INDEXATION AND LABOR MARKET TURNOVER IN BRAZIL

Guillermo Tomás Málaga*

ABSTRACT

The issue of wage indexation in the economic literature is well understood from the point of view of its macroeconomic consequences. Nevertheless, its effects as a regulatory intervention on the labor market have been relatively less studieds. Since indexation does not correct for real effects, real shocks may create serious deviations of employed workers' wages from current labor market conditions. This deviations may lead to an increase in labor turnover rates to adjust current costs in firms. The evidence for Brazil shows that this is, in fact, the case. Labor turnover in Brazil is extremely high compared to international rates.

SÍNTESIS

El problema de la indexación de salarios en la literatura económica es bien entendido desde el punto de vista de sus consecuencias macroeconómicas. Sin embargo, sus efectos como una intervención regulatoria en el mercado laboral han sido menos estudiados. Dado que la indexación no corrige los efectos reales, los impactos reales pueden originar serias desviaciones en los salarios de los trabajadores en relación a las condiciones vigentes en el mercado laboral. Estas desviaciones pueden llevar a un aumento en las tasas de rotación del empleo para ajustar los costos vigentes en las empresas. La evidencia para Brasil muestra que esto es, de hecho, el caso. La rotación laboral en Brasil es extremadamente elevada comparada con las tasas internacionales.

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1. INTRODUCTION

Labor turnover by itself is not an inefficient outcome of economic activity. On the contrary, economists tend to see it as a socially productive activity: matching workers with jobs. Recent work by Blanchard and Diamond (1990), estimating the aggregate matching function for the United States, concludes that this activity is highly efficient. Their statistical data suggests that when the ratio of job vacancies to unemployment is about 1:5, then the average duration of a job vacancy is only two weeks; when the ratio is 1:1, this rises to four weeks. This constant activity of matching workers with jobs is a desirable activity. Nevertheless, we can suggest at least two instances in which this occasionally may turn into a socially unproductive activity.

In the first case, where the accumulation of specific human capital allows firms to reach high productivity levels, excess labor turnover may be unproductive since these skills are acquired over time in the firm. Firms may prevent excessive labor turnover with private wage policies and job security provisions in their internal labor relations. Nevertheless, macroeconomic instability and labor market regulations could provoke an undesired reallocation of workers. Higher labor turnover may arise, even under conditions of overall macroeconomic stability, if a higher variability of economic activity is accompanied by sectoral shifts of economic resources and, consequently, shifts of the labor force. Labor market regulations which create real wage rigidities due to indexation also may lead to labor turnover. For example, recent comments by officials at the Brazilian Ministry of Labor suggest that the number of workers earning between one and one-and-a-half mandatory minimum wages increased from 23.5 percent of total workers hired in 1991, to 27.1 percent in 1992, while the number of workers earning more than five minimum wages fell from 9 percent in 1991 to 6.1 percent in 1992. This signifies that during the deep recession in the Brazilian economy in 1992, the drop in market wages induced labor substitution. We will develop this argument further below.

A second undesirable aspect of labor turnover arises when firms rely too heavily upon labor turnover as a mechanism to control costs. In such cases (assuming that much time will be spent finding a new job), a higher proportion of the labor force than otherwise will be devoted to this job search activity, thereby reducing the employment of the productive fraction of the labor force.

In this paper, we will present some simulations to measure the importance of socially unproductive labor turnover.[1] First, we discuss alternative methods of measuring labor turnover, and make some international comparisons. Second, we show that labor turnover might have been effected by economy-wide factors, since sectoral labor turnover shows an impressive conformity of behavior. Some arbitrage conditions in the labor market are estimated: Average wages in the firm should equal market wages represented by current wages of new hirings. Then it is tested if labor turnover is induced by deviations around this arbitrage conditions, together with shocks in output and inflation.

2. MEASURING LABOR TURNOVER IN BRAZIL

Three principal methods exist for measuring labor turnover. The first method, based upon family surveys, counts the number of workers which, at the time of the survey, have job tenure for less than a pre-specified period (e.g. one year). A second method of measuring labor turnover computes the increase in employment at growing or new establishments and the decrease in employment at shrinking or closing establishments. Both methods measure roughly the same phenomenon. For example, based upon Current Population Surveys, Hall (1982) calculated that 28.2 percent of American workers employed in 1978 held their jobs for less than a year. Davis and Haltiwanger (1990) corrected this calculation to include the number of unemployed workers which had held a job in 1978 - which was 8.6 percent - yielding a total of 36.8 percent of employed workers which had switched jobs during a typical year. Nevertheless, the latter procedure presents some problems. Suppose that a particular firm had 100 workers employed at the beginning of the year and that at the moment of the new survey the firm has 120 workers employed. This signifies that the firm has hired at least 20 workers during that year. Nevertheless, the firm could have hired much more than 20 workers and dismissed them before the survey was conducted. A third and more direct way to measure labor turnover is to ask the firm how many workers were hired and laid off during a fixed period of time (e.g., last month). In this case, we would rely upon the firm's declared level of hiring and firing, rather than the actual number of currently registered employees. This is a much better measurement, if the numbers provided are reliable. By virtue of labor market regulations in Brazil, these answers can be cross-checked with employment registers. We have used this method in this study. Future research will include cross-checking these numbers with family surveys and with a census of establishments.

[1] This is one of the applications of the econometric study presented in Section 3.

A second issue in measuring labor turnover arises in relation to selecting a turnover index. For example, Davis and Haltiwanger (1990) use four measurements. The first index is the weighted average of employment growth from new and expanding firms (POS in their notation). The second index is the weighted average of employment reduction in contracting and closing establishments (NEG in their notation). Finally, they use two indices to measure overall worker reallocation: the former being the sum of both previous indices, and the latter being the maximum of both indices, POS and NEG. These measurements, however, still retain the problems mentioned in the previous paragraph. They can be understood only as workers' reallocations due to job creation and elimination, and not due to other factors such as search policies of firms and workers, natural reallocations due to retirement and entrant workers in the labor force. Since the main aim of these authors is to study the mechanics of worker reallocation, these are good measurements. For the purposes of studying possible sources of excess turnover, however, we will use another measurement.

As this study is not concerned with fluctuations in employment levels but with job reallocation, it is better to define turnover as:

$$x_t = Min(H_t, S_t)$$

the minimum between the hiring level being H_t and the level of dismissals S_t. Nevertheless, labor turnover will have cyclical components, although it is not clear in which direction. In order to determine how this index will correlate with a scale variable, such as output or aggregate employment, we can define the following simple relations:

$$H_t = az_t + c \; a, c > 0 \qquad z_t \sim N(0, v^2)$$

$$S_t = -bz_t + c \qquad b > 0$$

In this formula, z_t can be interpreted as the excess of output above its natural level.[2] These relations merely indicate that hiring will increase with positive deviations of output, and that dismissals, in turn, will decrease. The parameter c can be interpreted as normal turnover (i.e., that which holds employment constant). Therefore, the process that determines x_t is:

$$x_t = az_t + c \qquad z_t < 0$$
$$x_t = -bz_t + c \qquad z_t \geq 0$$

[2] This can also be considered as an increase in employment. In such a case, we would have to impose the restriction a+b=1 on parameters a and b. This is easy to see, since $H-S=E-E_{-1}=z$.

We are interested in examining two specific moments of the random variable x_t. First, we examine the mean that is:

$$Ex_t = \int_{z<0} (az_t + c)\, \phi\,(z_t/v \mid z_t) < 0\, dz +$$

$$\int_{z \geq 0} (-bz_t + c)\, \phi\,(z_t/v \mid z_t \geq 0)\, dz$$

This can be simplified to:

$$Ex_t = -\frac{a}{v}\,\frac{\phi(0)}{\Phi(0)} - \frac{b}{v}\left[\frac{\phi(0)}{1-\Phi(0)}\right] + c$$

We can simplify this expression due to the fact that the standard normal distribution is symmetric around zero:

$$Ex_t = -0.7989\left(\frac{a+b}{v}\right) + c = \bar{x}$$

Therefore, it can be easily seen that the mean is an under-estimation of the component c of the labor turnover rate. Second, we also want to know how x_t covaries with z_t. This is easily calculated using the same technique of hazard rates:

$$cov(x_t, z_t) = \int_{z<0} (az_t + c - \bar{x})\, z_t \phi\left(\frac{z_t}{v} | z_t < 0\right) dz +$$

$$\int_{z \geq 0} (-bz_t + c - \bar{x})\, z_t \phi\left(\frac{z_t}{v} | z_t \geq 0\right) dz$$

This can be simplified to:

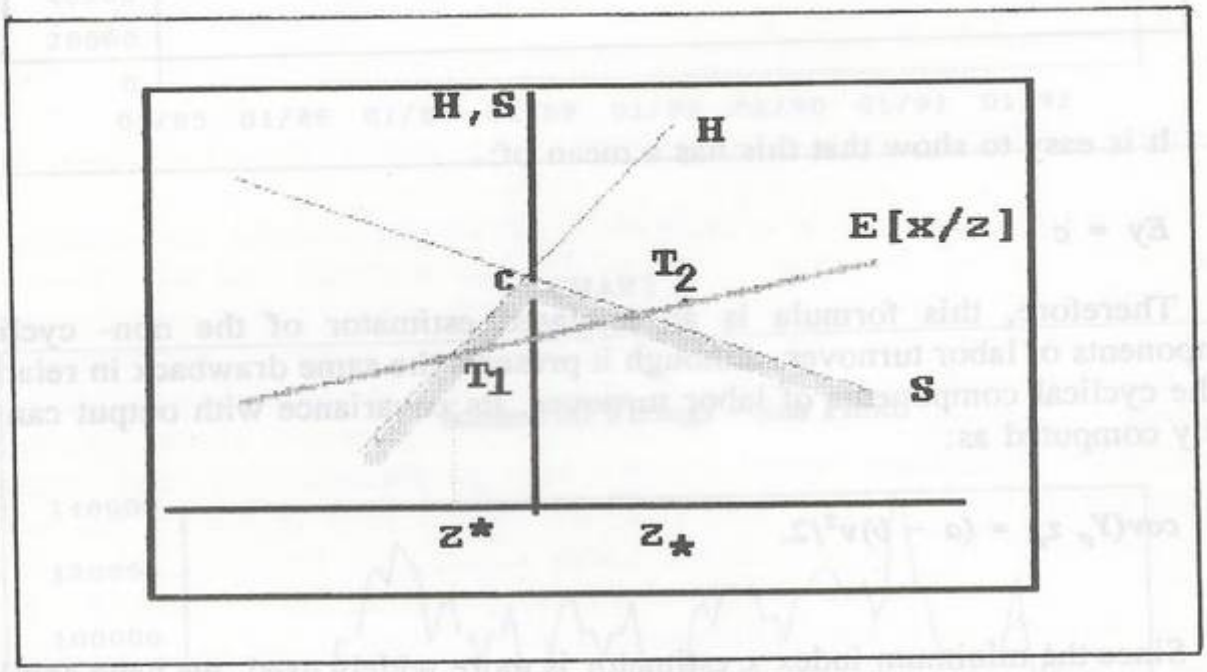
$$cov\,(x_t, z_t) = \frac{a-b}{v}\left[1 - \left(\frac{\phi(0)}{\Phi(0)}\right)^2\right] = 0.3635\,\frac{a-b}{v}$$

