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EVIDENCE OF REGIONAL SEGMENTATION OR NATIONAL MARKETS?

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ABSTRACT

In spite of Brazil's rapid pace of economic integration in recent decades, there remains substantial evidence of regional differences in wages. Numerous studies have also cited the impact of the country's form of economic development on various skill and occupational categories. On the other hand, macroeconomic models generally simplify labor market processes by assuming a single homogeneous national labor market. Are wages in Brazil, then, determined by isolated regional, occupational, or nationwide factors? This study develops an econometric model for decomposing annual, occupational and regional effects on wages and applies it to the Brazilian urban labor force to test whether annual wage changes are more similar among occupational or local categories. It shows that wages are affected both by local conditions and national occupational trends, and furthermore that the underlying patterns of regional and occupational wage differentials are remarkably stable.

I. INTRODUCTION

Brazil is an extensive country of sharp economic, social and geographical contrasts. Its labor force of over 50 million people work in a complete range of formal and informal activities, sectors, and climates. They work in electronics assembly plants in the free zone of Manaus in the heart of the tropical amazon; in the orange groves of Rio de Janeiro; the soya fields of Mato Grosso; the automobile plants of São Paulo; and the oil refineries of Salvador. They work for multinationals like IBM and Exxon, for parastatals like Petrobras and Embraer, for domestic giants like Votorantim or Estrela, for local merchants, for small workshops. They produce sophisticated aircraft for export, and roasted peanuts for sale on street corners. They earn a median income of approximately $150 per month, but some earn thousands of dollars per day. On average, those in São Paulo earn twice the wage of those in Fortaleza.

This paper seeks to address one aspect of this extensive diversity: do wages in Brazil appear to be more heavily influenced by local or by national factors? In particular, there is considerable evidence which could be interpreted as suggesting that wages are set by local demand and supply conditions--with slack labor markets generating low wage levels in the Northeast while relatively tight labor markets generate higher wage levels in the country's Southeast. On the other hand, numerous studies have considered wage determination and Brazil's highly skewed distribution of income by emphasizing the role of relative scarcity for skills (generally measured by education, but also by occupation), irrespective of local conditions. Furthermore, macroeconomic models frequently treat the economy as if it generated a single national wage level. Which of these three levels of analysis is most appropriate to wage-setting in Brazil? Can they be statistically separated and analyzed?

In order to consider this question, this study divides the urban labor force into geographical and occupational categories and tests whether annual wage changes are more similar among occupational or local categories. It will show that wages are affected both by local conditions and national occupational trends, but that the underlying pattern of regional and occupational wage differentials are remarkably stable.

Note that this paper separates the question of whether wages are determined by local or national conditions from an analysis of the process of wage determination itself. That is, the methodology permits an evaluation of the pattern of wage changes without explicitly addressing whether those wage changes are caused by market forces, bargaining outcomes, political changes, institutional processes, etc. In the process, however, it will be noted when evidence is more consistent with one or another of these theories of wage determination.

The following two sections discuss the meaning of occupational and regional categories for wage determination in Brazil. They are followed by Section III which develops and discusses a model for statistically testing the key issue of whether wages are influenced by national or local factors. Section IV presents the results of this analysis, while Section V concludes the paper by summarizing the findings and exploring their implications.

II. REGIONAL WAGE DIFFERENTIALS IN BRAZIL

The main question in this paper addresses whether or not wages are affected by national or local conditions. The regional contrast in wages in Brazil has elicited numerous studies,[1] not to mention a variety of large government programs (e.g. SUDENE, FINOR, etc.) It is evident that Brazil's poor population is disproportionately concentrated in the Northeast, and that wages are generally lower in that region than elsewhere. Some 30% of Brazil's population resided in the Northeast in 1985, but 52% of the families with less than one minimum wage lived in that region. In the metropolitan regions, about 27% of São Paulo's residents were living below the poverty level in 1985, a low proportion compared to the poverty shares of Fortaleza (37%) and Recife (48%).[2] The median wage in São Paulo is almost twice as high as in Fortaleza (See Table 1).

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[1]Numerous economists have addressed this question, including Baer 1964, Furtado 1973, Fishlow 1972, Almeida 1989, Savedoff 1989, and Pfefferman and Webb 1984. Political scientists have also considered these regional wage differences, including Chaloult 1979 and Mitchell 1981.

[2]All figures calculated by the author from the IBGE's tabulations of PNAD 1985, except for the metropolitan region poverty shares which are found in Rocha and Villela (1990).

