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**Wage Policies and Labor Turnover:  
An Empirical Analysis of the Brazilian Data**

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# WAGE POLICIES AND LABOR TURNOVER: AN EMPIRICAL ANALYSIS OF THE BRAZILIAN DATA\*

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## I. Introduction

There are three main research issues in this paper: (i) Do turnover rates respond to wage differentials, particularly, to the relative cost of workers recently hired and the ones with more time remaining within a firm? (ii) If labor turnover is a cost reducing device, we should observe an arbitrage equilibrium between wages outside the firm and those within it. In other words, is there a tendency for both wages to balance in the long run? (iii) If these two wages balance in the long run is labor turnover the main mechanism for balancing them or it is the inflation rate the main mechanism producing this effect as the Peak-Average wage hypothesis suggests?

The plan of this paper is the following: in section two the univariate properties of the time series involved in the analysis are studied; in section three the multivariate analysis is accomplished: since, the second question, above is much easier to answer than the other two, it will be analyzed first. Finally, a concluding section summarizing the findings and assessing the model's robustness is offered in section four.

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\* Preliminary version, August 1992.

## II. The Data Set

To test the above hypothesis it was used monthly data on labor hirings and dismissals, average and hiring wages in the industrial sector in the state of Sao Paulo from 1985 to the first quarter of 1992. A labor turnover index is also employed calculated as the minimum of hirings or dismissals as a percent of employment in the industrial sector of Sao Paulo. This index has the advantage of measuring only the labor turnover rate, filtering out the effects of employment movements. The industrial output index and the consumer price index at national level are also considered. The analysis in a previous paper is based on the supposition that firms require a certain turnover rate and not too extensive amount of training.<sup>2</sup> Therefore, a priori, this technology seems to be more representative of service sector or low technology industries with relatively intensive use of labor than for high technology industries that are intensive in the use of capital. However, if evidence is found for the effects of wage policies and the labor turnover rate, this will be evidence that the phenomena might be important in other sectors as well.

The period of analysis was chosen due to data availability. However, this is a particularly rich period since there were five different wage indexation regimes (see appendix). To summarize these indexation regimes, an wage

<sup>2</sup> See Malaga (1992)

policy index was constructed applying all mandatory wage increases to a base year . This is an average mandatory wage index, since (as discussed in the appendix), most of the wage policies distribute wage adjustments over the calendar year according to industrial segment. A more detailed description of the variable used in the analysis and the source of data are presented at the end of the appendix.

Time series analysis must be performed carefully in order to avoid spurious correlation among the variables. To test for the integration order of the variables it was used the test proposed by Dickey and Fuller (1981) - the Augmented Dickey-Fuller test (ADF). The choice of the number of lags in the Dickey-Fuller regression is not straight forward: a low number of lags leads to invalid statistics due to autocorrelation remaining in the residual and a high number implies a reduction in the power of the test. Dolado and Jenkinson (1987) suggest a number of lags ranging from 1 to 24 for monthly data. Since there are only 88 observations the test was performed using 12, 8 and 6 lags. To get a more accurate understanding of the series, the results of the ADF tests were contrasted with the more traditional approach of visual inspection of correlograms (available from the author). Recently it has become widely recognized that unit root tests have low power and that their results may conflict with the visual inspection.<sup>3</sup>

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3 For a discussion of the problems of unit root tests see Maddala(1992).

Table 1 summarize the results of the ADF tests:

Table 1

DICKEY-FULLER UNIT ROOT TEST						
INTEGRATION ORDER						
	I(0)		I(1)		I(2)	
	ADF1	ADF2	ADF1	ADF2	ADF1	ADF2
12 LAGS						
AVERAGE REAL WAGE	3.02	2.13	2.69	1.80	11.83	7.89
HIRING REAL WAGE	3.78	2.97	4.18	2.80	8.47	5.65
INDUSTRIAL OUTPUT	2.13	1.42	5.99	4.00	21.81	14.54
CONS. PRICE INDEX	0.95	1.35	1.64	1.12	5.87	3.92
LABOR TURNOVER	2.65	1.88	6.57	4.45	17.93	11.96
8 LAGS						
AVERAGE REAL WAGE	4.07	2.78	10.29	6.86	14.60	9.74
HIRING REAL WAGE	5.77	4.10	9.03	6.02	11.64	7.76
INDUSTRIAL OUTPUT	2.94	1.97	22.22	14.82	24.98	16.70
CONS. PRICE INDEX	1.49	2.61	2.78	1.88	7.67	5.11
LABOR TURNOVER	2.73	1.87	11.16	7.45	11.55	7.71
6 LAGS						
AVERAGE REAL WAGE	3.25	2.26	11.22	7.48	20.75	13.84
HIRING REAL WAGE	3.33	2.66	8.40	5.63	15.87	10.64
INDUSTRIAL OUTPUT	5.24	3.49	28.72	19.14	17.66	11.82
CONS. PRICE INDEX	1.41	2.81	3.73	2.51	8.90	5.94
LABOR TURNOVER	2.86	1.96	12.27	8.18	20.13	13.43
$\text{ADF1: } dY_t = \beta_0 + \beta_1 T + \alpha Y_{t-1} + \sum_{i=1}^n \mu_i dY_{t-i} \quad n = 12, 8 \text{ e } 6$						
$\text{ADF2: } dY_t = \alpha Y_{t-1} + \sum_{i=1}^n \mu_i dY_{t-i} \quad n = 12, 8 \text{ e } 6$						

As it can be seen in Table 1, the inclusion of 12 lags to take into account the autocorrelation of residuals, leads to rejection of the null hypothesis of unit-root in second

difference for the real variables and the nominal variables are not stationary even in third difference. These results conflict with previous tests done with Brazilian time series that suggest that nominal series tend to be integrated of order 2, while the real ones are integrated of order 1 or 0 (see for instance Valls Pereira 1988). On the other hand, performing the tests with 8 and 6 autoregressive terms these previous results are confirmed: average real wage, hiring real wage, industrial output and labor turnover are stationary in first difference while the consumer price index is stationary in second difference.

The visual inspection of the correlograms confirms the results of the ADF test. The correlograms also point out the presence of seasonality in the labor turnover variable.

### III. A Test on Equilibrium Wages.

Wages inside the firm should converge to market wages in the model studied. The argument can be further simplified. Suppose the firm already has a certain amount of labor hired sometime in the past and market wages have not changed. This mean that the firm has an average wage equal to the market wage in the past:

$$W_{a,0} = W_{n,0}$$

Suppose at moment 1 there is an once for all decrease in  $W_n$ . Since regulations prevent nominal wage reductions for workers already employed and indexation assures them of

exact correction for inflation, there is a real wage rigidity that is solved replacing labor. Assuming a fraction  $h$  of currently employed workers is dismissed, this fraction will be less than the one indicated by the previously discussed technical and institutional reasons. Suppose fraction  $h$  is hired at the new wage, holding employment constant. In any moment  $t$ , before the adjustment being completed, the average wage of the firm will be:

$$W_{a,t} = (1-th) W_{n,0} + th W_{n,1}.$$

At moment  $t=1/h$  the process will be completed and:

$$W_{a,1/h} = W_{n,1}.$$

The higher  $h$  is, the faster the process of adjustment will be and, since  $h$  is a function of the wage differential, the higher is  $W_{n,0}/W_{n,1}$ , the higher  $h$  will be. When the opposite case occurs, firms should try to follow the market with wage adjustments above the inflation rate otherwise  $h$  will get higher because workers will search for jobs that offer  $W_{n,1} > W_{n,0}$ .

