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"THE EFFECTS OF OPENNESS ON INDUSTRIAL EMPLOYMENT IN BRAZIL"

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The Effects of Openness on Industrial Employment in Brazil *

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Resumo

Este artigo tem dois objetivos principais. Primeiramente, apresentamos as principais evidências de que a baixa qualidade do emprego é o maior problema do mercado de trabalho brasileiro. Mostra-se que o país tem absorvido um crescimento da oferta de trabalho significativo ao longo dos últimos anos sem registrar um aumento da taxa de desemprego. No entanto, os postos de trabalho no Brasil são, em média, extremamente precários. Em grande medida, a precariedade do emprego no Brasil está relacionada à alta rotatividade da mão-de-obra, que desincentiva o investimento em treinamento, impedindo o crescimento da produtividade do trabalho. De acordo com os indicadores passíveis de comparação internacional, o Brasil apresenta uma das maiores taxas de rotatividade do mundo.

Em segundo lugar, estuda-se a evolução recente do emprego industrial, uma vez que o setor industrial está tradicionalmente associado à geração de bons empregos no Brasil. Mostra-se que o nível de emprego industrial tem se reduzido de forma praticamente contínua desde o início desta década. A estimação de um modelo de ajustamento parcial do emprego nos permite explicar este fenômeno. Mudanças estruturais significativas na elasticidade custo salarial do emprego e no coeficiente de tendência são detectadas a partir do início da década de 90. Um simples modelo teórico é usado de forma a interpretar estas mudanças estruturais como a resposta ótima das empresas industriais ao ambiente de maior competição externa, devido à abertura comercial. Isto, junto com o uso crescente de tecnologias poupadoras de mão-de-obra, são suficientes para explicar a brutal queda do emprego industrial no Brasil ao longo dos últimos seis anos.

I. Introduction

This article has two main objectives. The first one is to characterize the behavior of the Brazilian labor market over the more recent years. The idea is to identify current trends in some key labor market indicators, and reversals that could be attributed to structural reforms.[1] The findings of some recent articles that the main Brazilian labor market problem seems to be the bad quality of jobs, and not lack of job creation, are confirmed here. It is shown that the occupied population has been growing faster than total population without exerting significant pressure on the unemployment rate. Since the Brazilian economy has grown less than the number of job positions over the last fifteen years, labor productivity has decreased. The productivity reduction has been reflected in a decline of the quality of Brazilian jobs, on average. In fact, the quality of Brazilian jobs is very low. This is illustrated in several dimensions: low pay, low productivity growth, high turnover, high number of informal jobs, and a significant reduction in the proportion of industrial jobs.

Given the importance of the industrial sector in providing good jobs, the second objective of this paper is to study the evolution of industrial employment over the last eleven years. It is shown that the level of industrial employment has significantly declined in an almost continuous fashion since the beginning of this decade. The estimation of a partial adjustment labor demand equation for the industrial sector allows us to provide an explanation for this decline. A significant structural change in the main parameters of this equation is detected in the beginning of this decade. A simple theoretical model is used to interpret the structural change as an optimal response of profit-maximizing industrial firms - mostly, producing traded goods - to a more open environment to foreign competition. This, coupled with the effects of an increase in the use of job-saving technologies, such as outsourcing and downsizing, is able to explain the recent evolution of industrial employment in Brazil.

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[1] The major structural reforms recently implemented in Brazil were the opening of the economy, which has speeded up considerably since 1990, and the reforms associated with the inflation-stabilization Real plan of 1994. Labor legislation has not changed significantly since the Constitution of 1988.

The paper is organized as follows. The next section characterizes the functioning of the Brazilian labor market over the last fifteen years. It presents and discusses data on job creation, job quality and income inequality. The third section presents a dynamic labor demand model in which the revenue function of profit-maximizing firms depends on the degree of market power. The assumption that the degree of market power is affected by the degree of openness is the main source of structural change in the labor demand equation. Section 4 estimates a partial adjustment labor demand equation for the Brazilian industrial sector. It is shown that the key parameters of the equation changed significantly over the more recent years. This is interpreted as a natural response of industrial firms to a more competitive environment, coupled with the effects of an increasing use of job-saving organization technologies.

II. Characterization of the Brazilian Labor Market Problem

In Amadeo *et al.* (1994), Amadeo and Gonzaga (1995) and Gonzaga (1996b), the Brazilian labor market was characterized as one with a high capacity of job creation, but with a poor quality of the jobs created, on average. The problem of the Brazilian market, thus, seems to be a problem of job quality, rather than one of quantity. In this section, I review and update the main Brazilian labor market indicators that confirm this diagnostic.

Table 1 below presents some selected data, taken from the two main FIBGE household surveys: the *Pesquisa Mensal de Emprego* (PME) and the *Pesquisa Nacional por Amostras de Domicílio* (PNAD), and from the National Accounts. The evidence point to a labor market which is capable of absorbing a growing number of people without generating an increase in the open unemployment rate.

Table 1: Brazil - High Capacity of Job Generation
Main Indicators of Job Creation

Average Annual GNP Growth (National Accounts, 1980-95)	2,0%
Average Annual Total Population Growth (National Accounts, 1980-95)	1,6%
Average Annual Occupied Population Growth (PNAD, 1981-95)	3,1%

Average Unemployment Rate - Six Main Metropolitan Regions (PME, 1982-95)	5,3%
Average Participation Rate (PNAD, 1981-95)	53,4% (81) - 61,3%(95)

On average, Brazil increased by 3.1% a year its occupied population in a 14-year period, which rose from 45.5 millions in 1981 to 69.6 millions in 1995, and accumulated a 53% increase over the whole period. The labor force has also increased significantly in that period, from 47.5 million workers in 1981 to 74.1 millions in 1993. The participation rate increased from 53.4% to 61.3% between 1981 and 1995, reflecting mostly a growing trend of female participation in the labor market, from 32.9% to 48.1%.

