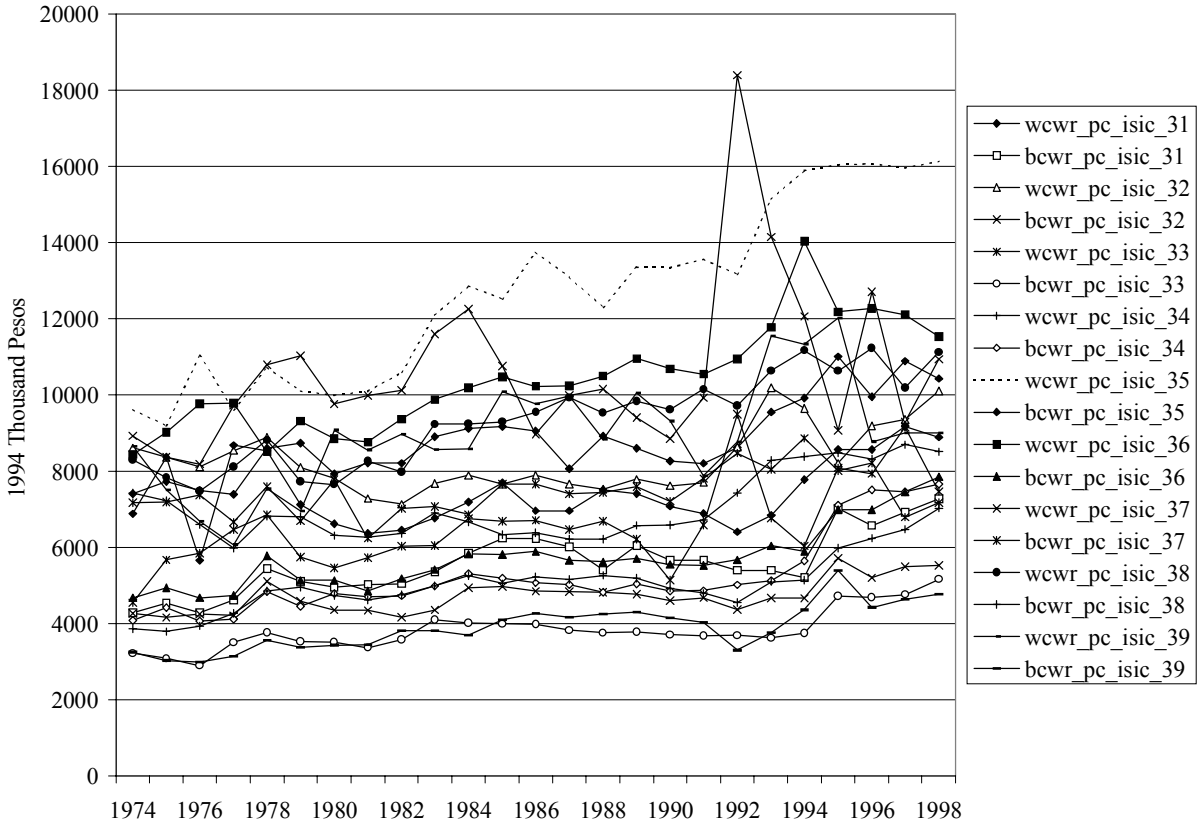
Notes: * Aproximates ranges in millions
Source: DANE (1994) and author calculations

Employment trends are stable among ISIC codes, blue collar workers in most of the cases triples white collar workers for all the years studied. The ISIC sector with higher employment is the number 37 (Iron and steel manufactures) which also presents an interesting decline in employment reducing its use of labor force from 450 workers in 1974 to 233 in 1998. Table 2 summarize this information.

For wages on our sample the most interesting feature is the, already stated fact for the whole industry, of downward wage rigidity. Either for white and blue collar workers at ISIC two level, on average, wages remain constant and for some periods increasing. Figure 7 shows this behavior. It is also worth remarking that on average real per-capita wages for white collar in all ISIC sectors is higher than per-capita wages for blue collar workers (Table 3). Clearing out these features let us a procedee towars our econometric calculation and understanding of wages behavior around turnover rates in the industry.