Of course, the argument must be more complicated allowing for technical and institutional problems that impede labor force replacement as discussed in Málaga (1992) and also because of workers' reluctance to change jobs.<sup>4</sup> But if labor turnover is going to be a device for cost

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<sup>4</sup> Málaga (1992) emphasize the effects of external wage shocks to the firm on the layoff rate. Stiglitz (1985) and Salop (1979) emphasize the quit rates as reactions to the internal wage policy of firms. Joinning this two views is my actual research. See also Blanchard and Diamond (1990).

adjustment both wages should converge to equilibrium.<sup>5</sup> Not with equality, as most economists would expect, for instance, for forward and future spot exchange rates, but wages should not fall too far apart. The obvious test in this case is to test for the cointegration of  $W_h$  and  $W_a$ . Since these two variables are  $I(1)$  when measured in real terms, as discussed in the previous section, we can test their cointegration in levels. The results obtained in logs for these two wages in real terms are:

$$(1) \quad \log(W_a) = 0.6459 \log(W_h) - 1.1056$$

(14.24)                      (8.41)

$$R^2 = 0.7512 \quad DW = 0.7762 \quad \text{Std. Err.} = 0.0611$$

$$ADF(1 \text{ lag}) = -5.44 \quad \text{Deg. Free.} = 86$$

Applying the Augmented Dickey-Fuller test (ADF) to the residuals of this equation and simple inspection of the correlogram rejects the hypothesis that the residual has a unit root, suggesting that, in fact, this two variables cointegrate. This is the easy part.

How is that these two series converge? There are at least three alternative hypothesis: (1) wages are perfectly flexible so they adjust any time to market conditions; (2) labor turnover does the job as discussed previously; (3) given a wage policy, usually based on past inflation, the

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<sup>5</sup> It was shown that under the assumption of specific human capital and Cobb-Douglas production function, both wages don't balance with equality due to the impossibility of replacing all experienced workers.



acceleration of inflation will reduce the average real wage of workers already hired. Hypothesis (1) is ruled out by the evidence, since in such a case both wages should not only cointegrate but they should also show absence of serial correlation in the residuals. The Durbin Watson statistics in equation (1) show evidence of first order serial correlation. Hypotheses (2) and (3) are competing explanations and it is difficult to set up a nested test for the two. The approach attempted here is to test an error correction specification as suggested by Engle and Granger (1987) and deal with turnover, acceleration of inflation and mandatory wage policy as short run deviations. Since labor turnover should itself be an endogenous variable reacting to the average wages/hiring wages differential, it is necessary to deal with them as a system of equations.

In order to get an error correction term for labor turnover a cointegrating equation for turnover was attempted. That is, a long-run relation between labor turnover and industrial output is postulated and only short-run deviations will be explained by wage differentials. Since labor turnover shows a strong seasonality, evidenced by the significance of seasonal dummies and also verified by simple inspection of the correlograms (available from the author), seasonal dummies were included for the cointegrating equation and also for the short run regression. The cointegrating regression obtained for labor turnover was:

$$\begin{aligned}
 (2) \log(LT) = & 2.06 \gamma \quad -8.42 \text{ SEAS1} \quad -8.41 \text{ SEAS2} \quad -8.50 \text{ SEAS3} \\
 & (11.00) \quad (-9.63) \quad (-9.68) \quad (-9.59) \\
 & -8.63 \text{ SEAS4} \quad -8.71 \text{ SEAS5} \quad -8.76 \text{ SEAS6} \quad -8.74 \text{ SEAS7} \quad -8.82 \text{ SEAS8} \\
 & (-9.63) \quad (-9.89) \quad (-9.59) \quad (-9.61) \quad (-9.64) \\
 & -8.79 \text{ SEAS9} \quad -8.94 \text{ SEAS10} \quad -8.45 \text{ SEAS11} \quad -8.31 \text{ SEAS12} \\
 & (-9.79) \quad (-10.28) \quad (-9.73) \quad (-9.43)
 \end{aligned}$$

$$\begin{aligned}
 R^2 = 0.7384 \quad DW = 0.8838 \quad \text{Std. Err.} = 0.1386 \\
 ADF(1 \text{ lag}) = -4.13 \quad \text{Deg. Free} = 73
 \end{aligned}$$

