TEXTO PARA DISCUSSÃO Nº 1110

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TEXTO PARA DISCUSSÃO

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SUMÁRIO

SINOPSE

O mercado de trabalho brasileiro apresentou uma dinâmica espacial diversa durante a década de 1990. Em 2000, aproximadamente um quinto dos trabalhadores vivia em municípios aparentemente estagnados em termos econômicos, em que os salários reais caíam, mas em que o emprego crescia acima da taxa de crescimento populacional do Brasil. Por outro lado, mais de um terço dos trabalhadores vivia em municípios dinâmicos, com crescimento dos salários reais e crescimento do emprego acima do crescimento populacional brasileiro: essas áreas absorveram mais da metade do crescimento líquido do emprego durante o período. A fim de elucidar essa dinâmica, o presente artigo estimou um modelo espacial de demanda e oferta por trabalho no qual descreve as mudanças no nível de salários e empregos dos municípios. Foi utilizado o método GMM espacial desenvolvido por Conley (1999), que permite o uso de variáveis instrumentais na presença de autocorrelação espacial. Os principais resultados incluem: a influência muito forte do nível educacional inicial da força de trabalho na taxa de crescimento subseqüente dos salários (mesmo após controlar por diversas variáveis, tais como distância e clima); presença de efeitos de transbordamento positivos do crescimento do município sobre os níveis de salário e emprego de seus vizinhos; queda no emprego em atividades rurais; elasticidade na resposta dos salários a um aumento na oferta de trabalho; e presença de efeitos multiplicadores das transferências governamentais.

ABSTRACT

There was substantial spatial variation in labor market outcomes in Brazil over the 1990's. In 2000, about one fifth of workers lived in apparently economically stagnant municipios where real wages declined but employment increased faster than the national population growth rate. More than one third lived in apparently dynamic municipios experiencing both real wage growth and faster-than-average employment growth; these areas absorbed more than half of net employment growth over the period. To elucidate this spatial variation, we estimated spatial labor supply and demand equations describing wage and employment changes of Brazilian municípios. We used Conley's spatial GMM technique to allow for instrumental variable estimation in the presence of spatially autocorrelated errors. Chief findings include: a very strong influence of initial workforce educational levels on subsequent wage growth (controlling for possibly confounding variables such as remoteness and climate); evidence of positive spillover effects of own-municipio growth onto neighbors' wage and employment levels; an exodus from farming areas; relatively elastic response of wages to an increase in labor supply; and evidence of a local multiplier effect from government transfers.

1 INTRODUCTION AND MOTIVATION

In Brazil, as in other large, heterogeneous countries, there is considerable policy concern about spatial patterns of growth and development. Brazil exhibits large and relatively persistent differentials in income and welfare measures between north and south, and between rural and urban areas. The semi-arid Northeast, in particular, has been an area of concern for at least a century, and still is home to the hemisphere's largest concentration of poor people. At the same time, there has been concern about environmental and social problems associated with rapid expansion of the largest metropolitan areas.

For this reason, there is long-standing interest in finding regional development policies that would stimulate growth in lagging and rural regions. The underlying assumption is that targeting regional development policies on these poorer regions could simultaneously reduce aggregate poverty and regional inequality, and thereby reduces migration to large urban centers. Some of these policies include federal and state incentives for industrial location in lagging areas; provision of basic education; infrastructure development including dams and roads; support for agriculture, including familial agriculture, and community-driven development projects. More recent there has been an interest in a 'territorial approach', which would promote integrated development in a secondary city and its rural hinterland. This approach emphasizes improvement of urban amenities and services as a means of unlocking local growth.

The impacts of these approaches have not been rigorously examined. Indeed, many of the underlying assumptions are open to debate. Do we know how to boost the productivity of secondary cities? Does a thriving secondary city stimulate growth in its surroundings – or displace that growth? Are local investments reflected in higher local wages, or in higher employment? Are there persistent differences in returns to investment in large vs. small cities, or in high vs. low population density areas, in more or less agroclimatically favored areas?

This paper addresses these issues by modeling wages and labor supply at the município[1] level. In contrast to the more familiar Barro-style growth models, such as in Barro and Sala-i-Martin (1991), the proposed models focus on the role of policy and local social and environmental assets in shaping labor incomes and net migration across the landscape. Working in a spatial econometric framework, we allow for spatial spillovers and for spatial autocorrelation of unobserved variables.

The plan of the paper is as follows. The second part of this paper reviews trends in regional growth in Brazil and reviews policies that have tried to reduce regional inequalities. The third section reviews the literature on income, wage, and employment growth at the subnational level. This leads to specification of a simple labor demand-supply model. Next, we describe the data and the econometric specification employed. The final sections present results, discussion, and conclusions.

1. The município is roughly equivalent to a US county: the administrative level beneath the state. They are extremely heterogeneous in size, ranging in population from a few hundred to over eight million. There are currently 5561 municípios in Brazil.

2 ISSUES IN BRAZILIAN GROWTH

Brazil is a country with large disparities in income between individuals and at all geographical scales. Much though not all of this inequality stems from inequalities between regions. In particular, the Northeast of the country has historically lagged behind the South and Southeast, where much of the Brazilian economy is concentrated. The income per capita ratio of the richest State and the poorest one was 8.9 in 1960 and 6.2 in 1996. (Azzoni *et al*., 2000). The 2000 figure was 7.7. This analysis can be extended also to social indicators such as the human development index (HDI). Out of the 10 cities with worst HDI in Brazil, seven were in Northeast in 1991 and eight in 2000.[2] Within regions, there are substantial inequalities between states and among municípios. And even within municípios there are substantial inequalities, with many indigent people living in the municipíos with the highest mean income.

Particular attention has been focused on longstanding regional inequalities, especially between the Northeast and the rest of the country. There is some evidence of convergence in incomes between states over the periods 1939-1985 (Azzoni 2001) and 1970-1985 (Ferreira and Diniz 1995). However, several papers find evidence that this convergence process stalled after 1985, with one or two groups of poor states tending towards a lower-income equilibrium than the richer part of Brazil. (Azzoni 2001; Ferreira 1998; Pontual; Porto Júnior 2000; Magalhães and Miranda 2005). Azzoni *et al.* (2000) estimated traditional regressions of growth with microdata for 19 Brazilians states. They divided their dataset in cohorts and used a big list of variables as determinants of growth, including microdata from Pnad – National Household Survey. The results suggest that per capita incomes of the Brazilian states have already converged to their steady state level and that they will remain unaltered due to huge educational and geographic differences between the states.

What accounts for these disparities? The North and Northeast of the country lag far behind other regions in quantity and quality of education, and these differentials are strongly correlated with differences in labor income, as human capital theory would suggest (Fiess and Werner 2004). However, education and other observable individual characteristics do not fully explain interregional wage and income differentials. Azzoni e Santos (2002) compared the differences in salary in the 10 biggest Brazilian metropolitan areas in 1992, 1995 and 1997. Those salary differences remained significant even after controlling for cost of living measures, by the traits of the workers (education, age, sex, race and family position) and by the traits of their jobs (occupational position, sector and experience). Fiess and Werner (2004) estimated mover/stayer models of wage and migration. They found that low-education Northeasterners could boost their wages by 80% through migration; the differential declined with higher levels of education. Evidently, judging from the evidence cited above, the substantial degree of interregional migration is not sufficient to induce convergence between the regions.

2. The others were in the North Region.

Brazilian policy has been concerned with reducing interregional inequalities. Best-known, perhaps, are the national programs of tax and fiscal incentives, including the Constitutional Funds, subsidized loans from development banks including BNDES and BNB, the Zona Franca of Manaus, and Finor. Some programs were explicitly targeted on poor regions. For instance, Projeto Alvorada sought to provide education and other services to states (and later microregions) with below-median HDI (Human Development Index). Individual states use fiscal incentives to influence intrastate location of industrial firms, but the scope and impact of these programs is not comprehensively known. Other programs were not explicitly regional in intent but may nonetheless have had differential regional impacts. Possibly the most important of these is transport. Brazil's transport infrastructure has improved markedly over the last forty years (Castro 2003). Lall, Funderberg, and Yepes (2005) show that the productivity of manufacturing firms tends to increase with decreasing transport cost to São Paulo, the country's industrial hub. On the other hand,increased access to São Paulo or other metropolitan centers exposes local firms to increased competition from possibly more efficient firms, so the net effect on regional development is indeterminant. Another important policy affecting regional development was Embrapa's development of soybean varieties adapted to low latitudes. This innovation was responsible for the massive expansion of soybean cultivation in the Center West after 1970.

There is widespread enthusiasm in Brazil and throughout Latin America for a new, more fine-grained approach to regional development, denominated 'territorial development.' This approach has many of the elements of the growth poles approach that was popular 30 or 40 years ago. Although there are differing interpretations of this concept, it typically focuses on spurring the development of secondary cities as means of stimulating growth in the surrounding area.

For instance, the states of Ceará and Bahia have devoted considerable analysis and planning to articulate detailed visions of territorial development. Both have adopted territorial development strategies emphasizing the development of secondary or strategic cities as cornerstones of regional growth. (Bar-el et al 2002; Governo do Estado da Bahia, 2003). Ceará's visions of regional development provide concrete examples of the territorial development approach (Secretaria de desenvolvimento Local e Regional 2004), emphasizing improvement of road and air transport, improvement of basic services including sanitation and communication, development of cultural and natural resources as the basis of a tourism industry, support services to agriculture, including sheep and goats, expansion of irrigated fruiticulture.

To sum up, interregional inequalities are a long-standing concern in Brazil. Principal strategies for combating these strategies have been the use of explicit or tax subsidies to attract industrial firms; improvements in transport and urban amenities; and investments in human capital. These strategies are implicitly assumed to boost wages and thereby to reduce poverty and interregional inequality. However, quantitative estimates of these impacts are lacking.

3 LITERATURE REVIEW

There has been an explosion in the production of subnational growth models. Most of these are in the tradition of Barro and Sala-i-Martin (1991), and are concerned with the detection of convergence in per capita income levels or growth rates across the subnational units. The models are sparsely parameterized; growth is represented primarily as a function of prior-period per capita income, possibly with some structural conditioning variables. This approach is not ideal for the present purpose because there is little scope for exploring the impact of policy interventions such as infrastructure investments. When policy-relevant variables are included as conditioning factors, they are constrained to affect growth rates rather than income or employment levels.

More apt for our purposes are the models applied by Fan and co-authors to India and China. (see Fan, Zhang, and Zhang (2002), Fan Hazell and Haque (2000), Fan and Chan-Kang (2004)). These papers seek to measure the marginal impact of government investments on income and on poverty, with particular attention to the returns to investment in less-favored areas. In Fan, Zhang, and Zhang (2000), for instance, a provincial production function relates agricultural GDP per capita to land per worker, agricultural capital per worker, agroclimate, and infrastructure stock. However, land per worker and capital per worker are taken to be fixed and exogenous. There is no allowance for interprovincial labor mobility.

While the assumption of immobile labor may be acceptable when considering large provinces, and for countries where there are strong legal or social barriers to migration, it is less apt for Brazilian municípios. Here, labor mobility may play an important role in understanding differential spatial patterns of development. As Pritchett (2004) points out, in the absence of barriers to migration, one would expect local market or technology shocks to be reflected in labor movements rather than wage changes. Hence local investments may be effective in alleviating poverty even if they do not result in a perceptible change in wages. It is possible, instead, that they attract labor from lower wage areas. In this case, regional interventions would be effective in alleviating poverty but not in reducing measured interregional inequalities.

Araujo, de Janvry, and Sadoulet (2004) present a município-level, spatial model of employment growth in Mexico that is the closest precursor of the current paper. They relate growth in employment over 1990-2000 to 1990 values of employment, proximity to urban centers and other employment nodes, geographic characteristics, and wages, and use spatial econometric techniques. They find that rural employment growth in both services and manufacturing is inversely related to distance to the nearest urban center.