FIGURE 7

WHITE AND BLUE COLLAR REAL PER-CAPITA WAGES



Source: Annual Manufacturing Industry Survey. Authors calculations

Table 2

Average employment by ISIC sector

ISIC	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
31	119	123	125	127	140	150	153	156	161	167	159	148	147
32	244	242	261	273	278	284	282	260	237	216	214	201	208
33	72	70	76	74	89	81	78	76	78	73	76	75	76
34	93	92	96	103	108	115	114	118	119	121	123	127	128
35	128	133	137	144	150	156	165	168	162	165	163	152	154
36	174	176	179	186	200	209	204	203	197	202	195	194	199
37	450	442	463	459	502	506	480	492	475	429	371	360	300
38	98	102	106	116	125	129	130	123	118	114	117	110	112
39	81	84	94	98	99	99	97	104	89	89	95	82	88
ISIC	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	
31	151	152	158	157	156	171	166	172	155	157	156	148	
32	209	213	224	220	228	246	237	234	231	218	218	203	
33	79	88	91	90	87	93	96	100	99	91	83	74	
34	132	132	134	143	145	154	158	166	157	155	151	149	
35	167	159	166	169	178	172	194	183	187	185	175	166	
36	208	211	209	213	209	216	230	226	222	206	195	185	
37	325	359	306	330	287	270	235	260	260	238	245	233	
38	115	115	115	116	117	122	127	125	124	116	111	102	
39	93	84	87	97	77	86	89	101	90	83	79	77	

