A bi-variate probit analysis of Job Turnover in Brazil*

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Abstract

Excessive job turnover can be considered to a large extent an undesirable feature of a particular economy. This follows from considerations such as under-investment in human capital by firms. Understanding the determinants of the rate of turnover in a particular labor market is therefore of great interest, including policy considerations. We propose an econometric analysis of turnover in the Brazilian labor market, based on a bi-variate probit model. Data at the individual worker level is obtained from a comprehensive survey in São Paulo/Brazil (PED/SEADE). Given the nature of the available information, we can only observe directly the case where both the employee and the firm jointly decide to maintain the employment relation. The other three possible cases, quitting/maintaining, staying/firing, and quitting/firing are observationally equivalent. This fact prompts us to estimate the bi-variate probit model within a partial-observability context, which allows us to estimate and identify the probabilities of the joint decisions of quitting or staying on the job on the workers' side, and maintaining or firing the employee on the firms' side, during a given time period. The estimated parameters relate these estimated probabilities to characteristics of the workers, their occupations, and to potential macroeconomic determinants at different points in time.

1 Introduction

The short duration of labor relationships is a dominant feature of the Brazilian labor market. Data on employees in the formal labor market show that 47.3% of them had, in 1989, held their jobs for less than two years. Although this figure decreased in the beginning of the 90s , it rose again in 1993-1995, according to the last issue of PNAD .

Taking the OECD countries as a benchmark, we can see that the percentage of workers with less than two years of job tenure was, in the beginning of the 80s, only 22.3%, on average. Moreover, even the USA, which has the most permissive labor legislation among all the OECD countries, did not show such a high indicator of labor turnover . This evidence put the problem of high labor turnover in Brazil in the spotlight. As a consequence, several studies were done discussing the causes and effects of this problem .

The acknowledged negative aspect of the high labor turnover is that it reflects the low commitment between employers and employees. The evidence suggests that the most common procedure adopted by firms in periods of decreasing production is the dismissal of a significant portion of the labor force. On the other hand, the majority of firms do not seem to be able to induce their employees to keep the same job in periods of expansion.

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This result is, at the very least, inefficient, inasmuch as the breakdown in labor contracts imposes transaction costs on both parties. That is, if a cooperative relationship does not take place, both employer and employee can lose, since the benefits derived from the acquisition of specific skills may be lost.

The emergence of mechanisms that are conducive to cooperation between firms and workers is, however, a complex issue. Regarding the effects of a rise in dismissal costs on the employment level, for instance, Metcalf (1987) emphasizes that very little is known about this subject. There are plenty of contradictory results presented by researchers such as Hamermesh and Gennard. However, it is known that excessive dismissal costs may reduce the labor allocation flexibility, making it difficult to shift the labor force between prosperous and deteriorating sectors.

The consequences of a rise in the functional flexibility of labor over the stability of labor relationships is subject to a major consensus. It is argued that the greater degree of freedom to use the labor force in qualitatively different functions - as well as the greater flexibility of the working day duration -, allow firms to adjust their demand for labor (as a response to changes in the demand for their products) not only by adjustments in the number of employees, but also by adjustments in the number of contracted hours and in the kind of function executed by workers.

In the Brazilian case, in particular, the imposition of dismissal costs has frequently been subject to analysis. Several authors suggest that the FGTS mechanism (a formal insurance in case of wrongful dismissals), which provides a short-term benefit for the worker in case of dismissal, may provide incentives to some workers to force their own dismissal. This problem occurs mainly in the case of workers that earn low wages and do not have career opportunities within the firm. The employers, in turn, aware of this problem, may prefer to fire the employees in advance, avoiding the payment of a high penalty .

This paper aims to bring new information to the debate regarding the problem of labor turnover in Brazil. Based on data from the metropolitan area of São Paulo, it seeks a jont analysis of the determinants of quits and dismissals. This analysis was made possible by the use of information from the monthly employment/unemployment survey (PED) conducted by Fundação SEADE and DIEESE.

The data from PED refer to the individual level, which permitted tests of correlation, by means of a cross-section analysis, taking advantage of the information available on each agent and his jobs. These tests were undertaken by estimation of a partial observability bivariate probit model, which will be presented in Section 3.

Starting from a brief presentation of the main contributions of economic theory to the study of labor turnover, the next section of this article emphasizes not only the contributions of human capital theory for a better understanding of this subject, but also the contributions of the theory of organizations, which breaks with the assumption of perfect competition, admitting the segmentation between firms.

The fourth section presents the estimation results of the bivariate probit model equations, enumerating and justifying the inclusion of each covariate based on the theories presented. It is important to highlight, however, that the estimations done do not aim to test the validity of any of the theories presented in particular. Instead, the objective of the estimations is to identify determinants of the dismissals by taking advantage of the available information as much as possible.The estimation results are stratified by major sectors of economic activity, which allows the comparison between the variables that are statistically significant in the determination of the probability of quit or dismissal in each sector. As to the estimation done only for the set of unskilled laborers, its objective is to find evidence with respect to the hypothesis that the FGTS mechanism generates an incentive for workers that receive low salaries to change jobs with more frequency.

In the last section some final considerations will be presented.

2 Theoretic contributions to the study of labor turnover

As the main contribution of human capital theory, the analysis developed by Gary Becker on the different types of job training deserves some attention. Gary Becker was the first author to formalize the idea that the processes of job training can contain elements of specificity in relation to the firm in which they occur. For this reason, investments in training generally need some mechanism that guarantees investors the continuity of the labor relationship. To Becker, this mechanism is the division of the costs and return from this specific investment.

More precisely, Becker classified the job training programs into two different types: general and specific. General training was defined as that which increases the productivity of the worker, in the same proportion, both in the firm where the training was received and in other firms. Specific training, however, was defined as that which increases the productivity of the worker only in the firm where the training occurred.

Thus, if all training furnished by an enterprise were absolutely specific, the productivity of the worker trained there would be, in any other firm, completely independent of the quantity of training already received. Therefore, it could be thought that the wage paid by the firm furnishing the training would also be independent of the occurrence thereof. In this case, the firm would pay the training costs, but, as a return, it would appropriate all the increase in productivity provided by that training.