4 APPROACH: THE SPATIAL DYNAMIC OF LABOR SUPPLY AND DEMAND

We model subnational development through a spatially disaggregate model of labor market dynamics. The labor market approach has several advantages for our purposes over Barro-type growth models. First, our model offers potentially better insight into poverty alleviation strategies because it looks at wages rather than GDP/capita – an

important consideration when wealth is unequally distributed. Second, while the growth models use regions as units of concern, looking only at mean income levels, the labor market approach looks also at employment. It is entirely possible for *regional* mean incomes to diverge even while incomes of *individuals* increase, if employment expands faster in higher-wage markets. Models focused only on mean income may entirely overlook such an outcome. Third, growth models typically employ a sparse set of policy-relevant variables. Here we employ examine the impact of a range of policy levers, including education, infrastructure, and transfers, while allowing for differential effects in regions with different agroclimatic conditions. Finally, our fine-scaled geographic approach facilitates an examination of local growth spillovers, allowing examination of the premises of territorial development policies.

5 A SPATIAL MODEL OF LABOR AND DEMAND

These considerations motivate a labor supply/demand model, which examines the determinants of labor income and employment growth at the município level. It is important to recall that labor income, and indeed municipal household income, does not necessarily track municipal GDP. For instance, some rural municípios may be dominated by capital-intensive farming systems, whose value-added accrues to absentee landlords. Nonetheless, a focus on labor income is justified by a policy concern with spatial aspects of poverty and welfare. Our results can be compared with those of growth regressions by taking wage growth as a proxy for productivity growth and employment as a proxy for município size.

Let each município i have a production function $f\left(K_a, L, Educ; A\right)$ for a composite output, where K is a vector representing industrial and agricultural capital, including land); L is the number of workers; *Educ* is a vector measure of the quantity and quality of worker education; A is a vector of productivity shifters, which include transport connectivity to markets, local governance quality, and agroclimate. These are typically time-invariant or change slowly over time. The município faces a price which is a function *P(MP,GT)* of local market potential or demand and of government transfers to individuals. The latter, which largely represent rural pensions, are locally important in some areas and may drive demand for local nontradeable services. *MP* is operationalized as an inverse-distance-weighted function of the total incomes of neighboring municipalities. A labor demand equation expresses the wage rate as the value of the marginal product:

$$w = P\left(MP, GT\right)\left(\partial f / \partial L\right) \quad (1)$$

Differencing over time, using a convenient ln-linear approximation, we have:

$$\Delta \ln w = X\beta_0 + \beta_1 \Delta \ln L + \beta_2 \Delta \ln MP + \beta_3 \Delta \ln GT + \beta_4 \Delta \ln K + \beta_5 \Delta Education$$

where X is a set of determinants of the rate of growth of productivity, and Education is the quality-adjusted mean educational level of the work force. We assume that wages adjust rapidly to changes in capital, labor supply, and prices.

We assume, in contrast, that capital and labor adjust relatively slowly to changes across the landscape, in relative wages and returns to capital. Thus we model the

change labor supply from *t-1* to *t* as a function of local wages, local amenities, and competing neighborhood wages in period *t-1*:

$$\Delta \ln L = \Delta \ln L(\ln w_{t-1}, \ln EWF_{t-1}, \ln MP_{t-1}, AMENITIES_{t-1}, AGROCLIMATE) \quad (2)$$

where EWF_{t-1} is the relative size of the cohort, in period t-1, which will enter the labor force by period t. We hypothesize that the labor force increases more rapidly when initial local wages are high, reflecting long-distance migration.[3] Holding constant wages within the município, employment is expected to grow less rapidly, the more rapid the change in local market potential, because local labor may be relatively easily attracted to neighboring dynamic areas. Agroclimate is postulated as an exogenous determinant of employment growth. This allows for the possibility that agricultural labor is shifting between agroclimatic zones – and perhaps, especially, out of less favorable zones – in response to changing agricultural market conditions.

We model capital investment as

$$\Delta \ln K = \Delta \ln K(MARKETACCESS_{t-1}, GOVERNANCE, AGROCLIMATE, \Delta \ln MP) \quad (3)$$

Better market access (measured by lower transport costs to São Paulo and to the nearest state capital) is associated with lower price levels and hence higher returns to capital. Better local government is expected to increase the município's attractiveness for investment. Increases in the market potential indicate location near a dynamic region; this potentially endogenous instrument must however be instrumented.

Because we lack reliable data on capital, we substitute (3) into (1). While we have data on mean years of education of the work force, we lack information on employees' educational quality. Moreover, a dynamic município may experience changes in mean educational level due to compositional effects, depending on the relative educational level of in-migrants, out-migrants, and stayers. Hence we use initial educational level of workforce, and initial educational level of public school teachers (a proxy for local educational quality) in place of educational change in (1). We interpret the result as describing the demand curve while allowing for the endogenous response of capital investment to initial conditions.

6 DATA

We examined patterns of employment and wage change over the period 1991-2000. The basic spatial unit of analysis was the município. A complication, however, is that some municípios experience splits over the study period, the total number growing from 4491 to 5507. In complicated cases, two municípios are reorganized into three. To address this problem, we merged municípios into 4267 Minimum Comparable Areas (MCAs) – consisting of sets of one to three municípios whose borders were constant over the study period.

3. Ideally the wage measure should be adjusted for spatial differentials in cost of living; unfortunately spatial price indexes are not available, so we use nominal wages, inflation-adjusted nationally over time.

Much of the data stems from the Brazilian Population Censuses of 1991 and 2000.[4] The key variables of interest were employment: total number of people reporting any employment and wage: reported labor income divided by the number of workers. Self-employed workers and farmers are counted as workers, and their earnings are counted as labor income. Table 6 gives the sources and definitions of variables employed in this paper. Table 7 provides summary statistics for these variables. Some of them are mapped in the appendix.

A unique feature of this analysis is the use of market potential and related variables. Market potential for a target MCA i is defined as the weighted sum of personal incomes of all other MCAs, where the weight is a decreasing exponential of distance to the target município:

$$MP_i = \sum_{j \neq i} \exp(-d_{ij}^2 / 2\alpha^2) \quad (4)$$

where d_{ij} is the great-circle distance between the centroids of i and j in kilometers, and α is the inflection point in kilometers, here set to 25. The effective radius of influence is about 50 kilometers. Analogous expressions were used to derive distance-weighted measures of population and of mean educational level, again excluding values from the target município. These variables were used as instruments for market potential.

The results reported here are divided into three categories: Brazil, non-metropolitan Brazil and the latter without the North region. The difference between the first two categories is based on Ipea, IBGE and Unicamp (2002). That work makes a comprehensive classification of Brazilian urban agglomerations. We used the municípios that belong to urban agglomeration only in the first category.

7 SPATIAL PATTERNS OF LABOR DYNAMICS

Map 1 and tables 1-5 illustrate the geographic diversity of Brazil's labor market dynamics over the period 1991-2000, a diversity we seek to explain. We classify MCAs into four categories, depending on whether wage growth was positive or negative, and whether employment growth was above or below the mean national population growth rate

The most striking point evident from the maps is the general decline in real wages in the North and Northeast, and general increase elsewhere in the country. However, because population density varies tremendously across Brazil (see Map 2), maps can give a misleading impression of the number of people who fall into the labor dynamics categories. Tables 1-5, and population density maps (Map 2), provide a more accurate representation of population breakdowns.

The main point of the tables is spatial divergence and heterogeneity in experience. Areas in which employment grew rapidly but real wages declined (E+W-, shown in yellow in Map 1) can be thought of as areas of economic stagnation. Here,

4. To be precise, they stem from the 12,5% Census sample of 1991 and 5% Census sample of 2000. Both samples represent município level data.

labor demand failed to keep up with the growth of supply. This may well reflect natural increase; the mean total fertility rate for the E+W- areas was 3.78 in 1991, far above the other three categories, and the proportion of immigrants in the 2000 population was substantially lower than for the E+W+ category. By 2000, about 22% of employed workers lived in the stagnant E+W- areas. They account for a particularly large share of population in the North and Northeast (figure 1).

A set of dynamic areas with both increasing wage growth and rapidly increasing employment (W+E+) absorbed more than half of the country's net increase in employment, ending up with 36% of Brazilian employment in 2000. Such an outcome may reflect a dynamic local economy, with a relative shift outward in the labor demand curve. Although the 1991 total fertility rate for these MCAs was a full point lower than that of the E+W- areas, the dynamic areas had a substantial higher proportion of recent immigrants in 2000; this suggests that these regions are growing via immigration, presumably drawn by economic opportunity. Most of the E+W+ population is urban. Among the regions, the Center West has by far the largest proportion of people living in E+W+ AMCs, nearly 70%. The Northeast has the lowest proportion, just 10%.

Tables 4 and 5 show also that about two thirds of employment is in the metropolitan agglomerations. Over the nine year interval, employment grew a total of 15% in the nonmetropolitan areas vs 20% in the metropolitan areas. Dynamic areas (W+E+) account for a much larger share of employment in metropolitan areas than in nonmetropolitan areas. Stagnant (W-E+) areas are much more prevalent in the nonmetropolitan areas.

Figure 4 shows an important correlate of wage growth that is associated with the north/south differential. It plots, in ln-ln form, the mean educational level of 1991 employees against wage growth over 1991-2000, by MCA. MCAs from the North and Northeast are shown in red; others are in blue. The figure shows that wage growth is strongly and significantly associated with initial educational level. It shows also that a significant disjunction in these variables between north and south. Northern and northeastern MCAs have markedly lower educational levels, and markedly lower wage growth.

Is this a causal relationship? Places with higher human capital may also have higher levels of social capital and may therefore be better able to attract further investment in human and physical capital, and to boost local productivity. On the other hand, causality may go in the opposite direction. Places with inherent social capital or other local advantages may experience both more rapid growth and greater investments in education. The labor supply and demand equations estimated below attempt to hold constant other characteristics that might be associated with educational levels.

8 ECONOMETRIC MODEL

We estimate independent, ln-linear approximations to the wage (labor demand) equation of (3) substituted into (1), and the labor supply equation (2). Endogenous variables are instrumented with time-lagged or space-lagged exogenous determinants.

In the wage equation, ΔlnL is instrumented with lagged demographic determinants of labor force growth; the exclusion of these variables from the wage equation identifies it. The labor supply equation is identified, more tenuously, via the exclusion of the market access variables and the government transfer variables,[5] and by the use of initial period wage rather than wage change. In the appendix we show the instruments for each endogenous variable.

Finally, a key issue in estimation is the likelihood of spatial autocorrelation of unobserved variables. Failure to account for this autocorrelation could lead to inaccurate estimates of standard errors. To address this issue, we use the GMM technique of Conley (1999) (as did Araujo, de Janvry and Sadoulet 2004 and Baicker 2005). In contrast to the more standard spatial econometric approach using a weight matrix, Conley's nonparametric technique requires only that users locate data points in a real or virtual space. Users specify a cutoff distance beyond which spatial autocorrelation is thought to be unimportant. For our analysis we use the latitude and longitude of the MCA centroid to locate the data points. This technique is attractive because it is computationally feasible for large numbers of observations; allows for the use of instrumental variables; and is robust to misspecification of the degree of autocorrelation among neighboring observations. Carvalho, da Mata and Chomitz (2005) discuss and assess the technique in detail.

9 RESULTS

We present the results for three samples. The model was intended to focus on nonmetropolitan Brazil, under the assumption that growth dynamics of these regions differ substantially from those of metropolitan areas. However, we test that assumption by running a regression also for the entire country. Finally, we run a model for nonmetropolitan regions outside the North. Many Northern MCAs have very small and volatile work forces, and Amazonian frontier regions may have very distinctive patterns of employment growth. The regression results are in tables 8-10.

For each model we present the results for both 2SLS and spatial GMM specifications. As a sensitivity test, we ran the GMM regressions using different cutoffs for spatial autocorrelation: 0.5, 1.0 and 2.0 degrees.[6]

For the Brazil-wide demand regressions, there is reasonable agreement among the specifications on a number of variables. All four variants find that initial educational level is significantly related to wage growth, other things constant, and the estimated coefficient is stable at about 0.06. This implies that an increase of one year in the initial mean educational level of the workforce is associated with a 6% increase in mean wages over the nine year period. Higher initial teacher qualification does not have a similar effect. This may reflect collinearity with years of education combined with nonlinearity in the relationship. In all specifications, rainfall is statistically significant and quantitatively extremely important. A 500 mm increase in

5. We assume that the transfers go mostly to old-age pensioners and thus do not affect labor supply.
6. Each unit in the cutoff measure is equivalent to a hundred kilometers.

annual rainfall is associated with a nine-year increase of 30% or more in wages. It is possible that this variable is capturing other aspects of inter-regional variation.