This increase, however, could be accommodated without a rise in the unemployment rate, which confirms that the Brazilian labor market is able to create a large number of new job opportunities. In fact, the average unemployment rate in the six main metropolitan regions in Brazil between 1982 and 1995 is 5.3%. It rarely exceeded 6 percent over that period. This is relatively low, by international standards. Data from CEPAL (1995), for example, show that Brazil had the second lowest urban unemployment rate in South America in 1994. The average European countries' unemployment rate in 1995 was above 10%.

The surprising aspect of these numbers is that the Brazilian economy did not grow much over that period. Table 1 shows that the average annual growth of Brazilian GNP was around 2% between 1980 and 1995, only slightly more than annual population growth, which was 1.6%, on average.

What could explain the fact that an ailing economy, such as Brazil's over the last fifteen years, was able to create so many new job opportunities? The answer lies in the poor quality of the jobs created. In general, a bad job is characterized by low pay, usually a result of low productivity. Therefore, low pay should be viewed as the most important symptom of a bad job. However, this information can be complemented by some other indicators, since bad jobs are also characterized by bad working conditions. Table 2 below presents some indicators that are usually associated with poor quality jobs in Brazil.

On average, a job in the six main metropolitan regions in Brazil paid 10% less at the end of 1995 than in the beginning of 1982, in real terms. If we compare annual averages, the decrease was even more pronounced: 14% between 1982 and 1995, an average annual fall of 1.2%.

This happened mainly as a result of the significant reduction in the proportion of formal jobs and industrial jobs. The proportion of workers with a formal contract (*com carteira assinada*, with a working card), and therefore covered by the Brazilian Labor Code (*Consolidação das Leis do Trabalho*, CLT), in non-agriculture activities decreased from 57% in 1982 to 48% in 1995, and to 46.3% by mid-1996.[2]

Table 2: Brazil - Bad Jobs
Job Quality Indicators

Average Annual Real Earnings Growth (PME, 1982-95)	-1,2%
Average Annual Formal Employment Growth (Labor Ministry, Lei 4923 - 1985-95)	1,0%
Proportion of Workers with a Working Card (PME, 1982-95)	57%(82) - 48%(95)
Average Monthly Admission Rate - Formal Sector (Labor Ministry, Lei 4923 - 1985-95)	3,2%
Average Monthly Separation Rate - Formal Sector (Labor Ministry, Lei 4923 - 1985-95)	3,1%
Proportion of Workers in the Tertiary Sector (PNAD, 1981-95)	43%(81) - 54,3%(95)

Data from the Labor Ministry confirm that working card employment increased very little over the last eleven years. While occupied population increased from 55,4 millions in 1986 to 69,6 millions in 1995 (an average annual growth of 2,6%), formal jobs increased only by 1% a year, on average, between 1985 and 1995. The absolute number of formal jobs by mid-1996 was about the same size as in 1990. This means that most of the reduction in the proportion of formal jobs in the occupied population happened after 1990. This suggests that Brazilian firms responded to the

[2] Workers hired under a formal contract, have a working card signed, which entitles them to receive social security benefits and protects them by job security policies.

increase in external price competition, a result of the removal of many import non-tariff barriers, by informalizing their labor force.

Labor turnover in the formal sector, on the other hand, is high when compared to other countries, suggesting little worker-firm attachment (and, therefore, little on-the-job training) even in the formal sector of the economy. Approximately 730 thousand workers (3.2% of the formally employed), on average, got a new formal job each month between 1985 and 1995, while about 720 thousand (3.1% of the formally employed), on average, left their formal jobs each month during the same period. Only a few countries collect data on gross labor turnover, which makes it hard to put these numbers in perspective.

However, there is another labor turnover measure, available for the Brazilian formal labor market, which allows us to make international comparisons. This is the proportion of workers with less than two years of tenure at the same job. The higher this measure, the higher is labor turnover.

Data from the Labor Ministry (RAIS, *Relatório Anual de Informações Sociais*) show that, on average, in the period 1988-1992, 49% of Brazilian formal workers remained less than two years in the same job. How does this number compare to those available for other countries? The answer is in Table 3 below, which shows the same measure for several other countries, for the industrial sector only. The years vary across countries, and correspond to the most recent available figures. The Table shows that Brazil presented the highest level of labor turnover.

Table 3: Labor Turnover in Several Countries
Proportion of Industrial Workers with less than Two Years of Tenure

Belgium	18%
Germany	21%
Denmark	27%
France	22%
Ireland	22%
Italy	13%
United Kingdom	31%

Netherlands	28%
Canada	33%
United States	39%
Finland	28%
Brazil	47%

Note: Source of data for other countries - Nickell, 1995.

Gonzaga (1996b) shows that this measure of labor turnover decreases significantly with education (completed years of study) and with the size of establishments. It is also shown that turnover does not reduce significantly if one considers only workers with more than 25 or 30 years of age. The implications are that Brazilian firms do not keep a long-term relationship with their workers, specially with low-educated workers.

Investment in training is a risky joint investment, since the appropriation of the investment returns is uncertain. A higher labor turnover increases this risk, since it increases the odds that workers trained would leave the firm and use the benefits of this training in other firms.[3] This implies very little on-the-job-training. The result is a low equilibrium for the society, characterized by high turnover, low investment in training, low productivity growth, and poor quality of jobs.