Becker, however, rejects this solution by arguing that, earning the same wage in any company, the probability of a worker resigning is not negligible, and, if the firm pays for the training, the worker's leaving interrupts the returns. At the same time, a worker would not risk paying for his own training with no guarantee against a possible dismissal, or breach of wage agreement on the part of the employer. If he were fired, or if the employer did not pay the agreed wage, the worker would lose future gains expected from his investment, since in other firms he will have had no increase in productivity.

The solution to this problem is not trivial. To Becker, given this set of interests involving risk, the balance will be such that employees and firm will divide both the cost of training and the returns resulting from the greater productivity attained through that training .

This arrangement clearly involves an inverse relationship between quantity of investment made in specific training and labor turnover. That is, if in fact the firm and the employee divide the costs and gains of specific training, both have incentives to maintain the work relationship. The longer the relationship, the greater the period of returns on the investment will be and, therefore, both will act in favor of stability.

The idea of dividing the costs of specific training was incorporated to dynamic models that strive to predict the oscillations in the demand for labor - considering that the costs of training assumed by the firms correspond to a portion of the fixed costs of the labor factor . In addition, the idea of specific training inspired the scholars of organizations. Both in classic theory of internal labor markets and in the more recently developed transaction costs economics, the specificity of the abilities acquired in training processes are placed as an important - or even the principal - factor of increasing costs resulting from the end of work relationships.

According to Doeringer and Piore (1971), the formation of internal labor markets (defined as administrative units in which the price and allocation of work are controlled by a set of rules and administrative procedures) can be understood as a result of a natural process, which occurs in competitive labor markets where three persuasive forces,

not traditionally considered in economics, are at work: specific skill, job training, and the internal laws established by custom.

For these authors, all jobs involve specific skills. They argue that the acquisition of this type of skill occurs in processes of informal training, almost automatically, by osmosis, inasmuch as the worker observes his fellow workers and repeatedly executes his functions. This process involves unavoidable costs for the employers and therefore influences them towards lowering labor turnover. On this point, in particular, the argument used by the authors is the same used by Becker: firms want to economize on costs resulting from the breach of a labor relationship that involves specific skills.

Doeringer and Piore, however, indicate very different mechanisms to economize labor turnover costs. According to the theory presented by these authors, the mechanism used by some firms - typically large firms that utilize advanced technology of production - consists in the adoption of a group of rules extremely valued by the workers. Among these rules are those that provide greater job security and more career opportunities within the company, as well as those that privilege seniority (time of service within the company) as a criterion for choosing among possible candidates for a promotion.

Thus the authors suggest that the rules typically adopted in internal labor markets emerge as a consequence of the value that the workers attribute to them, because this value on the part of the workers is, in turn, valued by employers who desire a reduction in the rate of quits. In other words, employers realize that the adoption of rules valued by the workers has the effect of reducing the rate of quits, since leaving a job that offers advantages involves the loss of those benefits. Thus, the rules valued by workers begin to be valued by the employers also.

The economically efficient situation that is created from the formation of an internal labor market does not necessarily maintain its character of efficiency. As a consequence of the third persuasive force mentioned initially, the internal laws established by custom, Doeringer and Piore argue that the internal labor markets are characterized by the rigidity of their rules in face of oscillations in the external labor market. In other words, the rules that are repeated for a long time - and become customary - end up acquiring an ethical status and, hence, even if these rules lose their character of efficiency, they become very difficult to change .

Finally, as an important contribution to the study of labor turnover, we must point out the development of on-the-job search models. These models are based on human capital theory, inasmuch as they interpret the action of searching for a job as a form of investment in human capital . The cost of this investment is related to the time and effort spent on processes of job search. The benefit obtained, in turn, would be the greater probability of finding a job that offers a better wage perspective, given the assumption of wage dispersion in a world of imperfect information.

Barron & McCafferty (1977) and Burdett (1978) developed models of job search - more precisely, models of job search undertaken by workers who are already employed. Burdett's model generates a function that determines the probability of quit, arguments for which are the present wage received and the time of labor force participation. Clearly, the higher the wage received in the present job, the lower the probability of quitting - as the probability of finding a job offer which is better than the present one will be lower. Also, the longer the time in the labor market, the lower the probability of quitting, because if a worker has had more time to search for jobs, his expected wage in the present job will be higher.

The author finally concludes that the worker's age and job tenure are also variables that are negatively related to the probability of quitting, for these are variables directly and positively related to the time of labor force participation. So, the inverse relation between job tenure and probability of quitting emerges in Burdett's model regardless of

the assumption that workers accumulate specific skills.

The model developed by Burdett and McCafferty (1977) is similar to that developed by Burdett, but the first model includes the level of aggregate labor demand in the set of relevant variables. The authors conclude that the total rate of quits in the economy rises in response to a rise in the level of aggregate labor demand (or in response to a drop in the level of unemployment). This conclusion is widely confirmed by empirical studies .

3 Econometric Issues – The Bi-Variate Probit Model

The main idea behind the proposed estimation procedures is the joint modelling of the utility maximizing behavior of

both firms and employees. In order to do so, we consider the binary choices of the firm, represented by $y_f = 0, 1$, where 1 stands for keeping a particular employee, and 0 for firing him, and of the employee, represented by $y_e = 0, 1$, where 1 stands for staying on the job, and 0 for quitting. We assume that these decisions are related to a particular period of time, in our case equal to one year. Therefore, we observe individuals who are employed at a particular month in our sample period, and once again a year later. In this second observation, the employment relationship could be mantained, or terminated, by any combination of the decisions of quitting made by the employee and/or firing made by the firm. Considering vectors W_{f0} and W_{f1} of fixed observable characteristics for the firm pertaining to choices 0 and 1, we assume utility functions of the form

$$\begin{aligned} U_{f0} &= g_{f0}(W_{f0}, y_e^*) + \eta_{f0} \\ U_{f1} &= g_{f1}(W_{f1}, y_e^*) + \eta_{f1} \end{aligned}$$

for the two possible choices by the firm. Likewise, employees are assumed to have utility functions of the form

$$\begin{aligned} U_{e0} &= g_{e0}(W_{e0}, y_f^*) + \eta_{e0} \\ U_{e1} &= g_{e1}(W_{e1}, y_f^*) + \eta_{e1} \end{aligned}$$