Table 1

COMPARISON OF HOURLY WAGES BY METROPOLITAN REGION
MEDIAN AND COEFFICIENT OF VARIATION
FOR MALE EMPLOYEES AND SELF-EMPLOYED - 1985

Metropolitan Region	Median Hourly Wage (Cr$/hour)	(US$/hour)	Expanded (US$/year)	Coefficient of Variation
Belém	4,000	0.51	980.84	169
Fortaleza	2,872	0.37	704.25	173
Recife	3,181	0.41	780.02	171
Salvador	4,167	0.53	1021.79	158
Belo Horizonte	3,958	0.51	970.54	166
Rio de Janeiro	4,166	0.53	1021.55	156
São Paulo	5,556	0.71	1362.39	139
Curitiba	4,688	0.60	1149.55	159
Porto Alegre	5,000	0.64	1226.05	163
All	4,167	0.53	1021.79	152

Note: Conversion at official exchange rate October 1, 1985 of Cr$7,830/US$ as reported in Conjuntura Economica, Jan. 1986. Expanded figure represents hypothetical annual income for an individual working 48 weeks for 40 hours/week at the median wage.
Source: Author's tabulations from the IBGE's PNAD data, 1985.

Although Brazil is a large country and distances are great, the country has become increasingly integrated in the last several decades. In terms of commerce, interstate trade tripled from 1943 to 1961, and then increased about ten-fold in the next 20 years. As a share of GDP, this interstate commerce grew from 16% in 1947 to 33.5% in 1976 (Ablas & Fava 1985).

Population movements across regions are also large. The 1980 Census showed that some 40 million people, about 35% of the population, were living outside their native state. On average, some 1.5 million people move annually from one state to another (Savedoff 1990). Furthermore, migration has become significantly easier and less costly. Meneghetti (1988) measured the increasing mobility of people by using census data to show that a 10% increase in distance reduced migration by some 18% in 1960, but only by 6% in 1980. The increasing integration of interregional trade and population movements indicates that local influences upon wages may be declining in importance relative to national ones.

On the other hand, the spatial dispersion and character of employment

has not changed in many ways. For example, São Paulo became Brazil's leading center of industrial activity in the 1930s, and the state of São Paulo has maintained its share of over 50% of national industrial production since 1960. Although employment growth in other regions accelerated in the 1970s and 1980s relative to São Paulo, the base of employment is so large in São Paulo that it continues to generate larger numbers of jobs in absolute terms. The uneven spatial distribution of industry, then, can contribute to local variations in wages whenever there is sectoral variation in demand or changes in intersectoral terms of trade.

In spite of the growing integration of commerce and large population flows, regional wage differences are significant and appear to be relatively stable.[3] Table 2 shows the real mean log wage for male non-agricultural employees residing in Brazil's nine major metropolitan regions . Even in 1984 and 1985 when the regional wage dispersion is lowest, wages range from 17% above the mean in São Paulo to 36% below the mean in Fortaleza. São Paulo is the city with the highest wage level in all years, while Fortaleza and Recife consistently have the lowest wage levels. For the purposes of this paper, it is interesting to note that the change in wages from year to year is quite comparable across regions. Figure 1 shows how the wage level in some selected cities rise and fall together. Even so, there is some interesting regional variation. For example, the wage level in Rio de Janeiro seems to have done relatively better than other cities in the late 1970s and to have suffered worse with the recession of the early 1980s.

Table 3 shows the results of projecting the regional mean log wage for different cities on the mean log wage in São Paulo. These figures are presented not as definitive measures, but rather as suggestive of the wage elasticities between one region and another. As the table shows, the estimated elasticities are all significantly different from zero, and most are significantly less than one. Wages in Belo Horizonte and Rio de Janeiro appear to have moved in concert with São Paulo's wage changes over this period, while the elasticities for the wage levels in the Northeast and Belem show them to be less strongly associated.

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[3] Savedoff (1989) argues that this stability is even more longstanding using industrial census data from 1949 to 1980.

Do the annual wage changes in Table 2 reflect gains or losses for all individuals in a particular city or only gains for some? Could the relative changes reflect changing compositions of employment or do they actually reflect changes in regional wage levels? Before responding to these questions, occupational wage differentials will be considered as a relevant category for analyzing national wage changes.

Table 2

MEAN LOG WAGE BY YEAR AND REGION

Metropolitan Region	1976	1977	1978	1979	1981	1982	1983	1984	1985	1986	Std. Dev.
Belem	1.94	1.98	2.02	1.87	1.93	1.94	1.55	1.46	1.55	1.90	0.20
Fortaleza	1.82	1.96	1.88	1.71	1.79	1.82	1.32	1.23	1.25	1.76	0.26
Recife	2.03	1.92	1.93	1.80	1.87	1.89	1.48	1.30	1.40	1.77	0.24
Salvador	2.40	2.20	2.26	2.12	2.20	2.18	1.81	1.59	1.65	1.98	0.26
Belo Horizonte	2.35	2.07	2.38	2.24	2.13	2.12	1.69	1.47	1.56	2.03	0.31
Rio de Janeiro	2.36	2.42	2.43	2.30	2.23	2.20	1.76	1.54	1.59	2.04	0.32
Sao Paulo	2.61	2.59	2.59	2.49	2.37	2.38	1.93	1.74	1.79	2.33	0.32
Curitiba	2.46	2.35	2.42	2.18	2.14	2.19	1.78	1.62	1.67	2.15	0.29
Porto Alegre	2.46	2.45	2.43	2.23	2.22	2.29	1.83	1.67	1.74	2.17	0.28
All	2.40	2.36	2.34	2.27	2.15	2.16	1.73	1.55	1.61	2.06	
Std. Deviation	0.25	0.23	0.24	0.24	0.18	0.18	0.18	0.16	0.16	0.18	

Note: All wages measured in 1976 cruzeiros.
Source: Author's Tabulations from the IBGE's PNAD data.