Source: Authors calculations

Table 3

White and blue collar real per-capita wages

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
wcwr_pc_isic_31	7419	7731	7507	7400	8617	8746	7940	8216	8214	8907	9131	9181	9063
bcwr_pc_isic_31	4284	4537	4296	4625	5447	5113	4957	5036	5053	5364	5853	6245	6237
wcwr_pc_isic_32	8619	8370	8114	8550	8891	8102	7822	7285	7138	7686	7895	7660	7901
bcwr_pc_isic_32	4269	4164	4253	4215	5115	4600	4363	4348	4173	4363	4943	4978	4855
wcwr_pc_isic_33	7178	7193	7381	6668	7598	6699	7794	6244	7020	7076	6874	7666	7667
bcwr_pc_isic_33	3222	3091	2899	3507	3763	3535	3520	3372	3585	4101	4016	3998	3984
wcwr_pc_isic_34	7430	7228	6612	5990	6821	6809	6314	6278	6364	6907	6679	6337	6388
bcwr_pc_isic_34	4084	4420	4070	4120	4843	4458	4798	4705	4733	4987	5317	5196	5073
wcwr_pc_isic_35	9620	9195	11037	9602	10726	10099	9992	10097	10594	12091	12866	12522	13751
bcwr_pc_isic_35	6888	8369	5662	8688	8533	7128	6626	6380	6456	6778	7194	7699	6967
wcwr_pc_isic_36	8447	9029	9767	9785	8514	9321	8860	8768	9375	9877	10188	10474	10231
bcwr_pc_isic_36	4679	4946	4680	4742	5788	5140	5140	4865	5186	5422	5827	5819	5896
wcwr_pc_isic_37	8935	8370	8193	9724	10792	11030	9761	9991	10121	11601	12260	10764	8972
bcwr_pc_isic_37	4551	5676	5853	6474	6867	5752	5467	5736	6036	6056	6764	6691	6715
wcwr_pc_isic_38	8308	7843	7484	8122	8820	7731	7656	8278	7990	9240	9250	9303	9556
bcwr_pc_isic_38	3866	3793	3941	4269	4867	4958	4745	4630	4763	4992	5261	5054	5226
wcwr_pc_isic_39	8661	7517	6689	6077	7541	6957	9088	8565	8980	8577	8586	10092	9770
bcwr_pc_isic_39	3255	3034	2989	3143	3561	3378	3439	3449	3817	3815	3701	4099	4272
	1987	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	
wcwr_pc_isic_31	8069	8924	8606	8267	8210	8633	9554	9924	11008	9951	10888	10430	
bcwr_pc_isic_31	6022	5409	6054	5672	5673	5404	5406	5215	7024	6582	6931	7280	
wcwr_pc_isic_32	7665	7537	7796	7622	7708	8639	10188	9654	8218	9196	9362	10101	
bcwr_pc_isic_32	4846	4829	4778	4605	4683	4372	4673	4668	5725	5205	5499	5528	
wcwr_pc_isic_33	7409	7447	7597	7218	7814	8481	8059	8873	8017	8222	6801	7182	
bcwr_pc_isic_33	3825	3759	3780	3709	3685	3695	3625	3748	4725	4691	4768	5169	
wcwr_pc_isic_34	6227	6225	6582	6588	6729	7439	8289	8393	8493	8319	8703	8519	
bcwr_pc_isic_34	5027	4824	5048	4857	4868	5023	5133	5645	7120	7515	7465	7668	
wcwr_pc_isic_35	13095	12302	13358	13339	13563	13166	15139	15897	16045	16073	15965	16135	
bcwr_pc_isic_35	6968	7519	7419	7086	6891	6412	6849	7787	8581	8573	9183	8899	
wcwr_pc_isic_36	10238	10497	10957	10686	10549	10949	11781	14044	12184	12269	12110	11537	
bcwr_pc_isic_36	5672	5625	5709	5556	5535	5676	6047	5905	6998	6993	7461	7858	
wcwr_pc_isic_37	9989	10154	9419	8859	9926	18396	14149	12066	9077	12710	9298	10939	
bcwr_pc_isic_37	6471	6688	6223	5150	6589	9503	6770	6044	8094	7943	9161	7471	
wcwr_pc_isic_38	9932	9538	9831	9624	10148	9721	10637	11169	10631	11227	10190	11122	
bcwr_pc_isic_38	5166	5271	5198	4934	4801	4556	5101	5146	5990	6243	6482	7033	
wcwr_pc_isic_39	9965	8839	10055	9323	7883	8770	11550	11340	12021	8785	9015	9005	
bcwr_pc_isic_39	4169	4259	4311	4160	4032	3306	3767	4366	5392	4430	4644	4773	

Source: Author calculations

Note: wcwr_pc: white collar real per-capita wages bcwr_pc: blue collar real per-capita wages

Econometric analysis

From equation (1.1) and data availability we estimate the following equation:

$$q_i = \beta_0 + \beta_1 wdij_{it} + \beta_2 wdik_{it} + \beta_3 ogi_{it} + \beta_4 ogij_{it} + \beta_5 ogk_{it} + \varepsilon_{it} + \upsilon_{it} \quad (8)$$

Where:

q_{it}: firm i labor turnover, obtained from the difference of employment in year t minus employment in year $t-1$

$wdij$: wage differential of firm i against its own industry j, $\left(\frac{w_{ij}}{\overline{w}_j}\right)$.

$wdik$: wage differential of firm i against remaining industry ISIC sectors k. $\left(\frac{w_{ij}}{\overline{w}_k}\right)$ where $k \neq j$

ogi: firm i output growth from period $t-1$ to period t.

$ogij$: industry j output growth from period $t-1$ to period t.

ogk: alternative industry k output growth from period $t-1$ to period t.

Equation (8) is estimated under panel data specification for white and blue collar workers; for wage differentials upon ISIC 2. Results are summarized in Table 4 and 5 for white and blue collar workers respectively, under different grouping of data, four output quartiles and employment halves.

A general interpretation of our econometric estimation is as follows. For our firm level data we have calculated the turnover rate, wage differentials and output growth as described above. The reggresion analysis for this data arrangement will show if the firm wage differential againts its own and remaining ISIC sector is significative and takes the sign expected from our model in section two. Whenever we fing that a fixed effects panel data model fit the data we should understand that firms have sistematic differences in the trade-off between wage differentials and its employment turnover rate.