This formula shows that the labor turnover index can be either pro-cyclical or counter-cyclical, depending on the parameters of the economy. If hiring responds too strongly to output shocks, then a will be relatively high and it will more likely measure pro-cyclical patterns of the labor turnover rate. To gain

some intuitive understanding of this phenomenon, Figures 1a and 1b illustrate how all these factors interact. In Figure 1a, the hiring function presents a relatively higher sensitivity to output movements. The turnover index will be represented by the shaded kinked portion of both lines: the hiring function and the dismissal function. Considering the left-hand truncated mean (i.e., z_*) and the right-hand truncated mean (i.e., z^*), the regression line should pass through the points on the kinked function of the minimum indicator, T_1 and T_2, which correspond to these means, revealing the positive covariance between these two variables. Figure 1b depicts the opposite case. Here, the dismissal function shows a stronger reaction to output, with the result that a regression line will show a negative covariance between labor turnover and output.

The sum index (or even better, the average index) will have some interesting features:

FIGURE 1.a

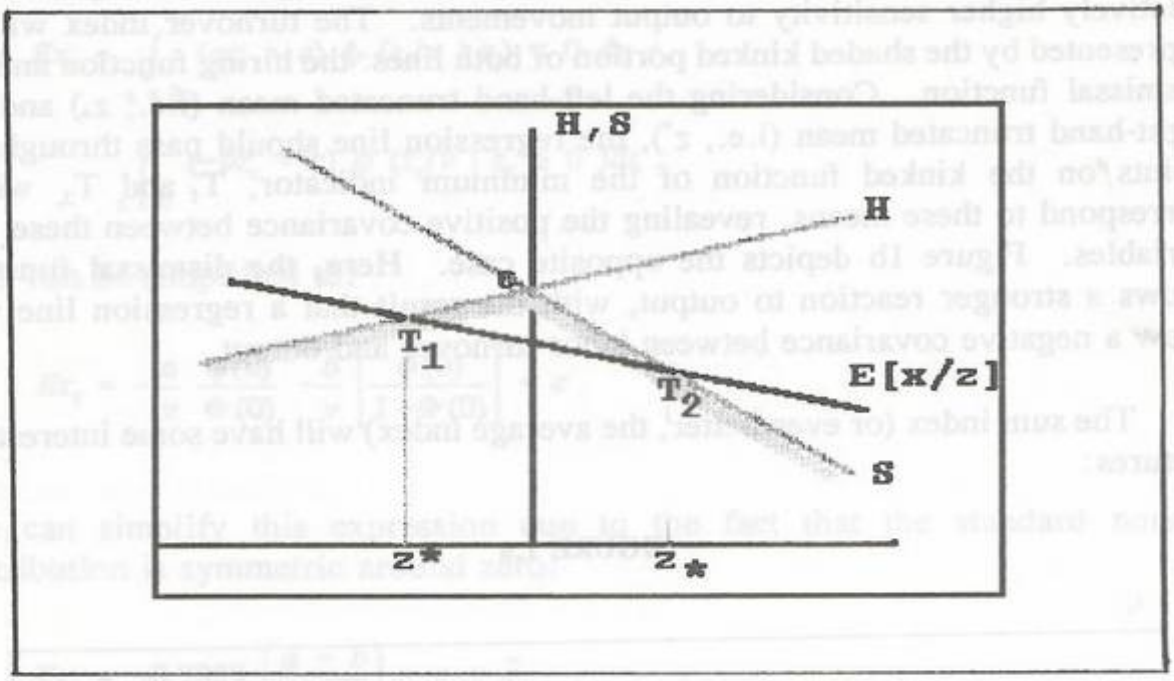


$$y = \frac{(H_t + S_t)}{2}$$

where y will be:

$$y = (a + b)z_t/2 + c$$

FIGURE 1.b



It is easy to show that this has a mean of:

$$Ey = c$$

Therefore, this formula is an unbiased estimator of the non- cyclical components of labor turnover, although it presents the same drawback in relation to the cyclical components of labor turnover. Its covariance with output can be easily computed as:

$$cov(Y_t, z_t) = (a - b)v^2/2.$$

Since the minimum index x_t estimator is more widely used, we have applied it in our estimations; nonetheless, the y_t seems to be a good alternative for this kind of study.

Using the x_t index, we have found significant pro-cyclical behavior for most sectors in Brazil, revealing that either the hiring function is much more reactive to output fluctuations or that the variance of positive shocks has been greater. Charts 1-3 show the behavior of hiring, firing and the minimum labor turnover index for the manufacturing sector in São Paulo - which is the sector on which we will rely heavily for econometric testing. During the period under analysis, the minimum index of labor turnover generally measures the level of dismissals.

In the next section, we compare labor turnover rates to see if it is evident to the naked eye whether Brazil has experienced excessive labor turnover rates.