Figure 1

MEAN OF LOG REAL WAGES FOR SELECTED METROPOLITAN REGIONS

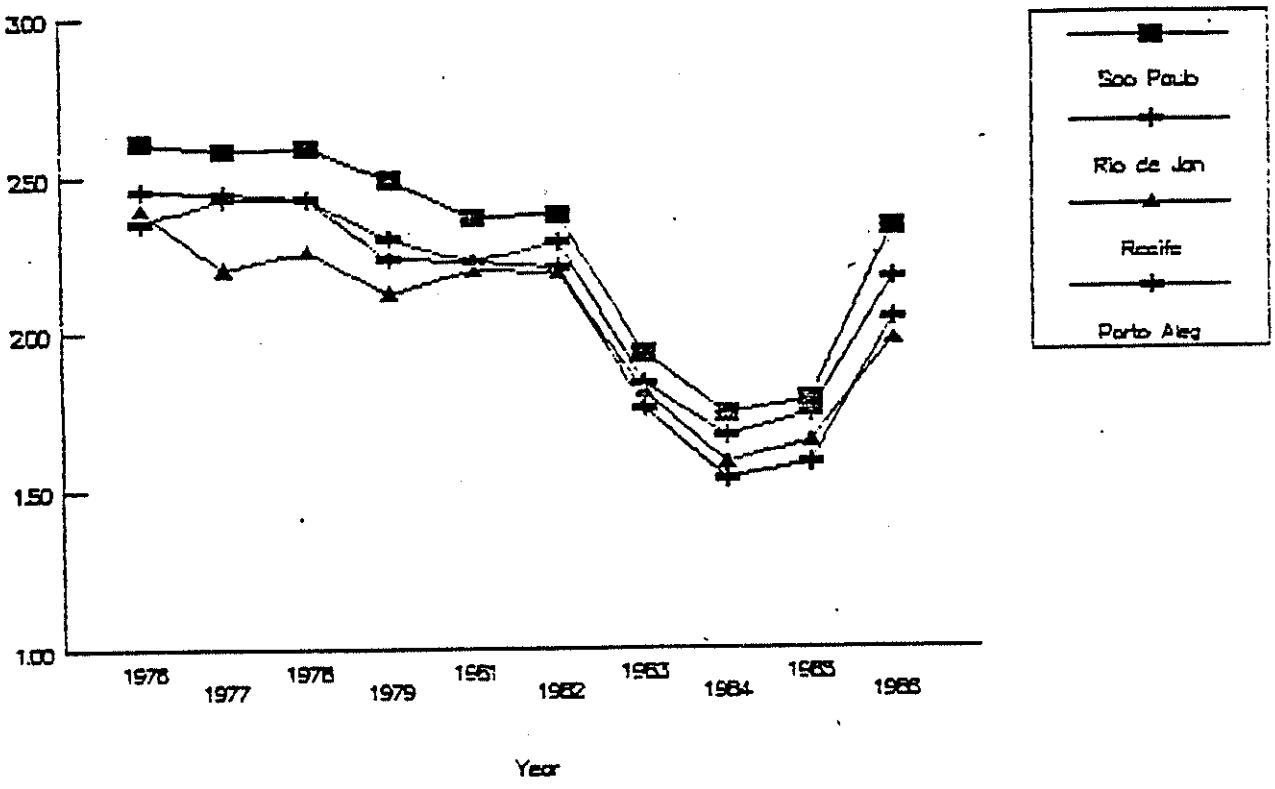

Table 3

ELASTICITIES OF MEAN LOG WAGES ACROSS METROPOLITAN REGIONS WITH RESPECT TO SÃO PAULO

Metropolitan Region	Elasticity	Standard Error	t-statistic for H: β=1	Statistical Significance
Belém	0.60	0.06	6.67	1% level
Fortaleza	0.79	0.07	3.00	2% level
Recife	0.73	0.06	4.50	1% level
Salvador	0.77	0.08	2.88	5% level
Belo Horizonte	0.93	0.09	0.78	-
Rio de Janeiro	1.00	0.05	0.00	-
São Paulo	-	-	-	-
Curitiba	0.89	0.05	2.20	10% level
Porto Alegre	0.87	0.04	3.25	2% level

Note: Elasticities estimated from a simple projection of mean log real wage in the given region upon the mean log real wage in Sao Paulo as follows:

$$w_j = \alpha + w_1 \beta + \varepsilon$$

Each regression contained 10 observations, one for each year, hence there are eight degrees of freedom.