Another piece of evidence regarding the poor quality of the new jobs created in Brazil in the last fourteen years is given by a sectoral decomposition of employment. The proportion of workers employed in the tertiary sector, for example, increased from 43% in 1981 to 54.3% in 1995. This is a matter of concern, since the typical service sector job in Brazil is held by the relatively unskilled, does not provide a formal contract, is not unionized, and has a short tenure. Amadeo *et al.* (1993) show that approximately 60% of workers employed in the services sector in the beginning of the 90s have 4 years or less of education. By contrast, the proportion of workers with 4 years or less of study in the industrial sector is around 40%, while for the whole economy is near 50%. Moreover, about 38% of employees in the services sector in the beginning of the 90s have a formal contract (have their working cards signed). The corresponding figure in the industrial sector is around 85%.

[3] Gonzaga (1996b) discusses how some Brazilian labor market institutions act as incentives for higher labor turnover.

Most of these service sector jobs display low tenure: 47% of employees have less than one year of job experience at the firm. In the industrial sector, the proportion is 31%.

Even among formal workers, turnover rates are much higher in the service sector. In the commerce sector, for example, approximately 4.2% of formally employed workers, on average, got a new job each month between 1989 and 1995. The corresponding figure in the industrial sector is 3.2%. The tertiary sector is also characterized by low unionization rates. Amadeo and Camargo (1993) show that the proportion of workers that belonged to a union in 1986 was 29.1% in the manufacturing sector, compared to 5.6% in the service sector and 14.4% in commerce.

Table 4 shows some evidence that income inequality in Brazil, one of the worst in the world, deteriorated in the last decade. Amadeo *et al.* (1994a) show that the income ratio of the richest 10% against the poorest 40% in Brazil is around 6, while for other countries with population over 5 million and good quality data this ratio is below 3.5. The rise in income inequality is illustrated by the time series behavior of the national Gini coefficient in the 1980s, which increased from 0.564 in 1981 to 0.602 in 1990, after reaching a peak of 0.630 in 1989 (data from PNAD, FIBGE). Barros and Mendonça (1994) present additional evidence that Brazilian income distribution worsened in the 1980s. They show that all tenths of the distribution lost income in the 1980s, but the poorest were the most affected. While average income declined by 1.5% a year, on average, between 1980 and 1990, the mean income of the 10% poorest decreased by 5.1% a year, on average, in the same period. The 1% richest, on the other hand, increased their income share from 12.1% in 1981 to 13.9% in 1990.

Table 4: Brazil - Income Distribution - 1980s

Gini Coefficient	0.564 (1981) - 0.602 (1990)
Average Mean Income Growth: 10% Poorest	-5.1% a year
Average Mean Income Growth: Total Population	-1.4% a year

The Gini coefficient for the years 1992, 1993 and 1995 were 0.571, 0.601 and 0.565, respectively. This shows an erratic behavior of income distribution in Brazil in the 90s. However, the significant drop in inequality after the Real Plan indicates that the success in bringing down inflation from an average of 45% a month to an average of 1.5% a month had a significant impact on lifting living standards of the poorest in Brazil. This is a consequence of the fact that workers earning less than two minimum wages in Brazil have little protection against the inflationary tax, since in general they have no access to indexed banking accounts.

III. Dynamic Labor Demand Models and Employment Adjustment Costs

In this section, I discuss the general framework of dynamic labor demand models and the issue of employment adjustment costs. I then propose one way by which openness affects employment determination. This is done by considering a monopolistic competition setup, which implies that revenues depend on price-setting dynamics. Openness is assumed to produce an increase in the price elasticity of product demand, since more firms compete in the domestic market in a more open environment . The assumption is that the transition from a closed economy to an open economy does not imply a transition from an imperfectly competitive economy to a perfectly competitive economy, which is usually assumed in open economy models. The direction here is the same, that is, to increase the degree of price competitiveness. However, it is assumed that domestic firms still carry a certain degree of monopoly power after the removal of import tariff (and non-tariff) barriers.[4] This allows us to evaluate the effect of changes in the degree of monopoly power on labor demand.

The increase in the price elasticity of product demand is shown to increase, in absolute terms, the wage elasticity of labor demand. This is easily shown in the static condition for profit maximization without costs of employment adjustment, which states that marginal revenue equals marginal cost. This condition, in the price-setting setup, implies that factor demand price elasticities depend on the product-demand price elasticity. In the dynamic framework, when one allows for

[4] Cruz (1996) computes that the average nominal import tariff in the manufacturing industrial sector in Brazil has been reduced from 44.9% in 1989 to 13.6% by mid-1993.

employment adjustment costs, the Euler equation is highly non-linear, as shown in Burda (1991). In the next section, a partial adjustment equation is used to test these implications of the model.[5]

The idea is to motivate the estimation of dynamic labor demand equations for the industrial sector in Brazil. The arguments in this section will be used as the theoretical background to test whether there were significant structural changes in any of the key parameters that could be explained by the opening of the economy. In what follows in this section, I briefly discuss the general reasoning for considering dynamic labor demand models, and how the introduction of imperfect competition affects the Euler equation in these models.

