Shifts in Regional Employment: An Application of the Haynes-Dinc Model for Brazil[1]

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Abstract. The principle aim of this article is to provide an analysis of the regional dynamics of employment in Brazil between 1985-97, a period of intense change in the economic environment. The exploratory analysis of the data shows that the regions showed distinctive performances during the period, with a slight tendency towards reduction of inequalities during the first subperiod (1985-90), and a possible point of inflection in the convergent trajectory in regional income at the start of the 1990s. Despite this reduction in regional growth differentials, the most developed regions showed gains in labor productivity, with implications for the national distribution of employment: with the exception of the more industrialized economies of the Northeast, the peripheral regions absorbed more workers than the South and Southeast regions. On the basis of the model of shift-share analysis, we evaluated the impact of variations in the level of activity (output), productivity gains and other factors unrelated to labor on changes in regional employment. We thereby demonstrated the existence of two dominant patterns during 1985-90, with a pattern of a positive "output effect", a negative "productivity effect" and a positive "other factors" effect, which generated an overall positive effect, becoming the rule during the second subperiod of 1990-97.

1. Introduction

The role of regions in explaining the process of national development has received greater attention over the last few years. The regional question has been "rediscovered" by economists, most notably those interested in the theory of international trade. Krugman (1991) suggests that one of the best ways of understanding how the international economy works is to begin by looking inside nations. The location of production and consumption within the territory should not, therefore, be ignored. As Frankel (1998) nevertheless observes, a large part of the theory of international trade has ignored the geographical dimension. Theoretical and empirical models of international trade, independently of their

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methodological variations, have tended until recently to have a rather odd common attribute: they have treated countries, the principal agents of the phenomenon under study, as entities without a physical location in geographical space.

International trade represents only one of the dimensions of recent change in the world economy, which has had a direct impact on the Latin American economies. Wider ranging transformations induced by technological change, are responsible for a new world order in which global competition has a particularly significant role. The opening of markets is a process that has occurred in various countries within the region, subjecting them to profound structural changes. Since these countries show a heterogeneous allocation of resources, these impacts may be perceived in different ways within sub-national areas.

The process of liberalization during the 1990s in Latin America resulted in an increase in and the diversification of regional trade. As one of the principal agents, Brazil intensified its insertion into the global economy through strategies of opening markets, adopting new production technologies and implementing a broad stabilization program. This program was based on a recipe familiar to Latin American countries: fiscal and monetary reforms, privatization to encourage private investment, and external capital flows, stimulated by interest rates that were more attractive than in other international markets (see Arocena, 1995).

Within this context, questions related to structural changes in the economy deserve special attention. The Brazilian economy is not internally homogeneous, with sharp variations between regions, sectors and income groups. In this way, it is to be expected that different economic policies will have differentiated impacts by area as well as between producers and consumers.

One of the principal aspects of these changes relates to employment. Total national employment grew at an average annual rate of 1.01% during the period 1985-97 (1.74% per year during the pre-liberalization period, 1985-90, and at 0.34% during the post-liberalization period of 1990-97). At the same time, as will be observed, there were sharp

variations between sectors and regions. In its spatial aspects, the development of employment during the period under analysis followed a sharply defined pattern, in which the less developed regions performed better at absorbing labor. As may be observed in the maps below in which the dynamic regions are highlighted – with rates of growth in employment above the national average – this pattern is even clearer during the period 1990-97.

Map 1. Regional Absorption of Labor within Brazil: Dynamic Regions, 1985-97

Map 2. Regional Absorption of Labor within Brazil: Dynamic Regions, 1985-90 and 1990-97

In this way, the objective of this study is to present an analysis of the regional dynamics of employment within Brazil between 1985-97, a period which experienced intense changes in the economic environment. On the basis of the shift-share model described in Section 3, we attempted to measure the impact of the changes in the level of activity (output), of productivity gains, and of other factors unrelated to labor, on changes in regional employment. This article contains four other sections in addition to this introduction. In the next section, we show the evolution of three variables of interest during the period, namely, employment, production and productivity. We then describe the methodology used to analyze the basic data. In section 4, we present the main results that are reconsidered in the final section.

2. Employment, Production and Labor Productivity in Brazil: 1985-97

Before entering into the formulation of the model and the methodological procedures for our calculations, as well as the evaluation of the results obtained in order to identify the principal factors that determine variations in employment within Brazil since the mid 1980s, we will describe the evolution of the principal variables to be investigated: employment, production and productivity. The behavior of these variables provides us with a scenario in which changes in employment occur.

To this end, we will use as data sources the Input-Output Matrix (MIP), the National Survey by Household Samples (PNAD) and the Regional Accounts, all of which are produced by the IBGE. While it is possible to establish a distinction between formal and informal employment, this is not the case with production. In this way, despite the fact that our analysis considers the evolution of total employment, we will present supplementary evidence in the last section of the text, using the General Register of Employed and Unemployed Persons - Law 4,923/65 (CAGED).

2.1. Sectorial Evolution

Employment

According to MIP data, in 1985 there were some 53.7 million Brazilian workers, a figure that rose to around 60.0 million at the end of 1997, i.e. an increase of some 11.6% over the period, according to the information presented in Tables 1 and 2. This growth in overall employment numbers led to sharp changes in composition by sector (Table 3): the relative share of agriculture fell from 31.8% to 22.8%; the transformation and construction industry also experienced a fall in share, while the commerce, and particularly the service sector registered an increase in share, with the share of total employment in services rising to 33.9% in 1997 (against 24.2% in 1985).

Table 1. Employment by Sector of Activity: Brazil, 1985-1990-1997

	1985	*1990*	*1997*
Agriculture	17.114.951	14.911.400	13.679.000
Mining	356.399	335.300	229.900
Manufacturing	8.153.945	9.089.500	7.750.500
Utilities	308.680	324.000	233.900
Construction	3.530.366	3.936.000	3.671.500
Commerce	5.889.394	7.619.200	8.852.300
Services	13.008.998	16.651.600	20.347.300
Public Sector	5.382.832	5.713.800	5.224.800
Total	53.745.565	58.580.800	59.989.200

Source: IBGE

Table 2. Employment by Sector of Activity: Brazil, 1985-1990-1997 (1985 = 100)

	1985	*1990*	*1997*
Agriculture	100.0	87.1	79.9
Mining	100.0	94.1	64.5
Manufacturing	100.0	111.5	95.1
Utilities	100.0	105.0	75.8
Construction	100.0	111.5	104.0
Commerce	100.0	129.4	150.3
Services	100.0	128.0	156.4
Public Sector	100.0	106.1	97.1
Total	100.0	109.0	111.6

Source: IBGE

Table 3. Sectorial Structure of Employment: Brazil, 1985-1990-1997

	1985	*1990*	*1997*
Agriculture	0.318	0.255	0.228
Mining	0.007	0.006	0.004
Manufacturing	0.152	0.155	0.129
Utilities	0.006	0.006	0.004
Construction	0.066	0.067	0.061
Commerce	0.110	0.130	0.148
Services	0.242	0.284	0.339
Public Sector	0.100	0.098	0.087
Total	1.000	1.000	1.000

Source: IBGE

This switch in the relative shares of employment by sector is easier to discern by observing Table 2. In the cases of agriculture, mining, manufacturing, utilities and the public sector, it is not just a question of slower growth in these sectors in so far as Brazil has been modifying its historical model of development. There was a genuine decrease in absolute terms in the level of employment. In agriculture and mining, this fall has been continuous since 1985, while for manufacturing, the decline began after the start of the 1990s, most notably with the broadening of trade liberalization that started after 1992.

Value Added

While the evolution of employment has varied substantially between sectors of economic activity, Table 4 reveals that this did not occur with production volumes, as determined by the behavior of value added. Overall, value added increased by 35.5% between 1985-97, most notably in agriculture (40.0%), services (43.0%), construction (47.0%) and commerce (47.3%).

Manufacturing not only registered a decrease in numbers of employment, but also showed slower growth in value added relative to the other sectors, pointing to a relative stagnation of this sector.

We may also note from Table 5 that divergences in production growth between sectors during the period under analysis did not cause any significant change in the share of each in national value added. There was only a minor switching of positions between manufacturing, whose share fell from 23.0% to 21.0%, and the service sector, whose share rose from 36.8% to 38.9%. The sectorial structure of value added nevertheless remained extremely stable between 1985 and 1997.

Table 4. Value Added by Sector: Brazil, 1985-1990-1997 (1985 = 100)*

	1985	*1990*	*1997*
Agriculture	100.0	109.3	140.1
Manufacturing	100.0	101.9	123.2
Construction	100.0	120.1	147.0
Commerce	100.0	114.0	147.3
Services	100.0	117.9	143.0
Public Sector	100.0	110.1	122.5
Total	100.0	112.2	135.5

* Excluding Mining and Utilities
Source: IBGE

Table 5. Sectorial Structure of Value Added: Brazil, 1985-1990-1997*

	1985	*1990*	*1997*
Agriculture	0.075	0.073	0.077
Manufacturing	0.230	0.209	0.210
Construction	0.091	0.097	0.098
Commerce	0.069	0.071	0.076
Services	0.368	0.387	0.389
Public Sector	0.166	0.163	0.150
Total	1.000	1.000	1.000

* Excluding Mining and Utilities
Source: IBGE

Labor Productivity

The behavior of production and employment described above resulted in an evolution of average labor productivity, the pattern of which may be observed in Table 6. The result is highly peculiar: in the sectors where there was a more pronounced decline in employment, such as agriculture, manufacturing and construction, productivity grew more, while in sectors where there was an increase in employment, such as commerce and services, labor

productivity fell slightly between 1985-97 despite the sharp increase in value added. It should be noted that the productivity gains in manufacturing during the period 1985-97 were around 5.0% per year.

Table 6. Average Labor Productivity* by Sector: Brazil, 1985-1990-1997 (1985 = 100)**

	1985	*1990*	*1997*
Agriculture	100.0	125.4	175.4
Manufacturing	100.0	91.4	129.6
Construction	100.0	107.7	141.4
Commerce	100.0	88.1	98.0
Services	100.0	92.1	91.4
Public Sector	100.0	103.7	126.2
Total	100.0	102.8	120.8

* Value Added /Employment
** Excluding Mining and Utilities
Source: IBGE

2.2. Regional Evolution

Employment

Table 7 presents the evolution of employment by region and for selected states, while Table 8 shows the regional structure of employment within Brazil.[5] It can be clearly seen that the regions and states with lower levels of employment and/or that represent frontier regions, particularly in the North of the country, show rates of growth in employment well above the national average. The states in the South and Southeast regions, on the other hand, or even the more developed regions of the Northeast, show a low rate of absorption of labor.

The most critical situation appears to be in the states of Pernambuco, Rio Grande do Sul, Paraná and Rio de Janeiro, in which levels of employment stagnated or even fell during the 1990s.