Results summrized in tables only show significant variables under 10% of significance, no sample data fitted a random effects model, for the whole sample and first output quartile sample the appropriate specification is fixed effects model, the rest of the groupin data fitted apropriately a pooled regression. This patter of model adjustment tell us that for lower levels of output and employment there are statistical differences on firm patterns in its turnover-wage relationship, and this differences are also observed for the whole sample. It is also worth notting that the fractioning of the data show the expected signs for different data groupings, revealing different relationships given the output and labor levels which let us observe some economies of scale and understand the differences in turnover-wage relationship as a matter of firm scale.

TABLE 4

ECONOMETRIC RESULTS FOR WHITE COLLAR WORKERS

Dependent variable: wce_turnover	White Collar fixed effects Total sample Model wc1	White Collar fixed effects 1st output quartile Model wc2	White Collar polled regression 2nd output quartile Model wc3	White Collar polled regression 3rd output quartile Model wc4	White Collar polled regression 4th output quartile Model wc5	White Collar fixed effects regression 1st WC employ half Model wc6	White Collar polled regression 2nd WC employ half Model wc7
wdij2_wc	4,3534	3,3102	2,7998	2,1197	.	4,3404	1,1810
	(0,424)	(0,577)	(0,479)	(0,544)	.	(1,828)	(0,294)
wdik31_wc	23,2393	11,5150	42,3548	46,0954	-30,7583	.	19,6470
	(1,239)	(3,229)	(4,666)	(3,900)	(7,291)	.	(1,728)
wdik32_wc	3,1456	-4,2431	.	.	-7,9831	.	1,6589
	(0,632)	(1,101)	.	.	(3,784)	.	(0,883)
wdik33_wc	3,9651	.	3,6789	5,9751	1,8448	4,4121	3,9768
	(0,256)	.	(0,418)	(0,671)	(1,058)	(1,299)	(0,362)
wdik34_wc	-2,8717	-4,5391	-16,9567	-18,4077	61,4173	.	-2,9328
	(0,921)	(1,463)	(2,323)	(2,242)	(10,118)	.	(1,297)
wdik35_wc	-33,6681	-13,6769	-53,7498	-56,7786	-112,0212	-17,7360	-36,0084
	(2,174)	(3,268)	(4,781)	(6,423)	(13,435)	(6,399)	(3,056)
wdik36_wc	-28,7136	29,9704	.	-22,7228	-35,5029	.	-27,0773
	(2,049)	(3,358)	.	(5,048)	(7,245)	.	(2,895)
wdik37_wc	-20,2264	-12,9230	-23,6034	-24,2959	-13,1554	-14,5108	-17,9786