III. OCCUPATIONAL WAGE DIFFERENTIALS IN BRAZIL

Occupational wage differentials are evident in Brazil, and have been variously interpreted as the outcome of market forces and skill differentiation (Langoni 1973), as results of social status unrelated to productivity (Medeiros 1984), and as a function of institutional positions in relation to the distribution of rents and profits (Saboia 1989, Lanzana 1987, Menezes 1988). Occupational categories are very difficult to interpret as they are jointly determined by individuals' abilities, training, experience, composition of economic activities, and patterns of organizing work. Nevertheless, there are numerous reasons to expect that wages for particular occupational categories should be relatively homogeneous, and change together over time.

First, people who exercise similar occupations generally undertake comparable training or apprenticeships which allow them to perform special tasks. Such training and experience is not homogeneous, but for occupational groups it is relatively homogeneous. For example, there are many different

ways and places to train for mechanics, farmhands, and bankers, but the range of methods is narrow within any one of these occupational groups relative to the methods used by the others. In a market system, each occupation would be treated as a separate market, to the degree that there is low elasticity of substitution between groups. This means that each occupation can have a separate wage reflecting the marginal productivity of workers with those skills as well as the rents they obtain whenever unforeseen changes in demand meet a less than infinitely elastic supply.

Secondly, occupational categories are closely related to the institutional organization of modern firms. Managers obtain higher wages along with perquisites and status when compared to clerical and production workers. To the degree that wages are determined by political economic forces which affect the functional distribution of social income, occupational categories more closely tied to the capitalist class would enjoy wage gains in times when the profit share of social income increases, at the expense of other occupational categories (Saboia 1989, Lanzana 1987). Under various and distinct models of wage determination, then, it is to be expected that workers in occupational groups make up relatively homogeneous groups in terms of wages, and are likely to be affected as a group by any nationwide factor which changes wages.

In Brazil, occupational wage differentials are relatively large. Administrators earn some 100% more than Clerical workers and about 170% more than service workers (See Table 4). These occupational wage differences are relatively stable over time and move together from year to year. Table 4 shows the real mean log wage for 10 occupational categories over time. The dispersion across occupational groups is high relative to the dispersion across regions, and is highly stable over the entire period. Even so, there are interesting annual variations which could reflect national changes in demand for occupational categories (Lanzana 1987), modifications in federal wage policy (Saboia 1989), or shifts between capital and labor (Storper 1984). Sales personnel show greater wage variation, being some 30% below the mean in 1976, only 18% below the mean in 1979, and again 30% below the mean in 1985. Service personnel had significant gains from 1979 to 1983 relative to the mean, but declined again thereafter. Figure 2 shows the wage changes over time for selected occupations. The ranking never changes, but some years reveal a somewhat wider or more compressed occupational wage pattern.

As before, it is interesting to project occupational wages upon one group in the sample. Table 5 shows the elasticities of the mean log wage for particular occupational groups when projected upon the mean log wage of administrators. In this case, too, the relationship between wages is signicantly different from zero and is positive. In three cases--clerical, skilled production, and transportation and communication workers--the elasticity of wages with respect to administrators' wages is not significantly different from one. In the other cases, professional, technical, sales, semi-skilled production and service personnel, the elasticity appears to be greater than one.

Does wage variation by occupation reflect shifting relative advantages for each group or does it result from the regional dispersion of occupations which are thereby affected variously by local conditions? The next section develops a methodology for analyzing the regional and occupational impact on wages.

Table 4

MEAN LOG WAGE BY YEAR AND OCCUPATION

Occupation	1976	1977	1978	1979	1981	1982	1983	1984	1985	1986	Std. Dev.
Miscellaneous	2.32	2.23	2.23	2.15	2.12	2.11	1.69	1.54	1.58	1.98	0.27
Administrators	3.52	3.43	3.48	3.40	3.27	3.29	2.91	2.76	2.84	3.24	0.26
Professional	4.10	4.03	3.96	3.87	3.71	3.73	3.32	3.16	3.26	3.64	0.31
Technical	2.87	2.82	2.74	2.59	2.47	2.55	2.09	1.94	2.06	2.47	0.31
Clerical	2.48	2.50	2.49	2.38	2.35	2.41	1.98	1.83	1.91	2.28	0.24
Semi-Skilled	1.96	1.95	1.93	1.86	1.75	1.75	1.31	1.11	1.18	1.67	0.31
Skilled	2.35	2.33	2.32	2.27	2.19	2.21	1.76	1.58	1.63	2.09	0.28
Transport	2.25	2.34	2.35	2.30	2.16	2.17	1.74	1.59	1.69	2.10	0.27
Sales	2.11	2.12	2.13	2.09	1.86	1.84	1.43	1.26	1.30	1.81	0.33
Services	1.74	1.75	1.72	1.65	1.56	1.59	1.16	0.96	1.00	1.45	0.29
All	2.40	2.36	2.34	2.27	2.15	2.16	1.73	1.55	1.61	2.06	
Std. Deviation	0.69	0.67	0.66	0.65	0.64	0.64	0.65	0.67	0.68	0.65	

Note: Wages in 1976 Cruzeiros.
Source: Author's Tabulations from the IBGE's PNAD data.