[5] The 'Greater North' region consists of the states of Acre, Amapá, Rondônia and Roraima; the 'Greater Northeast' region consists of the states of Maranhão, Piauí, Rio Grande do Norte, Paraíba, Alagoas and Sergipe; Mato Grosso refers to Mato Grosso and Mato Grosso do Sul; in 1997, Goiás included the state of Tocantins.

With regard to the sectors that were the major generators of employment among the regions considered, we would highlight the poor performance of the primary sector with the exception of the North region, and the significant losses in the manufacturing sector during the 1990s. The service sector showed itself during the whole of the period analyzed to be the main generator of employment in every region (Table 9).

Table 7. Employment by Region: Brazil, 1985-1990-1997 (1985 = 100)*

	1985	*1990*	*1997*
Greater North	100.0	162.5	205.1
Amazonas	100.0	134.9	147.0
Pará	100.0	124.6	146.1
Greater Northeast	100.0	107.0	113.2
Ceará	100.0	100.1	104.6
Pernambuco	100.0	104.5	104.8
Bahia	100.0	110.7	116.2
Minas Gerais	100.0	111.4	112.2
Espírito Santo	100.0	109.1	116.8
Rio de Janeiro	100.0	104.0	101.4
São Paulo	100.0	108.5	109.7
Paraná	100.0	104.4	103.7
Santa Catarina	100.0	111.9	114.9
Rio Grande do Sul	100.0	109.2	108.1
Mato Grosso	100.0	125.6	139.8
Goiás + DF	100.0	115.2	127.3
Total	100.0	109.4	112.8

Excluding Mining and Utilities
Source: IBGE

Table 8. Regional Structure of Employment: Brazil, 1985-1990-1997*

	1985	*1990*	*1997*
Greater North	0.005	0.008	0.010
Amazonas	0.007	0.009	0.010
Pará	0.013	0.015	0.017
Greater Northeast	0.112	0.110	0.113
Ceará	0.045	0.041	0.042
Pernambuco	0.047	0.045	0.044
Bahia	0.079	0.080	0.082
Minas Gerais	0.110	0.112	0.110
Espírito Santo	0.018	0.018	0.019
Rio de Janeiro	0.092	0.087	0.083
São Paulo	0.229	0.228	0.224
Paraná	0.068	0.065	0.063
Santa Catarina	0.035	0.036	0.036
Rio Grande do Sul	0.073	0.073	0.071
Mato Grosso	0.023	0.026	0.029
Goiás + DF	0.043	0.046	0.049
Total	1.000	1.000	1.000

Excluding Mining and Utilities
Source: IBGE

Table 9. Contribution by Sector to the Generation of Regional Employment

	1985-1990			*1990-1997*		
	Primary	*Manufacturing*	*Service*	*Primary*	*Manufacturing*	*Service*
Greater North	+	+	+	+	+	+
Amazonas	+	+	+	+	-	+
Pará	+	+	+	+	+	+
Greater Northeast	-	+	+	+	-	+
Ceará	-	-	+	-	-	+
Pernambuco	-	+	+	+	-	+
Bahia	-	+	+	+	-	+
Minas Gerais	-	+	+	-	-	+
Espírito Santo	-	+	+	-	+	+
Rio de Janeiro	-	-	+	-	-	+
São Paulo	-	+	+	-	-	+
Paraná	-	+	+	-	+	+
Santa Catarina	-	+	+	-	+	+
Rio Grande do Sul	-	+	+	-	+	+
Mato Grosso	+	+	+	-	+	+
Goiás + DF	-	+	+	-	+	+

Source: Calculations by the authors

Value Added

We have seen that value added grew by some 35.5% between 1985-97. Table 10 nevertheless indicates that this growth was highly heterogeneous between states and regions of Brazil. Indeed, this increase was slower due to the lower growth in value added in the principal Brazilian states: São Paulo, Rio de Janeiro, Rio Grande do Sul, Bahia and Pernambuco. Among the major Brazilian states, only Minas Gerais registered growth above the national average.

Table 11 nevertheless reveals that this spatial disparity in growth of value added did not produce significant changes in the relative shares of regions in national added value, merely pointing to a minor loss of share of São Paulo, Rio de Janeiro and Rio Grande do Sul, mainly during the period 1985-90. During the following period, 1990-97, the regional structure of value added remained even more stable in relative terms.

Table 10. Regional Value Added: Brazil, 1985-1990-1997 (1985 = 100)*

	1985	*1990*	*1997*
Greater North	100.0	123.6	164.0
Amazonas	100.0	126.2	207.8
Pará	100.0	131.8	151.2
Greater Northeast	100.0	118.2	140.0
Ceará	100.0	122.8	160.5
Pernambuco	100.0	109.4	125.9
Bahia	100.0	112.2	133.1
Minas Gerais	100.0	113.7	139.8
Espírito Santo	100.0	109.8	141.3
Rio de Janeiro	100.0	108.8	115.7
São Paulo	100.0	108.8	131.4
Paraná	100.0	121.3	150.0
Santa Catarina	100.0	115.6	154.2
Rio Grande do Sul	100.0	104.6	126.6
Mato Grosso	100.0	126.0	174.4
Goiás + DF	100.0	122.2	151.5
Total	100.0	112.2	135.5

Excluding Mining and Utilities
Source: IBGE

Table 11. Regional Structure of Value Added: Brazil, 1985-1990-1997*

	1985	*1990*	*1997*
Greater North	0.008	0.009	0.010
Amazonas	0.010	0.011	0.015
Pará	0.016	0.018	0.017
Greater Northeast	0.040	0.043	0.042
Ceará	0.018	0.019	0.021
Pernambuco	0.031	0.030	0.028
Bahia	0.044	0.044	0.043
Minas Gerais	0.097	0.098	0.100
Espírito Santo	0.017	0.017	0.018
Rio de Janeiro	0.128	0.124	0.109
São Paulo	0.355	0.345	0.345
Paraná	0.055	0.060	0.061
Santa Catarina	0.032	0.033	0.036
Rio Grande do Sul	0.085	0.079	0.080
Mato Grosso	0.017	0.020	0.022
Goiás + DF	0.046	0.050	0.052
Total	1.000	1.000	1.000

Excluding Mining and Utilities
Source: IBGE

3. The Theoretical Model: Shift-Share Analysis

As has already been mentioned, the object of this study is to identify the principal factors responsible for the regional dynamics of employment in Brazil during the period 1985-97. An exploratory analysis of the data showed distinct performances of the regions during the period, with a slight tendency towards a reduction in inequalities during the first sub-period (1985-90) and a possible turning point in the convergent trajectory for regional incomes and the start of the 1990s.[6] Despite this reduction in the differential in regional growth, the more developed regions began to show gains in labor productivity, with implications for the distribution of employment throughout the country: with the exception of the more industrialized economies of the Northeast, the peripheral regions began to absorb more workers than the regions of the South and Southeast.

[6] See Azzoni (2001), Haddad et al. (1999) and Haddad (1999) for a detailed discussion of the process of regional concentration of income within Brazil.

3.1. Traditional Model

In order to attain a better understanding of the dynamics of regional employment, isolating the specific effects of the growth process for each region, we apply an extension of the traditional shift-share model of analysis for the Brazilian economy. This shift-share model is essentially a descriptive method,[7] and is a practical model for evaluating the impacts of structural changes on sub-national economies, starting from the observation that it is possible to separate statistically, for any interval of time, the components of growth within a region that reflect national growth, the *mix* of activities within the region and its competitive position.

We may thus analyze, for example, the change (increase/decrease) in employment within a region for a given period, breaking this change into the following three basic components: the first, *NS,* refers to the component of change in total employment within a region relative to the change in employment for the country as a whole; the second, *PS*, reflects the variation in regional employment that would have occurred had all the sectors in the region shown the same sector growth rates recorded for the country as a whole, minus the "national effect" (which reflects the degree of specialization of the regional economy in sectors that are more or less dynamic); the third, *DS*, shows the difference between the observed change in employment and the change that would be expected if the regional sectors showed the same sector growth rates as the country as a whole.

It is easy to see that the sum of these three effects corresponds to the total variation observed in employment within the region. In formal terms, the three effects can be written in the following way:

National Effect: $NS \equiv E_{ir} g_n$ (1)

Industrial *Mix* Effect: $PS \equiv E_{ir} (g_{in} - g_n)$ (2)

Competitive or Regional Effect: $DS \equiv E_{ir}(g_{ir} - g_{in})$ (3)

where E_{ir} represents employment in sector i of region r, g_{ir} is the rate of change of employment in sector i in region r, g_{in} is the rate of change of employment in sector i within the reference area (country), and g_n the rate of growth of the reference area. As has already been highlighted, the total change in employment within the region is equivalent to the three effects taken concurrently ($TS \equiv NS + PS + DS$):

$$TS = E_{ir}g_n + E_{ir}(g_{in} - g_n) + E_{ir}(g_{ir} - g_{in}) \quad (4)$$

3.2. Extension of Haynes and Dinc[8]

The traditional model has a number of limitations. In particular, despite it being possible to identify the sectors that are growing (declining) during a given period of time, it is unable to identify the causes of this growth (or decline). The extension proposed by Haynes and Dinc (1997), on the basis of Rigby and Andersen (1993) – which explicitly incorporates changes in output and productivity in order to isolate the effects of these variables on changes in employment – attempts to highlight this limitation of the traditional method. We present a derivation of the alternative method below, with this allowing us to separate components according to the contributions of labor and of capital to changes in productivity.

Let Q_{irt} be the production of sector i in region r during time t. We can then define the average labor productivity for sector i in region r during t as:

$$q_{irt} = Q_{irt} / E_{irt} \quad (5)$$

[7] See Isard (1960), Haddad (1989), Dinc et al. (1998) for a detailed discussion of the method.
[8] This section is based on Haynes and Dinc (1997, 2001)

The expected variation in sectorial employment in the region over a given interval of time, resulting from an increase in production, considering that productivity remains unchanged, is then:

$$A_{ir} = (Q_{ir(t+1)} - Q_{irt}) / q_{irt} \tag{6}$$

and the potential change in sectorial employment in region *r* resulting from a change in productivity (with constant production) is given by:

$$B_{ir} = (Q_{ir(t+1)} / q_{ir(t+1)}) - (Q_{ir(t+1)} / q_{irt}) \tag{7}$$

In relative terms, $a_{ir} = A_{ir} / E_{ir}$ represents the rate of change in employment in sector *i* of region *r* resulting from changes in production with constant productivity, and $b_{ir} = B_{ir} / E_{ir}$ represents the rate of change in employment in sector *i* of region *r* resulting solely from changes in productivity. In this way,

$$g_{ir} = a_{ir} + b_{ir} \tag{8}$$

it being possible to define this relationship for a sector, a region or a reference area..