where g_{ji} are deterministic functions, η_{ji} are random unobserved attributes, and $y_j^* = U_{j1} - U_{j0}$ represents agent j 's "inclination" toward $y_j = 1$, all for $j = f, e$, and $i = 0, 1$. Following Poirier (1980), we further assume that

$$\begin{aligned} g_{f1}(W_{f1}, y_e^*) - g_{f0}(W_{f0}, y_e^*) &= \gamma_f y_e^* + X\delta_f \\ g_{e1}(W_{e1}, y_f^*) - g_{e0}(W_{e0}, y_f^*) &= \gamma_e y_f^* + X\delta_e \\ \eta_{f1} - \eta_{f0} &= \varepsilon_f \\ \eta_{e1} - \eta_{e0} &= \varepsilon_e \end{aligned}$$

where X is now a vector of covariates, $\delta_f, \delta_e, \gamma_f, \gamma_e$ are unknown parameters, and

$$\begin{bmatrix} \varepsilon_f \\ \varepsilon_e \end{bmatrix} \tilde{} N\left(0, \begin{bmatrix} \omega_{ff} & \omega_{fe} \\ \omega_{ef} & \omega_{ee} \end{bmatrix}\right).$$

It follows that

$$\begin{aligned} y_f^* &= \gamma_f y_e^* + X\delta_f + \varepsilon_f \\ y_e^* &= \gamma_e y_f^* + X\delta_{fe} + \varepsilon_{fe} \end{aligned}$$

which, according to the random utility maximization hypothesis, implies that agent j will select option 1 if $y_j^* > 0$, that is, $y_j^* = 1 \; iff \; U_{j1} > U_{j0}$, for $j = f, e$. Defining

$$\begin{aligned}
\beta_f &= (1-\gamma_f\gamma_e)^{-1}(\delta_f - \gamma_f\delta_e) \\
\beta_e &= (1-\gamma_f\gamma_e)^{-1}(\delta_e - \gamma_e\delta_f) \\
v_f &= (1-\gamma_f\gamma_e)^{-1}(\varepsilon_f + \gamma_f\varepsilon_e) \\
v_e &= (1-\gamma_f\gamma_e)^{-1}(\varepsilon_e - \gamma_e\varepsilon_f)
\end{aligned}$$

we have the reduced-form equations

$$\begin{aligned}
y_f^* &= X\beta_f + v_f \\
y_e^* &= X\beta_e + v_e.
\end{aligned}$$

The facts that the utility of each agent is specified as depending on the "inclination" of the other individual, and also that the two random unobserved components are potentially correlated, allow for interdependency between the utility functions of the two individuals (but does not necessarily requires it). This is an attractive feature of this model to the particular situation we want to analyse here: it is very intuitive to imagine that the "inclination" of a firm to keep or fire an employee has some relationship with the attitude of this employee towards his job, and vice-versa. Therefore, even though the two reduced-form equations are separate univariate discrete-choice models, they can benefit from joint estimation, which establishes the bi-variate model. This comes directly from consideration of greater asymptotic efficiency in the MLE context, in the case where $\omega_{fe} = \omega_{ef} \equiv \rho \neq 0$. If we further assume the bivariate standard normal distribution as a link function, denoted by $F(.)$, we have the bivariate probit model, with log-likelihood function given by

$$\begin{aligned}
l(\beta_f, \beta_e, \rho) = \sum_{i=1}^{N} \{ & y_{if}y_{ie} \ln F(X_i\beta_f, X_i\beta_e, \rho) \\
& + y_{if}(1-y_{ie}) \ln \left[\Phi(X_i\beta_f) - F(X_i\beta_f, X_i\beta_e, \rho)\right] \\
& + (1-y_{if})y_{ie} \ln \left[\Phi(X_i\beta_e) - F(X_i\beta_f, X_i\beta_e, \rho)\right] \\
& + (1-y_{if})(1-y_{ie}) \ln \left[\Phi(X_i\beta_e) - F(X_i\beta_f, X_i\beta_e, \rho)\right] \\
& + \ln \left[\Phi(X_i\beta_e) - F(X_i\beta_f, X_i\beta_e, \rho)\right] \}
\end{aligned}$$

where $\Phi(.)$ is the univariate standard normal distribution, and N is the sample size.

The above likelihood pressuposes that we have enough information to differentiate each of the possible four combinations of decisions by the firm and the employee. However, this is probably not the best assumption for dealing with the specific question we have here. The only combination of choices we can be sure about is the one where both the firm and the employee decide to maintain the employment relationship, which is directly observed by the fact that the employee is still in the same job after one year. When the employee left his job, we can observe his answer to the question of whether he decided to quit or was fired. In the cases where he answers that he quitted the job, we cannot be sure of the decision of the firm. As pointed out in Ehrenberg and Smith (1994, pg. 340) "While we may talk of a quit as "worker-initiated," the fact that an employer did not choose to take steps to retain potential quitters would seem to imply that the imployer believed keeping them was not worth the cost". Therefore, it is not warranted that a quit decision by the worker necessarily implies a keep decision by the firm. On the other hand, in the cases where the employee answers that he was fired, we also cannot be completely sure of his decision. The dismissal can be thought of as having occurred after a period

where the employee consistently slacked in his duties, perhaps while seeking another job. More specifically, Brazilian labor market legislation creates an incentive for workers to strike a deal with their firms, in which even though they decide to quit, they are formally fired, which entitles them to the FGTS severance payment. Therefore, this creates further doubts on the answer "I was fired" as really representing a decision initiated by the firm.