CHART 1

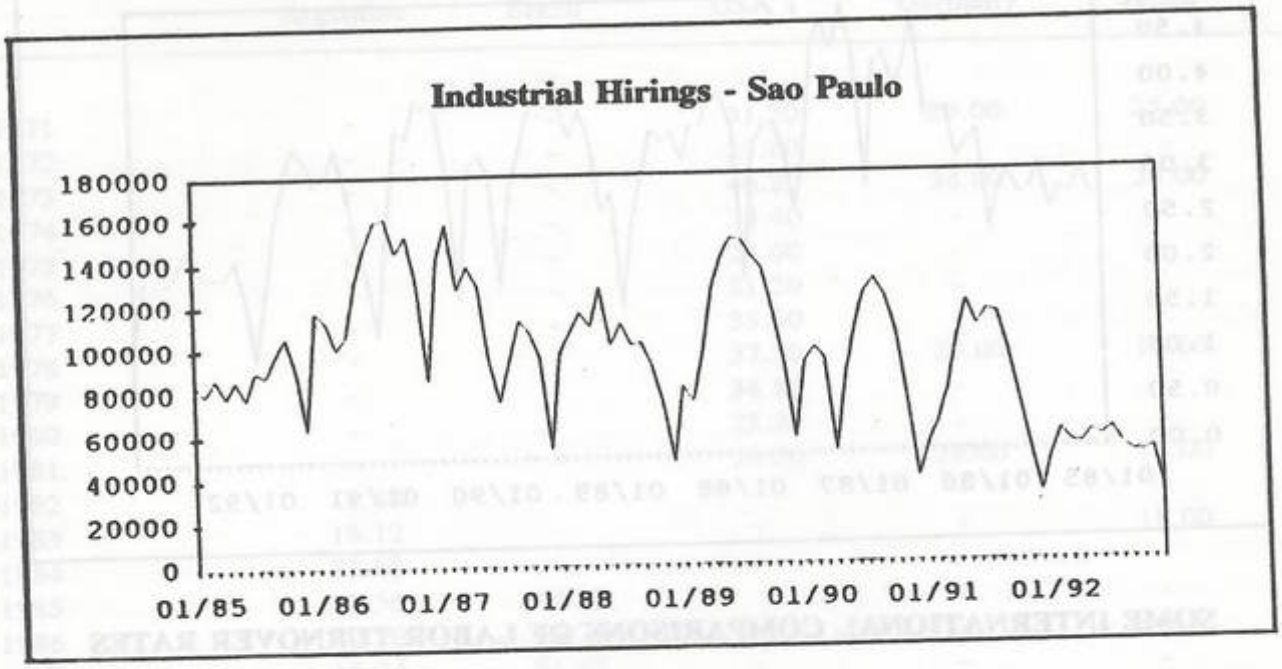


CHART 2

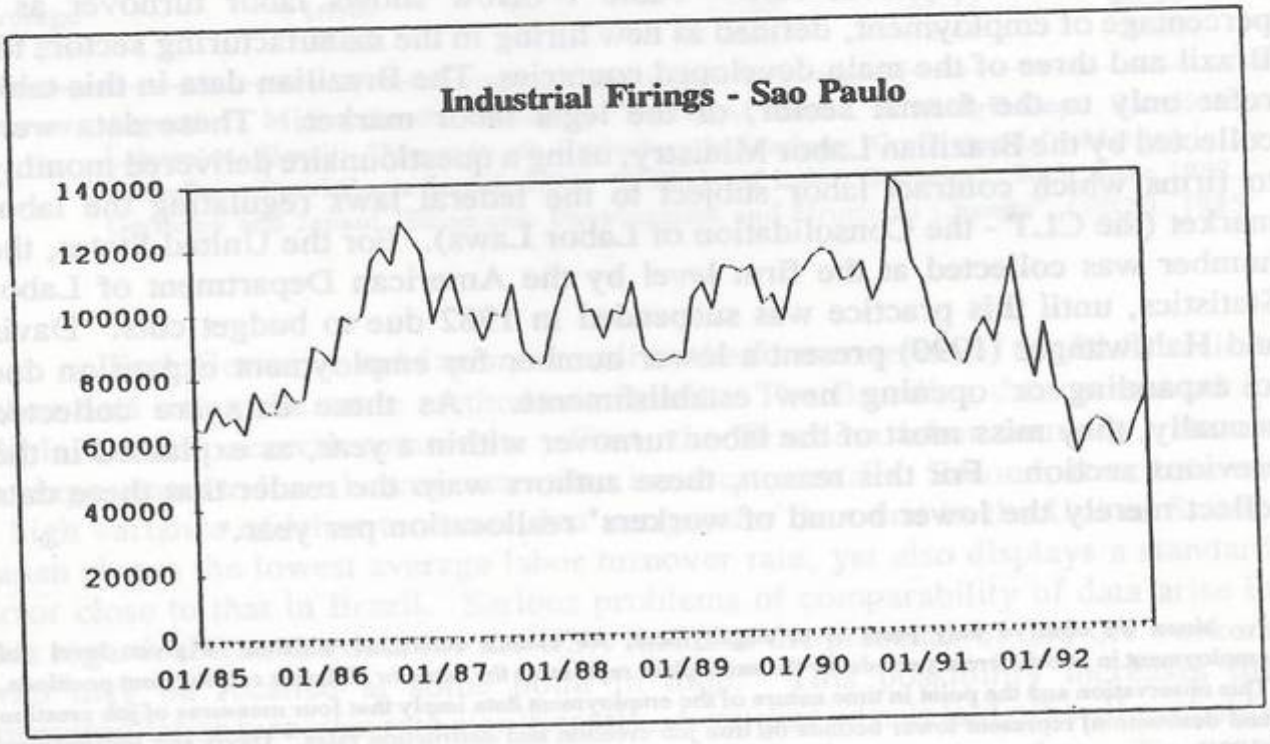
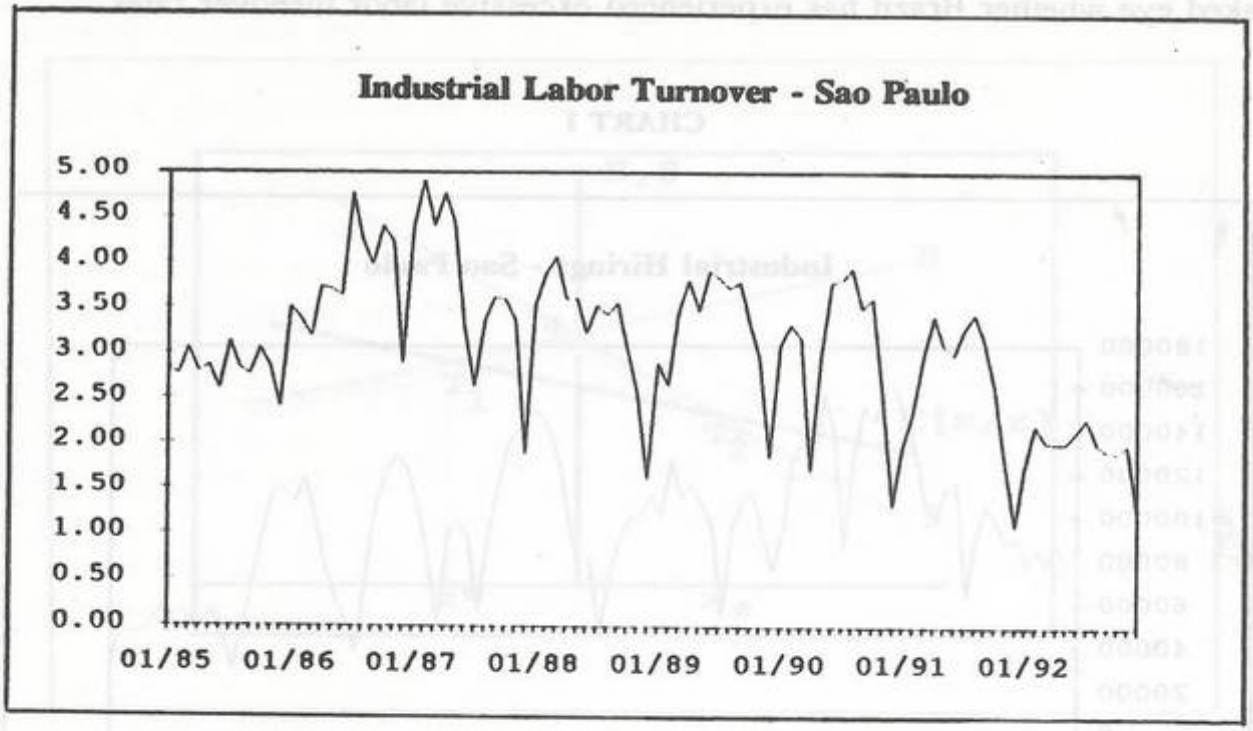


CHART 3



3. SOME INTERNATIONAL COMPARISONS OF LABOR TURNOVER RATES

The labor market in Brazil, particularly the formal or legal labor market, is characterized by high instability. One of the main symptoms of this instability is the high labor turnover rate. Table 1 below shows labor turnover as a percentage of employment, defined as new hiring in the manufacturing sector, for Brazil and three of the main developed countries. The Brazilian data in this table refer only to the formal sector, or the legal labor market. These data were collected by the Brazilian Labor Ministry, using a questionnaire delivered monthly to firms which contract labor subject to the federal laws regulating the labor market (the CLT - the Consolidation of Labor Laws). For the United States, the number was collected at the firm level by the American Department of Labor Statistics, until this practice was suspended in 1982 due to budget cuts. Davis and Haltiwanger (1990) present a lower number for employment expansion due to expanding or opening new establishments. As these data are collected annually, they miss most of the labor turnover within a year, as explained in the previous section. For this reason, these authors warn the reader that these data reflect merely the lower bound of workers' reallocation per year.[3]

[3] "... since we observe only plant level employment, we cannot determine whether a given level of employment in two different periods for the same plant represents the same or different employment positions. This observation and the point in time nature of the employment data imply that [our measures of job creation and destruction] represent lower bounds on true job creation and destruction rates." Davis and Haltiwanger (1991).

TABLE 1

AVERAGE LABOR TURNOVER RATES IN THE MANUFACTURING SECTOR IN FOUR COUNTRIES, 1971-1990

(as % of employment)

	Argentina	Brazil	USA 1	Germany	Japan
1971	-	-	31.20	29.00	25.00
1972	-	-	39.60	-	-
1973	-	-	46.80	34.00	24.00
1974	-	-	38.40	-	-
1975	-	-	24.00	-	-
1976	-	-	31.20	-	-
1977	-	-	33.60	-	-
1978	-	-	37.30	28.00	16.00
1979	-	-	34.80	-	-
1980	-	-	25.20	-	-
1981	-	-	24.00	28.00	18.00
1982	18.48	-	-	-	-
1983	18.12	-	-	-	18.00
1984	22.68	-	-	-	-
1985	10.56	40.37	-	-	-
1986	17.76	53.72	-	-	-
1987	15.24	51.02	-	-	-
1988	11.96	49.80	-	-	-
1989	-	47.74	-	-	-
1990	-	49.73	-	-	-
Average	16.40	48.73	33.28	29.75	20.20
Std. Err.	4.16	4.15	6.83	2.49	3.60

Sources: Argentina: Ministerio de Trabajo y Seguridad Social, DNRHyE-Dept. Estadísticas Laborales. Brazil: "Mercado de Trabalho: Indicadores Conjunturais", Ministério do Trabalho e Previdência Social. USA: "Bulletin of Labor Statistics", BLS, June 1982. Germany and Japan: "Economic Development and Structural Change", OECD, 1985

Both Germany and Japan, as well as the former series of the BLS, collect labor data using the same methods as Brazil. The Brazilian data presented in Table 1 merit several comments. First, the Brazilian labor turnover rate on average seems to have been greater than in other countries. Second, Brazil shows a high variance of labor turnover, but not greater than that in the United States. Japan shows the lowest average labor turnover rate, yet also displays a standard error close to that in Brazil. Serious problems of comparability of data arise in this regard. First, the data for the USA includes the presence of laid-off workers who may be recalled at some point in time. This possibility increases the measured labor turnover rate significantly. A worker who is laid off will probably find a temporary job and will be counted twice in the turnover data. To avoid

this confusion, we have used only new employment, which is closer to the data collected for Brazil. Another problem is that these data define labor turnover as the hiring rate per employed worker. Rapidly-growing economies, with expanding manufacturing sectors, should present a higher labor turnover rate with this measurement than stagnating economies - which is not the type of labor turnover which concerns us in this paper. For example, industrial output in Brazil during this period grew at a modest 0.3 percent per year and employment in this sector grew somewhat faster at 2.3 percent per year.

In summary, it seems that labor turnover rates in Brazil tend to be higher than in several developed countries (in this case Germany and Japan), but are comparable to turnover rates in the United States.[4] What remains significant is that though Brazil has several job security provisions, it still presents high turnover rates.

4. THE SECTORAL BEHAVIOR OF LABOR TURNOVER

Labor turnover rates in Brazil show reasonable conformity across sectors. Most of the sectors are very sensitive to the business cycle and are significantly pro-cyclical. Charts 4-6 present the average one year seasonal-difference index of turnover for nine sectors compared to the average turnover of the same nine sectors as a whole. The data were previously normalized, subtracting the mean and dividing by the standard error. Points on the first and third quadrant in the graph mean that, on average, sectors are moving in the same direction with the economy. Points in the second and fourth quadrants indicate sectors which do not conform with the average. Charts 7-9 show the same relation to the minimum index. The picture which emerges is nearly the same: sectors seem to move in unison. These charts are not affected by seasonality, since we accounted for seasonality effects by taking seasonal differences. The trend component, nevertheless, could be affecting the results. Yet, we believe this is unlikely, since it does not seem to be exogenous; rather, it is mainly due to the business cycle.

[4] It is interesting to note that the United States presents high rates of turnover compared to other industrialized countries. The following quotation taken from The Economist reveals the changes suffered currently: "Even in America where job mobility has been highest, many employees expect to spend their entire working life with a single company. Studies in the early 1980's showed that on the basis of past behavior, 25% of American workers were in jobs that would last 20 years or more. For workers over 30 years old, that figure was 40% longer and job tenure was probably much higher for employees of the country's biggest and most stable companies." The Economist, April 3, 1993.