The conventional view of how labor markets function in modern economies is one in which jobs usually last more than one day. In general, contracts between workers and firms are not reviewed every day. In most cases, relationships actually last for a considerable length of time. A major reason for this is the existence of non-trivial costs of hiring and firing workers. It has long been recognized that the firm's profit maximization problem should then be solved in an intertemporal framework that considers explicitly these labor turnover costs.[6] The general maximization problem in a dynamic labor demand model is set as:

$$Max \; E_t \sum_{i=0}^{\infty} \theta^i (R(Z_{t+i}, N_{t+i}) - W_{t+i} N_{t+i} - C(N_{t+i} - N_{t+i-1}))$$

where $E_t(.)$ denotes expectations formed at time t; $0 < \theta < 1$ is a real discount factor assumed to be constant for analytical simplicity; R(.) is a revenue function that depends on N_t, the employment level, and on Z_t, an index of product demand conditions; W_t is the real wage rate taken as given by the firm; and C(.) is the turnover cost function, which depends on the size of employment adjustment.

The standard assumption regarding the structure of adjustment costs, the C(.) function, is that it is strictly convex (usually, quadratic) and symmetric. It showed up first as a matter of

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[5] It is important to mention that only partial equilibrium effects are being considered here, without any effort to derive a general equilibrium model.

[6] See Holt *et al.* (1960), Oi (1962), for examples of early treatments of dynamic labor demand models. For extensive surveys of the literature, see Nickell (1986) and Hamermesh (1993).

analytical convenience and it is still present in most dynamic labor demand models. The intuition behind the quadratic structure is that the introduction of new hires in a workplace could be more disruptive the greater the size of the change. The costs of hiring new workers would thus increase more than proportionally with respect to the number of workers hired. Conversely, laying off several workers at once is also in general felt more intensively the larger the adjustment.

The quadratic structure implies that the firm adjusts slowly its labor input towards the desired employment level. It spreads the employment adjustment over time, approaching gradually and asymptotically each new target level. This gives the basis for the traditional employment partial adjustment equation, which one obtains from solving the maximization problem above, assuming quadratic adjustment costs, and a linear-quadratic (on labor) revenue function:

$$N_t = \alpha + \lambda N_{t-1} + \beta (L) F_t + \varepsilon_t \ ;$$

where F is a vector of forcing variables (such as W, Z, and real revenues), λ is a coefficient, and $\beta(L)$ is a lag polynomial, with coefficients given by a linear combination of the parameters of the model.[7]

Now, instead of assuming a linear-quadratic revenue function, consider an economy with a representative firm that uses labor as its only factor of production, according to a production function given by $Y_t = A_t N_t^a$, where A_t is a technology component, and $0<a<1$. The representative firm has some monopoly power and faces a constant-elasticity product demand curve given by $Y_t = Z_t P_t^{-1/(1-\mu)}$, where Z_t is an index of product demand, P_t is the firm's price, and $0<\mu<1$ is the inverse of the mark-up factor. Note that the perfect competition case is nested in this formulation, being observed when $\mu = 1$, which implies an infinite product-demand price elasticity.

The parameter μ, therefore, is an index of price competitiveness. The closer it gets to 1, the higher is the number of firms competing in the representative firm's product market. One can then examine the effects of openness on employment determination through its effects on the parameter

[7] The main alternative to the standard quadratic structure of C(.) is to assume that turnover costs are linearly related to the size of adjustment, *i.e.*, that turnover costs are fixed per worker hired or fired. The result is that the firm does not act continuously at the margin as before. The pattern instead is one of instantaneous adjustment whenever adjustment is activated. See Nickell (1978, 1986) and Bentolila and Bertola (1990) for examples of linear adjustment costs models.

μ. The idea is that the reduction in import tariffs (or the removal of non-tariff barriers) increases the number of firms competing in the domestic market. This can be modeled as an increase in the price elasticity of product demand, which would imply a decrease in the mark-up factor, *i.e.* an increase in μ.

The revenue function implied by combining the production function and the product demand function above is given by:

$$R_t = Z_t^{(1-\mu)} A_t^{\mu} N_t^{a\mu}$$

The firms' profit-maximization problem is thus given by:

$$Max \; E_t \sum_{i=0}^{\infty} \theta^i (Z_{t+i}^{1-\mu} A_{t+i}^{\mu} N_{t+i}^{a\mu} - W_{t+i} N_{t+i} - C(N_{t+i} - N_{t+i-1}))$$

The static labor demand condition is found by setting C(.) = 0 above, *i.e.* by deriving the model without considering costs of employment adjustment. The solution (in logs) for each period t is then given by:

$$\ln N_t = \frac{-1}{1-a\mu} (\ln W_t - \ln(a\mu) - (1-\mu) \ln Z_t - \mu \ln A_t)$$

Note that the wage elasticity of labor demand is -1/(1-aμ). Therefore, an increase in price competitiveness, represented in this model as a rise in the parameter μ, increases the employment-wage elasticity, in absolute terms. The reduction in rents, caused by the more open environment, decreases the steepness of labor demand curves. In other words, wage increases cost more jobs in the open economy.

Burda (1991) derives a non-linear dynamic labor demand equation in the monopolistic competition setup. The fact that the wage elasticity of labor demand increases is still valid in the case of non-zero adjustment costs. The process is shown to have richer dynamics than in the partial adjustment case and to depend on how expectations about future wages and product demand conditions are formed.

In the next section, I estimate a partial adjustment labor demand equation in order to test whether the labor cost elasticity of labor demand increased after the opening period in the Brazilian industrial sector.

IV. Structural Breaks in Industrial Employment Determination in Brazil

As we have seen in the first part of this paper, the main problem of the Brazilian labor market seems to be the low quality of jobs, not lack of job creation. Therefore, a legitimate concern of the Brazilian society lies on the ability of the economy in generating good jobs. Since most of the good jobs are in the industrial sector, I study this sector more closely. In particular, the objective of this section is to estimate a partial adjustment labor demand equation for the Brazilian industrial sector.