The error correction system proposed is the following:

$$\begin{aligned}
 (3) (1-L)\log(LT) = & \alpha_0(1-L)\log(W_a) + \alpha_2(1-L)\log(W_h) \\
 & + \alpha_3(1-L)\log(y) + \alpha_4 EC_{LT} + \text{seasonals}
 \end{aligned}$$

$$\begin{aligned}
 (4) (1-L)\log(W_a) = & \beta_0(1-L)\log(LT) + \beta_1(1-L)^2\log(P) \\
 & + \beta_2(1-L)\log(W_h) + \beta_3(1-L)\log(y) \\
 & + \beta_4 EC_{W_a}
 \end{aligned}$$

Where the  $EC_{W_a}$  and the  $EC_{LT}$  terms are the residuals from equations (1) and (2) respectively. The system formed by (3) and (4) is overidentified but as is widely known, Two Stage Least Squares provide optimal weights for estimating instrumental variables. Results obtained by 2SLS were the following:

$$(3') (1-L)\log(LT) =$$

$$\begin{aligned} & 1.912 (1-L)\log(W_a) - 1.055(1-L)\log(W_h) \\ & (2.37) \qquad\qquad\qquad (2.24) \end{aligned}$$

$$+1.46(1-L)\log(y) - 0.504(1-L)EC_{LT} + \text{seasonals} \\ (4.03) \qquad\qquad\qquad (-3.27)$$

$$R^2 = 0.6743 \quad DW = 1.75 \quad \text{Std. Err.} = 0.143 \\ \text{Deg.Free.} = 68$$

$$(4') (1-L)\log(W_a) =$$

$$\begin{aligned} & 0.2579(1-L)\log(P) - 0.087 (1-L)\log(LT) \\ & (3.20) \qquad\qquad\qquad (-3.17) \end{aligned}$$

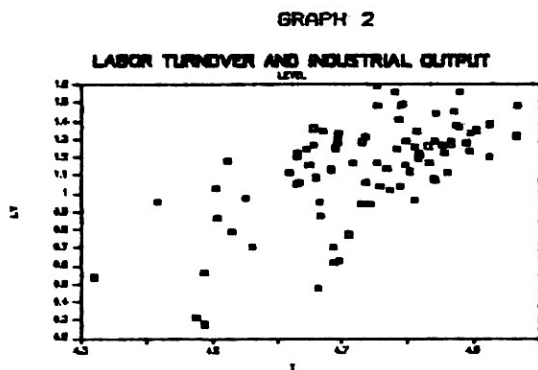
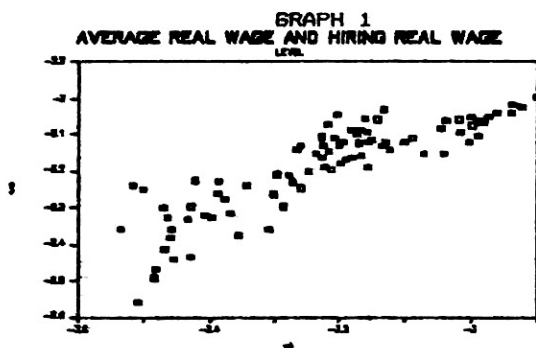
$$+0.0800(1-L)\log(y) + 0.5352(1-L)\log(W_h) + \\ (1.13) \qquad\qquad\qquad (4.07)$$

$$-0.4573 EC_{wa} \\ (-0.26)$$

$$R^2 = 0.549 \quad DW = 1.73 \quad \text{Std. Err.} = 0.0436 \\ \text{Deg.Free.} = 79$$