In all four specifications, delta ln employment is statistically significant. The estimated demand elasticity of wages with respect to labor increases in absolute magnitude with increasing cutoff distance (where we treat 2SLS as having a cutoff of 0). The elasticity is -0.49 in the 2SLS specification, increasing to -0.89 for a cutoff of 2.0.

All four specifications show significant impact of growth of market potential. The elasticity of wage growth with respect to market potential increases with cutoff distance, increasing from 0.55 in 2SLS to 1.30 in the cutoff 2 case. Coefficients of this magnitude suggest either very substantial local spillovers, or failures of the instrumental variables to control for unmeasured growth effects common to the MCA and its neighbors.

Other variables of interest are statistically significant in the 2SLS specification, but less so in the spatial GMMs. On theoretical and empirical grounds, we expected capital investment, and therefore wage growth, to decline with increasing transport costs to São Paulo and to the nearest state capital. However, in the 2SLS specification these variables, though statistically significant, were negligible in absolute magnitude. Significance and magnitude declined with increasing cutoffs. The change in government transfer payments was statistically significant in the 2SLS and the cutoff=0.5 specifications, with coefficients of about 0.3 and 0.2 respectively. This suggests marked local multiplier effects of such transfers. However, the variable declined in magnitude and significance at higher cutoffs. Finally a rough proxy for quality of municipal governance – an indicator of whether the municipal financial accounts had been computerized by 1999) had a modest effect under 2SLS, but not under the GMM specifications.

We turn now to the countrywide labor supply equation. Here all four specifications show strong agreement on the coefficients and significance of number of variables, although standard errors increase with the cutoff levels. First we consider wage variables. Labor supply has an elasticity of about 0.18 with respect to the 1991 wage level, so that higher initial wages are associated with a mildly faster rate of employment growth. Although we expected the change in ln market potential to have a negative coefficient, it was robustly determined at about 0.23. This suggests that location in a booming region has spillovers on labor supply as well as demand.

Consider next the impact of initial demographic and agroclimatic conditions. The 1991 ratio of workforce entrants to working age population was also robust and highly significant, as expected. Perhaps most striking, all the specifications found a very strong negative association between the proportion of employment in farming in 1991, and subsequent employment growth. This strongly suggests an exodus from farming regions. Lower temperature and higher precipitation are associated with faster employment growth. The first and third principal components of rainfall,[7] which capture variation in annual seasonality of rainfall, are also significant though

7. Calculated from the vector of the 12 monthly averages of precipitation. The second principal component is nearly collinear with total precipitation.

difficult to interpret directly. Very small MCAs showed more rapid growth than very large ones, all else equal.

Two demographic variables showed robust effects contrary to our expectations. We had expected the initial labor force participation rate to be negatively correlated with subsequent employment growth, on the argument that places which had already experienced growth in female labor force participation would have less scope for further employment expansion. But in fact labor force participation was strongly positively associated with employment growth. We expected also that places with high native proportion of population (i.e. born in the município of current residence) represented areas that had barriers to outmigration or were unattractive to in-migration, and hence predicted lower employment growth rates. However, the coefficient on this variable was positive, significant and robust.

Finally, the regression includes a few variables intended to capture the impact of local amenities on attracting and retaining labor. Initial homicides per capita had a negative effect on employment growth, though the significance of this coefficient declined with higher cutoffs. A one standard deviation increase in homicides corresponded roughly to a 4% decrease in employment growth over the nine year period. The initial level of teacher qualifications had a negative effect on employment growth, contrary to expectations, but the effect was of negligible magnitude.

The demand-side results for the nonmetropolitan sample (table 5) are quite similar to those for the nationwide sample, despite the huge disparity in MCA size. The coefficients on education and rainfall are of about the same magnitude as before. The labor elasticity coefficient is about -0.74 and significant in all the GMM specifications, slightly more negative than the 2SLS specification. The coefficient of the change in market potential is also relatively consistent across the GMM specifications, with an elasticity of about 0.6. In contrast to the nationwide sample, the coefficient on government transfers here stays robust across the GMM specifications, at about 0.16. The coefficients on transport cost are here more significant, though still negligible in magnitude. These results (including the effect of rainfall) are essentially unchanged when the North region is excluded.

The supply-side results for the nonmetropolitan samples also are very similar to the nationwide results. The main difference is that the effect of the initial proportion in farming is reduced in magnitude, but it is still quite important quantitatively and statistically. In addition, the initial participation rate is no longer significant in the nonmetropolitan analyses.

A final caution on our results relates to the J-test. For most of the GMM regressions, the test statistic is significant at the 5% level, which suggests potential problems with the instruments. It is not however significant at that level for the Brazilwide demand regression (cutoff of 2.0) and the nonmetropolitan supply regressions excluding the North (cutoffs of 1.0 and 2.0).

10 DISCUSSION

We have found a number of relationships that appear to be robust to different choices of sample and different controls for spatial autocorrelation.

Initial levels of workforce education are strongly related to subsequent wage growth, even after controlling for correlated variables such as remoteness and climate. Note that this is different from the well-known association between education and wage levels; it suggests an accelerator effect, where more-educated regions experience more rapid wage growth. And, the effect is large. In 1991, the mean educational level of workers was 3.9 years for the country as a whole and just 3.6 years for nonmetropolitan regions. The standard deviation for nonmetropolitan regions was 1.32 years. A change of this magnitude was associated with a 8% increase in wages over 1991-2000.

If confirmed, this a sobering finding from the viewpoint of reducing inter-regional inequalities. It suggests that wages will continue to diverge between the more-educated south and the less-educated north. And because it takes 40 years to turn over the labor force, it will take a long time for lagging regions to reduce the educational gap with leading ones, even if the former were to make more rapid progress – itself a questionable assumption.

Farming regions are losing employment, or growing more slowly, than other regions. In the nationwide sample, each 10 percentage point increase in the initial proportion of farmers among workers was associated with a 10 to 12 percent decrease in the nine-year rate of employment growth. Even when the sample is restricted to nonmetropolitan areas, this relationship holds, though it is less steep. Further investigation is needed to understand the degree to which this represents 'pull' factors – attraction to growing areas, vs. 'push' factors – e.g. displacement of smallholders by large farming enterprises.

Low rainfall areas lagged other areas in wage and employment growth. These patterns were evident even controlling for remoteness and education, which might be correlated with rainfall.

Wages respond relatively elastically to changes in labor supply. This suggests that in-migration could substantially reduce wages in an MCA with vigorous demand growth; that population growth would depress wages in a stagnant MCA; and that outmigration could put upward pressure on wages for those left behind in declining MCAs. The supply-elasticity of wages is important to keep in mind when evaluating regional performance. According to our estimates, a dynamic region that boosts labor demand by 10% and accommodates labor force growth of 20% would experience unchanged wages, other things equal. Assessing the region only on the basis of wage growth would completely miss its success in providing new jobs, possibly to migrants who substantially increase their individual earnings.

There appear to be positive spillover effects on wages and employment from income growth in nearby areas. Our estimates suggest that for nonmetropolitan areas a 10% increase in close neighboring regions' income is associated with a 7% increase in own wages and a 2% increase in employment. While we cannot rule out the possibility that this is due in part to a correlation with unobserved favorable factors common to the

município and its environs, it suggests some support for the territorial development approach which advocates stimulating the growth of small cities in order to benefit nearby neighbors. Whether or not it is possible, in fact, to spur the growth of such cities is a different question.

Government transfers – such as pensions—appear to stimulate local wage growth. More rapid growth in receipt of transfers is associated with more rapid wage growth. Since much of the growth in transfers over the 1990's is associated with the expansion of rural pensions, this finding supports the idea that such transfers result in favorable local multiplier effects, as the pensioners increase their demand for local goods such as services and some foodstuffs. This situation has been characterized as the 'economy without production' (Maia Gomes, 2001). That epithet carries a negative connotation. A more positive view is that an increase in transfers to poor locales, with little natural or human assets, not only serves direct social needs but stimulates the local economy.

11 CONCLUSIONS

The paper began by mapping the heterogeneity of labor market outcomes across Brazil during the 1990's. To understand the determinants of that heterogeneity, we developed a spatial model of labor supply and demand, and applied an estimation strategy that takes into account endogeneity of the explanatory variables and spatial autocorrelation of unobserved determinants of labor force outcomes. Our results strongly emphasize the role of work force education in determining growth prospects, the importance of local spillovers, and point to an exodus of labor from farming regions.

This paper must be viewed as an initial step in a large research agenda. Areas for further investigation include more explicit treatment of the impacts of changes in agricultural prices and technologies, including the stimulus of growth of agricultural service cities; and incorporation of better data on capital stock, and on municipal governance, agroclimate, and infrastructure.

APPENDIX

TABLES

TABLE 1

MCA average

Region	Fertility rate*		Percentage of immigrantsin population*		Population growth – geometric annual average**
	1991	2000	1991	2000	1991 - 2000
North	4,42	3,33	24,41	22,99	2,87
Northeast	3,89	2,82	16,99	16,12	1,29
Southeast	2,46	2,16	19,21	19,08	1,61
South	2,64	2,30	22,13	21,32	1,42
Center-West	2,82	2,36	31,95	29,27	2,33

Note: *Mean MCAs values weighted by population.

** Calculated by the aggregate data.

TABLE 2

MCA average

Quadrant	Fertilty rate*		Percentage of immigrants in population*		Population growth – geometric annual average**
	1991	2000	1991	2000	1991 - 2000
E+, W+	2,79	2,31	25,19	24,32	2,58
E-, W+	2,68	2,24	17,25	15,53	0,69
E-, W-	3,26	2,54	15,47	14,56	0,51
E+, W-	3,78	2,90	21,15	21,13	2,38

Note: *Mean MCAs values weighted by population.

** Calculated by the aggregate data.

TABLE 3

Metropolitan areas

Quadrant	Employment			Employment share		Population			Frequency
	1991	2000	Employment growth	1991	2000	1991	2000	Population growth	
E+, W+	14707336	19090991	4383655	40%	43%	37785537	47940239	10154702	332
E-, W+	10144794	10924107	779313	27%	25%	25298240	27583837	2285597	154
E-, W-	6188863	6547091	358228	17%	15%	15430178	16591747	1161569	73
E-, W-	5978230	7957879	1979649	16%	18%	16504563	21302846	4798283	176
Total	37021214	44522068	7500854	100%	100%	95018518	113420669	18402151	735

TABLE 4

Nonmetropolitan areas

Quadrant	Employment			Employment share		Population			Frequency
	1991	2000	Employment growth	1991	2000	1991	2000	Population growth	
E+, W+	3481048	4551220	1070172	19%	22%	9300552	10991493	1690941	701
E-, W+	5949685	5950681	996	33%	28%	15123906	15312581	188675	1172
E-, W-	4005760	4008645	2885	22%	19%	11833148	11888764	55616	743
E-, W-	4837597	6599279	1761682	26%	31%	15549351	18187663	2638312	916
Total	18276081	21111825	2835744	100%	100%	51806957	56382501	4575544	3532

TABLE 5

All areas

Quadrant	Employment			Employment share		Population			Frequency
	1991	2000	Employment growth	1991	2000	1991	2000	Population growth	
E+, W+	18188385	23642211	5453826	32%	35%	47086089	58931732	11845643	1033
E-, W+	16094479	16874788	780309	28%	25%	40422146	42896418	2474272	1326
E-, W-	10194623	10555736	361113	19%	17%	27263326	28480511	1217185	816
E+, W-	10815827	14557158	3741331	22%	23%	32053914	39490509	7436595	1092
Total	55295305	65631893	10336588	100%	100%	146825475	169801170	22975695	4267