In general, industrial jobs are, on average, better than others jobs in Brazil . They usually offer higher pay, a higher percentage of workers is formally hired (the employers sign the working card), and the level of turnover is lower. However, the industrial sector in Brazil has reduced its relative employment share over the last fifteen years. Data from PNAD (*Pesquisa Nacional de Amostras por Domicílio*), FIBGE, reveal that the share of workers on the manufacturing industry fell from 15% in 1981 to 12.3% in 1995, with most of the reduction happening after 1990. The result is a deterioration of the average quality of employment in Brazil.

Data from PIM (*Pesquisa Industrial Mensal*), a monthly industrial establishment survey from FIBGE, show that between 1985 and 1995, industrial production increased by 1.3% a year, on average, accumulating a total increase of 14% over the whole period (see Graph 1).[8] However, industrial employment fell by 1.9% a year, accumulating a total reduction of 17.8% in the same period. In fact, Graph 1 shows that there is an almost continuous trend of industrial employment reduction since the beginning of this decade. This suggests that the relation between production growth and employment growth worsened over the recent years.

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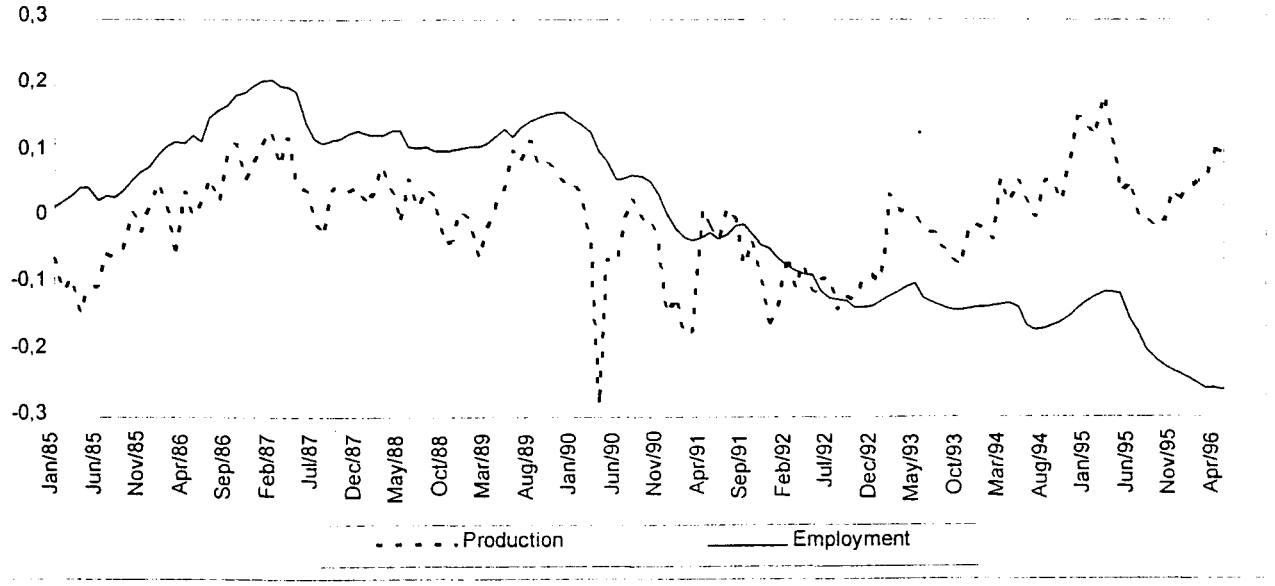
[8] The data source is PIM, from which it is possible to construct series of employment, production and average real labor cost. A data appendix at the end of the text describes those series in detail. The data start in January 1985 and end in May 1996, with a monthly frequency. In order to stabilize the variance of the series, I take logs of each variable.

Graph 1: Industrial Employment and Production
Seasonally Adjusted - 1985-96



To analyze the data in a more formal way, the simple partial adjustment model described in the previous section is estimated for the Brazilian industrial sector.[9] The use of a linear partial adjustment model, instead of a nonlinear model, is justified by the use of the aggregate industrial employment series. It is frequently argued that nonlinearities tend to cancel out in the aggregate, although there are only a few attempts to show this as a stylized fact (see Gonzaga, 1993, for one of these attempts). In future research, I intend to estimate nonlinear models, so as to capture the effects of not using a linear-quadratic revenue function in the dynamic labor demand equation. Nonlinear models are suited as well to study the effects of nonlinearities arising from asymmetric adjustment costs.

The model was originally used in Gonzaga (1996a), as part of a project on sectoral industrial employment. The main difference is that, in this section, I re-estimate the aggregate industrial sector equation with more observations, running until May 1996. I also study in more detail the issue of structural change. In fact, the results at the end of this section suggest that there

[9] The partial adjustment model has been extensively used in the literature, specially to compare the speed of employment adjustment across countries. For some examples of these studies, see Abraham and Houseman (1989), and Abraham and Houseman (1993). For an extensive survey of the empirical literature, see Hamermesh (1993).

was a significant structural change in the parameters of the partial adjustment equation in the beginning of this decade.