In the extension proposed by Rigby and Andersen (1993), these relationships are used to incorporate the effects of changes in productivity and production into the traditional model of shift-share analysis

$$NS \equiv NS(a) + NS(b) = \sum E_{ir}(a_n) + (b_n) \tag{9}$$

$$PS \equiv PS(a) + PS(b) = \sum E_{ir}[(a_{in} - a_n) + (b_{in} - b_n)] \tag{10}$$

$$DS \equiv DS(a) + DS(b) = \sum E_{ir}[(a_{ir} - a_{in}) + (b_{ir} - b_{in})] \tag{11}$$

At the same time, in order to isolate the effects of the contribution of specific production factors on productivity, (and not only of the labor factor), we may consider the "Total Factor Productivity" (TFP) approach, in which productivity is defined as the relationship between production of goods and services and the productive inputs in their broad sense. Hence:

$$TFP = Y/[\alpha L + (1-\alpha)K] \tag{12}$$

where Y is total production, L and K represent the total quantity of inputs of labor and capital, respectively, and α is the weighting of input L, which is estimated on the basis of the contribution of payments to the labor factor to generate regional income. In sectorial terms, we may write:

$$TFP_i = Y_i/[\alpha_i L_i + (1-\alpha_i)K_i] \tag{13}$$

The algebraic manipulation of equation (12) implies that:

$$1/TFP \equiv [\alpha L + (1-\alpha)K]/Y \tag{14}$$

$$1/TFP \equiv (\alpha L/Y) + [(1-\alpha)K/Y] \tag{15}$$

$$1/TFP \equiv 1/TFP_L + 1/TFP_K \tag{16}$$

Using equation (5), we have:

$$q_{ir} = Q_{ir}/[\alpha_i E_{ir} + (1-\alpha_i)K_{ir}] \tag{17}$$

And on the basis of (15) and (16), we may derive:

$$1/q_{ir} \equiv [\alpha_i E_{ir} / Q_{ir}] + [(1-\alpha_i) K_{ir} / Q_{ir}] \quad (18)$$

or

$$1/q_{ir} \equiv 1/q_{irL} + 1/q_{irK} \quad (19)$$

Substituting the values of q_{irL} and q_{irK} into equations (6) and (7), we may calculate A_{ir} and B_{ir}:

$$A_{irL} = (Q_{ir(t+1)} - Q_{irt}) / q_{irL} \quad (20)$$

$$A_{irK} = (Q_{ir(t+1)} - Q_{irt}) / q_{irK} \quad (21)$$

$$B_{irL} = (Q_{ir(t+1)} / q_{irL(t+1)}) - (Q_{ir(t+1)} / q_{irLt}) \quad (22)$$

$$B_{irK} = (Q_{ir(t+1)} / q_{irK(t+1)}) - (Q_{ir(t+1)} / q_{irKt}) \quad (23)$$

$$a_{irL} = A_{irL} / E_{ir} \quad (24)$$

$$a_{irK} = A_{irK} / K_{ir} \quad (25)$$

$$b_{irL} = B_{irL} / E_{ir} \quad (26)$$

$$b_{irK} = B_{irK} / K_{ir} \quad (27)$$

The new equations for the extension of the shift-share model that allow us to investigate the determining causes of variations in employment are thus:

$$TS_L \equiv NS_L + PS_L + DS_L \quad (28)$$

$$NS_L \equiv NS(a_L) + NS(b_L) = \sum E_{ir}[(a_{nL}) + (b_{nL})] \quad (29)$$

$$PS_L \equiv PS(a_L) + PS(b_L) = \sum E_{ir}[(a_{inL} - a_{nL}) + (b_{inL} - b_{nL})] \quad (30)$$

$$DS_L \equiv DS(a_L) + DS(b_L) = \sum E_{ir}[(a_{irL} - a_{inL}) + (b_{irL} - b_{inL})] \quad (31)$$

And the equations for investigating changes in capital are:

$$TS_K \equiv NS_K + PS_K + DS_K \quad (32)$$

$$NS_K \equiv NS(a_K) + NS(b_K) = \sum K_{ir}[(a_{nK}) + (b_{nK})] \quad (33)$$

$$PS_K \equiv PS(a_K) + PS(b_K) = \sum K_{ir}[(a_{inK} - a_{nK}) + (b_{inK} - b_{nK})] \quad (34)$$

$$DS_K \equiv DS(a_K) + DS(b_K) = \sum K_{ir}[(a_{irK} - a_{inK}) + (b_{irK} - b_{inK})] \quad (35)$$

The lack of reliable statistics on the capital stock reduces the analytical possibilities for using the model operationally in a Brazilian context. The procedure adopted in this study considers the contribution of other factors not related to the factor of labor – i.e. capital, technology, infrastructure and raw materials – to total productivity, and their impact on changes in employment as a residue.

Let ΔE be the observed change in regional employment. If TS_L is the change in employment due to changes in labor productivity and production, the difference between ΔE and TS_L results in the change in employment due to the contribution of other production factors to total factor productivity, ΔE_P.

$$\Delta E_P = \Delta E - TS_L \quad (36)$$

4. Results

This section presents the results of applying the extension proposed by Haynes and Dinc for the basic model of shift-share analysis. The basic information for the application of the methodology described in the previous section was compiled from official statistics on employment, added value and remuneration of labor for the years 1985, 1990 and 1997.[9] For each variable, a matrix of information was prepared. Four results are produced for each sector within a region.

i) Change in employment for change in output (output effect);
ii) Change in employment resulting from a change in productivity (productivity effect);
iii) Change in employment resulting from the contribution of other production factors apart from labor (other factor effect);
iv) Change in observed employment.

The discussion of results is divided into 2 sections. In the first, we consider the aggregate results for regional employment, without distinguishing between sectors. In the following section, we carry out a more detailed analysis of sector results, attempting to delineate models of sectorial/regional behavior for the period analyzed.

Tables 12 and 13 contain the principal aggregate results from applying the model, with the principal components of equations (29), (30), (31) and (36). The results referring to the "output effect", "productivity effect" and "other factors effect" columns are represented graphically in Figures 1-3. We may define distinct models for the two subperiods analyzed. With regard to the "output effect", all regions showed growth in the level of activity during both 1985-90 and 1990-97, and hence benefited from an increase in employment. As production grows, *ceteris paribus*, there is a tendency to create new jobs. In absolute terms

[9] The data sources used were the Input-Output Matrix, National Accounts, Regional Accounts and PNAD, all published by the IBGE. The data for employment presented in the input-output matrix were used as a benchmark.

(Table 12), the Greater Northeast region was the region that generated most jobs during the period 1985-90 (385,495 places), followed by the state of São Paulo and Goiás/Federal District (with 374,128 and 286,642 jobs, respectively). In relative terms, however, the North and Center-West macroregions, both frontier areas, were the main beneficiaries. During the period 1990-97, however, São Paulo was the absolute leader, with the creation of 1,126,348 new jobs, followed by the Greater Northeast (523,742 jobs), Minas Gerais (455,866 jobs) and Paraná (368,605 jobs). At the bottom of the list are the Greater North, Pará, Espírito Santo, Pernambuco and Rio de Janeiro. In relative terms, however, the results show that the North and Center-West macroregions are once again the main winners.

When we analyze the changes in regional employment resulting from the "productivity effect", we perceive two distinct situations. During the first subperiod, 1985-90, a number of regions preformed poorly, since a decline in productivity was seen in the same regions. Of the 16 regions analyzed, 8 showed a decline in productivity, most notably São Paulo, Bahia, Santa Catarina, Amazonas and Minas Gerais (in absolute terms), and Amazonas, the Greater North, Santa Catarina, Bahia and Espírito Santo (in relative terms). Between 1990-97, there were generalized gains in productivity, so that all regions reduced their level of employment.

When we consider the output and productivity effects together, in the first subperiod, 12 of the 16 regions showed an increase in the level of employment, while in the second period, in which a positive output effect but a negative productivity effect was registered (generalized gains in productivity), the output effect outstripped the productivity effect in only 4 regions (Greater Northeast, Paraná, Greater North, Ceará).

Finally, the analysis of results relating to the contribution of the "other factors effect" (i.e. new investments, technological progress) to changes in employment show this effect to be highly relevant to the generation of regional employment during the period analyzed (principally for the regions that show a joint "output plus productivity" effect that is negative. This category includes Ceará, Paraná and Rio de Janeiro in 1985-90, and Pará, Mato Grosso, Espírito Santo, Santa Catarina, Minas Gerais, Goiás/Federal District,

Amazonas, Pernambuco, Bahia and São Paulo in 1990-97. In these regions, the "other factors effect" was sufficiently large to offset the negative effect of the other two components evaluated jointly.

Tables 14 and 15 below, present a qualitative classification of changes in regional employment and the contribution of each of the identified components. It may be perceived that there are two dominant models between 1985-90, although in the second subperiod, the positive output effect, negative productivity effect and positive other factors effect becomes the rule.