TABLE 6A

Variables and sources

Variables used in the Wage Equation and their sources

Variable	Source	Instrument(s)	Source
Teacher qualification in 1991	IBGE – Census	Exogenous	
Years of schooling in 1991	IBGE – Census	Exogenous	
Total precipitation	DECRG – IE	Exogenous	
Government with accountability	IBGE – Munic	Exogenous	
		Employment rate in 1991	IBGE – Census
Delta employment	IBGE – Census	Soil quality	DECRG – IE
		First and third principal components of monthly rainfall	DECRG – IE
Transport cost to São Paulo	Nemesis	Transport cost to São Paulo in 1968	Nemesis
Transport cost to nearest state capital	Nemesis	Transport cost to nearest State Capital in 1968	Nemesis
		Dependency ratio in 1991	IBGE – Census
		Illiteracy rate in 1991	IBGE – Census
Delta government transference	IBGE – Census	Repetition rate in 1991	IBGE – Census
		Proportion of elderly persons in 1991	IBGE – Census
		Population in 1991	IBGE – Census
		Proportion 5-15 over 15-55 yrs old in 1991	IBGE – Census
		Delta education market potential	DECRG – IE
Delta market potential	DECRG – IE	Urbanization rate in 1991	IBGE – Census
		Population density in 1991	IBGE – Census

TABLE 6B

Variables used in the Labor Equation and their sources

Variable	Source	Instrument(s)	Source
Wage in 1991	IBGE – Census	Exogenous	
Proportion 5-15 over15-55 yrs old	IBGE – Census	Exogenous	
Proportion native in 1991	IBGE – Census	Exogenous	
Delta market potential	DECRG – IE	Exogenous	
Teacher qualification in 1991	IBGE – Census	Exogenous	
Homicides per capita in 1991	Datasus	Exogenous	
Proportion farmers in 1991	IBGE – Census	Exogenous	
Bank dummy	Central Bank	Exogenous	
Population in 1991	IBGE – Census	Exogenous	
Mean temperature	DECRG – IE	Exogenous	
Total rainfall	DECRG – IE	Exogenous	
Rainfall – first principal component	DECRG – IE	Exogenous	
Rainfall – third principal component	DECRG – IE	Exogenous	
Employment rate in 1991	IBGE – Census	Illiteracy rate in 1991	IBGE – Census
		Fertility rate in 1991	IBGE – Census

TABLE 7A

Summary statistics, all Brazil

Variable	Obs	Mean	Std. dev.	Min	Max
Delta in wage (2000/1991)	4267	-0.0101	0.2935	-1.5242	0.8495
ln teacher qualification in 1991	4267	1.3938	2.1088	-4.6052	4.2370
Years of schooling in 1991	4267	3.9181	1.4556	0.4425	9.6572
Total rainfall	4266	1337.3190	425.4345	368.6636	3361.7090
Government accountability	4267	0.9121	0.2832	0.0000	1.0000
Delta in employment (2000/1991)	4267	0.1422	0.2224	-0.6961	1.8755
ln transport cost to São Paulo in 1995	4266	7.0420	0.8469	2.3026	9.2603
ln transport cost to state capital in 1995	4256	5.8180	0.7780	1.3863	8.6910
Delta in transferences (2000/1991)	4267	0.8083	0.3221	-1.1823	2.4240
Delta in market potential (2000/1991)	4,258	0.4093	0.1375	-0.4691	2.0949
ln population in 1991	4,267	9.5287	1.0888	6.6214	16.0821
Dependency ratio in 1991	4267	0.4775	0.0466	0.3738	0.6205
ln transport cost to São Paulo in 1968	4266	7.6264	0.7874	3.2189	9.6385
ln transport cost to state capital in 1968	4256	6.2548	0.7959	1.3863	8.6910
ln proportion of elderly in 1991	4267	-2.2502	0.2621	-3.9145	-1.5332
Illiteracy rate in 1991	4267	35.5004	17.8266	2.4800	87.0500
Urbanization rate in 1991	4267	53.6356	23.1683	2.1562	100.0000
Population density in 1991	4267	93.6426	510.3321	0.0896	12199.7700
ln 5 to 15 over 15 to 55 years old ratio	4267	-0.7491	0.2303	-1.6218	-0.0354
Repetition rate in 1991	4267	4.2935	0.2071	2.3542	4.5756
ln employment rate in 1991	4267	-0.3760	0.1411	-1.2429	0.1601
Delta in education market potential (2000/1991)	4251	0.9737	0.1736	0.0535	2.7704
Percentage of good soils	4266	0.7904	0.3071	0.0000	1.0002
Rainfall – first principal component	4266	0.0000	2.2685	-4.2315	6.9861
Rainfall – third principal component	4,266	0.0000	1.5749	-2.6324	9.2440
ln wage in 1991	4267	8.0265	0.4963	6.6139	9.8121
Proportion of natives in 1991	4267	0.6565	0.1790	0.0855	1.0134
Homicides per capita in 1991	4265	0.0016	0.0011	0.0000	0.0090
Employment in farming activities in 1991	4,267	0.1777	0.0854	0.0000	0.5437
Bank dummy (1991)	4,267	0.7492	0.4335	0.0000	1.0000
	4267	9.5287	1.0888	6.6214	16.0821
Average Temperature	4266	22.3050	2.8451	13.8325	27.8109
Fertility Rate in 1991	4,267	3.6449	1.1885	1.7600	8.6800

TABLE 7B

Summary statistics, non-metropolitan Brazil

Variable	Obs	Mean	Std. dev.	Min	Max
Delta in wage (2000/1991)	3532	-0.0233	0.3097	-1.5242	0.8495
ln teacher qualification in 1991	3532	1.1990	2.1519	-4.6052	4.2370
Years of schooling in 1991	3532	3.6414	1.3197	0.4425	7.1707
Total rainfall	3,531	1,312.3340	436.0881	368.6636	3,361.7090
Government accountability	3,532	0.9023	0.2969	0.0000	1.0000
Delta in employment (2000/1991)	3532	0.1231	0.2173	-0.6577	1.3689
ln transport cost to São Paulo in 1995	3531	7.1172	0.7733	4.1589	9.2603
ln transport cost to state capital in 1995	3531	5.9358	0.6736	2.1972	8.6910
Delta in transferences (2000/1991)	3532	0.8316	0.3262	-1.1823	2.4240
Delta in market potential (2000/1991)	3523	0.4053	0.1330	-0.4691	2.0949
ln population in 1991	3,532	9.2629	0.8171	6.6214	12.9814
Dependency ratio in 1991	3532	0.4840	0.0460	0.3738	0.6205
ln transport cost to São Paulo in 1968	3531	7.6962	0.7123	4.3694	9.6385
ln transport cost to state capital in 1968	3531	6.3629	0.7037	3.1135	8.6910
ln proportion of elderly in 1991	3532	-2.2260	0.2566	-3.9145	-1.5332
Illiteracy rate in 1991	3532	38.0138	17.5883	2.4800	87.0500
Urbanization rate in 1991	3532	48.7978	20.6294	2.7639	100.0000
Population density in 1991	3532	31.1089	33.0202	0.0896	522.2028
ln 5 to 15 over 15 to 55 years old ratio	3,532	-0.7264	0.2329	-1.6218	-0.0354
Repetition rate in 1991	3,532	4.2707	0.2125	2.3542	4.5756
ln employment rate in 1991	3532	-0.3722	0.1462	-1.2429	0.1601
Delta in education market potential (2000/1991)	3516	0.9745	0.1732	0.0535	2.7704
Percentage of good soils	3531	0.7816	0.3179	0.0000	1.0002
Rainfall – first principal component	3531	0.0033	2.2334	-4.2315	6.8953
Rainfall – third principal component	3531	0.0262	1.6087	-2.4997	9.2440
ln wage in 1991	3532	7.9349	0.4619	6.6139	9.3168
Proportion of natives in 1991	3532	0.6778	0.1760	0.0855	1.0134
Homicides per capita in 1991	3530	0.0015	0.0010	0.0000	0.0090
Employment in farming activities in 1991	3532	0.1975	0.0743	0.0000	0.5437
Bank dummy (1991)	3532	0.7087	0.4544	0.0000	1.0000
	3532	9.2629	0.8171	6.6214	12.9814
Average temperature	3531	22.4151	2.8196	13.8325	27.7363
Fertility rate in 1991	3532	3.7759	1.2169	2.0100	8.6800

TABLE 7C

Summary statistics, non-metropolitan Brazil without north region

Variable	Obs	Mean	Std. dev.	Min	Max
Delta in wage (2000/1991)	3300	0.0000	0.2901	-1.3942	0.8495
ln teacher qualification in 1991	3300	1.3156	2.1187	-4.6052	4.2370
Years of schooling in 1991	3300	3.6858	1.3320	0.4746	7.1707
Total rainfall	3299	1251.7990	367.9959	368.6636	2532.2020
Government accountability	3300	0.9124	0.2827	0.0000	1.0000
Delta in employment (2000/1991)	3300	0.1103	0.2035	-0.6577	1.2464
ln transport cost to São Paulo in 1995	3299	7.0422	0.7355	4.1589	8.3051
ln transport cost to state capital in 1995	3299	5.8691	0.6163	2.1972	7.7619
Delta in transferences (2000/1991)	3300	0.8448	0.3073	-0.2986	2.3336
Delta in market potential (2000/1991)	3299	0.4101	0.1179	-0.2664	1.5442
ln population in 1991	3300	9.2337	0.8054	6.6214	11.9770
Dependency ratio in 1991	3300	0.4807	0.0447	0.3738	0.6205
ln transport cost to São Paulo in 1968	3299	7.6219	0.6676	4.3694	8.7367
ln transport cost to state capital in 1968	3299	6.2990	0.6601	3.1135	7.9077
ln proportion of elderly in 1991	3300	-2.1936	0.2204	-3.6893	-1.5332
Illiteracy rate in 1991	3300	37.7150	17.8150	2.4800	81.4600
Urbanization rate in 1991	3300	49.2604	20.7435	2.7639	100.0000
Population density in 1991	3300	32.7412	33.3495	0.2065	522.2028
ln 5 to 15 over 15 to 55 years old ratio	3300	-0.7464	0.2243	-1.6218	-0.1870
Repetition rate in 1991	3300	4.2817	0.1976	2.6575	4.5756
ln employment rate in 1991	3300	-0.3625	0.1406	-1.2429	0.1601
Delta in education market potential (2000/1991)	3297	0.9707	0.1575	0.1650	1.6027
Percentage of good soils	3299	0.7881	0.3192	0.0000	1.0002
Rainfall – first principal component	3299	-0.0130	2.1967	-4.2315	6.8953
Rainfall – third principal component	3299	-0.1705	1.3696	-2.4997	5.4633
ln wage in 1991	3300	7.9233	0.4684	6.6139	9.3168
Proportion of natives in 1991	3300	0.6765	0.1694	0.0855	1.0134
Homicides per capita in 1991	3299	0.0015	0.0010	0.0000	0.0090
Employment in farming activities in 1991	3300	0.1995	0.0752	0.0000	0.5437
Bank dummy (1991)	3300	0.7197	0.4492	0.0000	1.0000
Average temperature	3299	22.1518	2.7223	13.8325	27.7363
Fertility rate in 1991	3300	3.6513	1.1051	2.0100	7.9600

TABLE 8

Regression results, Brazilwide

Dependent variable: delta in wage	2SLS est.	2SLS SE	Spatial GMM est. (cutoff = 0.5)	Spatial GMM SE (cutoff = 0.5)
Intercept	-23969856	06883838	-56879473	30864844
ln teacher qualification in 1991	00548926	00230455	00416922	0057475
Years of schooling in 1991	06204049	00435942	05989964	01154468
Total rainfall	00005344	9.645e-06	00006334	00002661
Government accountability	02233476	01293292	01689856	03458774
Delta in employment	-49393135	05272667	-60942137	21566178
ln transport cost SP in 1995	-03205953	00590571	-02147947	02295913
ln transport cost capital in 1995	-04812287	00601824	-01909574	02022743
Delta in transferences	29663134	03118072	20129193	11094594
Delta in market potential	54819572	09031346	98877352	29459548
Crit. fn. test of overid. restrictions	----	----	24.106339	24.106339