As discussed in the previous section, the partial adjustment model of employment has the following specification:

$$N_t = \alpha + \lambda_1 N_{t-1} + \lambda_2 N_{t-2} + \beta Y_t + \gamma W_t + \delta t + \varepsilon_t \ ;$$

where N_t is the level of employment at time t; Y_t is the level of industrial output; W_t is the average real labor cost; t is a linear time trend; and ε_t is a disturbance. Seasonal dummies are also included in the equation and were found to be significant in every specification. Lags of output and real labor costs were not significant in pre-testing, being removed from the final specification. The second lag of employment was also found to be significant. This is usually associated with labor heterogeneity (see Nickell, 1986). Finally, higher order transformations of the linear trend were not significant in pre-testing.

The parameters of interest in the model are:

• The parameter $\lambda = \lambda_1 + \lambda_2$, the employment adjustment coefficient, which gives a measure of adjustment speed. For the model to be stable, λ has to lie between 0 and 1. Values closer to 1 indicate a slow adjustment process, while values near zero represent a very volatile series.

• The parameter β is the elasticity of employment with respect to output. Its expected sign is positive.

• The parameter γ is the elasticity of employment with respect to the average real cost of labor. Its expected sign is negative.

• The parameter δ is the deterministic trend of employment, and is usually associated with technology progress.

Since the data suggests the existence of a structural change, I present below the results of the estimation of two models by OLS, varying only the estimation period. The trade-off in choosing the appropriate period for estimating the model is between the number of observations and the relevance of these observations in explaining the recent behavior of the industrial firms. The first model uses all available data, starting in January 1985 and ending in May 1996. It gives more degrees of freedom, but at least half of these observations is representing a different economic environment, previous to the opening of the economy. The second model, on the other hand, uses

data from April 1990 to May 1996. It uses less observations, but possibly these are more relevant to capture the main characteristics of the new environment. The choice of which month corresponds to the beginning month of the opening period was based on the in-sample forecast performance of each model, *i.e.* the ability of each model to predict the last twelve months of data.

The results of the estimation of the two models are presented in Table 5 below.

Table 5: Partial Adjustment Model Estimation - OLS
Dependent Variable: Brazilian Industrial Employment

Period	Employment Adjustment Coefficient, λ	Output Elasticity, β	Labor Cost Elasticity, γ	Deterministic Trend δ	Ljung-Box P-Value	Adjusted R^2
Apr/90 - May/96	0.89* (0.02)	0.060* (0.014)	-0.022* (0.009)	-0.0004* (0.0001)	0.56	0.99
Jan/85 - May/96	0.95* (0.01)	0.043* (0.011)	-0.015* (0.007)	-0.0001*. (0.00003)	0.93	0.99

Note: Standard errors in parentheses. A (*) indicates significance at the 5% level.

Table 5 illustrates the difference in the estimation of the key parameters in the partial adjustment equation when we use only the post-openness period. The data show that, in the 1990s, Brazilian industrial firms tend to adjust much faster the employment level. The coefficient of employment adjustment is 0.95 for the complete period, confirming the smoothness of the series. However, when the more recent period is used, the coefficient drops to 0.89. This may be signaling an increase in the proportion of temporary jobs in the industrial sector, which have lower adjustment costs.

Note that an adjustment coefficient of 0.95 implies a median lag of 13.5 months, *i.e.* it implies that it takes 13.5 months to complete 50% of the employment adjustment to each new equilibrium level. By contrast, in the 90s, the implied median lag drops to 5.8 months, *i.e.* the half-way life labor demand adjustment happens in less than 6 months.[10]

On the other hand, in the short run, the estimation using only observations of the 1990s produced much higher output and labor real costs elasticities, in absolute terms. The elasticity of

[10] The median lag of adjustment is given by log (0,5) / log (λ).

employment with respect to industrial output was estimated to equal 0.06 for the more recent period, and to equal 0.043 for the complete period. The labor cost elasticity, on the other hand, was -0.022 for the more recent period, and -0.015 for the complete period.

This result is in line with the predictions of the theoretical model stressed in the previous section. The launching of the openness process in the 1990s reduced the degree of market power of industrial firms in Brazil. The reduction in rents decreased the steepness of their labor demand curves. The correct interpretation for this phenomena is that increases in real wages now cost more jobs than in the pre-openness period.

The deterministic trend term is also higher, in absolute terms, over the more recent period. The trend coefficient dropped from -0.0001 to -0.0004. This is probably capturing the effects of significant productivity gains associated with the increasing introduction of labor-saving technologies, like outsourcing and downsizing. Note that the negative deterministic trend is the main responsible for the significant reduction in industrial employment observed in Brazil since 1990.

The coefficients presented in Table 5, may, however, be biased and inconsistent, since the real labor cost variable is computed by dividing the total wage bill by employment. Moreover, real wages are probably endogenous if there is wage bargaining between workers and firms. Table 6 below presents the results of the re-estimation of the partial adjustment model for the two periods, when instrumental variables are used. Instruments included the previous set of right-hand side variables, with the exception of real wages, which were instrumented by their lagged values.

Table 6: Partial Adjustment Model Estimation - Instrumental Variables
Dependent Variable: Brazilian Industrial Employment

Period	Employment Adjustment Coefficient, λ	Output Elasticity, β	Labor Cost Elasticity, γ	Deterministic Trend δ	Ljung-Box P-Value	Adjusted R^2
Apr/90 - May/96	0.88* (0.02)	0.067* (0.014)	-0.035* (0.011)	-0.0004* (0.0001)	0.70	0.99
Jan/85 - May/96	0.94* (0.01)	0.054* (0.012)	-0.026* (0.008)	-0.0001* (0.00003)	0.86	0.99

Note: Standard errors in parentheses. A (*) indicates significance at the 5% level.

Note that labor-cost and output elasticities increase, in absolute terms, when instrumental variables estimation is used. The coefficient of employment adjustment, on the other hand, is slightly lower under instrumental variables.