This considerations prompt us to estimate the bi-variate probit model in the partial observability context of Poirier (1980) in which, instead of observing X_i, y_{fi} and y_{ei}, $i = 1, \ldots, N$, we observe X_i and z_i, $i = 1, \ldots, N$, where

$$z_i = \begin{cases} 1 \text{ if } y_{fi} = y_{ei} = 1 \\ 0 \text{ otherwise} \end{cases}.$$

This means that, from the four possible combinations of decisions by the firm and the employee {"keep/stay", "keep/quit", "fire/stay", "fire/quit"}, we can only distinguish the first from the other three. In this context the two equations must necessarily be estimated jointly, on top of the asymptotic efficiency arguments. The log-likelihood function is now

$$\begin{aligned} l(\beta_f, \beta_e, \rho) &= \sum_{i=1}^{N} \{ z_i \ln F(X_i\beta_f, X_i\beta_e, \rho) \\ &\quad + (1 - z_i) \ln \left[1 - F(X_i\beta_f, X_i\beta_e, \rho) \right] \}. \end{aligned}$$

This comes directly from the distribution of z_i, which is given by

$$\begin{aligned} \Pr(z_i &= 1) = p_i = \Pr(y_{fi} = 1 \text{ and } y_{ei} = 1) = F(X_i\beta_f, X_i\beta_e, \rho) \\ \Pr(z_i &= 0) = 1 - p_i = \Pr(y_{fi} = 0 \text{ and/or } y_{ei} = 0) = 1 - F(X_i\beta_f, X_i\beta_e, \rho). \end{aligned}$$

If the parameters β_f and β_e are identified, we can estimate the four distinct probabilities related to the four possible combinations of decisions by the firm and the employee using the reduced-form equations. A sufficient condition for local identification is that the information matrix of the above log-likelihood function be non-singular (Rothemberg(1971)). A second important issue related to partial observability is loss in efficiency for the estimation. Meng and Schmidt (1985) present some simulation results which assert the intuitive notion that the higher the proportion of values of 1 for z in the sample, the lower the efficiency cost coming from partial observability. Since, in our case, this corresponds to the proportion of employees who stayed on their jobs, it is encouraging to note that this proportion is very high in our sample.

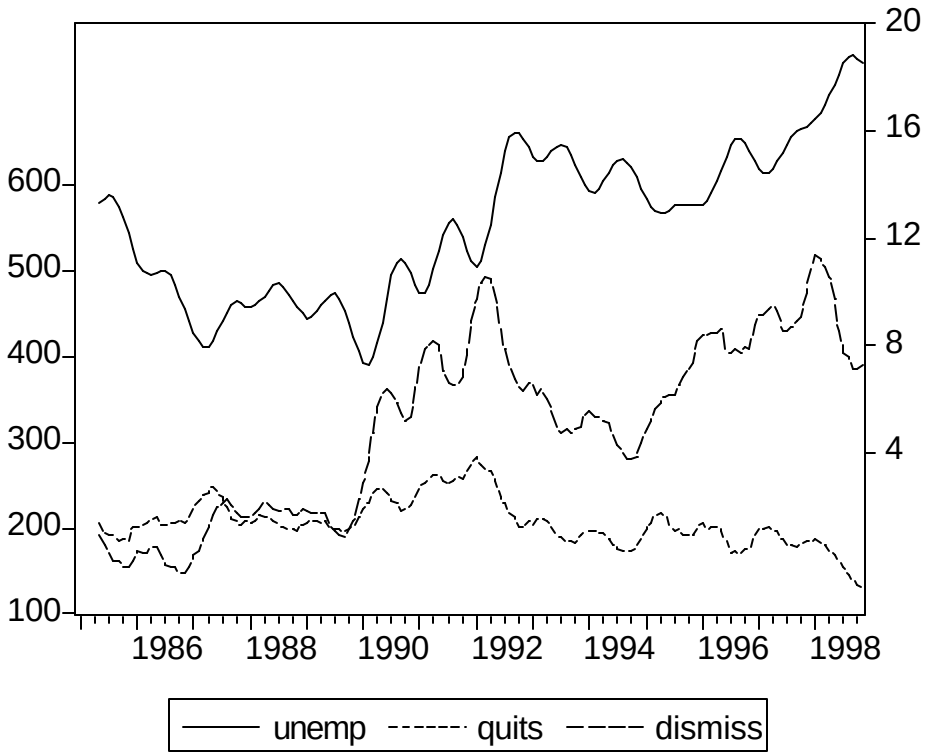
We estimated both the full-observability and the partial-observabilty specifications. In the case of full-observability, we not only assumed that the answers for the unemployed workers were exactly correct, but also that when one of the sides decided to interrupt the employment relationship the other wanted to maintain it, so that we never observe the combination "fire/quit". The estimation of the partial-observability model provides a comparison for the estimated coefficients without this assumption.

3.1 The Data

Our sample comes from data at the individual level collected by the Pesquisa de Emprego e Desemprego (PED). The PED has been consistently undertaken on a monthly basis by Fundação SEADE, and DIEESE, since 1984. These surveys are used to construct a monthly index of unemployment, among other aggregate indicators. We have information from January 1985 to December 1999. Each month, around 3000 randomly selected households are interviewed in the metropolitan area of São Paulo. Each individual is interviewed only once, contrary to the rotating-panel scheme which characterizes the

other major unemployment survey in Brazil, the PME/IBGE. However, there is a great advantage of the PED over the PME for our purposes here: it contains information on job tenure for both the currently employed and the previous job for the unemployed. Our sample consists of individuals who, at the time of the interview, were employed for at least a year in the same job, plus individuals who are unemployed for less than 12 months. From the original sample, we discarded individuals aged less than 10 years, domestic and public sector workers. Taking the whole selected sample, about 90% of the workers were employed. The 10% unemployment rate underestimates the average rate for the period covered by our sample. This is explained by the fact that we only have workers unemployed for less than a year in our sample. The mean age is 33, 64% of the workers are male, 48% are household heads, about 40% are formally employed ("carteira de trabalho"), and the median worker in the sample has completed four years of formal education.

Graph 1 depicts the evolution of six-months moving-averages of the unemployment index, and total number of quits and dismissals during our sample period, all calculated directly from PED.



According to standard job turnover theories, cyclical effects should enter in the firms' and employees' decisions in the following manner. Firms would fire workers with greater probability during recessions, which would tend to make total number of dismissals positively correlated with the unemployment rate over time, given that the dismissed workers would face a smaller probability of finding new jobs during recessions. On the other hand, workers would quit their jobs with higher probability during expansions, when it would be relatively easier to find another job, at least as good as the original. This, in turn, would impose a negative correlation between the quit rate and the unemployment rate over time. In spite of the above mentioned caveats concerning the responses to the ques-

tion regarding the causes for the workers who are separated from their previous jobs, this patterns seem to be confirmed in graph 1, especially for the total number of dismissals.

