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The Globalization Process and the Productive Structure of the Brazilian Economy in the 1990s: An Input-Output Approach

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Abstract

In the 1990s the Brazilian economy went through a lot of changes, caused mainly by the monetary stabilization and the globalization process occurred. To study the impact of this process over the Brazilian economy, one should go beyond the analysis of growth indicators, like GDP or inflation indexes, and use sectoral analysis to better understand what were the real structural changes in the economy. To do so, this study makes use of yearly national input-output tables, 1990 to 1999, constructed at the level of 42 sectors. The tables from 1990 to 1996 were obtained from the Brazilian National Institute of Statistics (IBGE), while the ones for 1997 to 1999 were estimated from the Brazilian National Accounts using the methodology presented by Guilhoto et al (2002). The main indicators used in the analysis were: a) multipliers of production and employment decomposed into their components; b) economic landscapes; and c) backward and forward linkages (Hirschman/Rasmussen and Pure). To better understand the changes that took place in the economy, the results were also aggregated at the level of 5 macro sectors. The study shows that the openness process had an impact on the productive structure of the Brazilian economy with sectors gaining and losing in this process. The agricultural sector went through a process of modernization in which, on one hand it increased its links in the economy, but, on the other hand reduced its capacity of generate employment. The industrial sector became more dependant on imported inputs for its production process, with a reduction in its level of employment. To the service sector was left the task of absorb the workers freed and/or not absorbed by the other sectors.

Key Words: Brazilian Economy, Input-Output, Globalization, Productive Structure.

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1. Introduction

The Brazilian economy has gone through a lot of changes in the 1990s, the main ones occurred due to the globalization process with the consequent openness of the economy, and due to the Real plan that caused a price stabilization, bringing the economy from a standard of hyperinflation to a much more stable monetary system.

The goal of this paper is to analyze how the productive structure of the economy changed throughout this time period. To do so, various techniques of analyses are applied to yearly national input-output tables, 1990 to 1999, constructed at the level of 42 sectors.

The next section will present the theoretical background used in the paper, section 3 presents an overview of the Brazilian economy in the 1990s, the results are presented into section 4, and the final comments are made in section 5.

2. Theoretical Background

The intersectoral flows in a given economy can be represented by the following system

$$X = AX + Y \quad (1)$$

where X is a (nx1) vector with the value of the total production in each sector, Y is a (nx1) vector with values for the final demand, and A is a (nxn) matrix with the technical coefficients of production (Leontief, 1951). In this model, the final demand vector can be treated as exogenous to the system, such that the level of total production can be determined by the final demand, i.e.,

$$X = BY \quad (2)$$

$$B = (I - A)^{-1} \quad (3)$$

where B is a (nxn) matrix of the Leontief inverse.

From equation (2) it is possible to evaluate the impact of the final demand over total production, and from there, over employment, imports, wages, etc.

To estimate the induced effect, i.e., how much the increase in employment would generate, for example, of production in the economy given the consumption of the newly

employed people, one can make the family consumption endogenous in the model, such that one has

$$\bar{A} = \begin{bmatrix} A & H_c \\ H_r & 0 \end{bmatrix} \quad (4)$$

where \bar{A} is the new matrix of technical coefficients with size $(n+1) \times (n+1)$, and H_r is a $(1 \times n)$ vector with the income coefficient in each sector and H_c is a $(n \times 1)$ vector with the families consumption coefficients.

As so, the new vectors of production and final demand would be given, respectively, by $(\bar{X}, (n+1) \times 1)$, and by $(\bar{Y}, (n+1) \times 1)$. They would be represented as

$$\bar{X} = \begin{bmatrix} X \\ X_{n+1} \end{bmatrix} \quad (5)$$

and

$$\bar{Y} = \begin{bmatrix} Y^* \\ Y_{n+1}^* \end{bmatrix} \quad (6)$$

The Leontief system would then be represented by:

$$\bar{X} = \bar{B}\bar{Y} \quad (7)$$

$$\bar{B} = (I - \bar{A})^{-1} \quad (8)$$

where \bar{B} is a $((n+1) \times (n+1))$ matrix of the Leontief inverse, taking into consideration the induced effect.

2.1. Multipliers

From the multipliers results it is possible to measure the direct and indirect effects of a change in the final demand over production, income, employment, etc. (see Miller and Blair, 1985).

From the Leontief inverse matrix (\bar{B}) defined above one has that the production multiplier of type I for each economic sector is given by:

$$P_j = \sum_{i=1}^n b_{ij} \quad (9)$$

$$j = 1, \dots, n$$

where P_j is the production multiplier for sector j and b_{ij} is an element of matrix B .

The production multiplier of type II, that takes into consideration the in induced effect, is given by:

$$\bar{P}_j = \sum_{i=1}^n \bar{b}_{ij} \quad (10)$$

$$j = 1, \dots, n$$

where \bar{P}_j is the production multiplier for sector j and \bar{b}_{ij} is an element of matrix \bar{B} .