Figure 2

MEAN OF LOG REAL WAGES FOR SELECTED OCCUPATIONS

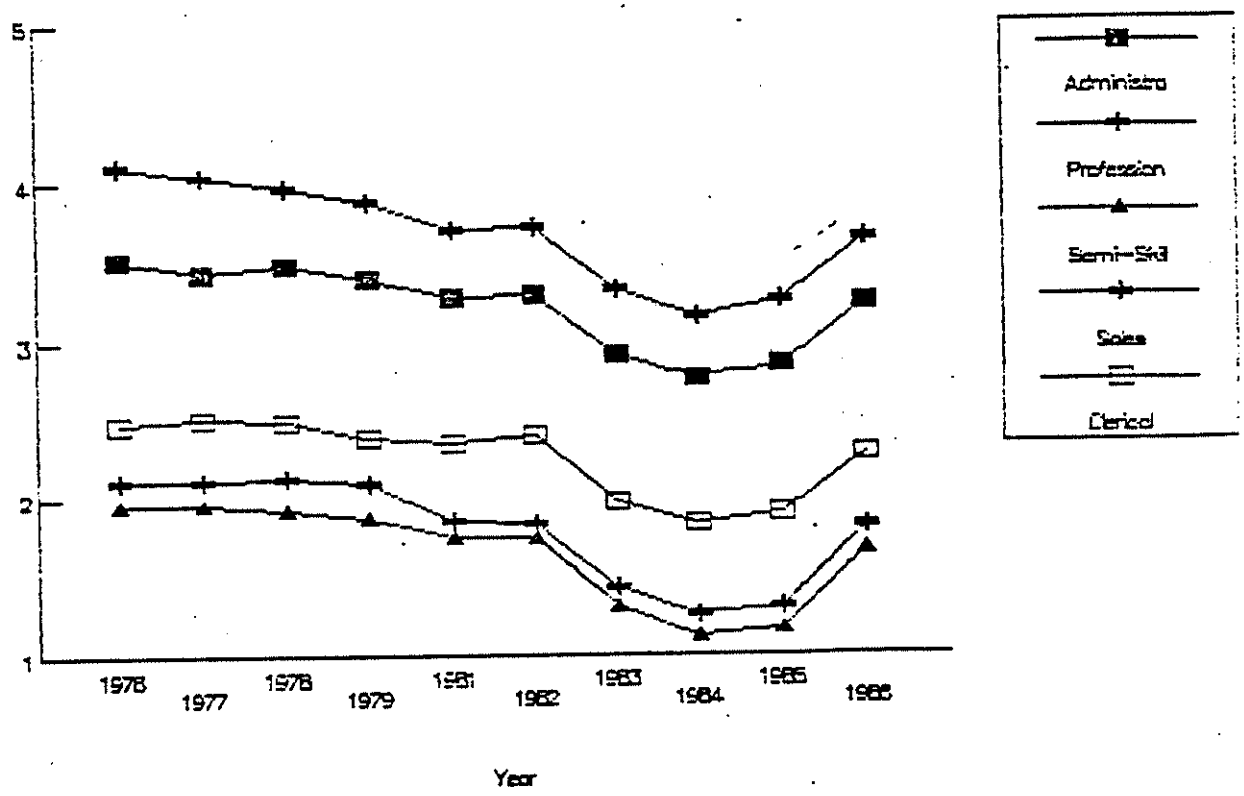

Table 5

ELASTICITIES OF MEAN LOG WAGES ACROSS OCCUPATIONS
WITH RESPECT TO ADMINISTRATORS

Occupation	Elasticity	Standard Error	t-statistic for H: β=1	Statistical Significance
Administrator	-	-	-	-
Professional	1.19	0.07	2.71	5% level
Technical	1.17	0.07	2.42	5% level
Clerical	0.91	0.05	-1.80	-
Semi-Skilled	1.18	0.04	4.50	1% level
Skilled	1.08	0.05	1.60	-
Transport	1.02	0.06	0.33	-
Sales	1.24	0.05	4.80	1% level
Services	1.10	0.05	2.00	10% level

Note: Elasticities estimated from a simple projection of mean log real wage in the given region upon the mean log real wage for Administrators as follows:

$$w_k = \alpha + w_m \beta + \varepsilon$$

Each regression contained 10 observations, one for each year, hence there are eight degrees of freedom.

IV. METHODOLOGY FOR EXPLORING REGIONAL AND OCCUPATIONAL WAGE CHANGES

With panel survey data, it is possible to follow individuals over time and analyze whether their annual wage changes move more in association with wage changes for other individuals in their own region (regardless of occupation) or for other individuals in the same occupation (regardless of region). Using the PNAD data of the IBGE it is possible to approximate a synthetic panel data set by calculating average wages by region and occupation for each year, assuming that the composition of each subgroup does not change significantly from year to year. The use of average wages is useful for eliminating stochastic variation under certain assumptions about random elements of wage determination. This section specifies these assumptions through a formal statistical model.