CHART 4

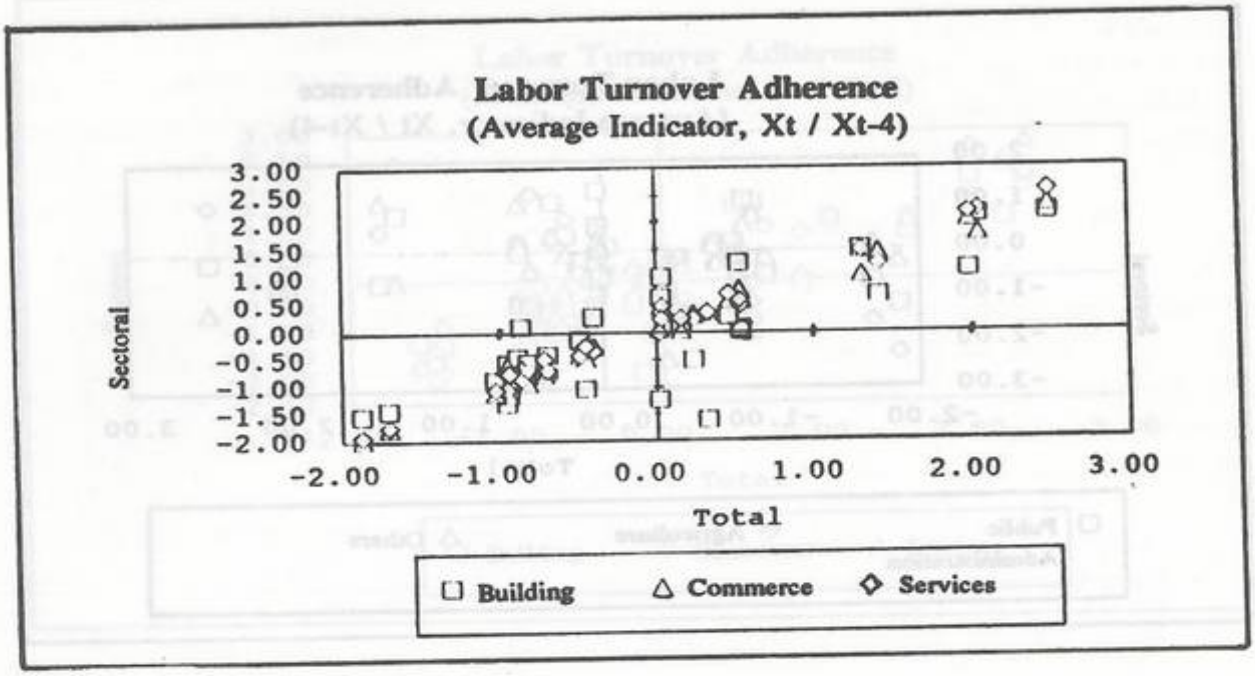


CHART 5

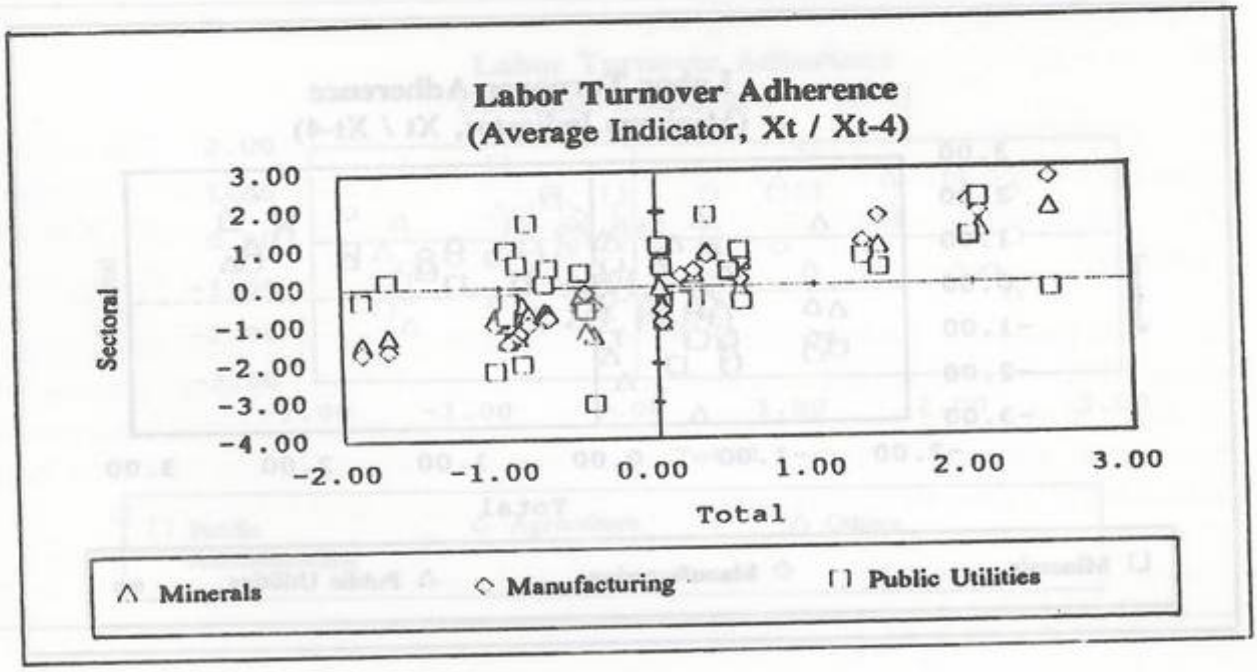


CHART 6

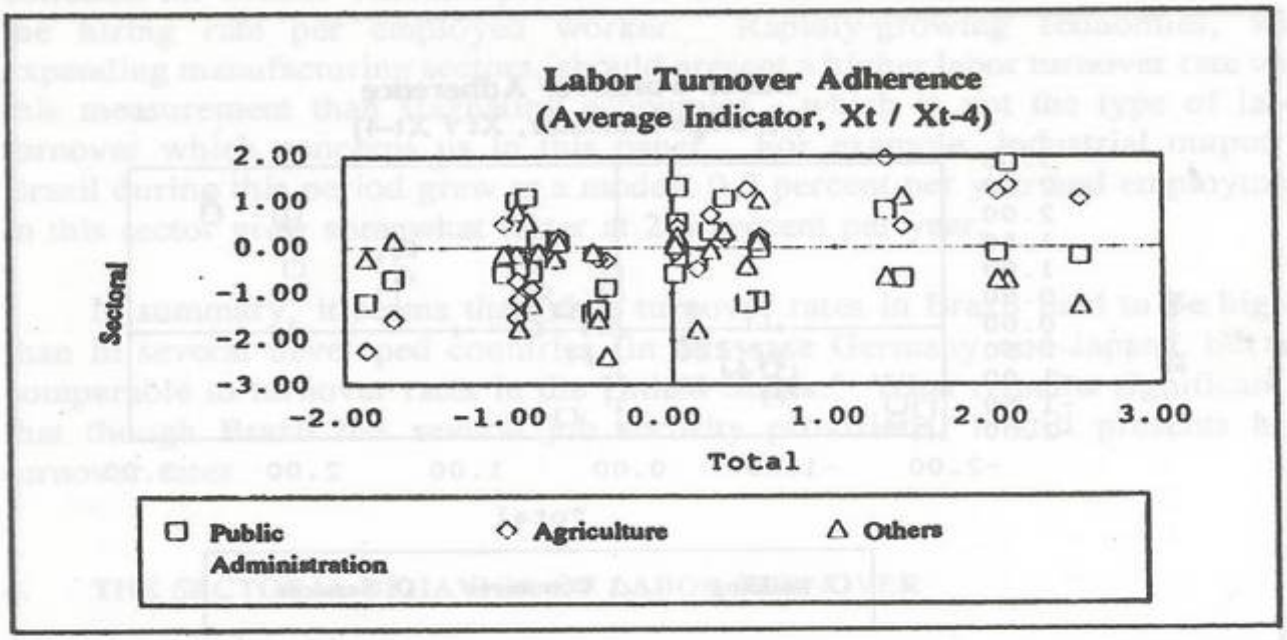


CHART 7

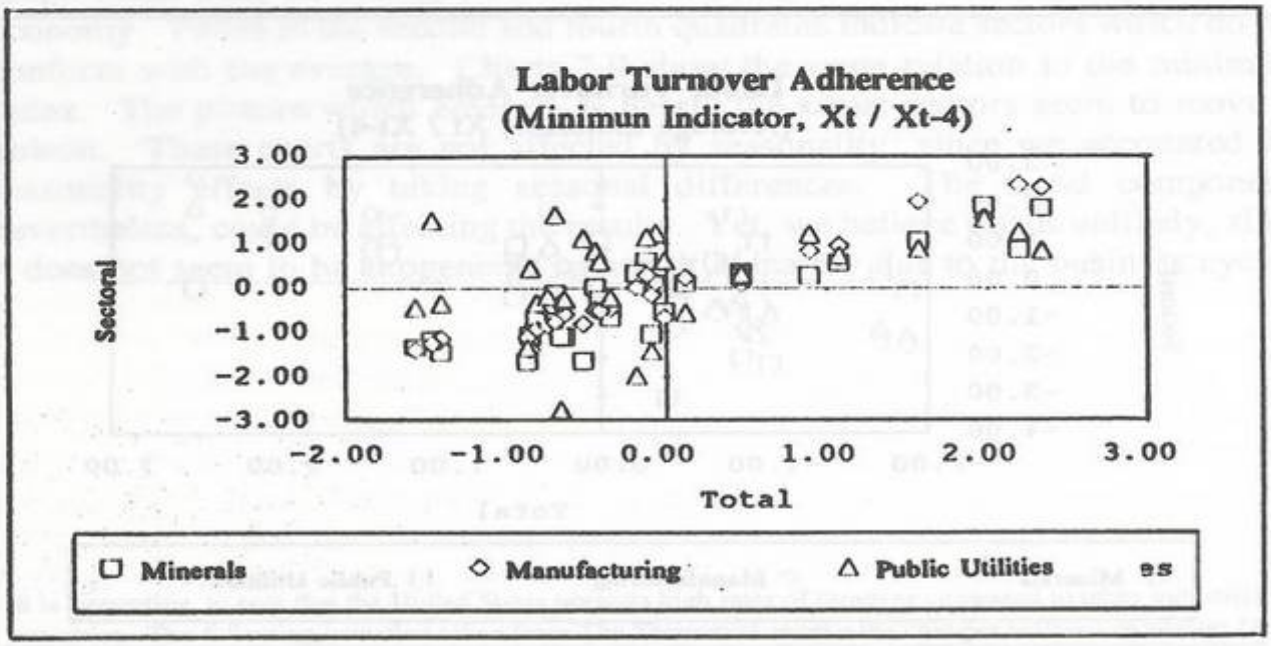


CHART 8

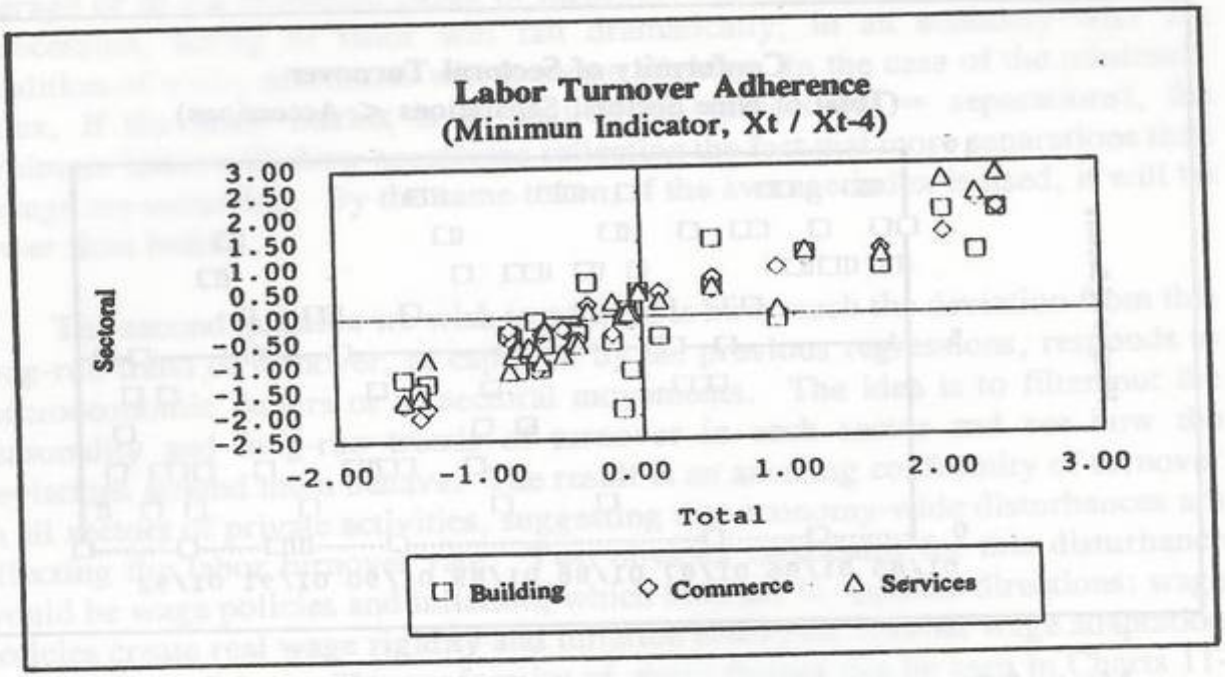


CHART 9

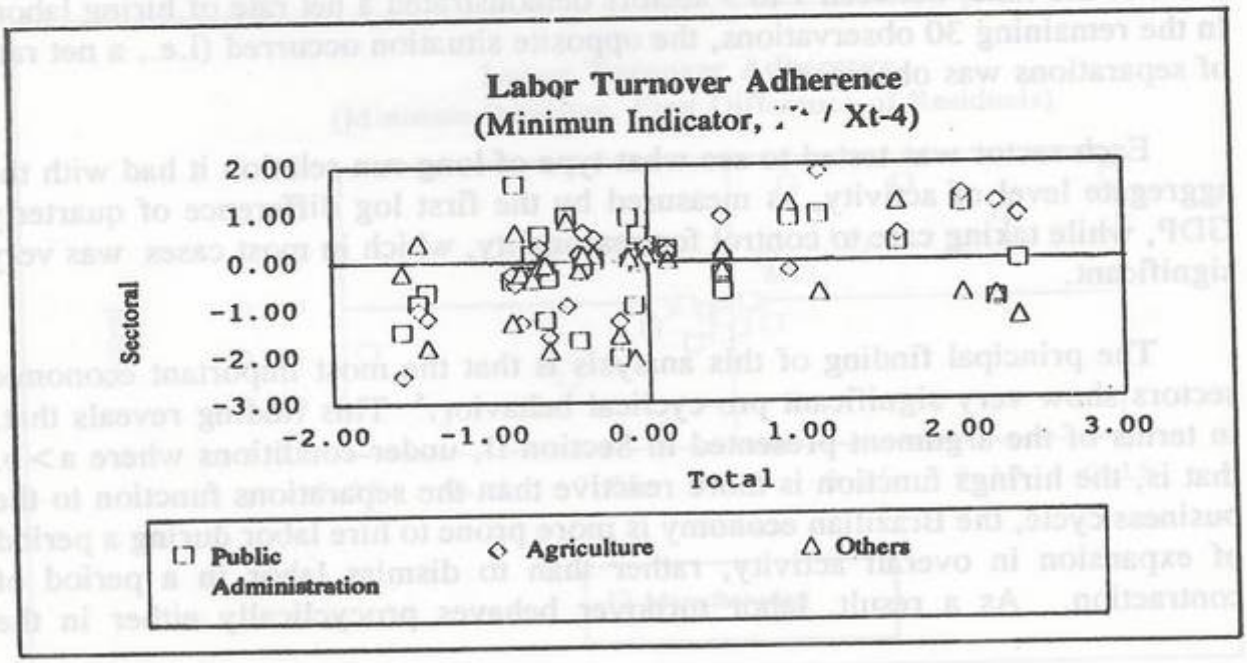
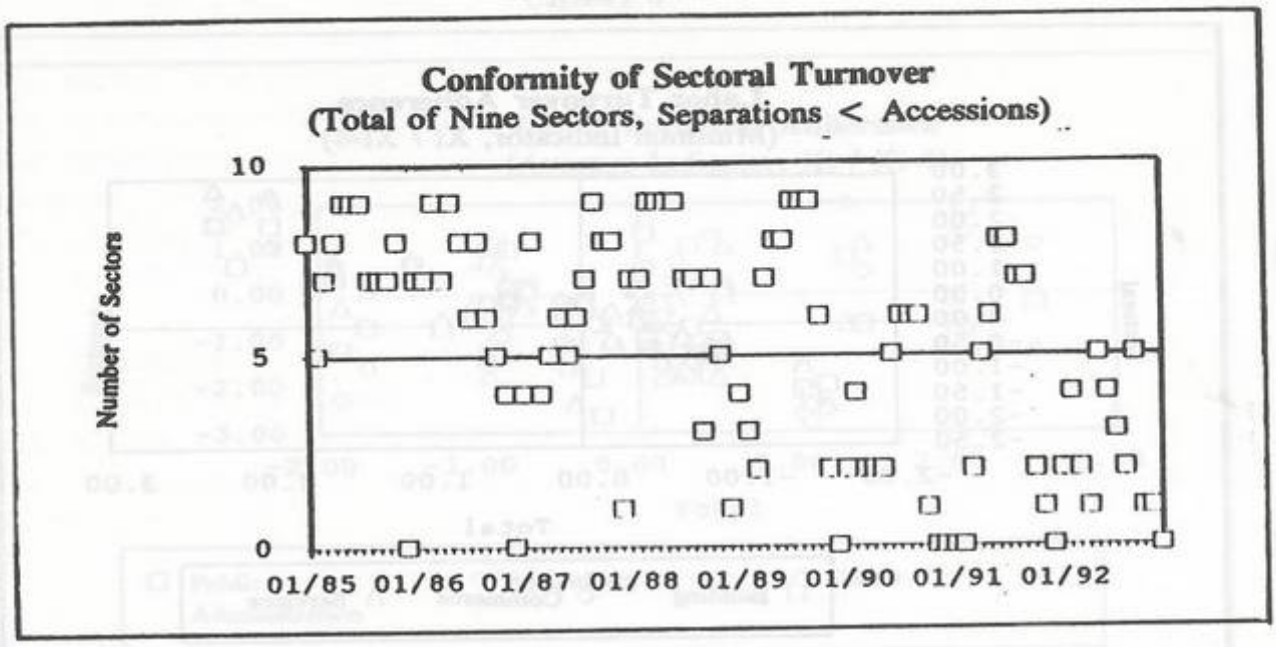


CHART 10



Most of the sectors examined maintained the same relative position in the labor market for every month during the sample period of 84 months. Chart 10 shows the number of sectors which experienced net hiring (separations < accessions) in each month of the sampling period. Of the 84 observations, only 25 show sectors in which about half of the firms demonstrated a positive net rate of separations and the other half demonstrated a positive net rate of accesions. Most of the time, between 7 to 9 sectors demonstrated a net rate of hiring labor. In the remaining 30 observations, the opposite situation occurred (i.e., a net rate of separations was observed).

Each sector was tested to see what type of long-run relation it had with the aggregate level of activity, as measured by the first log difference of quarterly GDP, while taking care to control for seasonality, which in most cases was very significant.

The principal finding of this analysis is that the most important economic sectors show very significant pro-cyclical behavior.[5] This finding reveals that, in terms of the argument presented in Section II, under conditions where $a > b$, that is, the hirings function is more reactive than the separations function to the business cycle, the Brazilian economy is more prone to hire labor during a period of expansion in overall activity, rather than to dismiss labor in a period of contraction. As a result, labor turnover behaves procyclically either in the

[5] It should be noted that all these sectors are formal sectors or registered sectors of the Brazilian economy. Therefore expansions of employment in these formal sectors may have their counterparts in contractions of employment in the informal sector. The regressions referred are reported in the Appendix.

average or in the minimum index of turnover. For example, at the beginning of a recession, hiring of labor will fall dramatically; in an economy with the condition of a>b, dismissals will increase slightly. In the case of the minimum index, if the labor market is in equilibrium (accessions = separations), the minimum index will show accessions reflecting the fact that more separations than hirings are occurring. By the same token, if the average index is used, it will be lower than before.

The second question we wish to address is how much the deviation from this long-run trend of turnover, as captured by the previous regressions, responds to macroeconomic factors or to sectoral movements. The idea is to filter out the seasonality and long-run trends of turnover in each sector and see how the deviations around them behave. The result is an amazing conformity of turnover in all sectors of private activities, suggesting that economy-wide disturbances are affecting the labor turnover rate. Two obvious candidates for this disturbance would be wage policies and inflation, which both act in opposite directions: wage policies create real wage rigidity and inflation eases real internal wage adaptation to market conditions. The conformity of these factors can be seen in Charts 11-14.