The result that the estimation using only observations of the 1990s produces much higher output and labor costs elasticities, in absolute terms, is still valid. The labor cost elasticity of employment is -0.035 for the more recent period, and -0.026 for the complete period. The output elasticity, on the other hand, is 0.067 for the more recent period, and 0.054 for the complete period.

Much has been debated in Brazil about the employment-generating effects of removing non-wage costs from the total wage bill of formal workers. However, the discussion so far has not been based on concrete numbers. The estimation of employment-wage elasticities above allows us to perform some simulation exercises of the effects of some proposals that have been made recently.

One of the proposals that have been discussed in Brazil is to change the base of incidence of some payroll taxes. These are social contributions that, according to the current labor legislation, finance several government programs, such as training and social programs, education, land reform, and small business institutions. In practice, these are payroll taxes that increase the total cost of labor. Since our measure of labor costs are based on the wage bill, one can use the labor cost elasticities estimated above to simulate the employment effects of removing some of these payroll taxes.[11]

Removing all payroll taxes, with the exception of social security (20%) and the *Fundo de Garantia por Tempo de Serviço* (8%), is equivalent to a reduction of 7.8 percentage points in wage bill social contributions, from 35.8% to 28%. This would imply a 5.74% reduction in labor costs. According to the labor-cost employment elasticities estimated above, using instrumental variables and the more recent period (-0.035), this proposal would generate an employment increase of 0.2% in the short run, as shown in Table 7 below.

[11] Gonzaga (1996a) contains a detailed discussion on the magnitudes and employment effects of wage-benefits and payroll taxes.

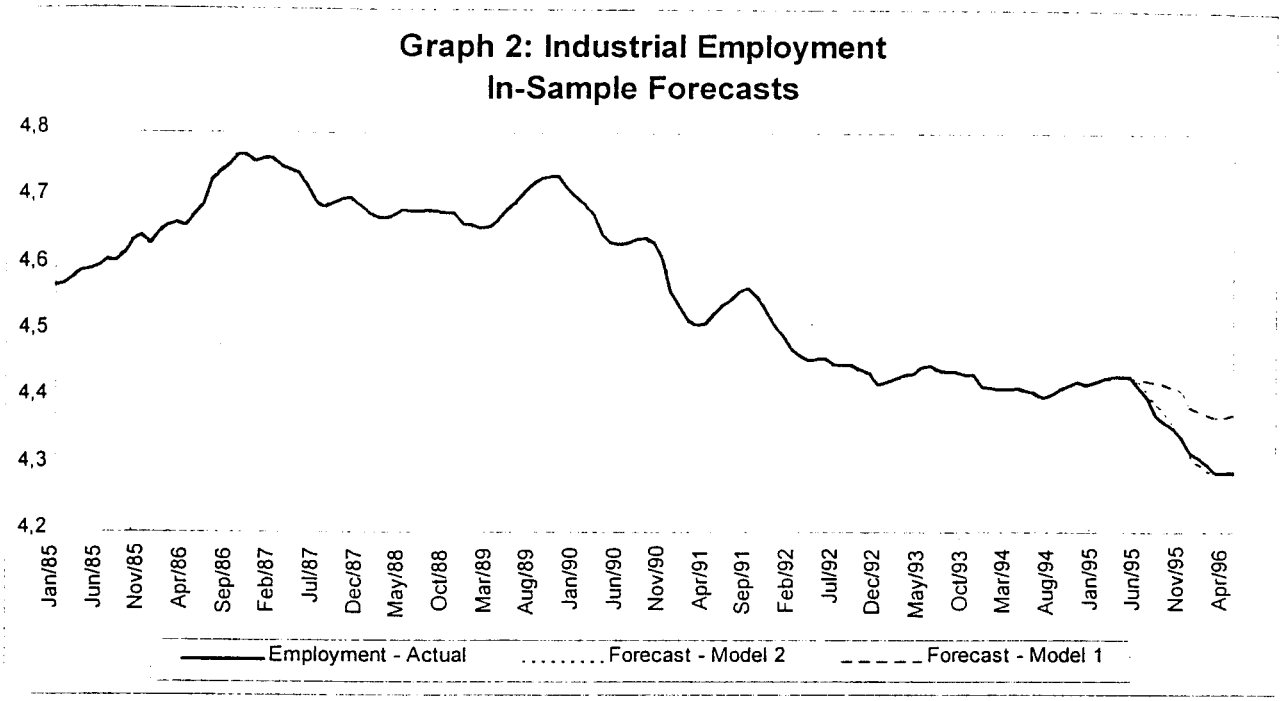
Table 7: Industrial Employment Effects of a Reduction of 7.8% in Payroll Taxes

After 1 Month	After 6 Months	After 12 Months	Long Run
0,21%	0,86%	1,32 %	1,66%

However, the long run effects are higher. Since half of the adjustment to each new long run equilibrium is attained in 5.7 months, this payroll tax reduction proposal is estimated to generate an employment increase of approximately 0.83% over the following six months. This is not much, if you consider that these effects are once-and-for-all, and that one has to compensate for the effects of a negative deterministic trend term.

Finally, I present the results of "in-sample" forecasts of the two models estimated above. The exercise consists of running each equation with data finishing in May 1995, and using the results to forecast the employment level between June 1995 and May 1996. As before, the first regression used data starting in January 1985, while the second used data starting in April 1990.

Graph 2 below shows the original (log) employment series, together with the "in-sample" forecasts of the two regressions. Observe how the equation using only data from the 90s track the employment series much more closely. Forecast performance statistics, not reported here, confirm the adequacy of using this model for analyzing the recent behavior of industrial employment in Brazil.