Figure 1. Change in Regional Employment resulting from the Output Effect

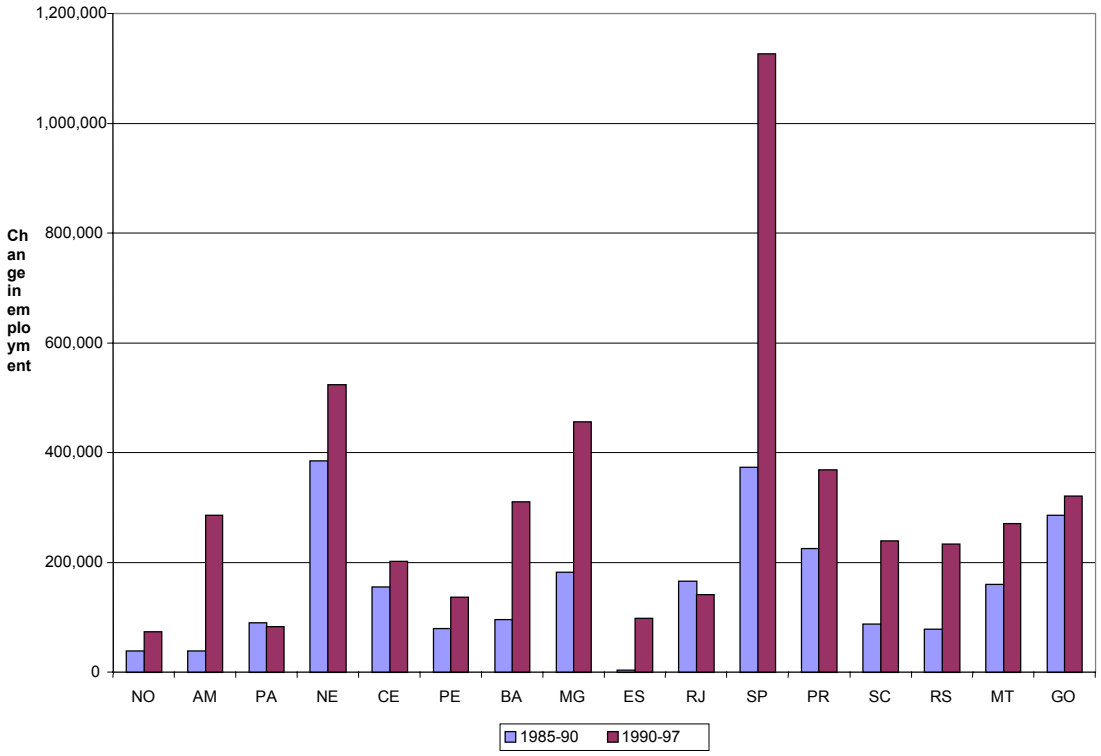


Figure 2. Change in Regional Employment resulting from the Productivity Effect

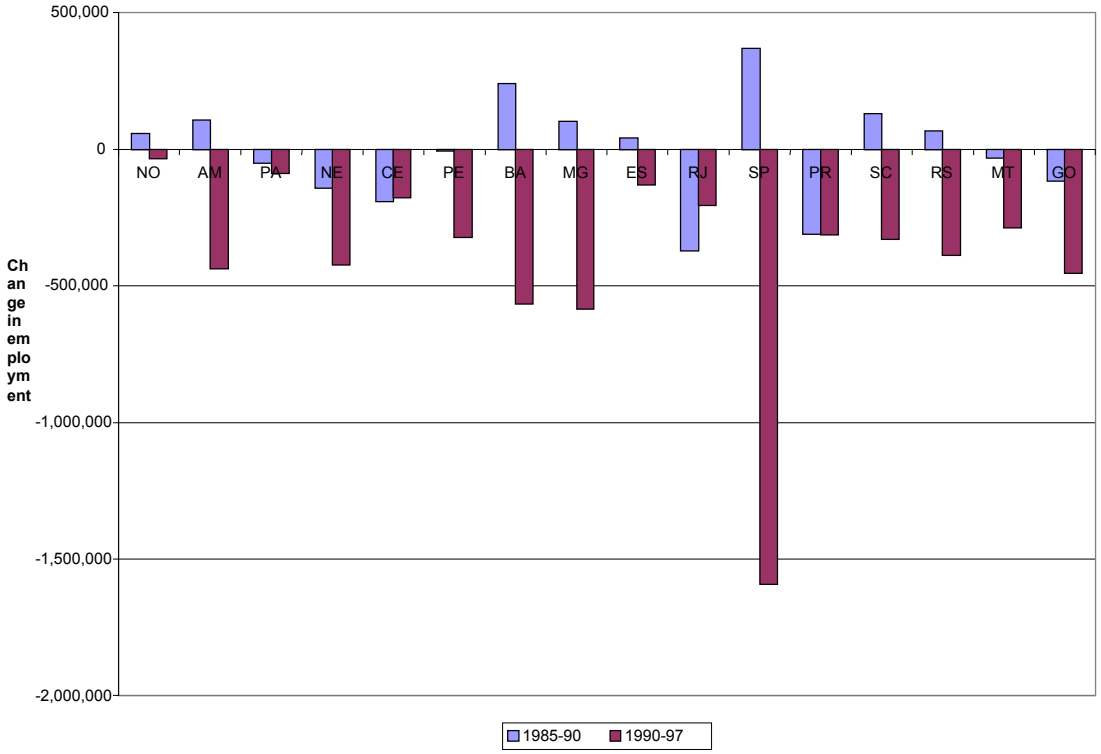


Figure 3. Change in Regional Employment resulting from the Other Factors Effect

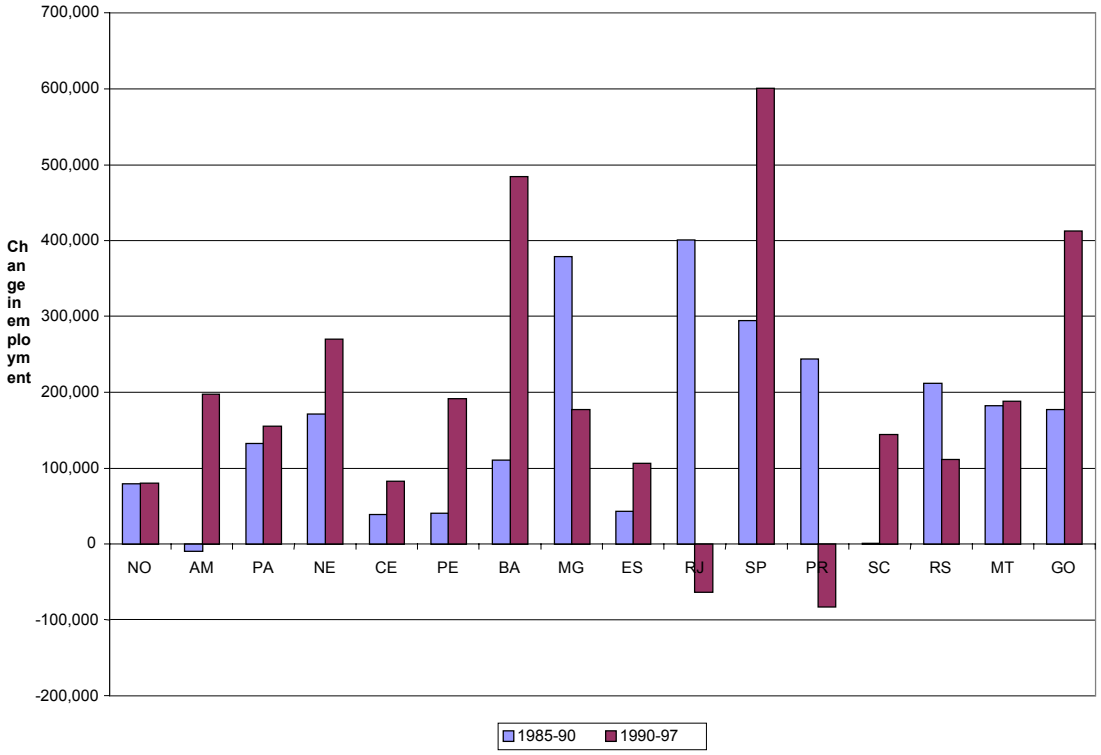


Table 12 Changes in Regional Employment, 1985-1990 and 1990-1997: Results from the H-D Model

	NS(a)		*NS(b)*		*PS(a)*		*PS(b)*		*DS(a)*		*DS(b)*	
	85-90	*90-97*	*85-90*	*90-97*	*85-90*	*90-97*	*85-90*	*90-97*	*85-90*	*90-97*	*85-90*	*90-97*
Greater North	15233	42237	-3329	-62424	20109	38955	65701	26662	2950	-7642	-4086	2610
Amazonas	21086	48569	-4608	-71781	18007	135884	100937	-265037	-818	101809	11429	-99806
Pará	37930	80671	-8289	-119227	62386	-33233	-86170	73198	-10963	35129	45889	-40699
Greater Northeast	320865	585854	-70120	-865850	225806	19997	-215330	394764	-161176	-82109	144077	47775
Ceará	127892	218536	-27949	-322981	149091	97382	-432602	-15257	-121522	-114042	269057	161221
Pernambuco	135726	242184	-29661	-357931	-34041	-72477	-36091	-22800	-22329	-32429	59850	58217
Bahia	225700	426364	-49323	-630136	-13428	-41383	155728	-20974	-116440	-74727	133949	85823
Minas Gerais	314368	597491	-68700	-883049	-10932	-13184	89603	17425	-121784	-128440	80535	281524
Espírito Santo	51752	96343	-11310	-142388	-13968	34730	47251	-58900	-34129	-32716	4393	70796
Rio de Janeiro	262364	465688	-57336	-688252	-54674	-334021	-423209	402509	-42314	8745	108746	82322
São Paulo	654559	1212612	-143044	-1792153	-212201	-19389	429102	-21443	-68231	-66876	82297	221884
Paraná	195371	348115	-42695	-514489	108161	-28749	-339835	200032	-78468	49238	72299	2451
Santa Catarina	99924	190867	-21837	-282088	2581	121066	199032	-233938	-15087	-72046	-45359	188159
Rio Grande do Sul	209823	391048	-45854	-577940	-142048	-49392	134290	-18387	10428	-107754	-20306	208838
Mato Grosso	65508	140427	-14316	-207541	103420	176810	22014	-195150	-8955	-46901	-39006	116466
Goiás + DF	123610	242948	-27013	-359060	152729	91995	-93167	-129517	10303	-13900	3447	34322

Table 12 **cont.**

	Output effect (a)		*Productivity effect(b)*		*Total a + b*		*Observed change*		*Other factors*		*% change*	
	85-90	*90-97*	*85-90*	*90-97*	*85-90*	*90-97*	*85-90*	*90-97*	*85-90*	*90-97*	*85-90*	*90-97*
Greater North	38291	73550	58287	-33151	96578	40399	176458	120469	79880	80070	62.5%	26.2%
Amazonas	38276	286262	107758	-436625	146034	-150363	136682	47005	-9351	197369	34.9%	8.9%
Pará	89353	82567	-48570	-86728	40783	-4161	173116	151472	132333	155633	24.6%	17.3%
Greater Northeast	385495	523742	-141373	-423311	244122	100431	414996	370626	170874	270195	7.0%	5.8%
Ceará	155460	201876	-191494	-177017	-36034	24860	2660	107074	38694	82214	0.1%	4.5%
Pernambuco	79356	137278	-5902	-322514	73454	-185236	114336	6073	40883	191309	4.5%	0.2%
Bahia	95832	310254	240354	-565287	336186	-255032	446967	229483	110781	484515	10.7%	5.0%
Minas Gerais	181652	455866	101437	-584099	283089	-128233	661982	49215	378893	177448	11.4%	0.8%
Espírito Santo	3655	98357	40335	-130493	43990	-32136	87059	73970	43070	106106	9.1%	7.1%
Rio de Janeiro	165376	140411	-371798	-203421	-206422	-63010	194233	-126619	400655	-63609	4.0%	-2.5%
São Paulo	374128	1126348	368355	-1591712	742483	-465364	1036558	135636	294075	601000	8.5%	1.0%
Paraná	225064	368605	-310231	-312006	-85167	56598	159184	-25967	244351	-82565	4.4%	-0.7%
Santa Catarina	87417	239887	131837	-327867	219254	-87980	220751	55979	1497	143959	11.9%	2.7%
Rio Grande do Sul	78203	233901	68130	-387489	146333	-153588	357678	-42135	211344	111452	9.2%	-1.0%
Mato Grosso	159973	270337	-31308	-286225	128666	-15888	310972	172548	182307	188437	25.6%	11.3%
Goiás + DF	286642	321044	-116733	-454255	169908	-133211	347382	279070	177473	412282	15.2%	10.6%

Table 13. Changes in Regional Employment, 1985-1990 and 1990-1997(in % of initial employment)