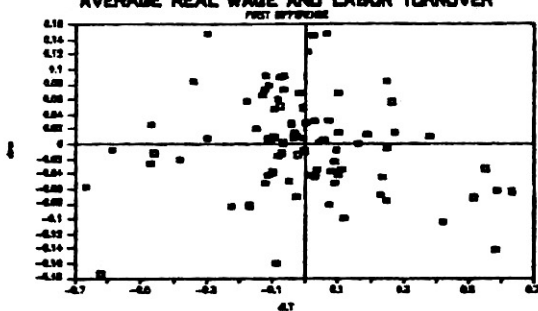
Equation (3') shows that, in fact, labor turnover responds positively to internal wages and negatively to hiring wages. In table 1 the in appendix the results of an OLS estimation are reported and it is apparent that this result depends crucially on the supposition that the first difference of  $\log(W_a)$  is an endogenous variable. Under OLS estimation (see appendix) both variables are not significant and the coefficient of  $\log(W_a)$  has also the wrong sign. This result is interesting because it confirms the

hypothesis that labor turnover and real average wages are endogenous. graph 3, plotting labor turnover against real average wage, shows a big concentration of observations in the second and third quadrant. The use of the 2SLS must have reduced the simultaneity bias implied by both equations.



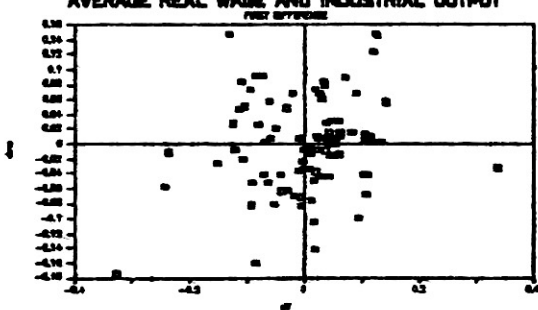
GRAPH 3

## AVERAGE REAL WAGE AND LABOR TURNOVER



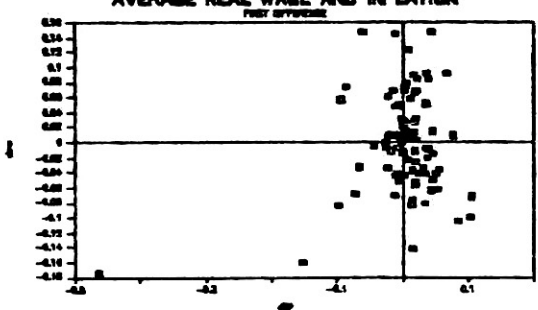
GRAPH 4

## AVERAGE REAL WAGE AND INDUSTRIAL OUTPUT

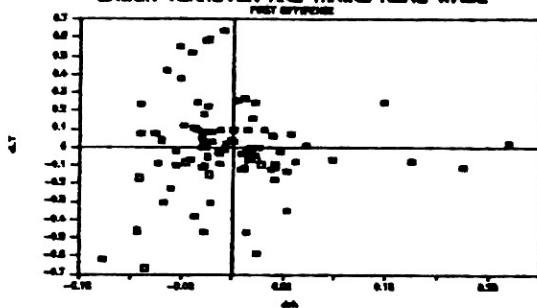


GRAPH 5

## AVERAGE REAL WAGE AND INFLATION

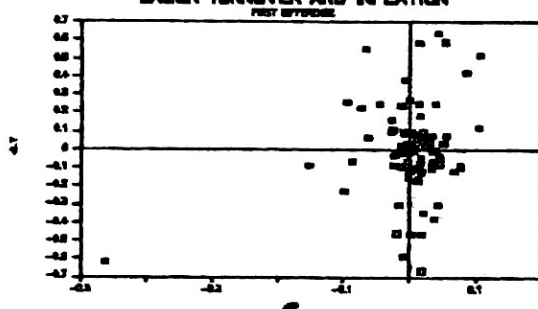


GRAPH 6  
LABOR TURNOVER AND HIRING REAL WAGE



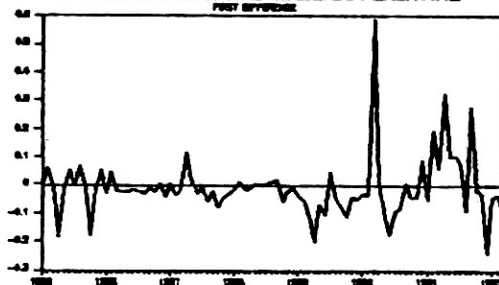
GRAPH 7

LABOR TURNOVER AND INFLATION



GRAPH 8

WAGE POLICY & HIRING WAGE DIFFERENTIAL



Equation (4') offers evidence that both kinds of shocks, turnover and the acceleration of inflation affect short run wages. Nevertheless, inflation seems to affect them positively while labor turnover is supposed to reduce the rate at which internal wages rise. This confirms the impression given by graph 5. Acceleration of inflation therefore seems to be associated with real wage growth rather than reducing real wages. This evidence agrees with that from Kiguel and Liviatan(1989).<sup>6</sup> The inclusion of acceleration of inflation in excess of wage policy instead of the acceleration of inflation was not significant and, without affecting significantly the other variables, increased the standard error of the regression.

Although the Durbin-Watson statistic is in the indetermined region to reject first order autocorrelation of residuals, the correlograms of the residuals of both equations don't show any particular structure in the residuals.

The strongest evidence is that growth of real market wages, here considered as hiring wages, is quickly transmitted to the growth in internal wages. Labor turnover, in its turn, seem to act in the expected direction. Even though the system analyzed does not fit

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<sup>6</sup> Kiguel and Liviatan(1989) do not seem to be too worried about spurious results though and their regressions will hardly pass the usual tests applied to time series.

the data with the accuracy desired the effects under study seem to be present.

The equations also show the strong association of labor turnover and industrial output, not only in the long-run (equation 2) but also in the short-run equation (4'). Since the period of analysis was one of enormous instability, this seems to have been transmitted dramatically to the labor market. According to equation (4'), it seems as if a 1% fluctuation in the growth rate of output is transmitted as more than 1% to the turnover rate. Given the high rates of turnover observed this can be considered as one of the social costs of macroeconomic instability.