	(0,755)	(3,670)	(4,223)	(3,758)	(2,967)	(2,808)	(1,061)
wdik38_wc	12,8929	-3,8527	5,7031	11,4848	49,7046	.	13,3751
	(1,029)	(1,164)	(1,740)	(2,293)	(5,867)	.	(1,454)
wdik39_wc	4,5181	.	3,5657	7,1775	2,5400	.	4,1613
	(0,231)	.	(0,566)	(0,644)	(0,900)	.	(0,326)
outputrg	0,0000	0,0000	0,0000	.	0,0000	0,0000	0,0000
	(0,000)	(0,000)	(0,000)	.	(0,000)	(0,000)	(0,000)
outputrg_~j2	.	.	.	.	.	.	.
	.	.	.	.	.	.	.
outputrg_d~1	0,0004	.	-0,0016	.	0,0007	-0,0004	0,0003
	(0,000)	.	(0,001)	.	(0,000)	(0,000)	(0,000)
outputrg~k32	0,0002	.	-0,0005	.	0,0002	-0,0014	0,0003
	(0,000)	.	(0,000)	.	(0,000)	(0,000)	(0,000)
outputrg_d~3	-0,0043	-0,0404	-0,0231	.	-0,0275	0,0208	0,0002
	(0,003)	(0,011)	(0,008)	.	(0,010)	(0,005)	(0,000)
outputrg_d~4	-0,0291	.	-0,0658	.	-0,0368	0,0109	-0,0064
	(0,002)	.	(0,015)	.	(0,007)	(0,004)	(0,003)
outputrg_d~5	-0,0426	0,0409	-0,0290	-0,1141	.	-0,0126	-0,0254
	(0,006)	(0,006)	(0,013)	(0,010)	.	(0,004)	(0,003)
outputrg_d~6	-0,0007	-0,0021	-0,0008	0,0027	-0,0501	.	-0,0582
	(0,000)	(0,001)	(0,000)	(0,000)	(0,010)	.	(0,008)
outputrg_d~7	-0,1071	0,2333	0,1670	0,0849	-0,1611	0,5434	-0,1268
	(0,009)	(0,059)	(0,050)	(0,041)	(0,028)	(0,015)	(0,012)
outputrg_d~8	-0,0449	0,2413	-0,0742	-0,1005	.	0,0402	-0,0771
	(0,009)	(0,013)	(0,032)	(0,023)	.	(0,010)	(0,013)
outputrg_d~9	0,0099	-0,0502	.	.	0,0122	-0,0491	0,0105
	(0,002)	(0,009)	.	.	(0,005)	(0,004)	(0,002)
_cons	-7,9821	-4,1249	-2,8149	-6,0514	-9,0176	-0,8372	-1,0270
	(0,297)	(0,147)	(0,589)	(1,151)	(2,735)	(0,123)	(0,494)
Number of obs	28896	18820	4488	3343	2245	14223	14188
Number of groups	1204	1190	.	.	.	905	.
R-sq: within	0,1262	0,1272	.	.	.	0,1459	.
between	0,0024	0,0600	.	.	.	0,0033	.
overall	0,0409	0,0565	0,1470	0,1481	0,1133	0,0996	0,0808
Obs per group:	.	.	.	.	.	.	.
min	24,0000	1,0000	.	.	.	1,0000	.
avg	24,0000	15,8000	.	.	.	15,7000	.
max	24,0000	24,0000	.	.	.	24,0000	.
F-test	199,7500	171,1500	45,3100	44,5100	16,7400	174,8700	62,2800
Prob > F	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
sigma_u	19,8819	22,5150	.	.	.	19,5220	.
sigma_e	35,8380	11,7102	.	.	.	7,3926	.
Rho	0,2353	0,7871	.	.	.	0,8746	.
F test that all u_i=0:	.	.	.	.	.	.	.
F(1203, 27672)	1.54	3,7200	.	.	.	11,0500	.
Prob > F	0.0000	0,0000	.	.	.	0,0000	.