To estimate the employment multipliers, one first go by estimating the coefficients of employment, given by

$$w_j = \frac{e_j}{x_j} \quad (11)$$

where w_j is the coefficient of employment in sector j , e_j is the total employment in sector j , and x_j is the level of production in sector j .

The total employment of type I (E_j) and type II (\bar{E}_j), generated in sector j are given by

$$E_j = \sum_{i=1}^n w_i b_{ij} \quad (12)$$

$$\bar{E}_j = \sum_{i=1}^n w_i \bar{b}_{ij} \quad (13)$$

where b_{ij} and \bar{b}_{ij} are elements of the matrices B and \bar{B} described above.

The employment multipliers, i.e., how much employment is generated in the economy for each person employed in a given sector, is given by equations (14) and (15) below, for the cases of the type I (W_j) and type II (\bar{W}_j) multipliers

$$W_j = \frac{E_j}{w_j} \quad (14)$$

$$\bar{w}_j = \frac{\bar{E}_j}{w_j} \quad (15)$$

2.2. The Rasmussen/Hirschman Approach

The work of Rasmussen (1956) and Hirschman (1958) led to the development of indices of linkage that have now become part of the generally accepted procedures for identifying key sectors in the economy. Define b_{ij} as a typical element of the Leontief inverse matrix, B ; B^* as the average value of all elements of B , and if $B_{\bullet j}$ and $B_{i\bullet}$ are the associated typical column and row sums, then the indices may be developed as follows:

Backward linkage index (power of dispersion):

$$U_j = [B_{\bullet j} / n] / B^* \quad (16)$$

Forward linkage index (sensitivity of dispersion):

$$U_i = [B_{i\bullet} / n] / B^* \quad (17)$$

One of the criticisms of the above indices is that they do not take into consideration the different *levels* of production in each sector of the economy, what it is done by the pure linkage approach presented in the next section.

2.3. The Pure Linkage Approach

As presented by Guilhoto, Sonis and Hewings (1996) the pure linkage approach can be used to measure the importance of the sectors in terms of production generation in the economy.

Consider a two -region input-output system represented by the following block matrix, A , of direct inputs:

$$A = \left(\begin{array}{c|c} A_{jj} & A_{jr} \\ \hline A_{rj} & A_{rr} \end{array} \right) \quad (18)$$

where A_{jj} and A_{rr} are the quadrate matrices of direct inputs within the first and second region and A_{jr} and A_{rj} are the rectangular matrices showing the direct inputs purchased by the second region and vice versa.

From (18), one can generate the following expression:

$$B = (I - A)^{-1} = \begin{pmatrix} B_{jj} & B_{jr} \\ B_{rj} & B_{rr} \end{pmatrix} = \begin{pmatrix} \Delta_{jj} & 0 \\ 0 & \Delta_{rr} \end{pmatrix} \begin{pmatrix} \Delta_j & 0 \\ 0 & \Delta_r \end{pmatrix} \begin{pmatrix} I & A_{jr}\Delta_r \\ A_{rj}\Delta_j & I \end{pmatrix} \quad (19)$$

where:

$$\Delta_j = (I - A_{jj})^{-1} \quad (20)$$

$$\Delta_r = (I - A_{rr})^{-1} \quad (21)$$

$$\Delta_{jj} = (I - \Delta_j A_{jr} \Delta_r A_{rj})^{-1} \quad (22)$$

$$\Delta_{rr} = (I - \Delta_r A_{rj} \Delta_j A_{jr})^{-1} \quad (23)$$

By utilizing this decomposition (equation 19), it is possible to reveal the process of production in an economy as well as derive a set of multipliers/linkages.

From the Leontief formulation:

$$X = (I - A)^{-1} Y \quad (24)$$

and using the information contained in equations (19) through (23), one can derive a set of indexes that can be used: a) to rank the regions in terms of its importance in the economy; b) to see how the production process occurs in the economy.

From equations (19) and (24) one obtains:

$$\begin{pmatrix} X_j \\ X_r \end{pmatrix} = \begin{pmatrix} \Delta_{jj} & 0 \\ 0 & \Delta_{rr} \end{pmatrix} \begin{pmatrix} \Delta_j & 0 \\ 0 & \Delta_r \end{pmatrix} \begin{pmatrix} I & A_{jr}\Delta_r \\ A_{rj}\Delta_j & I \end{pmatrix} \begin{pmatrix} Y_j \\ Y_r \end{pmatrix} \quad (25)$$

which leads to the definitions for the Pure Backward Linkage (PBL) and for the Pure Forward Linkage (PFL), i.e.,

$$\begin{aligned}
 PBL &= \Delta_r A_{rj} \Delta_j Y_j \\
 PFL &= \Delta_j A_{jr} \Delta_r Y_r
 \end{aligned}
 \tag{26}$$

where the PBL will give the pure impact on the rest of the economy of the value of the total production in region j , $(\Delta_j Y_j)$: i.e., the impact that is free from a) the demand inputs that region j makes from region j , and b) the feedbacks from the rest of the economy to region j and vice-versa. The PFL will give the pure impact on region j of the total production in the rest of the economy $(\Delta_r Y_r)$.