CHART 11

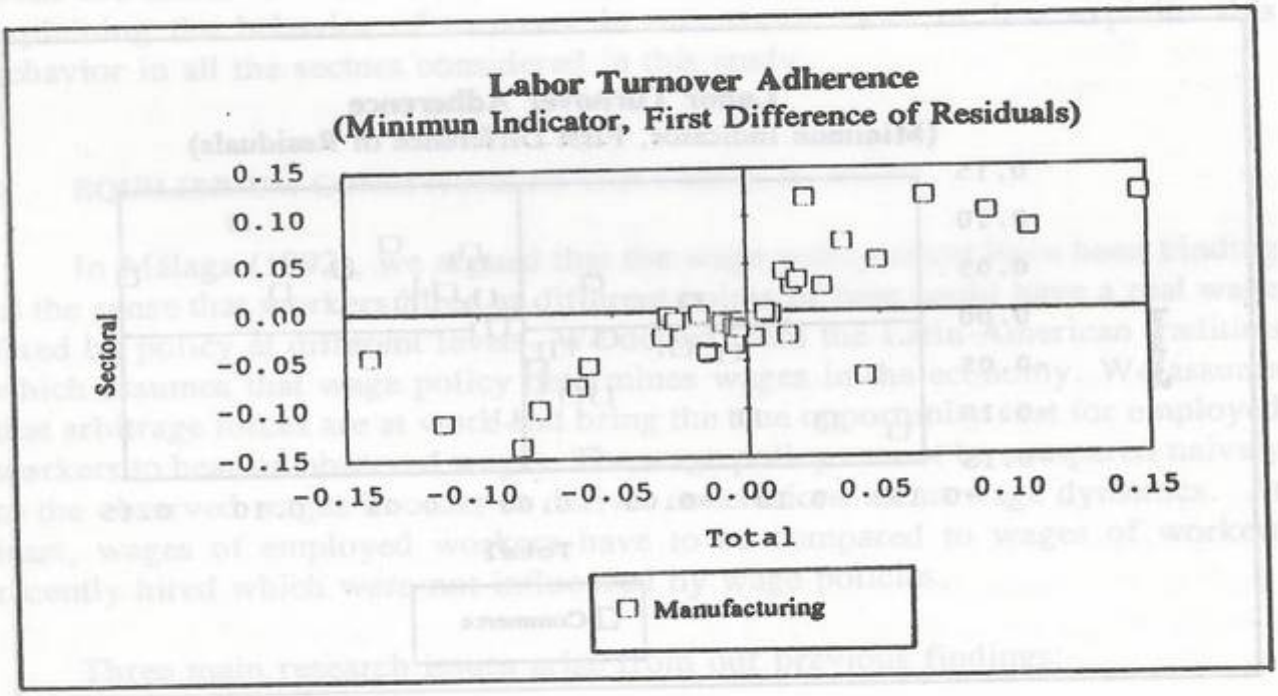


CHART 12

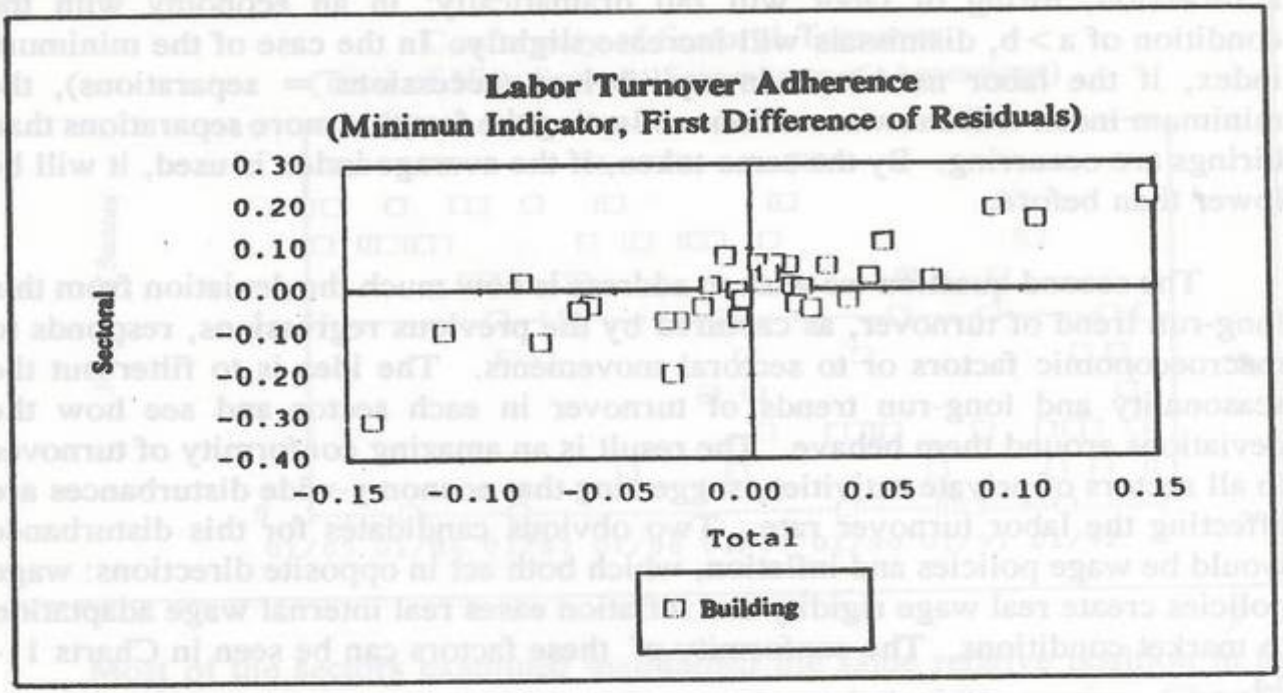


CHART 13

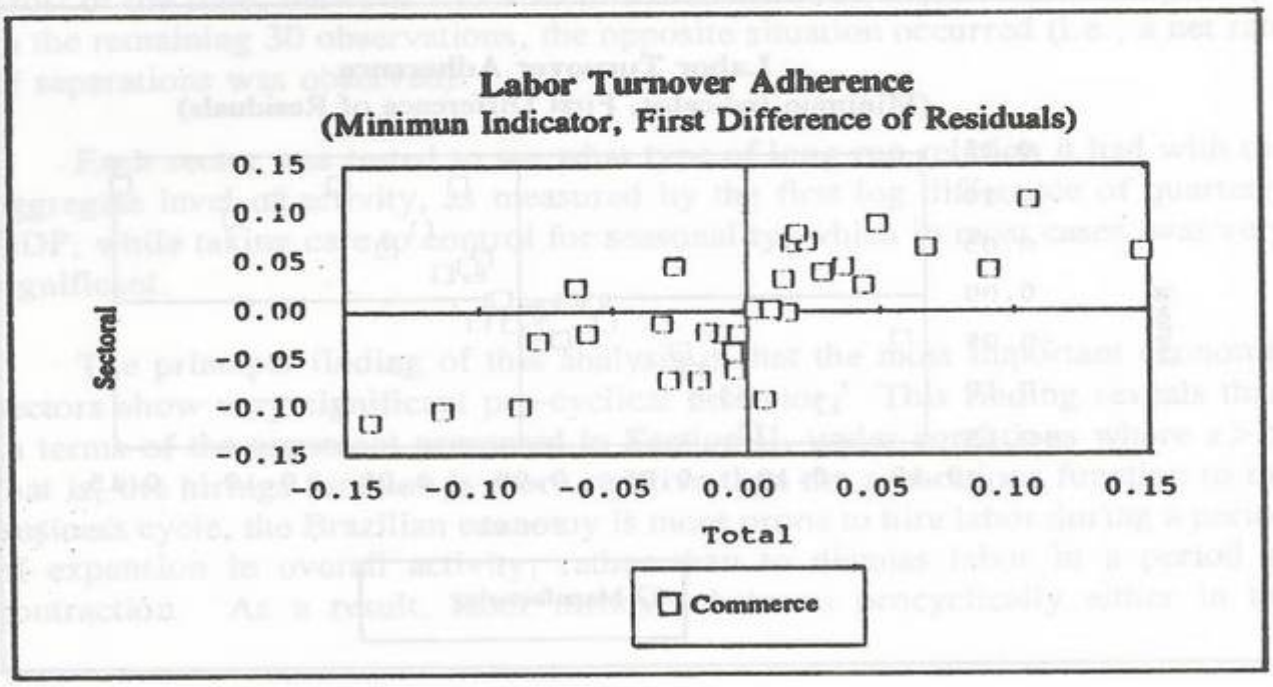
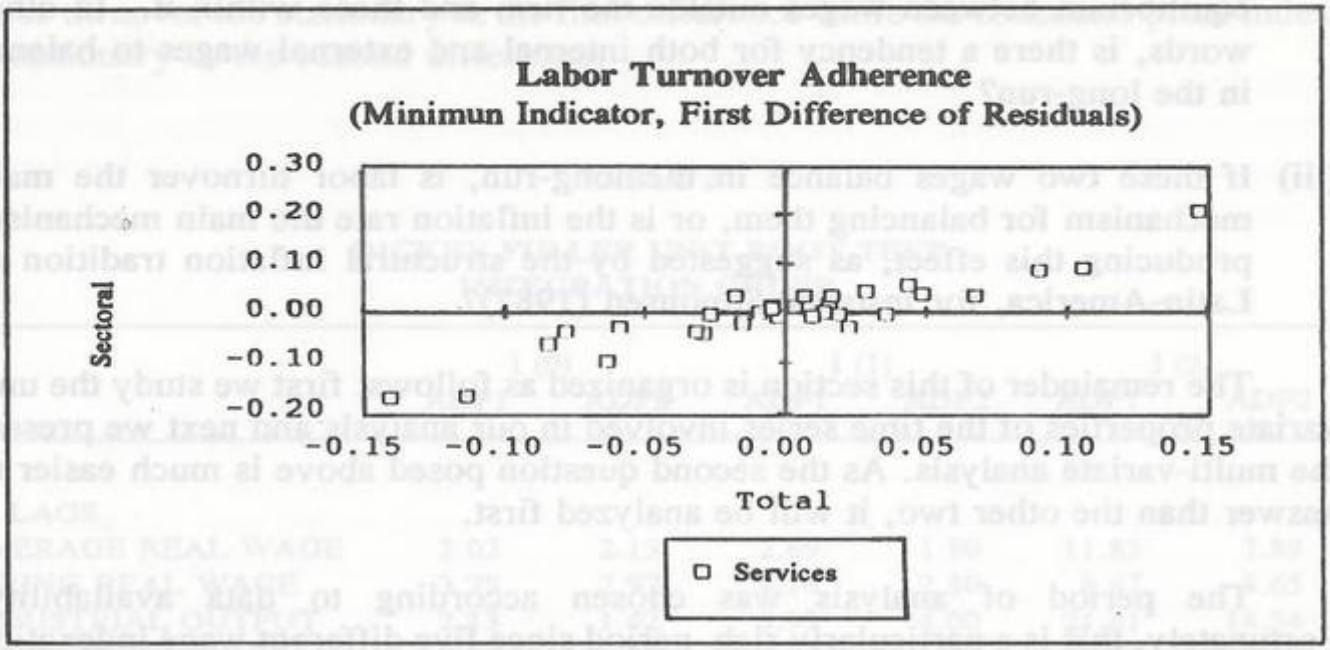


CHART 14



The main conclusion of this sectoral comparison is that not only have all sectors behaved pro-cyclically, but have also demonstrated long-run conformity between them - more importantly for our present purposes, conformity is also present for short-run deviations. Furthermore, underlying factors other than the business cycle seem to be present, since filtering the effects of the business cycle from the series does not remove conformity among sectors. In other words, explaining the behavior of turnover in one sector more or less explains this behavior in all the sectors considered in this study.