The fixed effects model for the total sample (Model wc1) show a negative sign on the wages as predicted from our model for 4 ISIC sectors, i.e.: printing and editorial industries, paper manufactures (34), chemical industries (35), non mineral manufactures (36) and steel and iron industry (37). The negative relationship expected between firm output and turnover applies for the same 4 ISIC sectors and additionally the wood manufactures (33) and metallic and non metallic machinery (37) sector. Going into the first output quartile (Model wc1) the clothing manufactures (32) sector show the expected sign as well as sector (37). For the second and third output quartile the story goes basically the same, there is a negative relationship between wages and firm turnove. The highest output quartile show a that there is a trade-off in sectors 31 (not observed before) and 32. In the lower employment half (Model wc6) several variables, corresponding to the relationsip of firms turnover against different sectos are un-significant and only for sectors 35 and 37, as in the previous models. For the highest employment half (Model wc7) the negative relationship appears in ISIC 34, 36, 37 and 38. One important conclussion from this findings is the evidence of turover-type relationship for above average wages paid for firms against th wages paid in sector 34, 35, 36 and 37; also in the 31 and 32 for the highest output quartile. Also in the highest output quiartile we observe the highest parameter associated with wage differentials (-112).

Regression results for blue collar workers are shown in Table 5. In this case the trade-off betwen wage differentials and employment turnover rate takes only the expected sign for two ISIC sectors in all estimated models (ISIC 35 and 36). Sector 32 shows the turnover evidence in Model bc3. Model bc4 also show negative sign in sectors 36, 38 and 39, not observed before. In the first half of employment level (Model bc6) there is a negative parameter for the wage differential in firms against its own sector, the only parameter found taking the expected sign.

Summarizing the results found in our econometric analysis, we can conclude on the existence of efficiency wages paid in some subsectors of colombia's industry. For white collar workers there seems to be more sectors which show that wage differentials have effect on turnover rate, for blue collar there are less industrial sectors for which firms have less responsiveness in turnover rate facing a wage differential. This difference among white and blue collar workers is consistent with the findings fro our third section which show that more firms pay wages above average on white than blue collar workers. No evidence of this kind has been ever shown before for colombia and such a broad evidence for a whole industry in any other study in the literature.

One caveat remains from our results. There is a considerable group of sectors for which firms show a positive relationship between wage differential and employment turnover rate. This means, given a positive wage differential on its own industrial sector or diferent sector, the turnover rate of firms is positive, this is a firm pay a wage above average of its sector or other sector and employment rotation still appears. It is not the explicit pourpose of this paper to answer this question but we can offer several explanations to this empirical finding. Employment rotation dos not respond exaclty to wage differentials in those sectors. There must be other reasons, such as internal adjustments to labor quality, output demand or firm reactions to macroeconomic shocks.