	NS(a)		*NS(b)*		*PS(a)*		*PS(b)*		*DS(a)*		*DS(b)*	
	85-90	*90-97*	*85-90*	*90-97*	*85-90*	*90-97*	*85-90*	*90-97*	*85-90*	*90-97*	*85-90*	*90-97*
Greater North	5.4%	9.2%	-1.2%	-13.6%	7.1%	8.5%	23.3%	5.8%	1.0%	-1.7%	-1.4%	0.6%
Amazonas	5.4%	9.2%	-1.2%	-13.6%	4.6%	25.7%	25.8%	-50.2%	-0.2%	19.3%	2.9%	-18.9%
Pará	5.4%	9.2%	-1.2%	-13.6%	8.9%	-3.8%	-12.2%	8.3%	-1.6%	4.0%	6.5%	-4.6%
Greater Northeast	5.4%	9.2%	-1.2%	-13.6%	3.8%	0.3%	-3.6%	6.2%	-2.7%	-1.3%	2.4%	0.8%
Ceará	5.4%	9.2%	-1.2%	-13.6%	6.3%	4.1%	-18%	-0.6%	-5.1%	-4.8%	11.3%	6.8%
Pernambuco	5.4%	9.2%	-1.2%	-13.6%	-1.4%	-2.8%	-1.4%	-0.9%	-0.9%	-1.2%	2.4%	2.2%
Bahia	5.4%	9.2%	-1.2%	-13.6%	-0.3%	-0.9%	3.7%	-0.5%	-2.8%	-1.6%	3.2%	1.9%
Minas Gerais	5.4%	9.2%	-1.2%	-13.6%	-0.2%	-0.2%	1.5%	0.3%	-2.1%	-2.0%	1.4%	4.3%
Espírito Santo	5.4%	9.2%	-1.2%	-13.6%	-1.5%	3.3%	4.9%	-5.6%	-3.6%	-3.1%	0.5%	6.8%
Rio de Janeiro	5.4%	9.2%	-1.2%	-13.6%	-1.1%	-6.6%	-8.7%	8.0%	-0.9%	0.2%	2.2%	1.6%
São Paulo	5.4%	9.2%	-1.2%	-13.6%	-1.7%	-0.1%	3.5%	-0.2%	-0.6%	-0.5%	0.7%	1.7%
Paraná	5.4%	9.2%	-1.2%	-13.6%	3.0%	-0.8%	-9.4%	5.3%	-2.2%	1.3%	2.0%	0.1%
Santa Catarina	5.4%	9.2%	-1.2%	-13.6%	0.1%	5.8%	10.7%	-11.3%	-0.8%	-3.5%	-2.4%	9.1%
Rio Grande do Sul	5.4%	9.2%	-1.2%	-13.6%	-3.6%	-1.2%	3.5%	-0.4%	0.3%	-2.5%	-0.5%	4.9%
Mato Grosso	5.4%	9.2%	-1.2%	-13.6%	8.5%	11.6%	1.8%	-12.8%	-0.7%	-3.1%	-3.2%	7.6%
Goiás + DF	5.4%	9.2%	-1.2%	-13.6%	6.7%	3.5%	-4.1%	-4.9%	0.4%	-0.5%	0.2%	1.3%

Table 13. cont.

	Output effect (a)		*Productivity effect(b)*		*Total a + b*		*Observed change*		*Other factors*	
	85-90	*90-97*	*85-90*	*90-97*	*85-90*	*90-97*	*85-90*	*90-97*	*85-90*	*90-97*
Greater North	13.6%	16.0%	20.6%	-7.2%	34.2%	8.8%	62.5%	26.2%	28.3%	17.4%
Amazonas	9.8%	54.2%	27.6%	-82.7%	37.3%	-28.5%	34.9%	8.9%	-2.4%	37.4%
Pará	12.7%	9.4%	-6.9%	-9.9%	5.8%	-0.5%	24.6%	17.3%	18.8%	17.8%
Greater Northeast	6.5%	8.2%	-2.4%	-6.6%	4.1%	1.6%	7.0%	5.8%	2.9%	4.2%
Ceará	6.6%	8.5%	-8.1%	-7.5%	-1.5%	1.0%	0.1%	4.5%	1.6%	3.5%
Pernambuco	3.2%	5.2%	-0.2%	-12.3%	2.9%	-7.0%	4.5%	0.2%	1.6%	7.3%
Bahia	2.3%	6.7%	5.7%	-12.2%	8.0%	-5.5%	10.7%	5.0%	2.6%	10.5%
Minas Gerais	3.1%	7.0%	1.7%	-9.0%	4.9%	-2.0%	11.4%	0.8%	6.5%	2.7%
Espírito Santo	0.4%	9.4%	4.2%	-12.5%	4.6%	-3.1%	9.1%	7.1%	4.5%	10.1%
Rio de Janeiro	3.4%	2.8%	-7.6%	-4.0%	-4.2%	-1.2%	4.0%	-2.5%	8.2%	-1.3%
São Paulo	3.1%	8.5%	3.0%	-12.1%	6.1%	-3.5%	8.5%	1.0%	2.4%	4.6%
Paraná	6.2%	9.7%	-8.6%	-8.2%	-2.4%	1.5%	4.4%	-0.7%	6.7%	-2.2%
Santa Catarina	4.7%	11.6%	7.1%	-15.8%	11.8%	-4.2%	11.9%	2.7%	0.1%	6.9%
Rio Grande do Sul	2.0%	5.5%	1.8%	-9.1%	3.8%	-3.6%	9.2%	-1.0%	5.4%	2.6%
Mato Grosso	13.2%	17.7%	-2.6%	-18.8%	10.6%	-1.0%	25.6%	11.3%	15.0%	12.3%
Goiás + DF	12.5%	12.2%	-5.1%	-17.2%	7.4%	-5.0%	15.2%	10.6%	7.7%	15.6%

Table 14. Classification of Combined Effects on Employment: 1985-90

Observed Change	*Output Effect*	*Productivity Effect*	*'Other Factors' Effect*	*Occurrence*
+	+	+	+	NO, BA, MG, ES, SP, SC, RS
+	+	+	-	AM
+	+	-	+	PA, NE, CE, PE, RJ, PR, MT/MS, GO/DF

Table 15. Classification of Combined Effects on Employment: 1990-1997

Observed Change	*Output Effect*	*Productivity Effect*	*'Other Factors' Effect*	*Occurrence*
+	+	-	+	NO, AM, PA, NE, CE, PE, BA, MG, ES, SP, SC, MT/MS, GO/DF
-	+	-	-	RJ, PR
-	+	-	+	RS

The analysis of individual sectors (Figures 4-15) also presents results that shed some light. Agriculture, for example, is a sector that has shown recurring gains in productivity. With a generalized tendency towards reduction in employment, we have been able to establish that this fact is not only due to the 'productivity effect', but also to the 'other factors' effect, which is dominant in some regions.

In the case of manufacturing, the definition of the periods used is fundamental in understanding the evolution of employment in the sector. During the first subperiod, the output effect is relatively more important than in the second, while the 'other factors' effect is also the force responsible for generating sector employment during that period. The

situation at the start of the 1990s changes radically, since the sector begins to show sharp increases in productivity, a phenomenon that takes control of its dynamics.

A similar pattern appears in the commerce and service sector. A positive "output effect" predominates in both periods, with "other factors" making a significant contribution in almost every region, and the "productivity effect" contributing to the generation of employment in a differentiated fashion: positively in 1985-90, with the exception of the service sector in Rio de Janeiro, and commerce in Pará, Ceará and Espírito Santo, and negatively (productivity gains) in a more or less generalized way in the service sector, albeit in a less pronounced way in the commerce sector (Amazonas, Pernambuco, Bahia, São Paulo, Paraná and Rio Grande do Sul).

The civil construction sector showed gains in productivity in almost every region during the entire period analyzed. Despite this, it does not succeed in overcoming the joint effects of output and other factors. The output effect, while weak, was positive in every region for both periods.

Finally, there is the public sector, which follows its own dynamics. The results for 1990-97 reflect in a crystal clear way the process of administrative reform of the public sector (positive output effect proportional to the presence of the state in each region), productivity gains (negative productivity effect on employment) and a reduction in investment spending (negative 'other factors' effect).