5. EQUILIBRIUM CONDITIONS IN THE LABOR MARKET

In Málaga (1992), we argued that the wage policy could have been binding in the sense that workers hired at different points of time could have a real wage fixed by policy at different levels. We depart from the Latin-American tradition which assumes that wage policy determines wages in the economy. We assume that arbitrage forces are at work and bring the true opportunity cost for employed workers to bear on observed wages. The wage policy cannot be compared naively to the observed wages in order to derive conclusions about wage dynamics. At least, wages of employed workers have to be compared to wages of workers recently hired which were not influenced by wage policies.

Three main research issues arise from our previous findings:

(i) Do turnover rates respond to wage differentials (in particular, to the relative cost of workers recently hired versus those who have worked longer in 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 internal and external 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 is the inflation rate the main mechanism producing this effect, as suggested by the structural inflation tradition of Latin-America, for instance Simonsen (1987)?

The remainder of this section is organized as follows: first we study the univariate properties of the time series involved in our analysis and next we present the multi-variate analysis. As the second question posed above is much easier to answer than the other two, it will be analyzed first.

The period of analysis was chosen according to data availability. Fortunately, this is a particularly rich period since five different wage indexation regimes were introduced between 1986 and 1992.

Time series analyses must be performed carefully in order to avoid spurious correlation amongst the variables. To test for the integration order of the variables, we 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 straightforward: a low number of lags leads to invalid statistics due to remaining auto-correlation in the residuals, whereas a high number reduces 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 in our study, the test was performed using 12, 8 and 6 lags. To obtain 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 (these can be obtained from the author upon request). Recently, it has become widely recognized that unit root tests have low explanatory power and that their results may conflict with visual inspection.[6] Table 2 below summarizes the results of the ADF test. As can be seen, the inclusion of 12 lags (in order to take into account the auto-correlation of residuals), leads to rejection of the null hypothesis of unit-roots in the second difference for the real variables and the nominal variables are not stationary even in the third difference. These results conflict with previous tests using Brazilian time series data, which suggest that nominal time series data tend to be integrated at an order 2, while real time series data are integrated at an order 1 or 0 (see, for example, Valls Pereira, 1988). On the other hand, performing the tests with 8 and 6 auto-regressive terms confirms

[6] For a discussion of the problems of unit root tests, see Maddala(1992).

these previous results: average real wage, hiring real wage, industrial output and labor turnover are stationary in the first difference while the consumer price index is stationary in the second difference.

TABLE 2

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

$$ADF1: \Delta Y_t = \beta_0 + \beta_1 T + \alpha Y_{t-1} + \sum_{i=1}^{n} \mu_i \Delta Y_{t-i} \quad n = 12, 8 \text{ and } 6$$

$$ADF2: \Delta Y_T = \alpha Y_{t-1} + \sum_{i=1}^{n} \mu_i \Delta Y_{t-i} \quad n = 12, 8 \text{ and } 6$$

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

5.1. A Test of Equilibrium Wages

Wages inside the firm should converge with market wages in the model studied. This 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 means that the firm has an average wage equal to the market wage in the past:

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

Where $W_{a,0}$ is the average wage at the firm at time 0 and $W_{h,0}$ is the hiring wage or market wage at instant 0. Suppose at moment 1 there is a once-for-all decrease in W_h. Since regulations prevent nominal wage reductions for workers already employed, and indexation assures them of correction for inflation, a real wage rigidity is present which is solved by replacing labor. Assuming a fraction h of currently employed workers is dismissed, this fraction will be less than the one indicated by the technical and institutional reasons discussed above. Suppose fraction h is hired at the new wage, holding employment constant. In any moment t, before the adjustment is completed, the average wage of the firm will be:

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

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

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

The greater h, the faster the process of adjustment is since h is a function of the wage differential, the greater $W_{h,0}/W_{h,1}$, then the higher h also will be.[7] When the opposite case occurs, workers will leave the firm and firms should try to follow the market with wage adjustments above the inflation rate; otherwise, h will rise because workers will search for jobs which offer $W_{h,1} > W_{h,0}$.

Of course, the analysis must be more sophisticated to allow for technical and institutional problems which prevent labor force replacement and due to workers' reluctance to change jobs. However, if labor turnover is to be used as a device

[7] In fact, this depends upon the wage differential, as well as the length of time that the wage differential is expected to last. This argument is developed in Málaga (1993). Based upon the adjustment cost of employment, it shows that marginal costs of firing are equated to the present value gains of the wage differential, and this becomes greater as W0/W1 increases and as this differential lasts longer.

for cost adjustment, both wages should converge to equilibrium.[8] However, these wages will not reach equivalent levels, as most economists would expect (such as with forward and future spot exchange rates), however wages also should not diverge too far. The obvious method in this case would be to test for the co-integration 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 co-integration in levels. The results obtained in logs for these two wages in real terms are:

$$\log(W_a) = \underset{(16.24)}{0.6459}\ \log(W_h) \underset{(8.61)}{-1.1056} \quad (1)$$

$R^2 = 0.7512$ DW $= 0.7762$ Std. Err. $= 0.0611$
ADF(1 lag) $= -5.44$ Deg. Free. $= 86$

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

How do these two series converge? At least three alternative hypotheses could be considered: (1) wages are perfectly flexible, so they adjust at any time to market conditions; (2) this problem is resolved by labor turnover, as discussed previously; or (3) given a wage policy, usually based on past inflation, the 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 co-integrate but they should also show an absence of serial correlation in the residuals. The Durbin Watson statistics in equation (1) show evidence of first order serial correlation, revealing that any noise in equation (1) vanishes in several months. 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 obtain an error-correction term for labor turnover, a co-integrating equation for turnover was applied. In other words, 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 exhibits

[8] It was shown that under the assumption of specific human capital and the Cobb-Douglas production function, both wages do not balance due to the impossibility of replacing all experienced workers. See Málaga (1992).

strong seasonality, as evidenced by the significance of seasonal dummies and also verified by simple inspection of the correlograms, seasonal dummies were included for the co-integrating equation and also for the short-run regression. The co-integrating regression obtained for labor turnover was:

(2) log(LT) = 2.06 y -8.42 SEAS1 -8.41 SEAS2 -8.50 SEAS3
(11.00) (-9.63) (-9.68) (-9.59)

-8.63 SEAS4 -8.71 SEAS5 -8.76 SEAS6 -8.74 SEAS7 -8.82 SEAS8
(-9.63) (-9.59) (-9.59) (-9.61) (-9.64)

-8.79 SEAS9 -8.94 SEAS10 -8.45 SEAS11 -8.31 SEAS12
(-9.79) (-10.28) (-9.73) (-9.63)

R^2 = 0.7384 DW = 0.8838 Std. Err. = 0.1386
ADF(1 lag,) = -4.13 Deg. Free= 73

We propose the following error correction system:

(3) $$\Delta \log(LT) = a_0 \Delta \log(W_a) + a_2 \Delta \log(W_h) + a_3 \Delta \log(y) + a_4 EC_{LT} + Seasonals$$

(4) $$\Delta \log(W_a) = \beta_0 \Delta \log(LT) + \beta_1 \Delta^2 \log(P) + \beta_2 \Delta \log(W_h) + \beta_3 \Delta \log(y) + \beta_4 EC_{W_a}$$

Both EC_{Wa} and EC_{LT} are the residuals from equations (1) and (2) respectively. The system formed by (3) and (4) is over-identified but, as is widely known, Two Stage Least Squares provide optimal weights for estimating instrumental variables. Results obtained by 2SLS are as follows:

Δ log(LT) = (3')

1.912 Δ log (W_a) - 1.055 Δ log (W_h)
(2.37) (2.26)
+1.46 Δ log (y) - 0.504 EC_{LTt-1} + seasonals
(4.83) (-3.27)

R^2 = 0.6743 DW = 1.75 Std. Err.= 0.143
Deg.Free.= 68

Δ log (W_a) = (4')

0.2579 Δ^2 log (p) - 0.087 Δ log (LT)
(3.28) (-3.19)
+0.08000 Δ log (y) + 0.5352 Δ log (W_h)
(1.13) (6.87)
-0.4573 EC_{wat-1}

R^2 = 0.549 DW = 1.73 Std. Err.= 0.0436
Deg.Free.= 79

Equation (3') shows that, in fact, labor turnover responds positively to internal wages and negatively to hiring wages. Table 1, in Appendix 2, presents the results of an OLS estimation. In this table, it is apparent that this result depends crucially upon the assumption that the first difference of $\log(W_e)$ is an endogenous variable. Under the OLS estimation, neither variable is significant and the co-efficient of $\log(W_e)$ also has the wrong sign. This result is interesting because it confirms the hypothesis that labor turnover and average real wages are endogenous. Chart 13, which plots labor turnover against average real wages, shows a large concentration of observations in the second and third quadrant. We argue that the use of the 2SLS must have reduced the simultaneity bias implied by both equations.

Equation (4') offers evidence that both kinds of shocks, labor turnover and the acceleration of inflation, affect short-run wages. Nevertheless, inflation seems to affect them positively while labor turnover should reduce the rate at which internal wages rise. The acceleration of inflation, therefore, seems to be associated with real wage growth rather than real wage reduction; this may be in accordance with the new theories of wage-price spiral suggested by Blanchard (1986) and Leiderman and Helpman (1990). This evidence confirms that presented by Kiguel and Liviatan (1991).[9] However, the principal image that emerges, from simple inspection of Chart 17, in Appendix 1, is that real wages are independent of the rate of inflation as is expected by super neutrality (homogeneity of degree zero) of the supply and demand for labor, $\beta_1 = 0$ in equation 4. Nevertheless, the period under analysis was subject to several price freezes that came along with the stabilization plans. As can be seen in Chart 19, in Appendix 1, the positive association is stronger in the outset of stabilization plans. Usually wage freezes are more effective to avoid real wage increases, and therefore real wages fall when inflation falls. Afterwards, a period of inflation and real wage rise follows as the price level settles on a path consistent with monetary equilibrium and wages return to their steady state level.[10]

The inclusion of accelerated inflation in excess of the wage policy, instead of the acceleration of inflation by itself, was not significant. Furthermore, it did not affect the other variables significantly and served to increase the standard error of the regression.

With respect to auto-correlation of residuals, the Durbin-Watson statistic is in the undetermined region to reject first order auto-correlation. However, the correlograms of the residuals of both equations do not show any particular structure.

[9] Kiguel and Liviatan(1991) do not appear concerned about spurious results and their regressions will hardly pass the usual tests applied to time series data.

[10] See Marconi(1993) for the discussion of the aftermath of price freezes.

The most significant finding of this study is that the growth of real market wages (considered here as hiring wages), is quickly transmitted to internal wages. Labor turnover, in turn, seems to act in the expected direction - labor turnover tends to decrease real average wages. Although the system analyzed here does not fit the data with the accuracy desired, the effects of wages on the rate of labor turnover seem to be present. These results confirm what is known among labor economists in Brazil as the *excess of flexibility* in the Brazilian labor market. (Amadeo et.al., 1993).