IV. Conclusions

In this paper, I studied the recent behavior of the Brazilian labor market. This was done in two ways. The first part of the article provided a general picture of the Brazilian labor market, by identifying current trends in some key labor market indicators, and reversals that could be attributed to structural reforms. It was found that the problem of the Brazilian market is a problem of job quality, rather than one of quantity, with the exception of formal and industrial jobs which have been falling steadily since 1990.

The second part of the paper looks more closely at the industrial sector of the Brazilian economy, trying to detect the effects of the opening process on employment determination. In fact, a structural change in the main parameters of a partial adjustment employment equation was found. A simple dynamic labor demand model is used to interpret the structural change as an optimal response of profit-maximizing industrial firms - mostly, producing traded goods - to a more open environment to foreign competition. This, coupled with the effects of an increase in the use of job-saving technologies, such as outsourcing and downsizing, is able to explain the recent evolution of industrial employment in Brazil.

The estimation of the partial adjustment model allowed us to study the effects of a payroll tax reduction proposal that have been discussed by the Brazilian society. Finally, "in-sample" forecast exercises confirmed the ability of the model, estimated using only data corresponding to the more recent period, in accurately tracking down the evolution of industrial employment in Brazil.

Data Appendix

The partial adjustment model was estimated using industrial series taken from *Pesquisa Industrial Mensal* (PIM), an establishment survey run by *IBGE*. The variables used were: Industrial Production (*Índice de Produção Física,* IPF), Payroll Payments (*Valor da Folha de Pagamento,* VFP), and Production Employment (*Total de Pessoas Ocupadas na Produção,* POP). The average wage cost series was obtained by dividing payroll payments by production employment, VFP/POP. These series was then deflated by industrial whosale prices (*Índice de Preços por Atacado, oferta global*), calculated by *Fundação Getúlio Vargas*), to get a measure of real labor costs.

References

Abraham, K. and Houseman, S. (1989), "Job Security and Work Force Adjustment: How Different Are U.S. and Japanese Practices?", *Journal of the Japanese and International Economics*, 3: 500-521.

Abraham, K. and Houseman, S. (1993), "Does Employment Protection Inhibit Labor MArket Flexibility? Lessons from Germany, France and Belgium", *NBER Working Paper* n. 4390.

Amadeo, E., Barros, R., Camargo, J.M., Mendonça, R., Pero, V., and Urani, A. (1993), "Human Resources in The Adjustment Process", Discussion Paper N° 317, DIPES/IPEA.

Amadeo, E., Barros, R., Camargo, J.M., Gonzaga, G. e Mendonça, R. (1994), "*A Natureza e o Funcionamento do Mercado de Trabalho Brasileiro desde 1980*", Série Seminários n° 11/94, DIPES/IPEA.

Amadeo, E. and Camargo, J.M. (1993), "Labour Legislation and Institutional Aspects of the Brazilian Labour Market", *Labour*, Spring, 7:157-180.

Amadeo, E. and Gonzaga, G. (1995), "Inflation and Economic Policy Reform: Social Implications

in Brazil", in David Turnham, C. Foy e G. Larraín (eds.), Social Tensions, Employment Generation and Economic Policy in Latin America, OECD Development Centre, Paris, France.

Barros, R. and Mendonça, R. (1994), "The Evolution of Welfare, Poverty and Inequality in Brazil over the Last Three Decades: 1960-1990", Série Seminários n° 8/94, DIPES/IPEA.

Bentolila, S. and Bertola, G. (1990), "Firing Costs and Labor Demand: How Bad is Eurosclerosis?", *Review of Economic Studies*, 57: 381-402.

Burda, M. (1991), "Monopolistic Competition, Costs of Adjustment, and the Behavior of European Manufacturing Employment", *European Economic Review*, 35: 61-79.

CEPAL (1995), *Panorama Social de América Latina, 1995.*

Cruz, L. E. (1996), "Emprego e Comércio Industrial: 1980-93", Unpublished Master Dissertation, PUC-Rio, Brazil.

Gonzaga, G. (1993), "Are Firm Employment Cycles Asymmetric?", Unpublished PhD. Dissertation, University of California, Berkeley.

Gonzaga, G. (1996a), "Determinação do Emprego Industrial no Brasil: Uma Análise Agregada e Setorial", forthcoming as a chapter in a book edited by CIET/SENAI, Brazil.

Gonzaga, G. (1996b), "Rotatividade, Qualidade do Emprego e Distribuição de Renda no Brasil", *Texto para Discussão* n° 355, PUC, Rio de Janeiro, Brasil,1996.

Hamermesh, D. (1993), *Labor Demand*, Princeton: Princeton University Press.

Holt, C., Modigliani, F., Muth, J., and Simon, H. (1960), *Planning Production, Inventories and Work Force*, Englewood Cliffs, NJ: Prentice-Hall.

Nickell, S. (1978), "Fixed Costs, Employment and Labor Demand Over the Cycle", *Economica*, pgs 329-345.

Nickell, S. (1986), "Dynamic Models of Labor Demand", in Orley Ashenfelter and Richard Layard, eds, *Handbook of Labor Economics*, Amsterdam: North-Holland Press, ch.9.

Nickell, S. (1995), "Labour Market Dynamics in OECD Countries", Institute of Economics and Statistics, Oxford University, mimeo.

Oi, W. (1962), "Labor as a Quasi-Fixed Factor", *Journal of Political Economy*, 70: 538-555.