Figure 4. Change in Employment in Agriculture, 1985-90

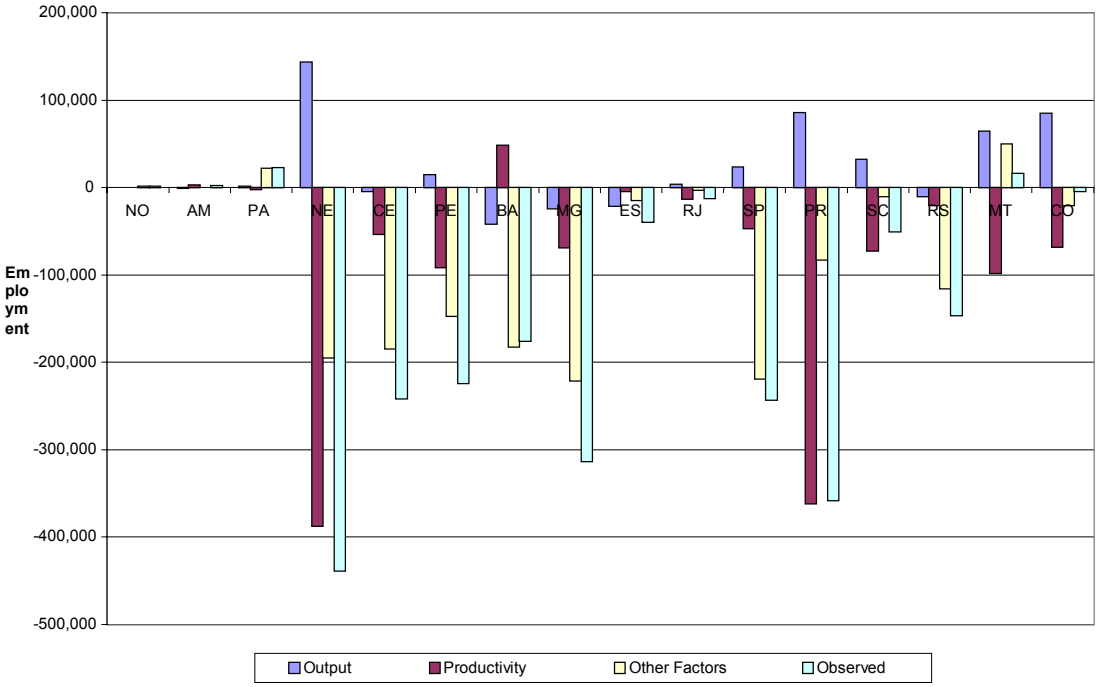


Figure 5. Change in Employment in Agriculture, 1990-1997

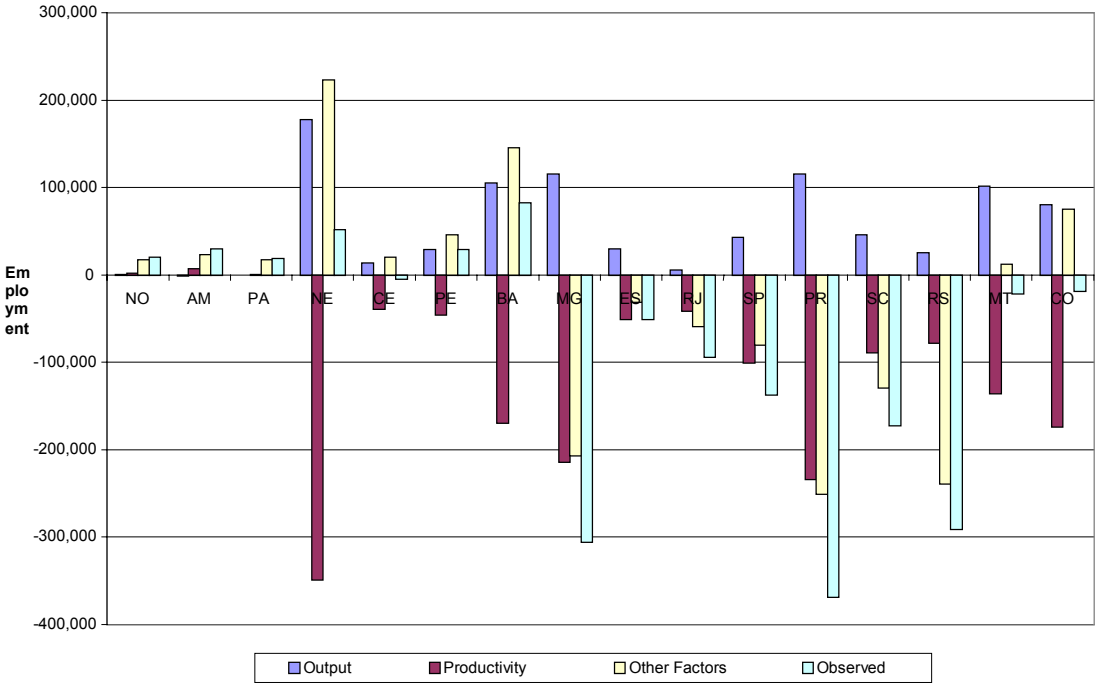


Figure 6. Change in Employment in Manufacturing, 1985-90

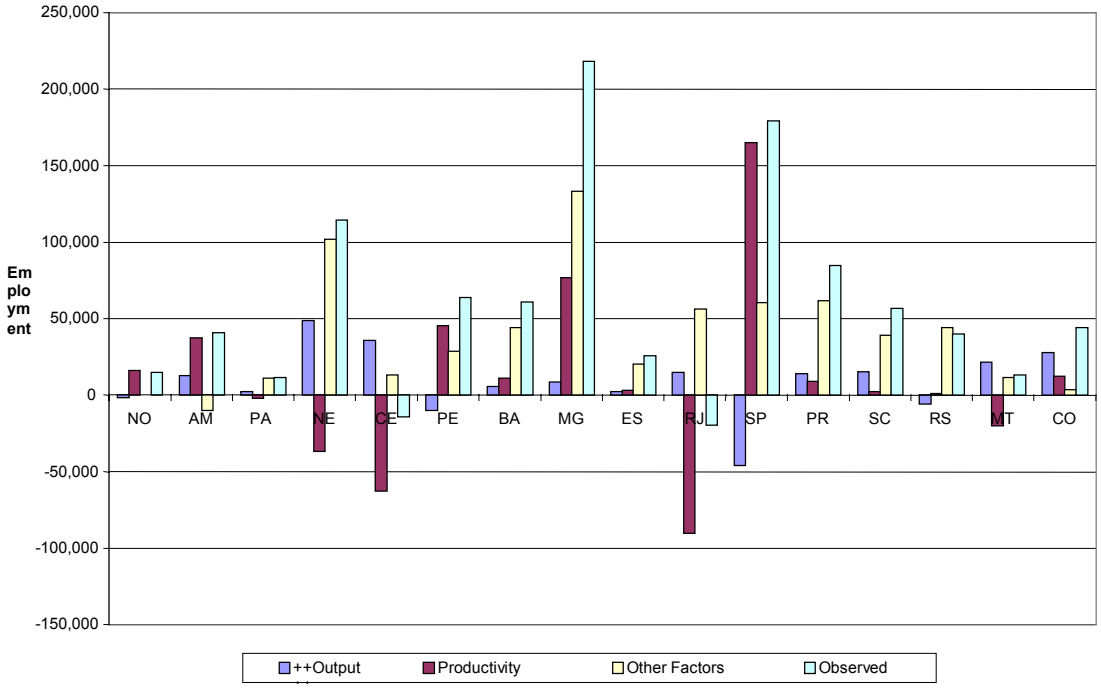


Figure 7. Change in Employment in Manufacturing, 1990-97

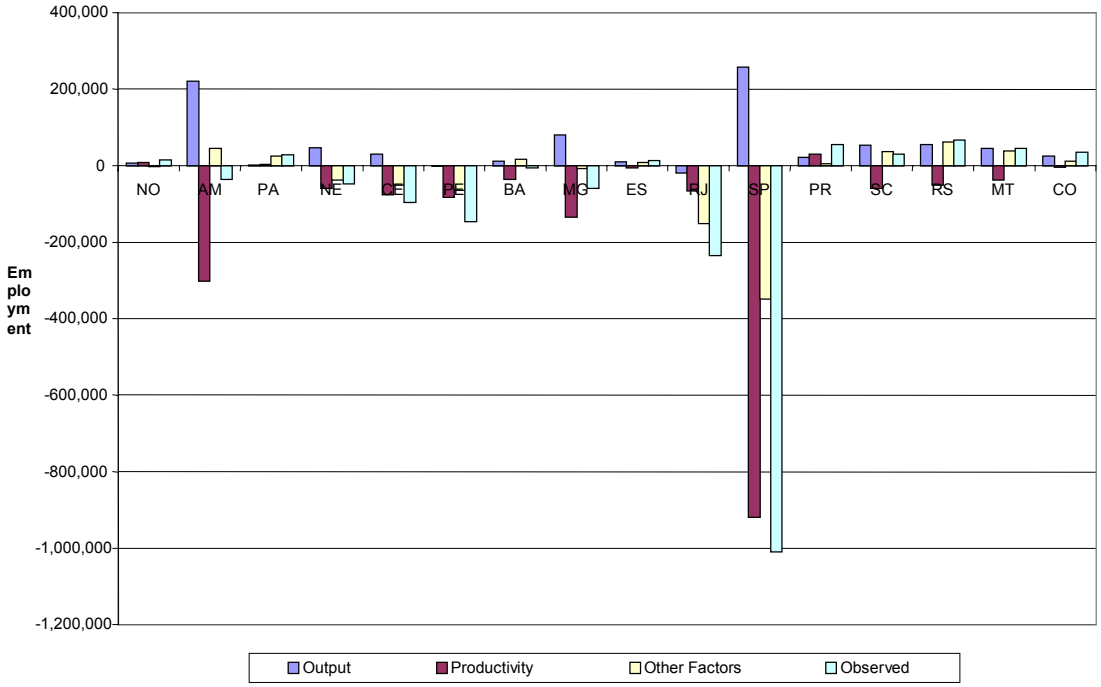


Figure 8. Change in Employment in the Construction Industry, 1985-90

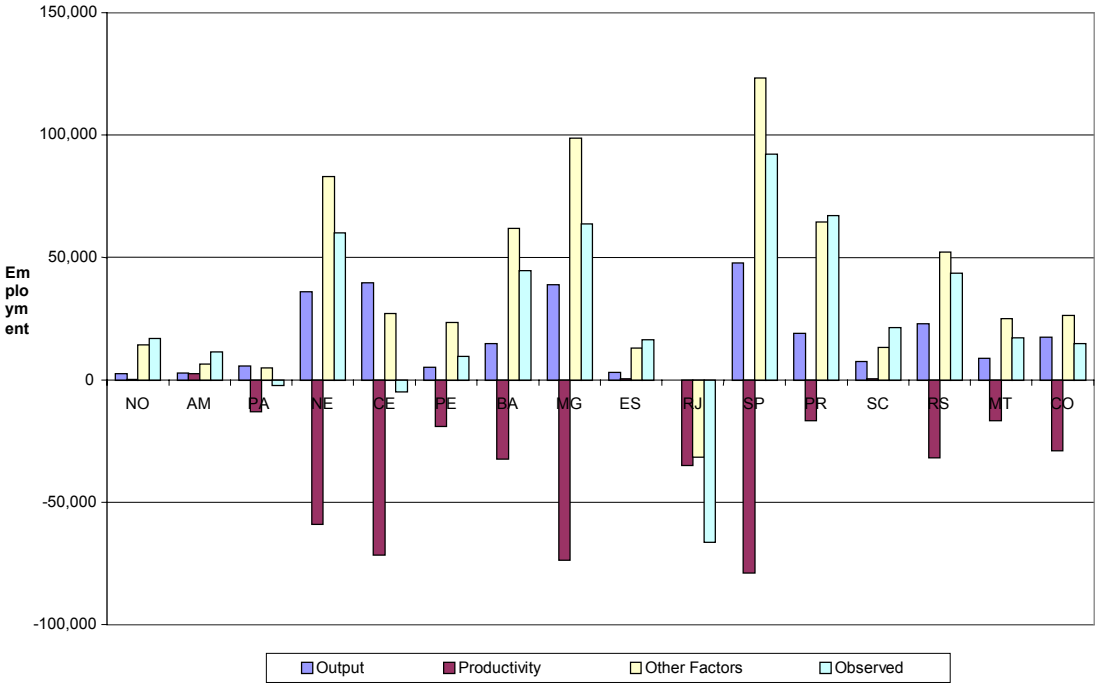


Figure 9. Change in Employment in the Construction Industry, 1990-97

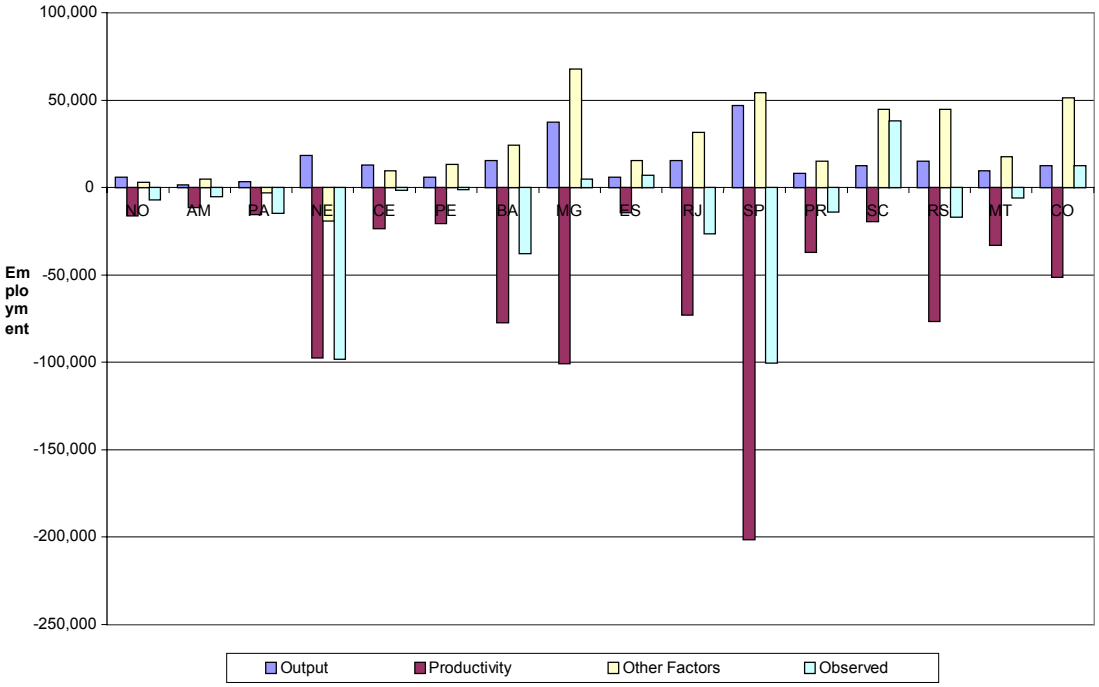


Figure 10. Change in Employment in Commerce, 1985-90

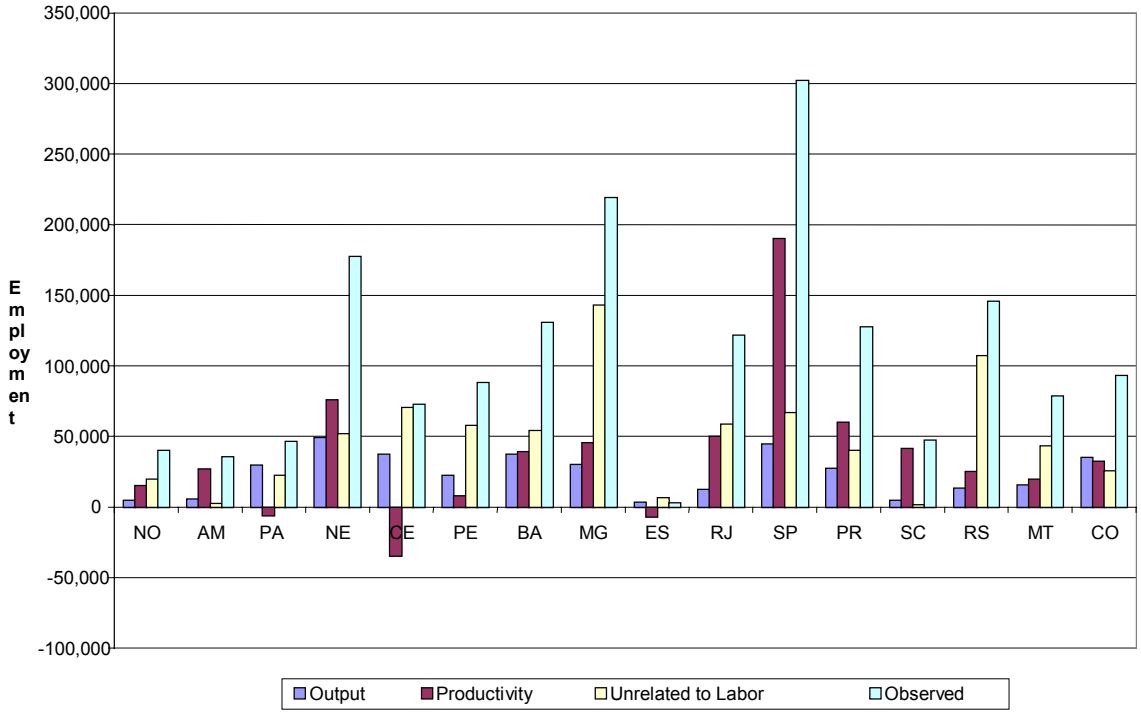


Figure 11. Change in Employment in Commerce, 1990-97

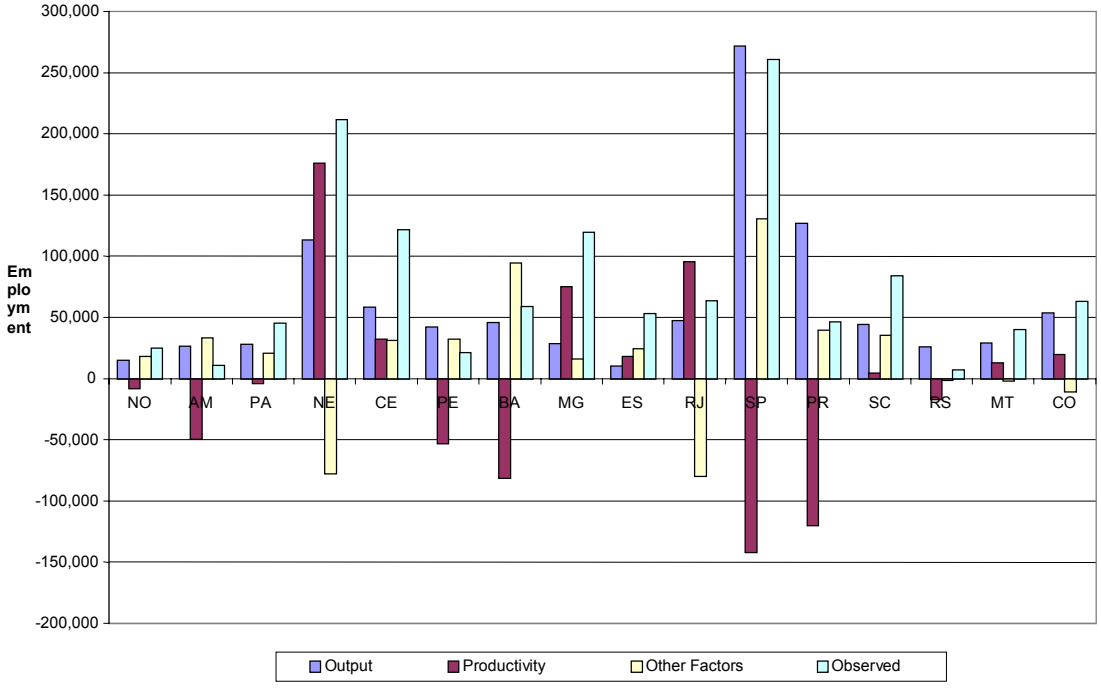


Figure 12. Change in Employment in the Service Sector, 1985-1990

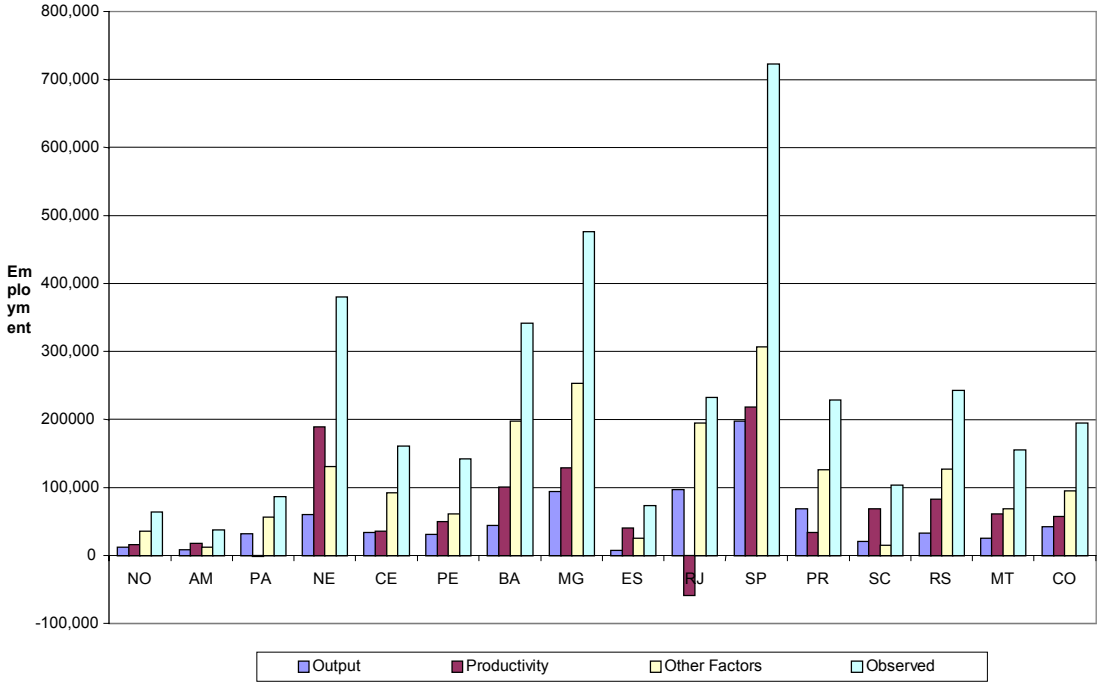


Figure 13. Change in Employment in the Service Sector, 1990-97

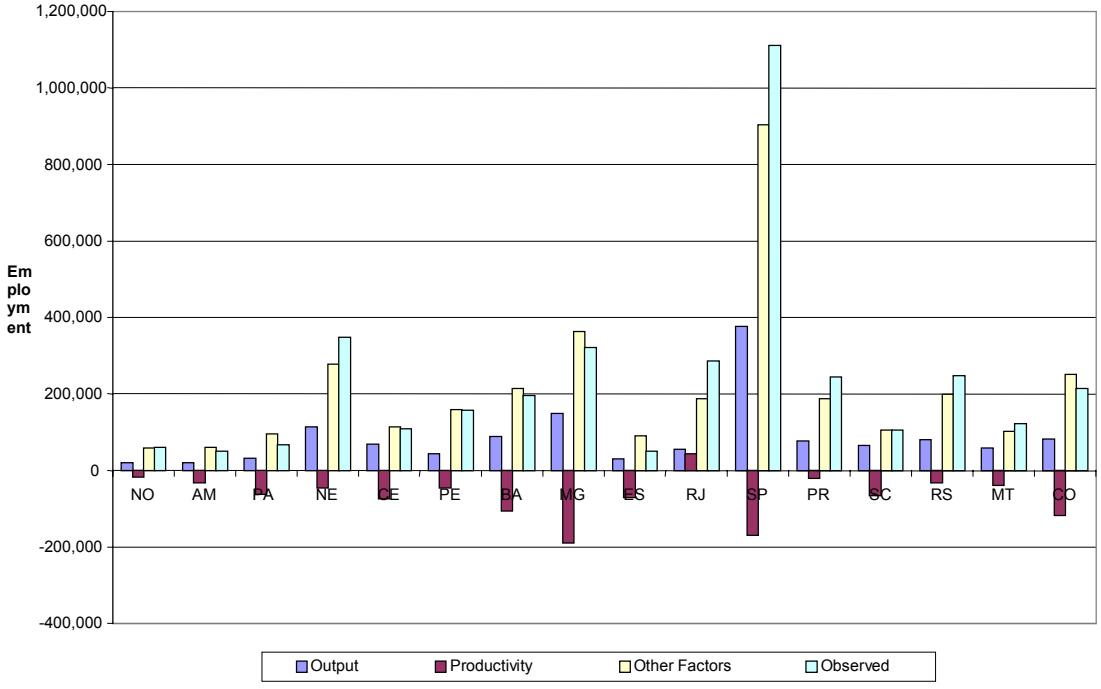


Figure 14. Change in Employment in the Public Sector, 1985-90

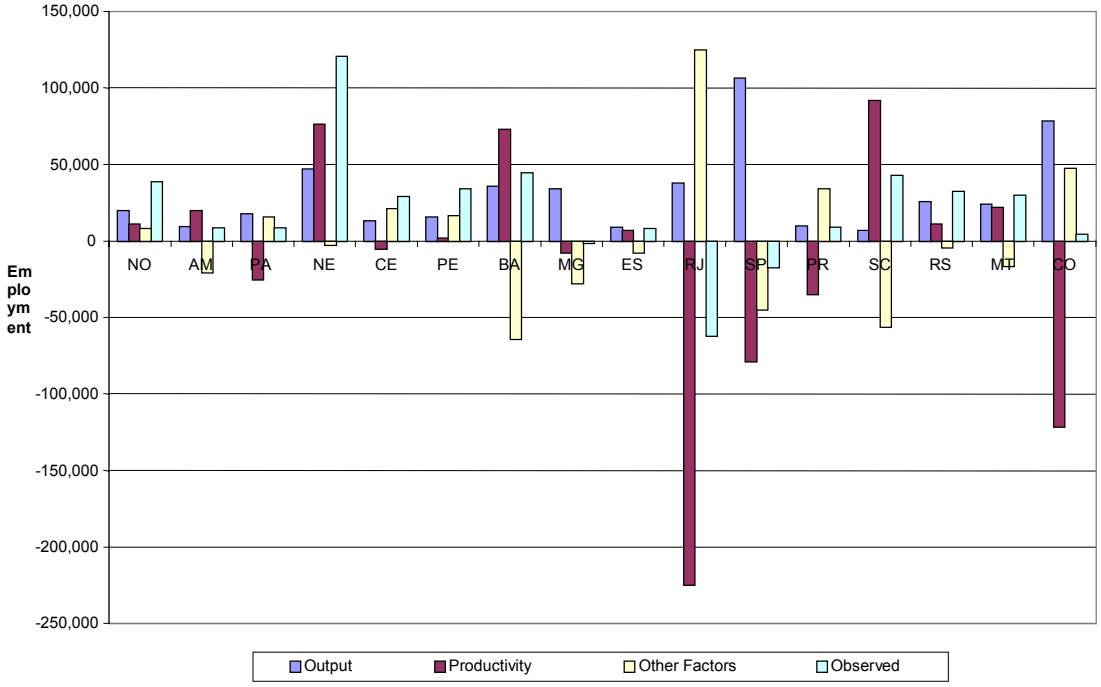
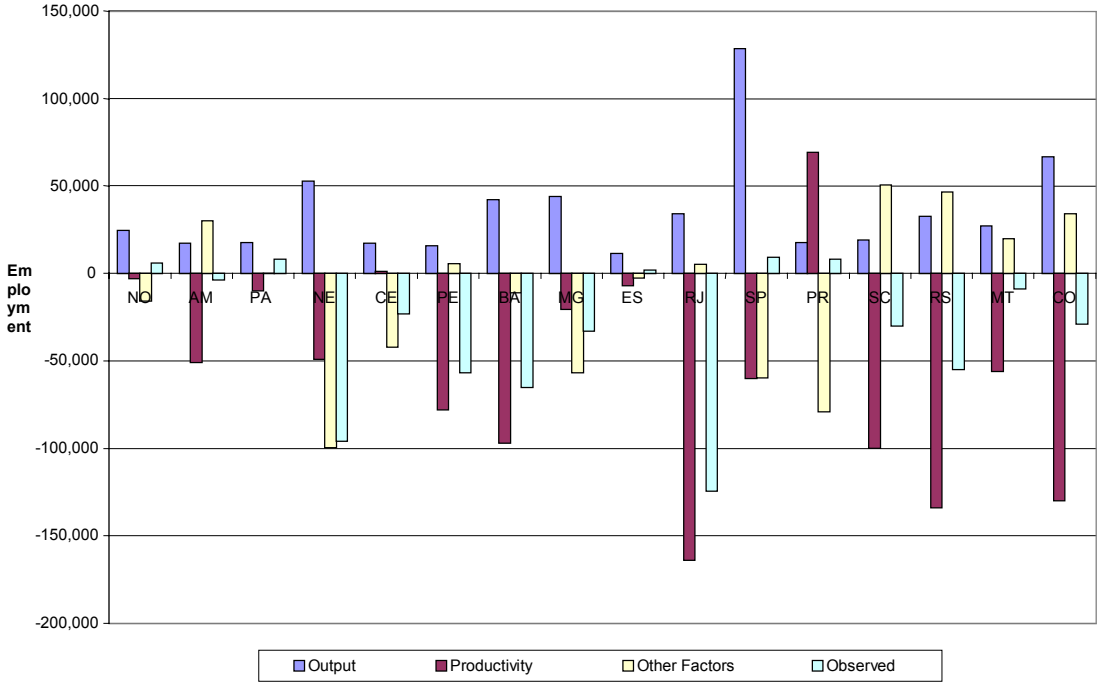


Figure 15. Change in Employment in the Public Sector, 1990-97



5. Final Considerations

The above analysis has characterized the regional dynamics of employment in Brazil for the period 1985-97, attempting to identify the principal determinants of sectorial occupation in Brazilian regions/states. It is nevertheless appropriate to add some additional considerations to place the results in perspective. We will concentrate on three specific aspects, namely absorption of labor, informality in the labor market, and regional growth strategies.

5.1. Absorption of Labor