3.2 Estimation Results

We estimated both the full and partial-observability of the bivariate probit model using the same set of covariates: gender, age, position in the household, tenure in the job, level of education, a dummy variable indicating whether the worker is of the "formal" sector, the level of unemployment at the date when a worker was fired, or its mean value throughout the period for the workers who stayed on their jobs, and a dummy variable indicating the period after November 1988, the date at which the new Brazilian constitution introduced new elements in the countrywide labor market legislation. Two potentially relevant facts were simultaneously implemented as a result of the new federal constitution. Mandatory severance payments by firms following dismissals were increased from 10% to 40% of the accumulated FGTS. Second, unemployment insurance was created for workers in the formal sector. It can be said that both of these factors, in periods of relatively low unemployment rates, would create incentivs for workers to quit their jobs, thereby increasing turnover and decreasing tenure rates. The estimated coefficients are in the appendix, organized by Sector of economic activity. Sector 1 includes industrial firms characterized by large-scale of operations and capital intensity. Sector 2 includes industrial firms in "traditional" activities (textiles, etc.). Sector 3 is building construction. Sector 4 is overall sales, and Sector 5 includes several services. Table 1 below summarizes the direction of the marginal effects of the covariates on the probabilities for dissmissals and quits in each sector.

		female	age	househead	tenure	educ	unemp	formal	1988+
Sector 1	dism.	-	-	+	-	-	+	-	-
	quit	+	-	-	-	-	-	-	-
Sector 2	dism.	-	-	+	-	-	+	-	-
	quit	+	-	-	-	-	-	-	-
Sector 3	dism.	0	-	-	-	-	+	-	-
	quit	+	-	-	-	0	-	-	-
Sector 4	dism.	0	0	+	-	0	+	-	-
	quit	+	-	-	-	0	-	-	-
Sector 5	dism.	-	-	-	-	-	+	-	-
	quit	0	-	-	-	-	-	-	-

Table 1

In general, the full and partial-observability models did not produce conflicting results in terms of both direction of the marginal effects of the covariates, and statistical significance of the estimated parameters. The intensity of the marginal effects, though, was significantly different between the two models. This fact is significant, given that, due to the known convergence problems of the MLE estimation of the partial observability specification, the estimated parameters of the full-observability specification were taken as initial conditions for the partial-observability estimation.

4 Conclusions

The estimation results summarized in Table 1 present some overall patterns accross the five sectors. It is interesting to contrast these patterns with the results of Menezes and Picchetti (2000), where expected duration of unemployment is estimated conditional on approximately the same set of covariates, using data from PME/IBGE for the same geographic region. Female workers are more likely to quit their jobs compared to male workers, whereas the effect in terms of dissmissal probabilities seems less clear, being negative in some sectors and insignificant in others. In terms of expected duration of unemployment, there seems to be no difference between male and female workers. The age effect is very strong in reducing the expected probabilities of quits and dissmissals, indicating that turnover is higher among the relatively young. This conclusion seems to be strenghtened by the fact the expected duration of unemployment is higher for the elderly. Household heads are less likely to quit their jobs, and also have a shorter expected duration of unemployment. Tenure time consistently decreases the probabilities of quitting and dissmissals, indicating a strong effect of the development of job-specific skills inducing lasting employment relationships and loyalty from both sides. This job-specific skills interpretation could also help to explain the finding that expected duration of unemployment is higher for those who stayed longer in their previous jobs. Except for the sales sector, education also plays an important role in reducing both probabilities of abbreviating the employment relationship. This probably indicates a higher relative quality of jobs for the more educated. It is interesting to note that unemployed workers who are relatively more educated face a higher expected duration of unemployment. Taken as a whole, these two findings seem to indicate higher reservation wages for the more educated, resulting in lower turnover rates, but higher expected duration of unemployment. The marginal effects of the overall unemployment rate are consistently according to standard turnover theories, increasing the probabilities of quits and reducing the probabilities of dismissals, accross all five sectors. Turnover rates for workers in the formal sector are relatively lower, with consistently negative effects on both probabilities of employment termination.This can be taken as an indicator of the "frictions" imposed by labor market legislations the formal sector, looking at the determinants of the decisions by the firms. The interpretation of this effect on the workers' side is less clear: since we are controlling somewhat for job quality, cyclical effects, etc., there should be some residual incentive for workers in the formal sector to quit their jobs more often, given that they receive severance payments equal to a month's wage, plus a fraction of their accumulated FGTS fund. This consideration, as a matter of fact, should be strenghtened by the fact that this payment increased after the 1988 constitution. However, the marginal effects for the dummy controlling for this period is, although consistently negative on the probabilities of firing, also consistently negative for the probabilities of quitting. Moreover, another residual incentive which this coefficient could be capturing is, as mentioned, the creation of the unemployment insurance, which grants the unemployed worker from the formal sector up to five months of benefits. Looking at the expected duration of unemployment, it is increasing conditional on the employee having worked in the formal sector. However, this cannot be taken as a result of the incentives created by the unemployment insurance, since this result holds in sign and intensity prior to 1988. Taken as whole, these findings seem to indicate that the labor market during the sample period was sufficiently tight for workers to hold on to their jobs, regardless of the potential effects of the incentives created by severance payments and unemployment benefits.

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Sector 1

Bivariate probit regression — Number of obs = 96644; Wald chi2(16) = 17758.44; Log likelihood = -23999.193; Prob > chi2 = 0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
fire						
female	.0044227	.0188169	0.24	0.814	-.0324577	.0413032
age	.0102416	.0008301	12.34	0.000	.0086146	.0118686
househead	-.0920486	.0193672	-4.75	0.000	-.1300076	-.0540896
tenure	.0024025	.0001458	16.48	0.000	.0021167	.0026883
educ	.0506284	.0042923	11.80	0.000	.0422156	.0590411
unemp	.0042062	.0024709	1.70	0.089	-.0006367	.0090491
formal	1.374109	.0148303	92.66	0.000	1.345042	1.403176
1988+	.3117634	.0207047	15.06	0.000	.2711828	.3523439
_cons	-.3192105	.0456439	-6.99	0.000	-.4086708	-.2297502
quit						
female	-.1345025	.0265859	-5.06	0.000	-.18661	-.0823951
age	.0136922	.0012912	10.60	0.000	.0111614	.016223
househead	.0795032	.0310833	2.56	0.011	.0185811	.1404253
tenure	.0017248	.0002444	7.06	0.000	.0012457	.0022038
educ	.0339669	.0067936	5.00	0.000	.0206518	.047282
unemp	.045799	.0040233	11.38	0.000	.0379136	.0536845
formal	1.514598	.0266469	56.84	0.000	1.462371	1.566825
1988+	.4954076	.0281068	17.63	0.000	.4403194	.5504958
_cons	-.2253375	.0665156	-3.39	0.001	-.3557057	-.0949693
/athrho	-3.29603	8.57124	-0.38	0.701	-20.09535	13.50329
rho	-.9972613	.0468833			-1	1