Dependent variable: delta in wage	Spatial GMM est. (cutoff = 1)	Spatial GMM SE (cutoff = 1)	Spatial GMM est. (cutoff = 2)	Spatial GMM SE (cutoff = 2)
Intercept	-71932918	39269048	-89149666	46470872
ln teacher qualification in 1991	00313908	00588544	00077822	00636871
Years of schooling in 1991	06201083	01286978	06663528	01474433
Total rainfall	0000674	00002795	00007651	00002947
Government accountability	02179158	03504303	03300684	035756
Delta in employment	-74141878	24696933	-89418358	27639595
ln transport cost SP in 1995	-01160188	02949758	00306388	03553532
ln transport cost capital in 1995	-00840394	02391369	00218674	02606355
Delta in transferences	13809767	12475475	05152986	13939323
Delta in market potential	1.1562178	.34490082	1.3035762	36538869
Crit. fn. test of overid. restrictions	19.804367	19.804367	14.762519	14.762519
Dependent variable: delta in employment	2SLS est.	2SLS SE	Spatial GMM est. (cutoff = 0.5)	Spatial GMM SE (cutoff = 0.5)
Intercept	-61966401	1396479	-59779578	19288857
ln wage in 1991	18148355	01471158	1805902	02061008
ln 5 to 15 over 15 to 55 yrs ratio	32737947	03751615	3284415	05359506
Proportion of natives in 1991	26274058	04047279	28160825	06166641
Delta in market potential	23244707	02541535	22884513	04132408
ln teacher qualification in 1991	-01008945	0023123	-01034963	00348222
Homicides in 1991	-23.377317	4.2814245	-26.064766	11.646685
Employment in farming in 1991	-1.0925149	16331391	-1.160606	25061706
Bank dummy	-00883696	00937983	-00637937	01263533
ln population in 1991	-0271189	00513829	-02845369	00796092
Mean temperature	-00216998	00263983	-00152014	00396835
Total rainfall	00002401	00001217	00002763	00001916
Rainfall – first princ. component	00693925	00183254	00660851	00291956
Rainfall – third princ. component	01082346	00425524	0101329	00634718
Employment rate in 1991	50765127	14583623	55593884	22256766
Crit. fn. test of overid. restrictions	----	----	4.3194265	4.3194265
Dependent variable: delta in employment	Spatial GMM est. (cutoff = 1)	Spatial GMM SE (cutoff = 1)	Spatial GMM est. (cutoff = 2)	Spatial GMM SE (cutoff = 2)
Intercept	-58264148	21309273	-55973566	23194173
ln wage in 1991	17833635	02288821	17472738	02582378
ln 5 to 15 over 15 to 55 yrs ratio	32701012	05974778	32103962	06498975
Proportion of natives in 1991	28581622	07064752	2838648	08167097
Delta in market potential	22956501	04807927	22942847	05732953
ln teacher qualification in 1991	-01069225	00410323	-01055971	00482079
Homicides in 1991	-29.090509	16.986828	-34.329254	26.672443
Employment in farming in 1991	-1.1970719	28437662	-1.2222365	31455466
Bank dummy	-00550414	01287836	-00412273	01383933
ln population in 1991	-028508	00898918	-02745768	01065978
Mean temperature	-00111862	00469047	-00119964	00556795
Total rainfall	00003371	00002314	00003857	00002848
Rainfall – first princ. component	00608015	00340453	0056972	00382822
Rainfall – third princ. component	00928193	00771074	00883827	00899555
Employment rate in 1991	5768252	24739395	58084285	26483339
Crit. fn. test of overid. restrictions	3.4865079	3.4865079	2.7619863	2.7619863

TABLE 9

Regression results, non-metropolitan Brazil

Dependent variable: delta in wage	2SLS est.	2SLS SE	Spatial GMM est. (cutoff = 0.5)	Spatial GMM SE (cutoff = 0.5)
Intercept	09597151	10607452	-07212585	15562966
ln teacher qualification in 1991	00297498	00255803	-00046191	00367207
Years of schooling in 1991	06753124	00544935	06342638	00746079
Total rainfall	00005995	00001096	00007959	00001616
Government accountability	01715587	01423606	00466584	02099178
Delta in employment	-58726752	07915421	-72860634	13080938
ln transport cost SP in 1995	-05128457	00834921	-04954901	01126003
ln transport cost capital in 1995	-06169838	00863113	-04358863	0138009
Delta in transferences	24978392	04062804	16556984	06593844
Delta in market potential	33007705	12288672	67970574	17956081
Crit. fn. test of overid. restrictions	----	----	51.198551	51.198551
Dependent variable: delta in wage	Spatial GMM est. (cutoff = 1)	Spatial GMM SE (cutoff = 1)	Spatial GMM est. (cutoff = 2)	Spatial GMM SE (cutoff = 2)
Intercept	-04565513	17729723	-0494362	21368676
ln teacher qualification in 1991	-00177951	00383909	-00199813	00412284
Years of schooling in 1991	06576312	00830697	06912613	00973923
Total rainfall	00008265	0000173	00007853	0000177
Government accountability	00246969	02073262	00032706	01966279
Delta in employment	-73485869	14010873	-74297255	15258759
ln transport cost SP in 1995	-05022805	01231244	-04537549	01413209
ln transport cost capital in 1995	-04676843	01599272	-04803535	01860846
Delta in transferences	16973922	07140593	16184129	08098298
Delta in market potential	64660937	19555643	60036469	22895648
Crit. fn. test of overid. restrictions	35.984318	35.984318	22.100483	22.100483

Dependent variable: delta in employment	2SLS est.	2SLS SE	Spatial GMM est. (cutoff = 0.5)	Spatial GMM SE (cutoff = 0.5)
Intercept	-1.0038159	14846142	-97731119	21782738
ln wage in 1991	19207975	01553089	190244	02302395
ln 5 to 15 over 15 to 55 yrs ratio	25067678	03711903	24860755	0545722
Proportion of natives in 1991	292077	04174566	31104589	06760336
Delta in market potential	2035026	02778313	19855203	04571589
ln teacher qualification in 1991	-00699189	00239773	-00710868	00376014
Homicides in 1991	-9.7408304	4.5089288	-13.952994	12.869347
Employment in farming in 1991	-55168569	17153628	-62525272	27117524
Bank dummy	-0029771	00978021	00085738	01357927
ln population in 1991	-02653262	00623792	-02801059	009894
Mean temperature	-00246354	00267179	-00177658	00416755
Total rainfall	3.313e-06	00001244	7.357e-06	00002025
Rainfall – first princ. component	00715906	00194123	00712434	0032946
Rainfall – third princ. component	01638063	0044276	01515498	00688489
Employment rate in 1991	17582282	14548762	21597567	23001887
Crit. fn. test of overid. restrictions	----	----	6.5507803	6.5507803
Dependent variable: delta in employment	Spatial GMM est. (cutoff = 1)	Spatial GMM SE (cutoff = 1)	Spatial GMM est. (cutoff = 2)	Spatial GMM SE (cutoff = 2)
Intercept	-94565964	24317868	-8953951	27096564
ln wage in 1991	1860382	02520692	17956887	02802359
ln 5 to 15 over 15 to 55 yrs ratio	2456395	06085758	2379445	06769622
Proportion of natives in 1991	31289083	07724686	30829117	08909906
Delta in market potential	19815785	05295998	19621347	06306989
ln teacher qualification in 1991	-00740787	00443293	-00709898	00504883
Homicides in 1991	-18.404268	18.498964	-26.86664	28.508017
Employment in farming in 1991	-6742841	31386852	-72451919	35913906
Bank dummy	00197269	0137091	00300001	01441328
ln population in 1991	-02758414	01119957	-02459399	01372423
Mean temperature	-00145903	00495593	-00197288	00596594
Total rainfall	00001497	00002414	00002119	00002897
Rainfall – first princ. component	00662112	00376597	00617786	00420715
Rainfall – third princ. component	01389925	00844409	01335848	009971
Employment rate in 1991	23755644	25803682	25136152	28428775
Crit. fn. test of overid. restrictions	5.2505856	5.2505856	4.0939112	4.0939112

TABLE 10

Non-metropolitan Brazil excluding north region

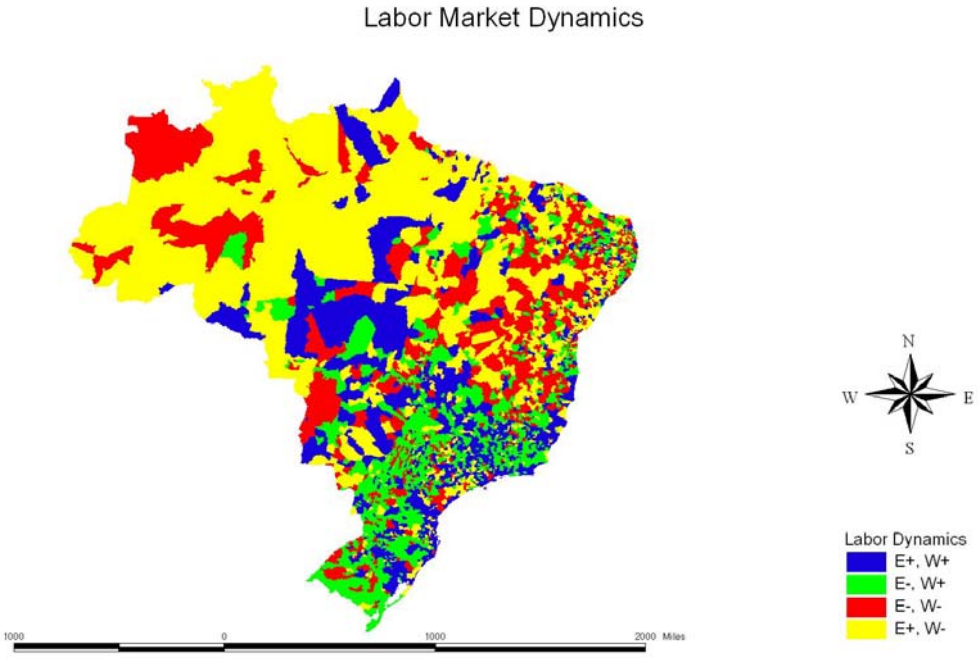
Dependent variable: delta in wage	2SLS est.	2SLS SE	Spatial GMM est. (cutoff = 0.5)	Spatial GMM SE (cutoff = 0.5)
Intercept	-15950009	10277873	-12074952	17974661
ln teacher qualification in 1991	0052535	00254925	00236128	00410509
Years of schooling in 1991	06246437	00536942	06088094	0082013
Total rainfall	00007979	00001297	00009786	00002296
Government accountability	-00584819	01443974	-00617702	02409457
Delta in employment	-53408098	07787127	-63237196	14710456
ln transport cost SP in 1995	-0404624	00821161	-04469861	0127028
ln transport cost capital in 1995	-04374225	00881383	-0422301	01622356
Delta in transferences	22328359	04042839	18064082	07351591
Delta in market potential	58404297	11290579	62033021	18144919
Crit. fn. test of overid. restrictions	----	----	44.336521	44.336521

Dependent variable: delta in wage	Spatial GMM est. (cutoff = 1)	Spatial GMM SE (cutoff = 1)	Spatial GMM est. (cutoff = 2)	Spatial GMM SE (cutoff = 2)
Intercept	-04462965	19892652	00716942	22615147
ln teacher qualification in 1991	00093057	00426831	00001553	00453575
Years of schooling in 1991	06330124	00894142	06656591	01025243
Total rainfall	00010275	00002402	00010328	00002395
Government accountability	-01646986	02421216	-02936971	02324613
Delta in employment	-68066132	16307582	-76383001	18872485
ln transport cost SP in 1995	-04688983	01363969	-042707	01531044
ln transport cost capital in 1995	-04913757	01864702	-05431722	02134752
Delta in transferences	17948617	0803842	15744109	09175749
Delta in market potential	58104956	19482417	52911681	22650729
Crit. fn. test of overid. restrictions	33.939201	33.939201	21.138334	21.138334