#### IV. Conclusions

The evidence presented here suggests that labor turnover reacts to wage differentials and that, in turn, labor turnover has effects on real wages. Even if the models presented here are not able to explain the totality of the short-run movements of labor turnover and average wages the particular effects analyzed seem to be in the correct direction and pass the usual test of hypothesis.

Average real wages and hiring wages cointegrate suggesting that there are market forces that operate despite the wage policy to balance both wages.

Finally, evidence supports the view that acceleration of inflation is not associated with real wage falls. On the



contrary, they seem to be associated with real wage increases.

## APPENDIX

## 1. Wage Policies Description

During the period of analysis, the Brazilian economy experienced six different wage policy regimes. Wage indexation was first established in 1966 with annual readjustment period based on an official rate involving monetary correction. Readjustments were not given at the same time to all workers but distributed over the year according to the date of collective negotiation of the worker's industrial group.<sup>7</sup>

In November 1979 the period involved in the readjustments was reduced to 6 months, with the collective renegotiation date taking place twice a year: first in the original month and then six months later. There was also a change of index used for the readjustment calculation, monetary correction was replaced by the Consumer Price Index that measures the official rate of inflation. This regime lasted until the beginning of 1986.

The Cruzado Plan, decreed at February 1986, replaced the semi-annual indexing by a sliding scale that would readjust wages, by 20%, any time inflation accumulated to this figure. The Plan first determined a wage freeze that

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7. In Brazil, the organization of workers and employers in associations, according to region and activity, is compulsory and each group has a date of collective wage negotiation, when wage readjustment is applied to all workers in the industrial group.

considered the average level of real earnings over the preceding six months. Given the staggered contract period of the previous system, workers with collective negotiation date between March and September had a positive readjustment while those with negotiation date between October and February a reduction in their wages. The wage freeze ended in November and by the following April all wages in the economy were being readjusted by 20% per month.

In June 1987, the sliding scale was replaced by a new indexing system, in which the readjustments were equivalent to the geometric mean of the last three months inflation. This system started being applied in September, after a two-month wage freeze. This indexation system lasted until January 1989 when a wage and price freeze was, again, adopted.