Table 16 presents some selected indicators for the 5 Brazilian macroregions. When the growth rates of the Economically Active Population (EAP) at the start of the 1970s are compared with the rate of change of employment, a generalized problem of absorption of labor is clearly observable. In every region, growth in EAP was superior to growth in employment. Even in the regions considered as dynamic in our analysis, which show generation of employment above the national average, the demographic pressure is notable. In the case of the North and Center-West macroregions, the good relative performance in job creation is substantially below regional requirements.

Table 16. Selected Regional Indicators: 1990-97 (% annual change, annual average)

	Population	*Added Value*	*Employment*	*EAP**	*Productivity*	*Formal Employment**
North	2.61	4.22	2.28	5.75	1.90	0.23
Northeast	1.16	2.58	0.62	2.62	1.95	-0.29
Southeast	1.45	2.43	0.07	3.08	2.35	-0.12
South	1.29	3.16	-0.02	1.85	3.18	-0.60
Center-West	2.15	3.59	1.48	3.29	2.07	0.47
Brazil	1.47	2.73	0.39	2.86	2.33	-0.18

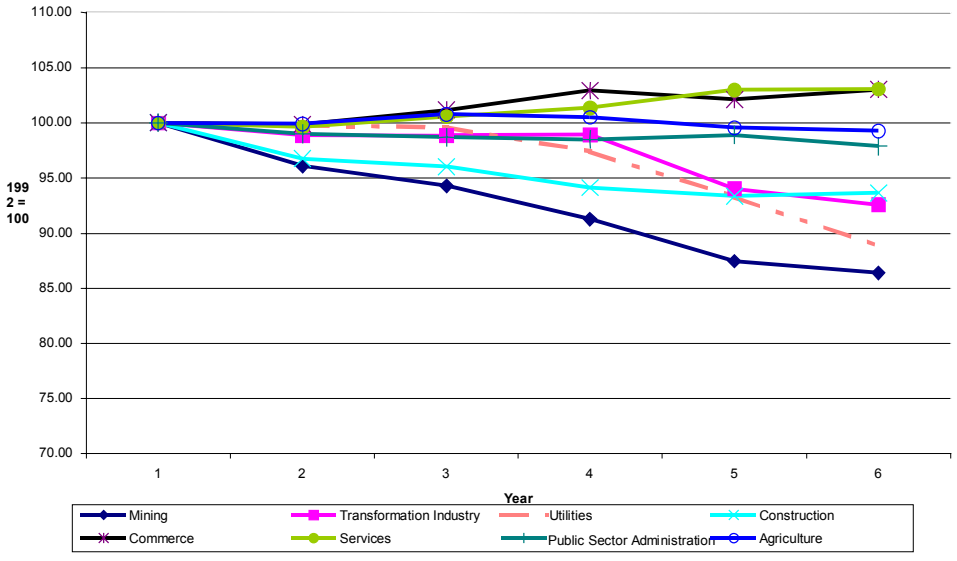
* 1992-1997
Source: Own data

5.2. Informality in the Labor Market

The information contained in the CAGED survey, mentioned above, only refers to the formal employment market (workers with officially registered jobs, qualifying for pension benefits), but allows additional inferences on the transformations in the Brazilian labor market. The last column of Table 16 indicates a reduction in the total volume of places offered in the formal labor market, of some 0.18% per year between 1992-97.