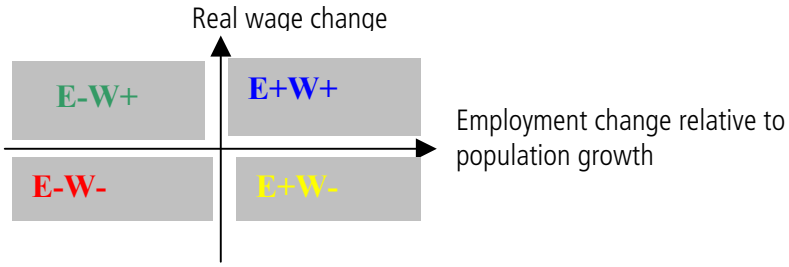
Dependent variable: delta in employment	2SLS.est.	2SLS.SE	Spatial GMM est. (cutoff = 0.5)	Spatial GMM SE (cutoff = 0.5)
Intercept	-95503801	15016687	-9338026	21124536
ln wage in 1991	19092101	0156507	18901078	02148466
ln 5 to 15 over 15 to 55 yrs ratio	1983383	03620152	19401434	05055868
Proportion of natives in 1991	28972116	04454679	3009288	06903289
Delta in market potential	30840242	03091629	30340591	05130368
ln teacher qualification in 1991	-00807114	00235408	-00812438	00351447
Homicides in 1991	-6.9250641	4.325995	-8.436305	11.13018
Employment in farming in 1991	-46696147	16523983	-50415081	25446269
Bank dummy	00072828	00950343	00397452	01257344
ln population in 1991	-02531787	00636568	-02616172	00975625
Mean temperature	-00678719	00265857	-00660142	00409379
Total rainfall	-00005046	00001317	-00004882	00002093
Rainfall – first princ. component	00971466	00196289	00973935	00324289
Rainfall – third princ. component	02245587	00465159	02228627	00712442
Employment rate in 1991	15742175	14161712	17703837	2183038
Crit. fn. test of overid. restrictions	----	----	3.819309	3.819309

Dependent variable: delta in employment	Spatial GMM est. (cutoff = 1)	Spatial GMM SE (cutoff = 1)	Spatial GMM est. (cutoff = 2)	Spatial GMM SE (cutoff = 2)
Intercept	-91925794	23347463	-8959102	25081733
ln wage in 1991	18708293	02332669	183212	0248753
ln 5 to 15 over 15 to 55 yrs ratio	19600923	05612046	19536939	06081697
Proportion of natives in 1991	30085957	07981306	29273868	09316006
Delta in market potential	30237946	05999995	30237827	06949838
ln teacher qualification in 1991	-008132	00415266	-0078909	0047722
Homicides in 1991	-9.6619034	15.947038	-12.576632	24.664917
Employment in farming in 1991	-52499872	29569033	-53298384	3420592
Bank dummy	00465381	01249154	00546396	01298614
ln population in 1991	-02584312	01101769	-02346004	01342835
Mean temperature	-006529	00497929	-00703587	00608096
Total rainfall	-00004341	0000258	-00003918	00003218
Rainfall – first princ. component	00924989	00368997	00853621	00395734
Rainfall – third princ. component	02213984	00880441	02222459	01032099
Employment rate in 1991	18801478	2473453	18705417	27703223
Crit. fn. test of overid. restrictions	3.0782778	3.0782778	2.4566422	2.4566422

MAP 1



GRAPH 1
Categorization of MCA by its labor dynamics



MAP 2

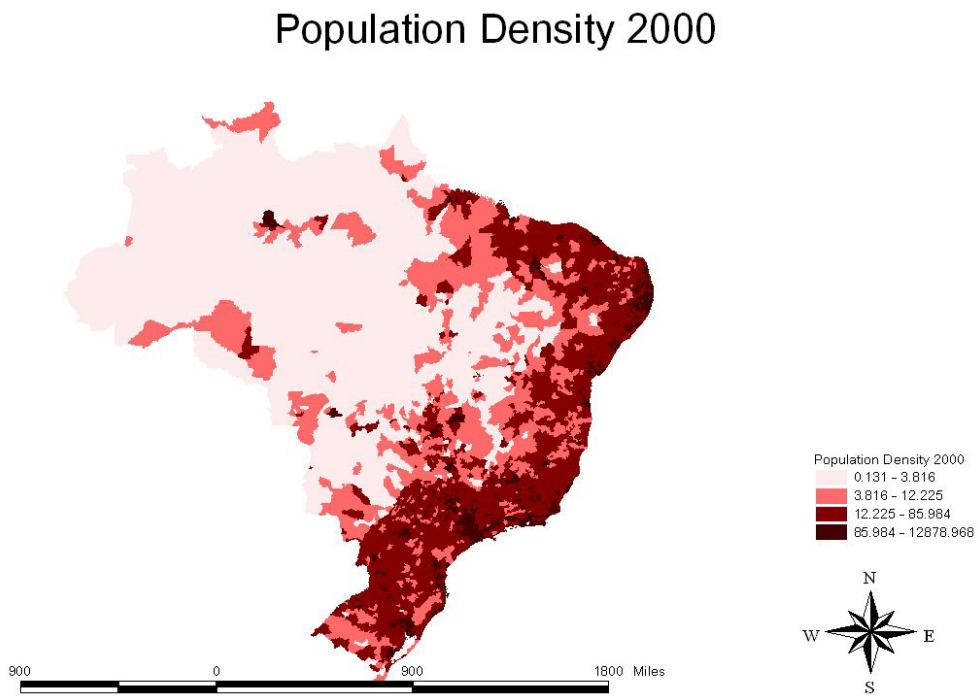


FIGURE 1
Population distribution by region and labor market outcome

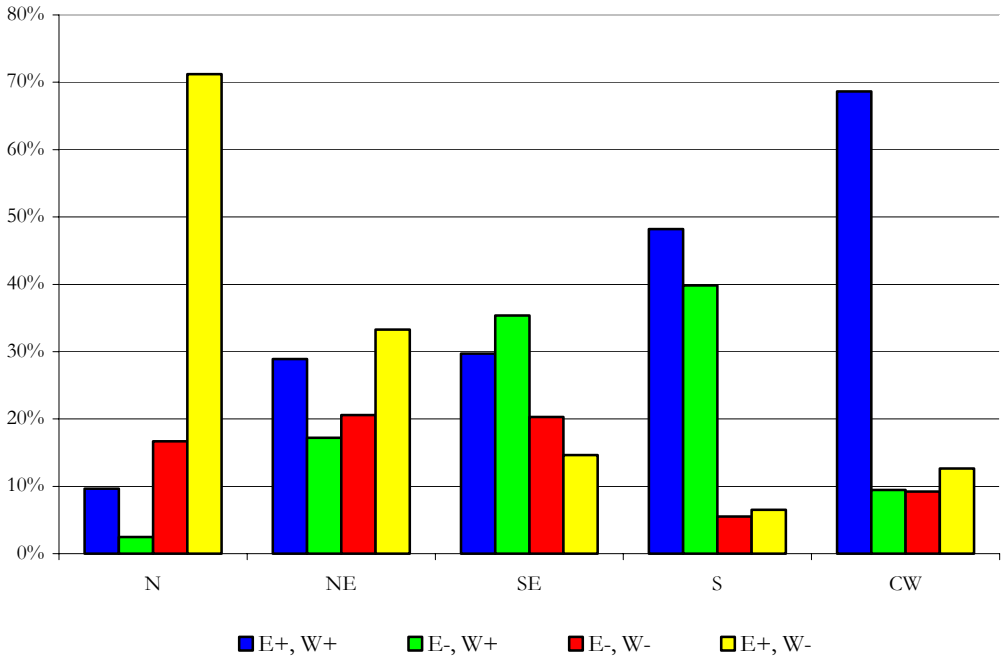
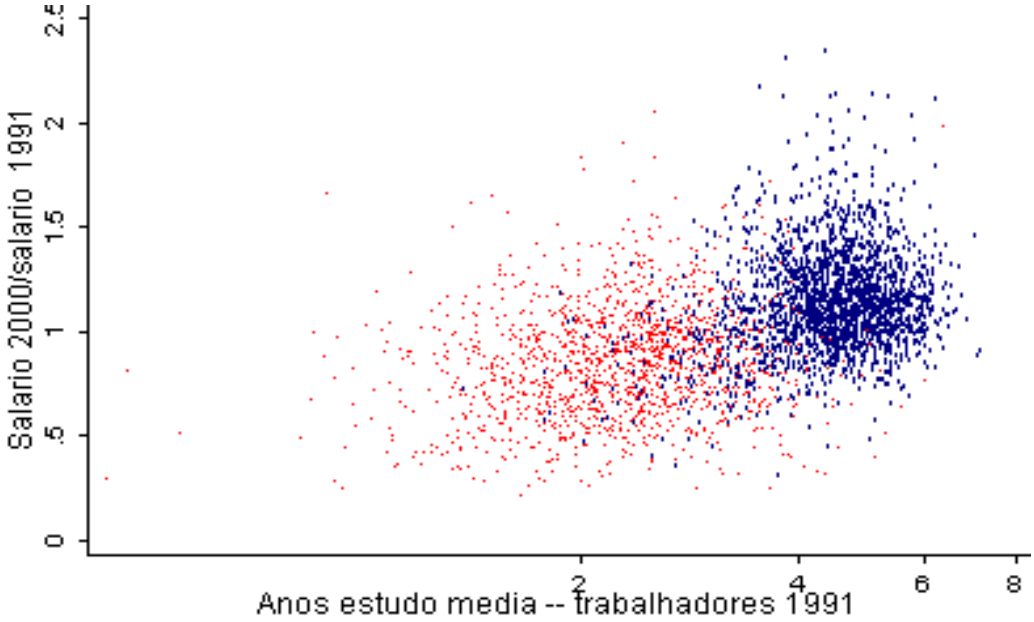
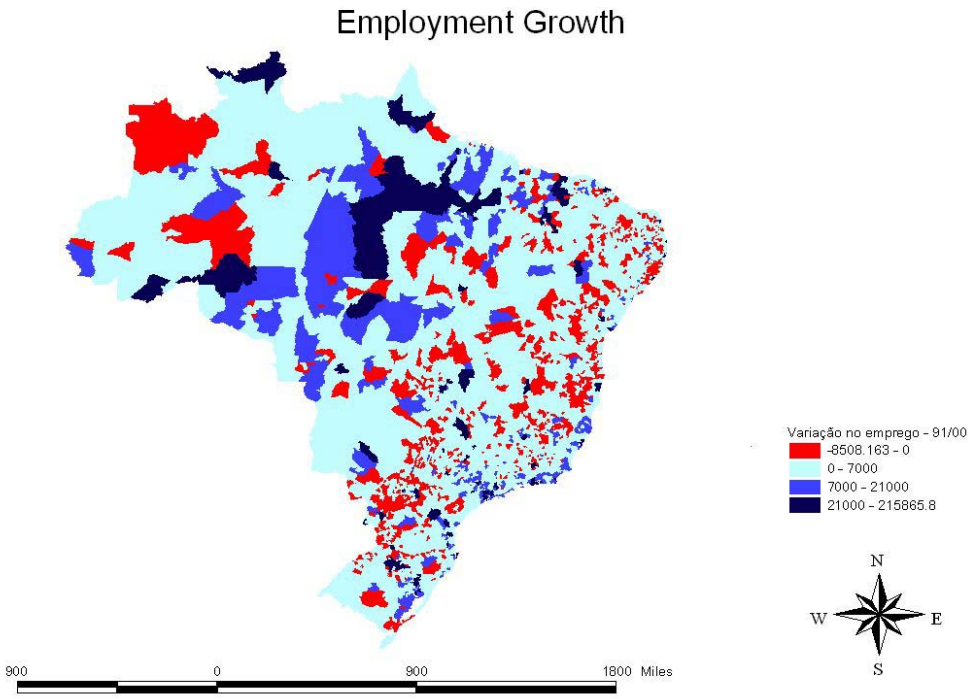


FIGURE 2
Worker education vs. wage growth



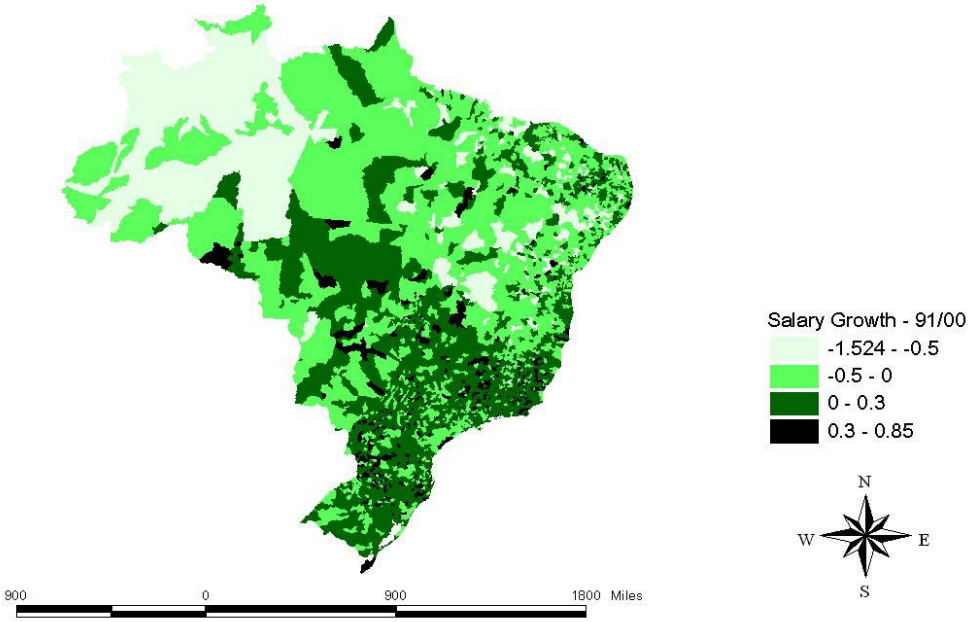
Red – North and Northeast Regions.
Blue – Southeast, South and Center-West Regions.