In May 1989, new rules were defined and monthly indexation was practically established. The wage of each worker was divided in three parts: the first, corresponding to the amount up to 3 minimum wages, would be readjusted monthly according to the previous month inflation; the second, corresponding to the amount between 4 and 20 minimum wages, would be readjusted by the previous month's inflation in excess of 5% monthly and the remaining residual, quarterly; the third, corresponding to the fraction above 20 minimum wages, that represents 3% of the economy's payroll, would be readjusted according to free negotiation. This system lasted until March 1990.

In April 1990, the new government abolished all indexation of the economy and, until September 1991, there was no wage policy at all. In this month partial indexation was reintroduced in the economy. The new law determined that the fraction of a worker's wage corresponding to three minimum wages should be readjusted every two months by at least 50% of the accumulated inflation in the previous two months and every four months by the remaining inflation accumulated in the period. The fraction of wages corresponding to three minimum wages represents around 60% of the economy's total payroll, meaning that indexation is only partial with this new law.

## 2. Description of the variables and source of data

- Average wage,  $W_a$ , is the average wage paid by the Federacao das Industrias do Estado de Sao Paulo - FIESP, the largest industrial association of the country. The industries of this association respond to 20% of total GDP and to 50% of industrial GDP.
- Hiring wage,  $W_h$ , is the hiring wage in the industrial sector of Sao Paulo compiled by the Labor Ministry.
- Labor turnover,  $LT = \min(\text{dismissals}, \text{hirings}) / \text{employment}$ , refers to labor turnover in the industrial sector of Sao Paulo compiled by the Labor Ministry
- Industrial Output,  $y$ , is the manufacturing output at national level of Instituto Brasileiro de Geografia e Estatistica-IBGE
- Prices,  $P$ , is the consumer price index at national level computed by Instituto Brasileiro de Geografia e Estatistica IBGE.

## APPENDIX 1

## 1. REGRESSION RESULTS

	2SLS	OLS	2SLS	OLS
	LT	LT	$W_n/P$	$W_n/P$
SEAS12	-0.0980 (-1.72)	-0.0896 (-2.04)		
SEAS11	-0.0088 (-0.14)	0.0589 (1.33)		
SEAS10	-0.1227 (-1.99)	-0.1356 (-2.89)		
SEAS9	-0.1041 (-1.83)	-0.1268 (-2.98)		
SEAS8	-0.0707 (-1.28)	-0.0574 (-1.34)		
SEAS7	-0.0571 (-1.04)	-0.0516 (-1.23)		
SEAS6	0.0859 (1.39)	0.0161 (0.37)		
SEAS5	-0.0961 (-1.74)	-0.0732 (-1.74)		
SEAS4	-0.1268 (-1.44)	0.0303 (0.68)		
SEAS3	-0.2381 (-3.48)	-0.1961 (-3.82)		
SEAS2	0.6108 (7.91)	0.4741 (10.40)		
SEAS1	0.1714 (2.87)	0.1215 (2.80)		
$d(W_n/P)$	1.9125 (2.37)	-0.0861 (-0.30)		
$d(W_n/P)$	-1.0554 (-2.24)	-0.1333 (-0.83)	0.5353 (4.87)	0.5336 (4.87)
dy	1.4579 (4.83)	1.8235 (8.80)	0.0800 (1.13)	0.0860 (1.27)
$d(LT)$			-0.0871 (-3.19)	-0.0909 (-3.78)
$d^2(INPC)$			0.2579 (3.29)	0.2599 (3.32)
ECLT	-0.5035 (-3.28)	-0.4685 (-4.01)		
ECW <sub>n</sub>			-0.4573 (-8.26)	-0.4567 (-8.84)
Deg. Free.	68	68	79	79
R <sup>2</sup>	0.6743	0.8107	0.5491	0.5492
Std.Err	0.1427	0.1088	0.0437	0.0437
DW	1.7515	1.9466	1.7290	1.7425

(All variables in logarithms)

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