First, let log wages be a function of a variety of individual characteristics.

$$\ln w_i = X_i \beta + \varepsilon \qquad (1)$$

where w_i is the individual i's hourly wage, X is a vector of all (observed and unobserved) characteristics associated with individual i which determine wages, and ε is an orthogonal term. The orthogonal term, ε, can be considered to have three components:

$$\varepsilon = \mu_i + \nu_j + \varphi_k \tag{2}$$

where

μ_i = random variations in wages associated with individual i;

ν_j = disturbances or premia associated with the individual's occupation, J; and

φ_k = disturbances or premia associated with the individual's place of residence, k.

Each of these variables and terms also has a time component, so equation (1) can be rewritten as:

$$\ln w_{it} = X_{it}\beta + \mu_{it} + \nu_{jt} + \varphi_{kt} + \eta_t \tag{3}$$

where the subscript t represents a particular year and η_t has been included as a disturbance term specific to a given year, t.

If we take the average of all wages across individuals in a given occupation, region, and year, the resulting mean log wage will be:

$$\omega_{.jkt} = \bar{X}_{.t}\beta + \mu_{.t} + \nu_{jt} + \varphi_{kt} + \eta_t \tag{4}$$

where $\omega_{.jkt} = E(\ln w_{ijkt} \mid j=J,\ k=K,\ t=T)$.

Now, if the randomness associated with individuals in a given year, μ_{it}, is distributed with mean zero independently of region and occupation, then the mean log wage for each occupational regional group in a particular year will be:

$$\omega_{.jkt} = \bar{X}_{.t}\beta + \nu_{jt} + \varphi_{kt} + \eta_t. \tag{5}$$

This creates a "synthetic individual" with the mean characteristics of the group (j,k,t), written as $\bar{X}_{.jkt}$. This synthetic individual can be followed through time as though part of a panel survey to the degree that the composition of individuals in each group remains the same. The process of averaging seeks to eliminate individual variation in earnings which is not

associated with X as a source of wage dispersion.

In order to facilitate further decomposition of the effects, each term is divided into two parts: one part is the average effect over the entire study period, and the second part is the deviation from this average. In particular, each of the right hand terms can be defined as:

$$\bar{X}_{.jkt} \equiv \bar{X}_{.jk.} + \hat{X}_{.t}$$

$$\nu_{jt} \equiv \bar{\nu}_{j.} + \hat{\nu}_{jt}$$

$$\varphi_{kt} \equiv \bar{\varphi}_{k.} + \hat{\varphi}_{kt}$$

where the first right hand term in each definition represents the average over the entire study period, and the second right hand term represents the deviation in a particular year t from that mean. Note that a similar decomposition for the final term, η, would be meaningless, since it essentially measures the time-specific deviation from the study period mean.

The resulting equation is:

$$\omega_{.jkt} = (\bar{X}_{.jk.} + \hat{X}_{.t})\beta + (\bar{\nu}_{j.} + \hat{\nu}_{jt}) + (\bar{\varphi}_{k.} + \hat{\varphi}_{kt}) + \eta_t \qquad (6)$$

This equation is entirely identified since we know the occupation, region, and time period for each synthetic observation. The only difficulty arises in specifying what set of variables make up the wage determining characteristics in the vector X. This can be addressed with commonly utilized observable variables such as years of schooling, age, and marital status. On the other hand, there are numerous unobservable factors — ability, contacts, quality of school, etc. — which would necessarily be left out. Instead, this paper seeks to capture this set of factors indirectly through the addition of one assumption and a particular mapping. First, it is assumed that the composition of each subgroup, stratified by occupation and region, does not change from year to year, i.e.

$$\hat{X}_{.t} = 0.$$

Since we are not interested in estimating β — the coefficients on the wage defining characteristics — we can use a matrix of dummy variables, Q, which represents the interaction of region and occupation and can serve as a proxy

for the mean wage defining characteristics of any particular occupation-region group. Q is a matrix of 1's and 0's with jxk columns and n rows. Each column has a single "1" in it, indicating the occupation-region category which is associated with a particular observation. The mean characteristics for any particular occupation-region group can be projected upon Q by a matrix H which has jxk rows and h columns, where h is the number of variables in the vector X. In matrix notation, then

$$X = Q \cdot H$$

where X is the matrix of mean wage characteristics for each of the jxk occupation-region groups and is constructed by stacking the $\bar{X}_{.jk.}$ vectors. Equivalently, for any particular occupation-region group

$$\bar{X}_{.jk.} = q \cdot H$$

where q represents the appropriate row vector from Q.