MAP 3



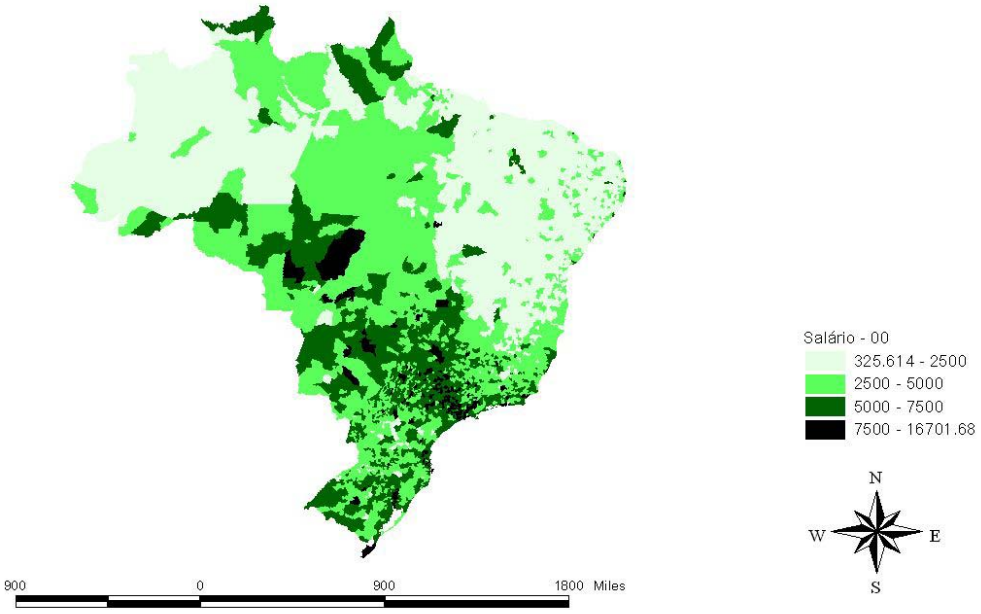
MAP 4

Salary Growth



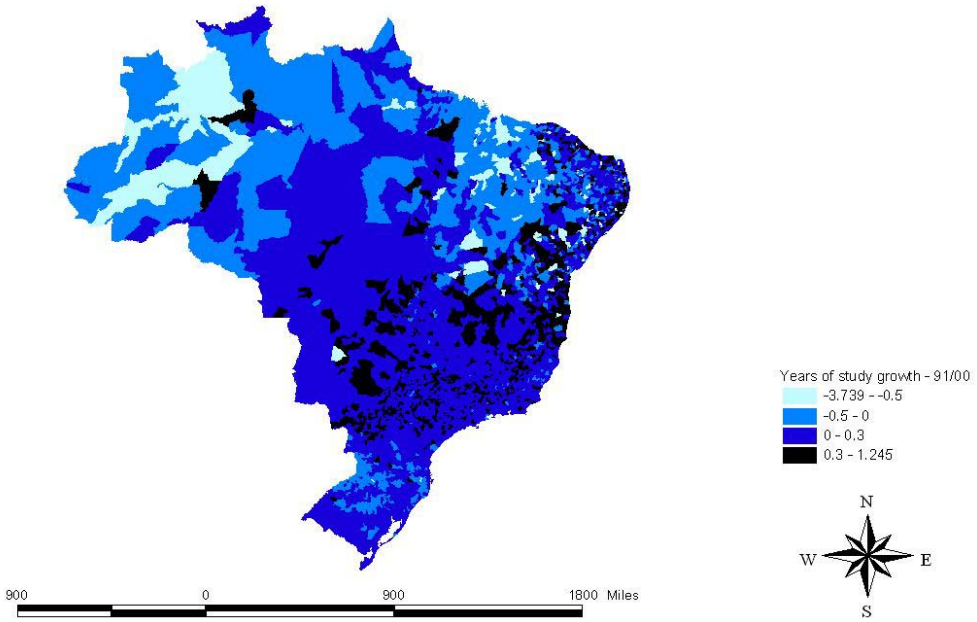
MAP 5

Salary. Brazil. 2000



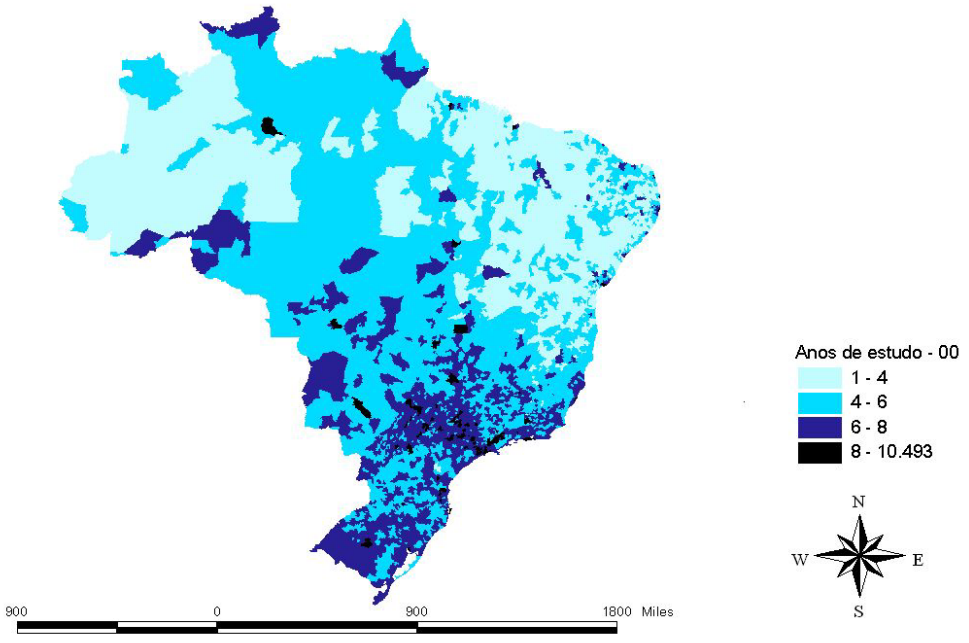
MAP 6

Years of study growth



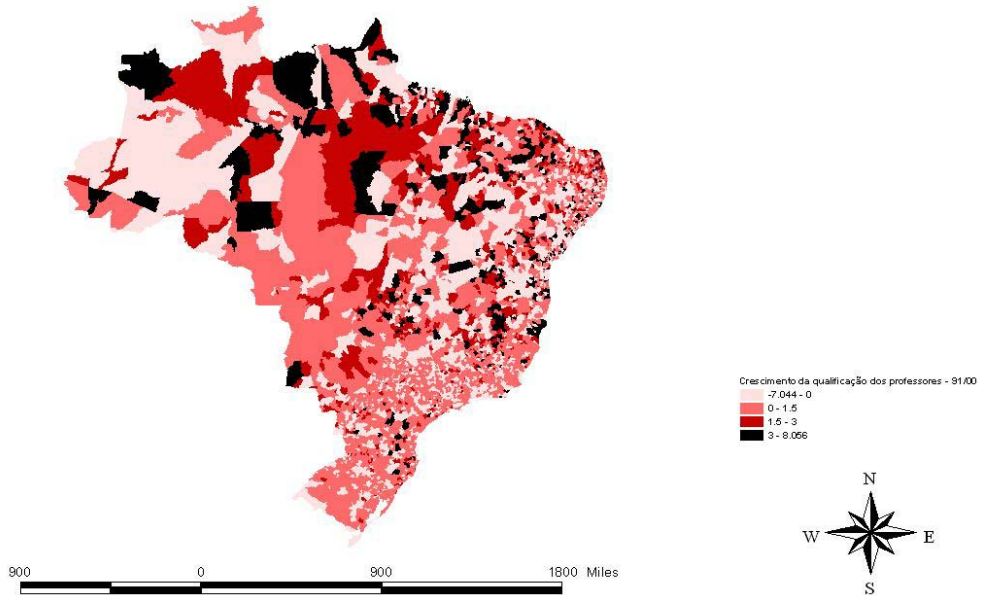
MAP 7

Years of study 2000



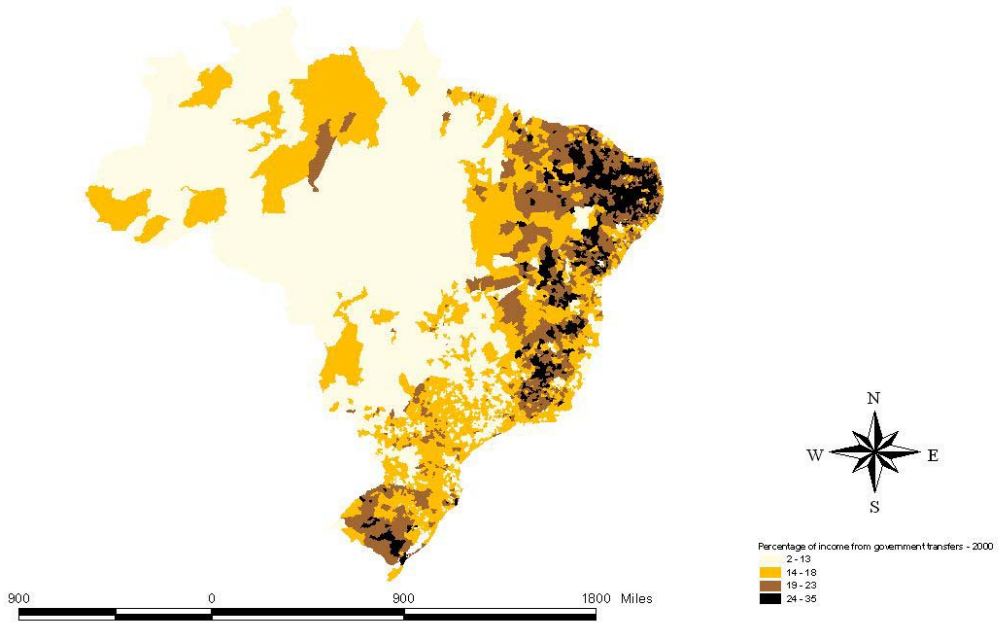
MAP 8

Teacher qualification growth. 2000



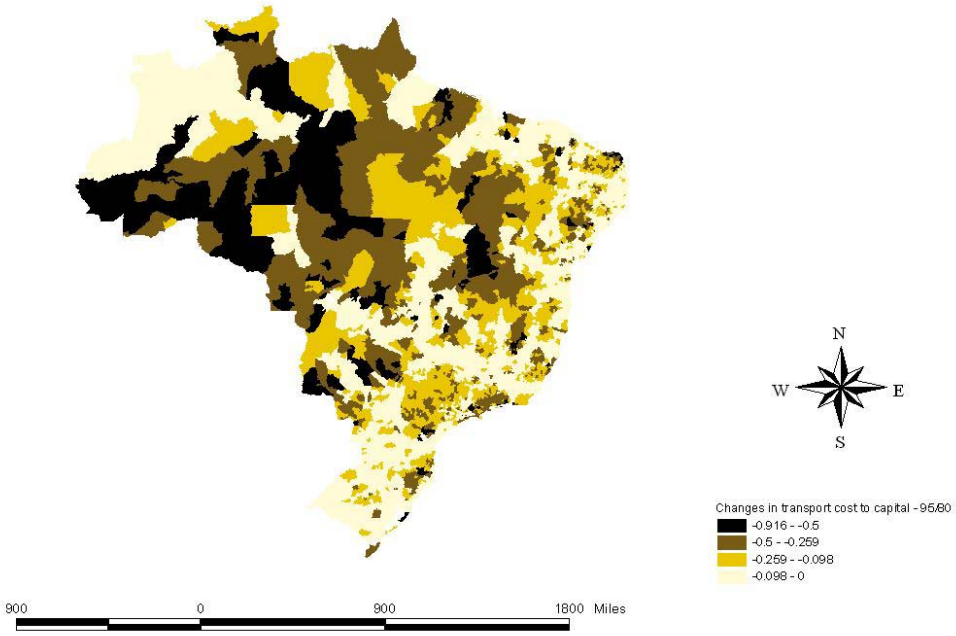
MAP 9

Percentage of income from government transfers 2000



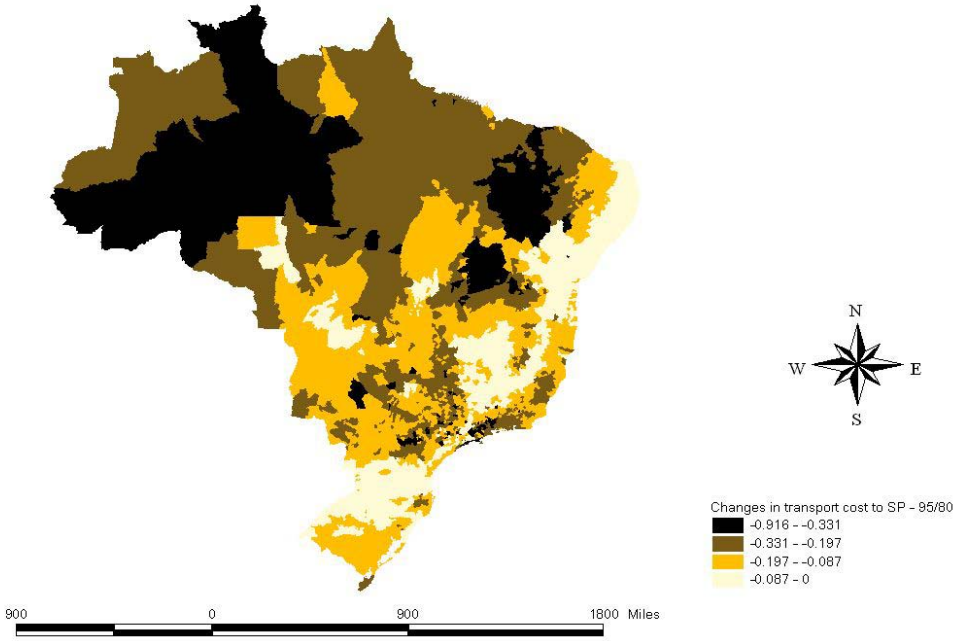