Likelihood ratio test of rho=0: chi2(1) = 1901.39 Prob > chi2 = 0.0000

Partial observability bivariate probit — Number of obs = 96644
Wald chi2(16) = 3057.78
Log likelihood = -19228.108 — Prob > chi2 = 0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
fire						
female	.0841478	.0283307	2.97	0.003	.0286205	.139675
age	.0044716	.0011655	3.84	0.000	.0021872	.0067559
househead	-.0650442	.0264706	-2.46	0.014	-.1169255	-.0131628
tenure	.0013496	.0001767	7.64	0.000	.0010033	.0016959
educ	.0227412	.0054832	4.15	0.000	.0119944	.0334881
unemp	-.0106245	.0033019	-3.22	0.001	-.0170961	-.0041528
formal	.5215773	.1066089	4.89	0.000	.3126276	.7305269
1988+	.3174664	.0285323	11.13	0.000	.2615442	.3733886
_cons	.9236465	.1375069	6.72	0.000	.654138	1.193155
quit						
female	-.1674157	.0311265	-5.38	0.000	-.2284225	-.1064089
age	.0182696	.0012991	14.06	0.000	.0157234	.0208158
househead	-.0215145	.0333457	-0.65	0.519	-.0868709	.0438419
tenure	.0046076	.0004348	10.60	0.000	.0037555	.0054597
educ	.0814522	.0072653	11.21	0.000	.0672125	.0956919
unemp	.0503388	.0043787	11.50	0.000	.0417568	.0589208
formal	5.433472	15.29606	0.36	0.722	-24.54625	35.4132
1988+	.5064099	.0371935	13.62	0.000	.4335119	.5793079
_cons	-1.436942	.0905507	-15.87	0.000	-1.614419	-1.259466
/athrho	-13.04514	.	.	.	.	.
rho	-1	.			-1	1

Wald test of rho=0: chi2(1) = . Prob > chi2 = .

Sector 2

Bivariate probit regression — Number of obs = 86436; Wald chi2(16) = 12879.28; Log likelihood = -28025.658; Prob > chi2 = 0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
fire						
female	.0413882	.0160128	2.58	0.010	.0100037	.0727727
age	.0155519	.0007489	20.77	0.000	.0140841	.0170197
househead	-.0548849	.0192711	-2.85	0.004	-.0926555	-.0171143
tenure	.0035196	.0001742	20.20	0.000	.0031781	.0038611
educ	.052388	.0046751	11.21	0.000	.043225	.0615511
unemp	-.0102995	.0024385	-4.22	0.000	-.0150788	-.0055201
formal	1.083368	.0157531	68.77	0.000	1.052492	1.114243
1988+	.34255	.0212356	16.13	0.000	.300929	.384171
_cons	-.0608818	.0436892	-1.39	0.163	-.146511	.0247475
quit						
female	-.1084318	.0212363	-5.11	0.000	-.1500542	-.0668095
age	.0224089	.0010687	20.97	0.000	.0203144	.0245035
househead	.0861442	.0283507	3.04	0.002	.0305778	.1417107
tenure	.0031143	.0002522	12.35	0.000	.00262	.0036087
educ	.0372119	.0066014	5.64	0.000	.0242735	.0501504
unemp	.0200109	.0034442	5.81	0.000	.0132603	.0267615
formal	1.463634	.0301669	48.52	0.000	1.404508	1.52276
1988+	.6653998	.0255374	26.06	0.000	.6153473	.7154522
_cons	-.2297482	.0581638	-3.95	0.000	-.3437472	-.1157493
/athrho	-2.262254	1.019545	-2.22	0.026	-4.260525	-.2639825
rho	-.9785524	.0432646			-.9996016	-.2580167

Likelihood ratio test of rho=0: chi2(1) = 1949.82 Prob > chi2 = 0.0000

```
 ( 1)  [athrho]_cons = 0.0
       Constraint 1 dropped

Partial observability bivariate probit           Number of obs   =      86436
                                                 Wald chi2(15)   =          .
Log likelihood = -22014.562                      Prob > chi2     =          .

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
fire         |
      female |    .080801   .0306926     2.63   0.008     .0206447    .1409574
         age |   .0039705   .0013143     3.02   0.003     .0013946    .0065465
   househead |  -.1116216   .0324996    -3.43   0.001    -.1753196   -.0479236
      tenure |   .0020544   .0002332     8.81   0.000     .0015974    .0025113
        educ |   .0089099   .0069674     1.28   0.201    -.0047458    .0225657
       unemp |  -.0193792   .0039854    -4.86   0.000    -.0271904    -.011568
      formal |   .4087638   .0653554     6.25   0.000     .2806696     .536858
       1988+ |   .3548824   .0365196     9.72   0.000     .2833054    .4264595
       _cons |   1.237336   .1149294    10.77   0.000     1.012078    1.462593
-------------+----------------------------------------------------------------
quit         |
      female |  -.0937546   .0258864    -3.62   0.000    -.1444911   -.0430182
         age |   .0302364   .0013156    22.98   0.000     .0276577     .032815
   househead |    .106807   .0351825     3.04   0.002     .0378505    .1757636
      tenure |   .0057405   .0003236    17.74   0.000     .0051063    .0063747
        educ |    .088659   .0073284    12.10   0.000     .0742956    .1030225
       unemp |   .0151238   .0037849     4.00   0.000     .0077055    .0225421
      formal |   43.04568          .        .       .            .           .
       1988+ |   .6426913   .0302721    21.23   0.000      .583359    .7020236
       _cons |  -1.250419   .0678743   -18.42   0.000     -1.38345   -1.117388
-------------+----------------------------------------------------------------
     /athrho |  -4.989317          .        .       .            .           .
-------------+----------------------------------------------------------------
         rho |  -.9999072          .                             -1           1
------------------------------------------------------------------------------
Wald test of rho=0:                 chi2(1) =        .    Prob > chi2 =      .
```