TABLE 5

ECONOMETRIC RESULTS FOR BLUE COLLAR WORKERS

Dependent variable: bce_turnover	Blue Collar fixed effects regression Total sample Model bc1	Blue Collar fixed effects regression 1st output quartile Model bc2	Blue Collar polled regression 2nd output quartile Model bc3	Blue Collar polled regression 3rd output quartile Model bc4	Blue Collar polled regression 4th output quartile Model bc5	Blue Collar fixed effects regression 1st WC employ half Model bc6	Blue Collar polled regression 2nd WC employ half Model bc7
wdij2_bc	9,8050	15,6807	.	2,6559	7,9297	-4,9999	3,0540
	(0,687)	(1,244)	.	(0,651)	(1,411)	(2,370)	(0,432)
wdik31_bc	23,8058	48,8325	.	81,4406	37,1698	77,8975	30,2520
	(1,045)	(3,517)	.	(6,906)	(9,912)	(6,350)	(1,325)
wdik32_bc	.	.	-61,4441	62,1242	61,9489	.	.
	.	.	(3,645)	(7,420)	(11,739)	.	.
wdik33_bc	-1,4458	14,1169	9,8389	11,8024	-15,0730	14,9666	.
	(0,532)	(1,811)	(1,109)	(2,020)	(2,576)	(3,189)	.
wdik34_bc	6,2408	6,7967	.	-4,6508	11,8990	16,5050	4,4620
	(0,879)	(2,306)	.	(2,233)	(3,555)	(3,553)	(1,196)
wdik35_bc	-2,9645	-25,9316	-16,0948	5,4487	-18,4843	-66,1156	-5,8821
	(1,119)	(2,371)	(2,167)	(2,868)	(6,219)	(5,786)	(1,466)
wdik36_bc	-64,4577	-85,6597	.	-155,5063	-104,0765	-95,3239	-76,4936
	(4,157)	(12,053)	.	(17,297)	(18,223)	(17,259)	(4,819)
wdik37_bc	6,9383	15,9734	60,0141	.	-19,4618	59,3196	.
	(1,340)	(4,056)	(6,099)	.	(7,359)	(5,958)	.
wdik38_bc	.	-26,1050	.	-33,1617	.	-23,2795	.
	.	(3,247)	.	(4,456)	.	(6,292)	.
wdik39_bc	4,0447	3,8389	4,6530	-7,4340	6,2343	.	3,9940
	(0,487)	(1,387)	(1,507)	(1,442)	(2,009)	.	(0,606)
outputrg	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000
	(0,000)	(0,000)	(0,000)	(0,000)	(0,000)	(0,000)	(0,000)
outputrg_~j2	-0,0005	0,0038	0,0029	-0,0023	.	-0,0003	-0,0003
	(0,000)	(0,001)	(0,001)	(0,001)	.	(0,000)	(0,000)
outputrg_d~1	0,0015	.	0,0029	0,0019	0,0014	.	0,0014
	(0,000)	.	(0,002)	(0,001)	(0,001)	.	(0,000)
outputrg_d~2	.	.	0,0008	.	.	.	.
	.	.	(0,000)	.	.	.	.
outputrg_d~3	-0,0289	-0,1116	-0,0432	-0,0284	-0,0574	-0,0379	-0,0310
	(0,004)	(0,021)	(0,013)	(0,010)	(0,012)	(0,006)	(0,005)
outputrg_d~4	0,0408	0,0706	-0,0876	-0,0532	0,0613	0,0746	0,0462
	(0,003)	(0,012)	(0,026)	(0,016)	(0,009)	(0,005)	(0,005)
outputrg_d~5	-0,1071	.	-0,1769	-0,0627	-0,3022	.	-0,0986
	(0,008)	.	(0,021)	(0,015)	(0,083)	.	(0,011)
outputrg_d~6	-0,0045	-0,0126	-0,0152	.	.	-0,0121	-0,0060
	(0,000)	(0,002)	(0,001)	.	.	(0,003)	(0,001)
outputrg_d~7	0,1052	0,3045	-0,4073	.	.	.	0,0844
	(0,011)	(0,109)	(0,081)	.	.	.	(0,015)
outputrg_d~8	-0,0975	0,0944	0,1408	0,0816	-0,2467	0,1501	-0,0975
	(0,013)	(0,030)	(0,052)	(0,034)	(0,054)	(0,016)	(0,018)
outputrg_d~9	-0,0286	-0,0251	0,0628	.	-0,0305	-0,0323	-0,0278
	(0,002)	(0,016)	(0,021)	.	(0,006)	(0,004)	(0,003)
_cons	-12,0850	-8,0009	-1,1349	-2,5525	-7,4623	-3,1982	1,2422
	(0,489)	(0,348)	(0,837)	(1,356)	(3,646)	(0,196)	(0,698)
Number of obs	28896	18820	4488	3343	2245	14314	14393
Number of groups	1204	1190	.	.	.	863	.
R-sq: within	0,1317	0,0997	.	.	.	0,0675	.
between	0,1302	0,0651	.	.	.	0,2890	.
overall	0,0251	0,0353	0,1926	0.1395	0,1765	0,1064	0,1014
Obs per group:	.	.	.	.	.	.	.
min	24	1	.	.	.	1	.
avg	24	16	.	.	.	17	.
max	24	24	.	.	.	24	.
F-test	233.28	114.70	66,6700	33.71	29,8500	64,8700	101,3800
Prob > F	0.0000	0.0000	0,0000	0.0000	0,0000	0,0000	0,0000
sigma_u	32,2674	34,0547	.	.	.	28,2733	.
sigma_e	50,9728	22,6792	.	.	.	9,5032	.
rho	0,2861	0,6928	.	.	.	0,8985	.
F test that all u_i=0:	.	.	.	.	.	.	.
F(1203, 27674)	1,3500	2,3200	.	.	.	10.99	.
Prob > F	0,0000	0,0000	.	.	.	0.0000	.

Conclusions

There are two main conclusions of the simple test carried out in this paper. About 25% of incumbent firms of Colombian manufacturing industry pay wages above their corresponding ISIC3 industry. This calculation clearly suggests the existence of efficiency wages procedures on a significant number of firms.

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