MAP 10

Changes in transport costs to capital. 1995/1980



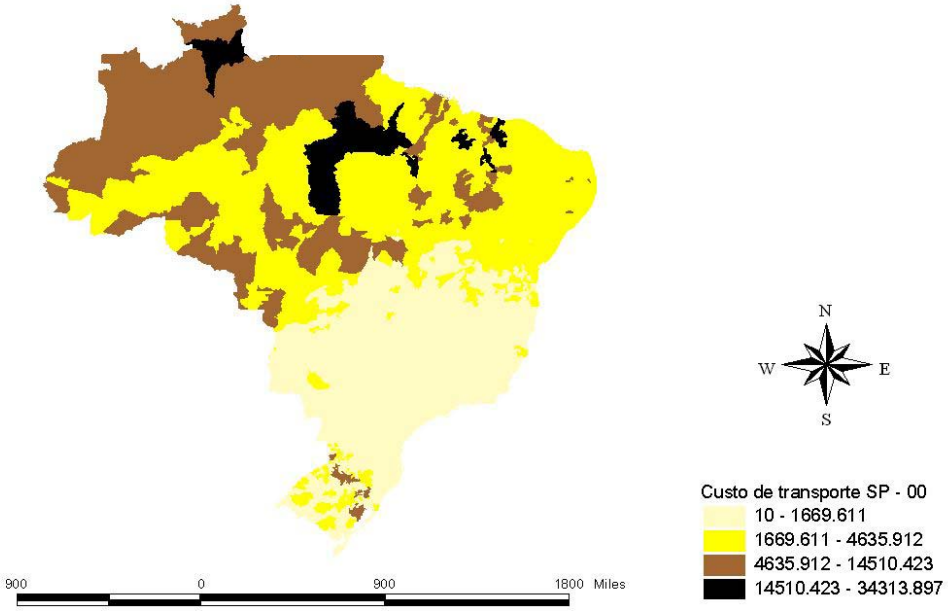
MAP 11

Changes in transport costs to SP. 1995/1980



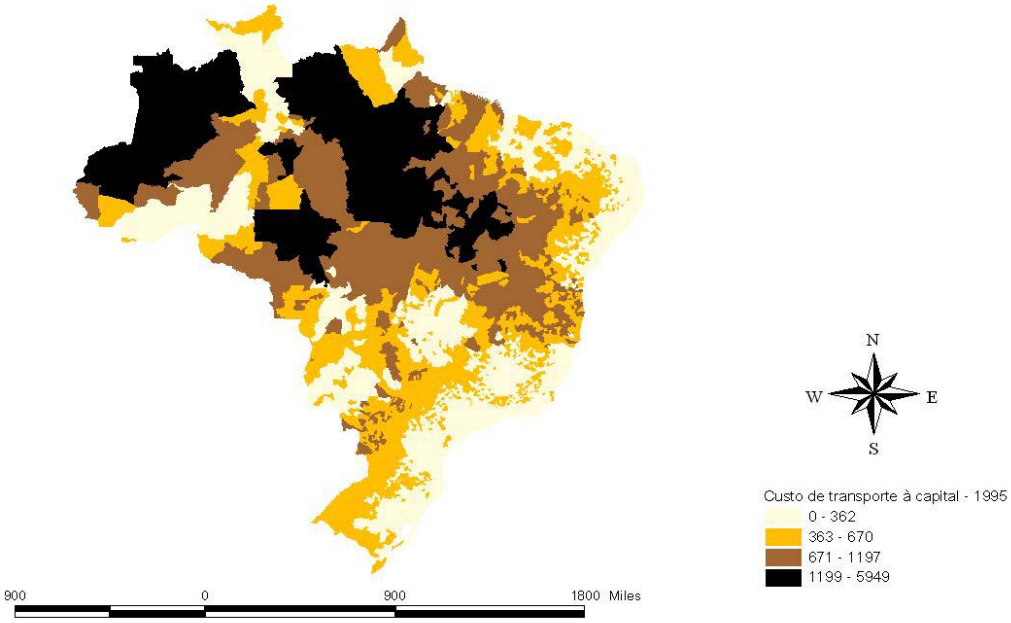
MAP 12

Transport costs to São Paulo. 2000



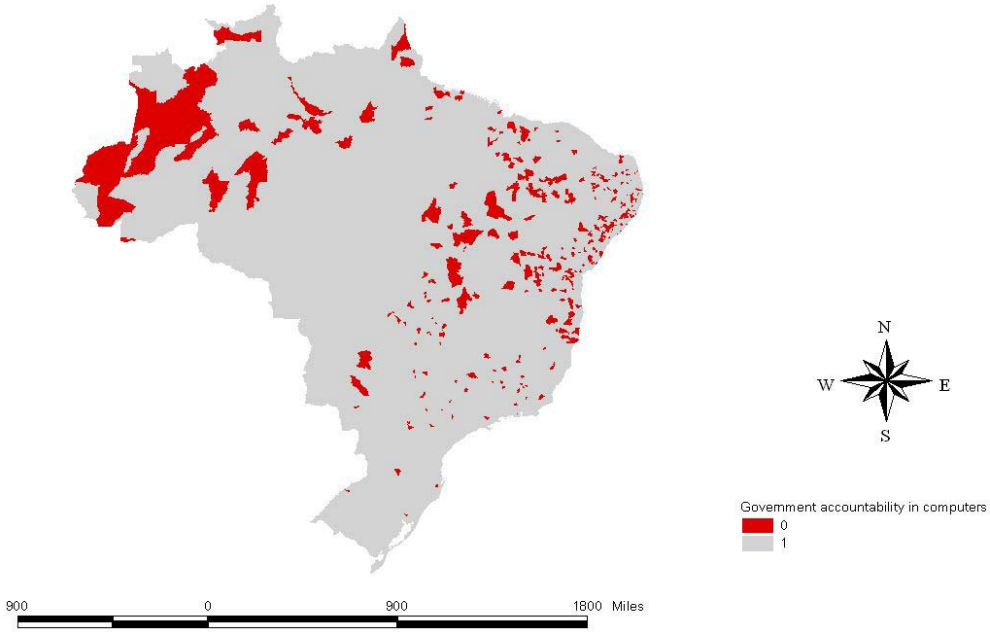
MAP 13

Transport costs to nearest capital. 1995



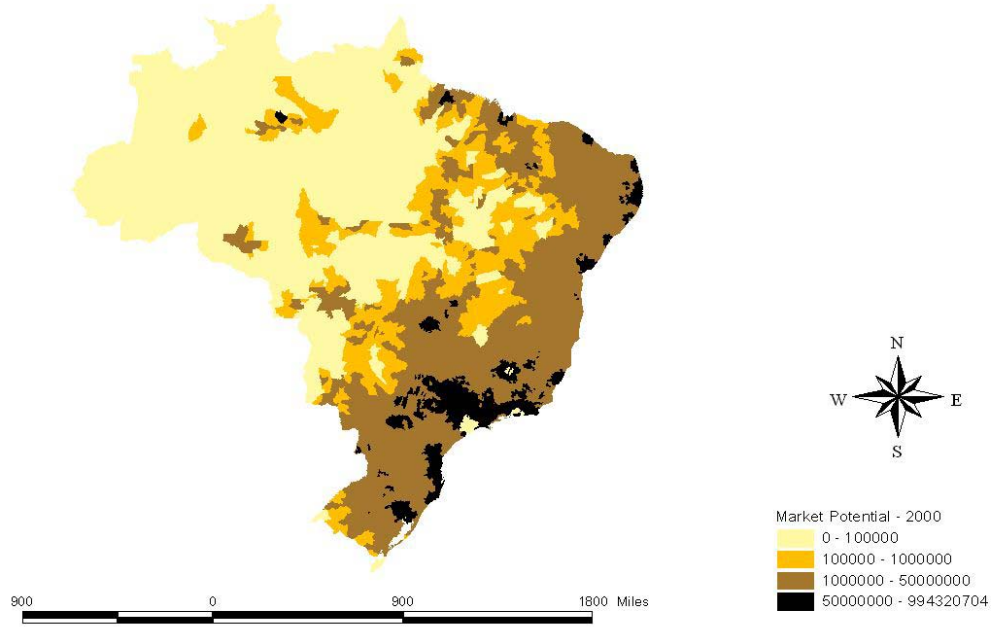
MAP 14

Government accountability in computers



MAP 15

Market potential 2000



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