Sector 3

Bivariate probit regression — Number of obs = 37119; Wald chi2(16) = 2443.35; Log likelihood = -13779.414; Prob > chi2 = 0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
fire						
female	-.0758884	.0563186	-1.35	0.178	-.1862709	.0344941
age	.0050485	.0008716	5.79	0.000	.0033403	.0067567
househead	.1895616	.0233826	8.11	0.000	.1437325	.2353907
tenure	.0033768	.0002032	16.62	0.000	.0029786	.0037751
educ	.03087	.0072024	4.29	0.000	.0167535	.0449864
unemp	-.042408	.0032307	-13.13	0.000	-.0487401	-.0360759
formal	.905492	.0289989	31.23	0.000	.8486551	.9623289
1988+	.2376981	.0357381	6.65	0.000	.1676528	.3077434
_cons	1.030574	.0772253	13.35	0.000	.8792155	1.181933
quit						
female	-.3730592	.076287	-4.89	0.000	-.522579	-.2235393
age	.0098696	.001582	6.24	0.000	.0067689	.0129703
househead	.200162	.0393236	5.09	0.000	.1230891	.2772349
tenure	.003415	.0003811	8.96	0.000	.0026681	.0041619
educ	-.0062917	.0120217	-0.52	0.601	-.0298539	.0172705
unemp	.0342404	.0055152	6.21	0.000	.0234307	.04505
formal	.9005744	.0547596	16.45	0.000	.7932476	1.007901
1988+	.4786068	.0456477	10.48	0.000	.3891389	.5680747
_cons	.8670042	.1101076	7.87	0.000	.6511972	1.082811
/athrho	-1.642525	6.648793	-0.25	0.805	-14.67392	11.38887
rho	-.9278247	.9251215			-1	1

Likelihood ratio test of rho=0: chi2(1) = 269.156 Prob > chi2 = 0.0000

```
 ( 1)  [athrho]_cons = 0.0

           chi2(  1) =    0.01
         Prob > chi2 =    0.9202


Partial observability bivariate probit            Number of obs   =      37119
                                                  Wald chi2(16)   =     728.14
Log likelihood =  -11852.09                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
fire         |
      female |  -.0388235   .0945047    -0.41   0.681    -.2240492    .1464022
         age |   .0003648   .0016174     0.23   0.822    -.0028051    .0035348
   househead |   -.038445   .0598962    -0.64   0.521    -.1558394    .0789494
      tenure |   .0035747   .0002883    12.40   0.000     .0030097    .0041396
        educ |   .0289867    .008666     3.34   0.001     .0120016    .0459717
       unemp |  -.0301808   .0043681    -6.91   0.000    -.0387421   -.0216194
      formal |   .7569312   .0585115    12.94   0.000     .6422507    .8716116
       1988+ |   .3025705   .0483077     6.26   0.000     .2078892    .3972517
       _cons |   1.144379   .1678711     6.82   0.000     .8153582    1.473401
-------------+----------------------------------------------------------------
quit         |
      female |  -.4865628   .1200706    -4.05   0.000    -.7218969   -.2512287
         age |   .0310769   .0068671     4.53   0.000     .0176176    .0445361
   househead |   .7227675   .2011631     3.59   0.000     .3284951     1.11704
      tenure |   .0034633   .0009722     3.56   0.000     .0015579    .0053688
        educ |  -.0052428   .0241169    -0.22   0.828     -.052511    .0420254
       unemp |  -.0202033   .0115736    -1.75   0.081    -.0428873    .0024806
      formal |   4.077789   32.15311     0.13   0.899    -58.94114    67.09672
       1988+ |   .4836487   .1139757     4.24   0.000     .2602605     .707037
       _cons |   .6348388   .2302341     2.76   0.006     .1835884    1.086089
-------------+----------------------------------------------------------------
     /athrho |   .0595631    .594407     0.10   0.920    -1.105453    1.224579
-------------+----------------------------------------------------------------
         rho |   .0594928   .5923031                     -.8024493    .8409998
------------------------------------------------------------------------------
Wald test of rho=0:                chi2(1) =  .010041    Prob > chi2 = 0.9202
```

Sector 4

Bivariate probit regression — Number of obs = 112341; Wald chi2(16) = 11299.34; Log likelihood = -34145.911; Prob > chi2 = 0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
fire						
female	-.022871	.0153408	-1.49	0.136	-.0529385	.0071964
age	.0212237	.0007406	28.66	0.000	.0197722	.0226751
household	.0558982	.019581	2.85	0.004	.0175202	.0942763
tenure	.0043421	.0001887	23.01	0.000	.0039722	.004712
educ	.0062974	.0043751	1.44	0.150	-.0022776	.0148724
unemp	-.0218005	.0023729	-9.19	0.000	-.0264513	-.0171498
formal	.7585097	.0171524	44.22	0.000	.7248916	.7921279
1988+	.3988552	.0227491	17.53	0.000	.3542677	.4434427
_cons	.5943642	.0410391	14.48	0.000	.513929	.6747994
quit						
female	-.1634364	.0173706	-9.41	0.000	-.1974822	-.1293906
age	.0262045	.0008737	29.99	0.000	.0244921	.0279169
household	.1637296	.0239853	6.83	0.000	.1167192	.21074
tenure	.0042932	.0002225	19.29	0.000	.003857	.0047294
educ	.0048407	.0051856	0.93	0.351	-.0053229	.0150043
unemp	.0216024	.0027935	7.73	0.000	.0161273	.0270776
formal	1.250092	.0274268	45.58	0.000	1.196336	1.303847
1988+	.6652394	.0227974	29.18	0.000	.6205574	.7099214
_cons	-.0658833	.0467412	-1.41	0.159	-.1574943	.0257277
/athrho	-2.170194	4.213742	-0.52	0.607	-10.42898	6.088589
rho	-.9742723	.2140304			-1	.9999897