According to Figure 16, the behavior of formal employment, and its effects on total employment for the period analyzed, were due to the sharp reduction in formal posts in manufacturing, in construction, in agriculture, in mining and in public utility industrial services. Formal growth only grew between 1992-97 in the commerce and service sectors. In this way, comparing the performance of formal employment with total employment, a trend towards employment informality may be identified, which is present in all regions.

Figure 16. Evolution of Formal Jobs, 1992-97



Source: MTE/SPPE/CGETIP/Law 4,923/65

5.3. Regional Growth

The results of this study suggest some important implications for the theory of regional growth. According to the characterization of Haynes and Dinc (2001), a state/region may contemplate sectorial policies that privilege more dynamic sectors or that revive sectors in decline. Examples of policy strategies that may be adopted include:

a) A market-oriented strategy, that generates growth in output with consequent growth in employment ('output effect');
b) A strategy that generates investments in 'other factors' through the provision of economic incentives and other mechanisms for attracting capital ('other factors' effect);
c) A strategy of investing in human capital to improve productivity; despite the short-term reduction in employment, this strategy should be thought of in dynamic terms, since it increases sectorial/regional competitiveness, with implications for job creation (e.g. attracting new companies, increased exports, etc.)

Finally, the above considerations suggest new opportunities for study to understand better the dynamics of regional employment within the country. Complementary studies, including aspects related to regional demographic dynamics, informality and regional growth strategies, for example, should be considered in order to assemble the spatial mosaic of employment within Brazil.

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