The equations 3' and 4' also show strong association between labor turnover and industrial output, not only in the long-run (see equation 2) but also in the short-run (see equation 4'). Since the period of analysis was one of enormous instability, this instability seems to have been transmitted dramatically to the labor market. Equation 4' suggests that a 1 percent fluctuation in the growth rate of output is transmitted as more than 1 percent to the turnover rate. Given the high rates of turnover observed, this can be considered as one of the social costs of macroeconomic instability.

6. CONCLUSIONS

The evidence presented in this paper suggests that labor turnover reacts to wage differentials and that, in turn, labor turnover has an impact on real wages. Even if the models presented here are unable to explain the totality of short-run movements of labor turnover and average wages, the particular effects analyzed seem to be in the correct direction and pass the usual hypothesis tests.

Average real wages and hiring wages were found to co-integrate, suggesting that market forces operate despite the wage policy, to balance both wages. Finally, the evidence presented supports the view that an acceleration of inflation is not associated with a fall in real wages. On the contrary, these factors appear to be unrelated, and in some cases the acceleration of inflation appears to be associated with real wage increases.

ANEXO

1. AVERAGE OF HIRING AND FIRING - LOG OF FIRST DIFFERENCE

DEPENDENT VARIABLE 34 TOTAL
FROM 1985: 2 UNTIL 1992: 4
OBSERVATIONS 31 DEGREES OF FREEDOM 26
R**2 .51360163 RBAR**2 .43877111
SSR .14924456 SEE .75763945E-01
DURBIN-WATSON 1.48920368
Q(15)= 11.8995 SIGNIFICANCE LEVEL .686623

NO.	LABEL	VAR	LAG	COEFFICIENT	STAND. ERROR	T-STATISTIC
1	GDP	33	0	1.385743	.4361914	3.176916
2	SEASONS	64	-3	.1302953	.3727317E-01	3.495685
3	SEASONS	64	-2	-.1239428	.4953265E-01	-2.502244
4	SEASONS	64	-1	.6074603E-02	.2806571E-01	.2164422
5	SEASONS	64	0	-.2572146E-01	.3422620E-01	-.7515136

DEPENDENT VARIABLE 36 MANUFACTURING
FROM 1985: 2 UNTIL 1992: 4
OBSERVATIONS 31 DEGREES OF FREEDOM 26
R**2 .59670497 RBAR**2 .53465959
SSR .21834353 SEE .91639664E-01
DURBIN-WATSON 1.29165544
Q(15)= 17.3939 SIGNIFICANCE LEVEL .295868

NO.	LABEL	VAR	LAG	COEFFICIENT	STAND. ERROR	T-STATISTIC
1	GDP	33	0	2.228990	.5275917	4.224839
2	SEASONS	64	-3	.1733491	.4508346E-01	3.845070
3	SEASONS	64	-2	-.1837642	.5991181E-01	-3.067244
4	SEASONS	64	-1	-.7572616E-02	.3394665E-01	-.2230741
5	SEASONS	64	0	-.2292284E-01	.4139802E-01	-.5537182

DEPENDENT VARIABLE 38 BUILDING
FROM 1985: 2 UNTIL 1992: 4
OBSERVATIONS 31 DEGREES OF FREEDOM 26
R**2 .31581889 RBAR**2 .21056026
SSR .33881338 SEE .11415465
DURBIN-WATSON 1.76630786
Q(15)= 5.08660 SIGNIFICANCE LEVEL .991367

NO.	LABEL	VAR	LAG	COEFFICIENT	STAND. ERROR	T-STATISTIC
1	GDP	33	0	.6640983	.6572160	1.010472
2	SEASONS	64	-3	.8653159E-01	.5616003E-01	1.540804
3	SEASONS	64	-2	-.9360720E-01	.7463157E-01	-1.254257
4	SEASONS	64	-1	.6400839E-01	.4228701E-01	1.513665
5	SEASONS	64	0	-.6180589E-01	.5156912E-01	-1.198506

DEPENDENT VARIABLE 39 COMMERCE
FROM 1985: 2 UNTIL 1992: 4
OBSERVATIONS 31 DEGREES OF FREEDOM 26
R**2 .42808752 RBAR**2 .34010098
SSR .11087717 SEE .65303190E-01

DURBIN-WATSON 1.81197699
Q(15)= 11.3352 SIGNIFICANCE LEVEL .728491

NO.	LABEL	VAR	LAG	COEFFICIENT	STAND. ERROR	T-STATISTIC
1	GDP	33	0	1.246593	.3759663	3.315704
2	SEASONS	64	-3	.8396906E-01	.3212685E-01	2.613672
3	SEASONS	64	-2	-.1372640	.4269366E-01	-3.215090
4	SEASONS	64	-1	.2384323E-01	.2419066E-01	.9856377
5	SEASONS	64	0	.1985977E-01	.2950058E-01	.6731993

DEPENDENT VARIABLE 40 SERVICES
FROM 1985: 2 UNTIL 1992: 4
OBSERVATIONS 31 DEGREES OF FREEDOM 26
R**2 .52086667 RBAR**2 .44715385
SSR .14154986 SEE .73784994E-01
DURBIN-WATSON 1.76010331
Q(15)= 7.72688 SIGNIFICANCE LEVEL .934265

NO.	LABEL	VAR	LAG	COEFFICIENT	STAND. ERROR	T-STATISTIC
1	GDP	33	0	1.139140	.4247981	2.681602
2	SEASONS	64	-3	.1373005	.3629959E-01	3.782425
3	SEASONS	64	-2	-.1071521	.4823886E-01	-2.221282
4	SEASONS	64	-1	.1062309E-01	.2733263E-01	.3886596
5	SEASONS	64	0	-.3589815E-01	.3333221E-01	-1.076981

2. MINIMUM OF HIRING AND FIRING - LOG OF FIRST DIFFERENCE

DEPENDENT VARIABLE 54 TOTAL
FROM 1985: 2 UNTIL 1992: 4
OBSERVATIONS 31 DEGREES OF FREEDOM 26
R**2 .69579942 RBAR**2 .64899933
SSR .11046942 SEE .65183002E-01
DURBIN-WATSON 2.10236443
Q(15)= 14.9095 SIGNIFICANCE LEVEL .457956

NO.	LABEL	VAR	LAG	COEFFICIENT	STAND. ERROR	T-STATISTIC
1	GDP	33	0	1.932105	.3752743	5.148514
2	SEASONS	64	-3	.1713365	.3206772E-01	5.342957
3	SEASONS	64	-2	-.1825058	.4261508E-01	-4.282657
4	SEASONS	64	-1	.1001063E-02	.2414614E-01	.4145851E-01
5	SEASONS	64	0	-.1664957E-01	.2944628E-01	-.5654217

DEPENDENT VARIABLE 56 MANUFACTURING
FROM 1985: 2 UNTIL 1992: 4
OBSERVATIONS 31 DEGREES OF FREEDOM 26
R**2 .82632895 RBAR**2 .79961032
SSR .13637809 SEE .72424520E-01
DURBIN-WATSON 1.47019624
Q(15)= 16.4034 SIGNIFICANCE LEVEL .355761

NO.	LABEL	VAR	LAG	COEFFICIENT	STAND. ERROR	T-STATISTIC

```
 1     GDP     33  0  3.167642       .4169655       7.596893
 2   SEASONS   64 -3   .2613450       .3563029E-01   7.334910
 3   SEASONS   64 -2  -.2780203       .4734941E-01  -5.871673
 4   SEASONS   64 -1  -.1182998E-01   .2682866E-01  -.4409457
 5   SEASONS   64  0  -.2902616E-01   .3271762E-01  -.8871721

DEPENDENT VARIABLE  58    BUILDING
FROM 1985: 2 UNTIL 1992: 4
OBSERVATIONS        31    DEGREES OF FREEDOM     26
R**2          .36018865   RBAR**2        .26175613
SSR           .33415150   SEE            .11336658
DURBIN-WATSON 2.17553356
Q( 15)=   10.4031     SIGNIFICANCE LEVEL  .793649
NO.   LABEL   VAR LAG  COEFFICIENT   STAND. ERROR   T-STATISTIC
***   *******  *** ***  ************  ************  ************
 1     GDP     33  0  1.070042       .6526788       1.639463
 2   SEASONS   64 -3   .1122658       .5577233E-01   2.012929
 3   SEASONS   64 -2  -.1181337       .7411635E-01  -1.593895
 4   SEASONS   64 -1   .3985764E-01   .4199508E-01   .9491026
 5   SEASONS   64  0  -.6128119E-01   .5121311E-01  -1.196592

DEPENDENT VARIABLE  59    COMMERCE
FROM 1985: 2 UNTIL 1992: 4
OBSERVATIONS        31    DEGREES OF FREEDOM     26
R**2          .57795163   RBAR**2        .51302111
SSR           .11520939   SEE            .66566735E-01
DURBIN-WATSON 1.70239193
Q( 15)=   13.0484     SIGNIFICANCE LEVEL  .598561
NO.   LABEL   VAR LAG  COEFFICIENT   STAND. ERROR   T-STATISTIC
***   *******  *** ***  ************  ************  ************
 1     GDP     33  0  1.728275       .3832408       4.509632
 2   SEASONS   64 -3   .1386408       .3274847E-01   4.233505
 3   SEASONS   64 -2  -.1826134       .4351973E-01  -4.196104
 4   SEASONS   64 -1   .1507287E-01   .2465873E-01   .6112590
 5   SEASONS   64  0   .2019152E-01   .3007138E-01   .6714531

DEPENDENT VARIABLE  60    SERVICE
FROM 1985: 2 UNTIL 1992: 4
OBSERVATIONS        31    DEGREES OF FREEDOM     26
R**2          .55738991   RBAR**2        .48929605
SSR           .14734998   SEE            .75281517E-01
DURBIN-WATSON 2.34809597
Q( 15)=   22.0227     SIGNIFICANCE LEVEL  .107210
NO.   LABEL   VAR LAG  COEFFICIENT   STAND. ERROR   T-STATISTIC
***   *******  *** ***  ************  ************  ************
 1     GDP     33  0  1.485902       .4334139       3.428368
 2   SEASONS   64 -3   .1487945       .3703583E-01   4.017583
 3   SEASONS   64 -2  -.1453490       .4921725E-01  -2.953213
 4   SEASONS   64 -1   .1377646E-01   .2788700E-01   .4940103
 5   SEASONS   64  0  -.2271198E-01   .3400826E-01  -.6678371
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