Likelihood ratio test of rho=0: chi2(1) = 1511.63 Prob > chi2 = 0.0000

```
 ( 1)  [athrho]_cons = 0.0
       Constraint 1 dropped

Partial observability bivariate probit           Number of obs   =     112341
                                                 Wald chi2(16)   =    4776.41
Log likelihood = -27039.367                      Prob > chi2     =     0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
fire         |
      female |   .0453079   .0326472     1.39   0.165    -.0186794    .1092952
         age |   .0028566   .0013878     2.06   0.040     .0001367    .0055766
   househead |  -.0670567   .0361319    -1.86   0.063    -.1378739    .0037605
      tenure |   .0025307   .0002682     9.44   0.000      .002005    .0030563
        educ |  -.0022055   .0068517    -0.32   0.748    -.0156345    .0112236
       unemp |  -.0188124   .0040925    -4.60   0.000    -.0268335   -.0107913
      formal |   .0500391   .0532096     0.94   0.347    -.0542498    .1543279
       1988+ |   .3033057   .0443767     6.83   0.000      .216329    .3902823
       _cons |   1.773738    .112751    15.73   0.000      1.55275    1.994726
-------------+----------------------------------------------------------------
quit         |
      female |  -.1805964   .0202124    -8.93   0.000    -.2202119   -.1409809
         age |   .0387828   .0012101    32.05   0.000     .0364111    .0411545
   househead |   .2416536   .0328438     7.36   0.000     .1772808    .3060263
      tenure |   .0065983   .0002736    24.12   0.000     .0060621    .0071346
        educ |   .0048821   .0058178     0.84   0.401    -.0065206    .0162849
       unemp |   .0056045   .0030133     1.86   0.063    -.0003014    .0115103
      formal |   4.892061   14.28279     0.34   0.732    -23.10169    32.88581
       1988+ |   .7585721   .0266435    28.47   0.000     .7063519    .8107924
       _cons |  -.6621854   .0520225   -12.73   0.000    -.7641477   -.5602232
-------------+----------------------------------------------------------------
     /athrho |  -1007.686          .        .       .            .           .
-------------+----------------------------------------------------------------
         rho |          .          .                            -1           1
------------------------------------------------------------------------------
Wald test of rho=0:                 chi2(1) =        .    Prob > chi2 =      .
```

Sector 5

Bivariate probit regression — Number of obs = 250423; Wald chi2(16) = 20892.19; Log likelihood = -68498.058; Prob > chi2 = 0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
fire						
female	.0895823	.0107984	8.30	0.000	.0684178	.1107468
age	.0143273	.0004805	29.82	0.000	.0133856	.015269
househead	.0386779	.0123535	3.13	0.002	.0144654	.0628903
tenure	.0037734	.0001089	34.64	0.000	.0035599	.0039869
educ	.0551476	.0025823	21.36	0.000	.0500865	.0602088
unemp	-.0281938	.0016074	-17.54	0.000	-.0313442	-.0250433
formal	.7754698	.0112965	68.65	0.000	.753329	.7976105
1988+	.3722531	.0161764	23.01	0.000	.3405479	.4039582
_cons	.4478098	.0284101	15.76	0.000	.392127	.5034926
quit						
female	-.1039715	.012957	-8.02	0.000	-.1293667	-.0785764
age	.0232537	.0006328	36.74	0.000	.0220134	.0244941
househead	.1090598	.0161107	6.77	0.000	.0774834	.1406362
tenure	.0049431	.000157	31.49	0.000	.0046354	.0052507
educ	.0530134	.00328	16.16	0.000	.0465848	.059442
unemp	.0158937	.0020113	7.90	0.000	.0119517	.0198356
formal	1.228902	.0193552	63.49	0.000	1.190967	1.266838
1988+	.6111516	.0170203	35.91	0.000	.5777924	.6445108
_cons	-.2024613	.0341178	-5.93	0.000	-.269331	-.1355916
/athrho	-1.978647	2.243891	-0.88	0.378	-6.376592	2.419298
rho	-.9624875	.1651902			-.9999942	.9842881

Likelihood ratio test of rho=0: chi2(1) = 2331.91 Prob > chi2 = 0.0000

```
 ( 1)  [athrho]_cons = 0.0
       Constraint 1 dropped

Partial observability bivariate probit          Number of obs   =     250423
                                                Wald chi2(16)   =    8848.69
Log likelihood = -55381.601                     Prob > chi2     =     0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
fire         |
      female |   .1506931   .0219146     6.88   0.000     .1077414    .1936449
         age |   .0014859   .0009194     1.62   0.106    -.0003161    .0032879
   househead |   .0016029   .0224688     0.07   0.943    -.0424353     .045641
      tenure |   .0015162   .0001708     8.88   0.000     .0011815     .001851
        educ |   .0253458   .0044905     5.64   0.000     .0165447     .034147
       unemp |  -.0194076   .0028171    -6.89   0.000    -.0249291   -.0138861
      formal |   .0623327   .0413748     1.51   0.132    -.0187604    .1434258
       1988+ |   .3763362   .0292364    12.87   0.000     .3190339    .4336385
       _cons |    1.50741   .0787367    19.14   0.000     1.353089    1.661731
-------------+----------------------------------------------------------------
quit         |
      female |  -.0674835   .0148721    -4.54   0.000    -.0966322   -.0383348
         age |   .0285694   .0008674    32.94   0.000     .0268694    .0302695
   househead |   .1142578   .0168139     6.80   0.000     .0813032    .1472123
      tenure |   .0073802   .0001953    37.79   0.000     .0069974    .0077629
        educ |   .0759588   .0034025    22.32   0.000       .06929    .0826275
       unemp |  -.0077745   .0020288    -3.83   0.000    -.0117509    -.003798
      formal |   5.148366   20.29082     0.25   0.800     -34.6209    44.91763
       1988+ |   .6385122   .0192896    33.10   0.000     .6007054     .676319
       _cons |  -.7067746   .0365004   -19.36   0.000     -.778314   -.6352353
-------------+----------------------------------------------------------------
     /athrho |  -445.1306          .        .       .            .           .
-------------+----------------------------------------------------------------
         rho |         -1          .                            -1           1
------------------------------------------------------------------------------
Wald test of rho=0:                 chi2(1) =        .    Prob > chi2 =      .
```