With the additional assumption regarding the temporal stability of mean wage-determining characteristics and the one-to-one mapping H, equation (6) can be rewritten solely as a function of dummy variables representing occupation, region, year, and their interactions. That is,

$$\omega_{.jkt} = (q \cdot H)\beta + (\bar{\upsilon}_{j.} + \hat{\upsilon}_{jt}) + (\bar{\varphi}_{k.} + \hat{\varphi}_{kt}) + \eta_{t} \qquad (7)$$

can be rewritten in matrix notation as:

$$w = Q\,\lambda + (O\,\alpha + OT\,\delta) + (R\,\rho + RT\,\gamma) + T\,\tau + \xi \qquad (8)$$

where w is a column-vector of observed mean log wages; Q, O, OT, R, RT, and T are matrices of dummy variables representing the interaction of occupation and region, occupation, the interaction of occupation and time, region, the interaction of region and time, and time, respectively; the coefficients λ, α, δ, ρ, and γ represent the associated disturbance or premium of the respective factor (with $\lambda = H\beta$); and ξ is a true residual in the sense that it represents all of the variation in the mean log wage which cannot be attributed to all of the groups in a particular year, region, or occupation or to all of the groups in a given occupation in a particular year, a given region in a particular year, or a given region and occupation for all years.

Because all of the independent variables are dummy variables, the

estimation is essentially non-parametric. For example, α measures the average wage advantage of a particular occupation, j, relative to an omitted occupational category. Similarly, γ measures the wage advantage (or disadvantage) for all of the groups in region k in a particular year t relative to the omitted year and region. In the event that there is a stable impact upon wages for particular occupations and regions, the coefficients α and ρ will be statistically significant and non-zero. If on the other hand, occupations and regions have no generalized impact upon wages, these coefficients will be indistinguishable from zero. Additionally, if there is no annual fluctuation in occupational and regional effects, then the coefficients δ and γ will be statistically indistinguishable from zero. If on the other hand there is significant annual fluctuation in occupational and regional effects, then the coefficients δ and γ will be statistically significant and non-zero.

A particular case that will be investigated is the hypothesis that occupational and regional effects are non-zero and that they represent an underlying stable pattern of effects, only modified from year to year by fluctuations which have no net impact toward divergence or convergence. This particular set of hypotheses can be represented by

$$H_0: \quad \alpha_j \neq 0, \ \forall j$$

$$H_1: \quad \sum_t \delta_{jt} = 0, \ \forall j$$

for occupational categories; and

$$H_2: \quad \rho_k \neq 0, \ \forall k$$

$$H_3: \quad \sum_t \gamma_{kt} = 0, \ \forall k$$

for the regional categories.

A further hypothesis should be considered as well regarding the main effect of the year variables, i.e.

$$H_4: \quad \tau_t = 0, \ \forall t$$

Rejecting this hypothesis would mean that all groups experience annual wage variations indepently of occupational and regional categories. That is, it would be evidence for nationwide influences upon wages which operate over all the regions considered and across all the occupational categories. This coefficient, however, is particularly sensitive to the method utilized for deflating wages since the index chosen is crucial to distinguishing (and

thereby identifying) the nominal and real components of the annual wage changes.

Some comments are in order about the interpretation of the final results. First, if the assumption that the average individual's wage-determining characteristics are stable through time is incorrect, then this omitted source of annual variation will bias the other coefficients. On the other hand, specifying this term would introduce the problem of which variables ought to be included. It may not be unreasonable to expect that average attributes affecting wages change little from year to year when one considers such factors as age, education and marital status to be the prime candidates for these variables in a particular occupation-region group. For example, individuals in a particular sample will all age from one year to the next, but the group of people in the following year's sample will include new entrants as well as excluding older workers who retire or die. Hence, the average age may easily remain essentially the same. On the other hand, it is possible to imagine selection effects which vary systematically over time, such as choices over who to fire in a recession. If less productive workers are laid off in economic downturns, then the composition of the remaining employed category of workers will have systematically more productive attributes. To the degree that this is true, the occupation-or-region-specific effects will be overestimated.

It is also important to note that the coefficients decompose the variation in mean wages without implying any particular causal model. A good example is the coefficient τ which measures the average annual variation across all occupational and regional groups. This term measures the real change in mean wages common to all groups in a particular year, but it does not tell us anything about why the real wage changed in that year. Similarly, a positive coefficient on the dummy variable for a particular occupation in a given year tells us that that occupation received a real wage gain without relating this to shifts in supply or demand, bargaining power, government policy, or any other conceivable theory of wage determination. This paper does not seek to distinguish these effects, only to ascertain whether or not the annual wage changes are systematically related to occupational or regional groupings and hence would indicate the operation of local or national markets.

V. SAMPLE AND RESULTS

The sample utilized here is from the IBGE's annual household survey data (PNAD). It included non-agricultural male workers residing in Brazil's nine major metropolitan regions. The sample excluded rural workers because of the difficulties in comparing urban and rural wages. Employment relations and non-pecuniary benefits differ too much between the agricultural and non-agricultural sectors to combine them. The sample excluded women because women's earnings have a higher degree of dispersion and because the regional composition of each occupation-region group could be strongly affected by the large changes in female labor force participation rates which have occured during this period (Sedlacek 1990). The use of the 9 metropolitan regions enforced some homogeneity upon the place of residence, since other urban areas are much more dispersed and varied. Public sector employees were also excluded because of evidence that wage determination is significantly different for these subgroups (Savedoff 1990).

The log wage was calculated for each individual in the sample, and averages across these individuals were calculated for each occupation-region cell in each year. The wages were also deflated by the Índice Geral de Preços to eliminate nominal price effects. The individuals were grouped into 10 occupations and 9 metropolitan regions over an 11 year period from 1976 to 1986. The year of the Decennial Census, 1980, was left out because the PNAD survey was not conducted that year. Consequently, the sample includes 10 surveys. This resulted in 90 occupation-region groups for each sample, and 900 observation in all for the entire study period.

The results show that there are significant occupation-and region-specific effects on wages. The regression captures virtually all of the log wage variation, with an R^2 of 0.99. Table 6 shows the results of testing various hypotheses. The joint hypothesis that coefficients for the year variables are zero is easily rejected by an F-test at the 0.1% level, indicating that there are national influences upon annual wage changes independent of occupational and regional categories. This confirms the observations made about Figures 1 and 2 which show the relatively strong impact of the nationwide recession and recovery upon the overall wage level. The metropolitan region and occupation variables are also jointly significant at the 0.1% level, showing that they too account for a significant part of the

wage differences. The coefficients on the interactions are also significantly different from zero in all three cases: occupation-region, occupation-year, and region-year. The occupational wage structure has the greatest marginal contribution to the explained sum of squares, some 3.6%. It is followed by the interaction of occupation and region (1.3%) and the main effect for the year (1.0%). The marginal contributions for region (0.1%), region-year (0.5%), and occupation-year (0.3%) are all smaller. It should be noted, however, that interpreting these marginal contributions as lower bound measures of the relative importance of each set of variables in wage determination is problematic.[4] They do show, however, that we cannot reject the hypothesis that regional-specific and occupational-specific effects are important in wage determination.

In terms of the questions presented above, a further hypothesis was tested: are the occupational and regional effects entirely stable, or is their significant annual fluctuation from these main effects? Recall that these hypotheses can be presented as

$$H_1: \quad \sum_t \delta_{jt} = 0, \ \forall j$$

for occupational categories; and

$$H_3: \quad \sum_t \gamma_{kt} = 0, \ \forall k$$

for regional categories. These hypotheses were also rejected at the 0.1% level, as shown in Table 6 as "Sums of Coefficients". In other words, although we have clear evidence of a strong pattern of occupational wage differences and a strong pattern of regional wage differences, we cannot claim that these patterns are so persistent that there is no "drift" over time.

[4]The use of proportions of explained sums of squares to indicate relative importance of included variables is criticized in Hendrey and Marshall 1983.

Table 6

RESULTS OF STATISTICAL TESTS FOR COMPLETE REGRESSION

Source	DF	Sum of Squares	Mean Square	F-Value
Model	251	131314	523	481
Error	648	705	1.09	
C Total	899	132019		
Root MSE	1.04	R-Square	0.99	
Dep Mean	2.05	Adj R-Sq	0.99	
C.V.	50.81			

JOINT HYPOTHESIS TESTS

(ALL SIGNIFICANT AT THE 0.1% LEVEL)

Tests	Category	F-Value	Degrees of Freedom (Numerator)	Marginal Contribution to ESS
Main	Year	131.7	9	1290
Main	Occupation	492.3	9	4815
Main	Region	22.33	8	194
Interaction	Occupation-Region	21.5	72	1684
Interaction	Occupation-Year	5.04	81	444
Interaction	Region-Year	7.68	72	601
Sums of	Occupation-Year	7.22	9	
Coefficients	Region-Year	3.58	8	

Note: Sums of Coefficients refers to hypotheses 1 and 3 as explained in the text.

VI. CONCLUSIONS AND IMPLICATIONS

This paper has shown that in Brazil, both national and local factors affect wages in the country's major metropolitan regions. This would not be a dramatic finding except that Brazil is a country of continental dimensions, still underdeveloped in many ways, and with large regional differentiation. It appears that the pace of commercial integration and increasing possibilities of migration have created a significant national integration of wage determining processes. Nevertheless, significant local effects are also apparent.

The evidence of national effects indicates that regionally- targeted labor policies are likely to have spillover effects. This may be desirable in cases where projects or policies are spatially concentrated but it is hoped that their benefits will be more widely dispersed. It is less helpful for programs aimed at improving wages in a target area without spillover. The importance of regional influences on wages, however, also suggests that comparative work may elicit key factors which contribute to improving wage levels and income distribution, and thereby suggest appropriate public policy for the country's grave regional disparities. In all, the evidence shows that wages in Brazil result from dynamics which have strong national and local components and that it would be mistaken to treat wage determination as either a purely national or an isolated regional process.

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