As the PBL and PFL are show in current values, the pure total linkage (PTL) can be obtained by adding the two previous indices, i.e.,

$$PTL = PBL + PFL \tag{27}$$

The pure linkage indices can also be normalized by the average value of the sectors in the economy such that the normalized indices show how many times a sector is bigger or smaller than the average sector in the economy. In such a way it is possible to use these indices to a direct comparison of the productive structure of economies with different sizes and currencies. In the same way they do allow for a time comparison in economies with inflation or that have changed their currency.

3. The Brazilian Economy in the 1990s

In this section it will be shown the main economic factors that haven taken place in the Brazilian economy in the 1990s.

At the end of the 1980s the Brazilian economy was faced with a scenario of stagnation of economic growth and hiperinflation. The strategy of development based on the import substitution industrialization has reached its end, and a new model of growth need to redefined. This new model has to be redefined under a new world economic environment, where the theories of economic globalization and of a economy freed from government intervention in the economy were the dominant ideas.

In such a way, the economic stabilization plans adopted by the government during the 1990's were used to direct the country towards modernity, but there is still a need for an effective adoption of structural adjustment in the tax collection system as well as in the social security system.

The economic stabilization plans, whose main objective was inflation control, have begun with the "Cruzado" Plan in February 1986. At that time the inflation had surpassed the monthly rate of 16%. The expected success was not reached, generating other economic plans: a) Bresser plan (June/1987); b) Summer plan (January/1989); c) Collor I plan (March/1990); and d) Collor II plan (February/1991).

Since the successive economic plans had failed, the government adopted an orthodox position, just trying to avoid strong price increases. On July 1st, 1994, the Real plan was launched. Together with this Plan was implemented a Program of Immediate Action (PAI) that was successful in decreasing budget expenditures and in the conclusion of the internal and external debts agreements.

As can be seen in Table 1, the Brazilian economy started to grow in 1993, keeping a reasonable growth until 1997, in 1998 and 1999 the GDP growth was under 1%. The inflation rate measured either by the GDP deflator or by the General Price Index (Internal Availability) show a considerable decrease after the Real Plan was implemented in mid 1994. For the average unemployment rate it has shown an oscillation between 5% and 6% in the 1990 to 1997 period, reaching the level of 8% in 1998 and 1999, as a reflex of the slow down in the economic activity.

Through the use of interest rates and exchange rates controls and trade liberalization policies, the government was successful in getting the prices stabilization in the early months of the Real plan implementation, and at the same time there was a growth in the GDP and an improvement in the trade balance. Some time after the Real plan have being implemented it was verified a currency valorization, as a result of the great capital inflows attracted by the high internal interest rates and, as a consequence, after a long time period of surplus in the external trade balance, the first deficit was verified in November of 1994.

Table 1. Main Macroeconomic Indicators of the Brazilian Economy, 1990 to 1999.

	GDP Growth (%)	GDP Deflator (%)	Inflation (IGP-DI) (%)	Investment as a GDP Share (%)	Average Unemployment (%)
1990	-4.35	2736.97	1216.97	20.66	4.65
1991	1.03	416.68	496.71	18.11	5.24
1992	-0.54	969.01	1167.17	18.42	6.14
1993	4.92	1996.15	2851.33	19.28	5.75
1994	5.85	2240.17	908.01	20.75	5.44
1995	4.22	77.55	15.02	20.54	4.96
1996	2.66	17.41	9.22	19.26	5.81
1997	3.27	8.25	7.11	19.86	6.14
1998	0.13	4.85	1.84	19.69	8.35
1999	0.81	4.59	19.91	19.10	8.26

Source: IPEADATA (2002)

The import tariff decreased around 50% in the 1990s, going from 32.2% in 1990 to 16.7% in 1999 (Table 2). At the same time, the exports went from US\$ 31.4 billions in 1990 to US\$ 48.0 billions in 1999, reaching a peak of US\$ 53.0 billions in 1997, for the imports they went from US\$ 20.7 billions in 1990 to US\$ 49.2 billions in 1999, reaching a peak of US\$ 59.8 billions in 1997 (Table 2).

As it is shown in Table 2, from a surplus of US\$ 10.5 billions in 1994, the trade balance went to a deficit of US\$3.5 billion in 1995, reaching a deficit of US\$ 6,6 billions in 1998. With the currency devaluation in the beginning of 1999, the trade deficit decreased to US\$ 1.2 billion in this year.

The external debt, with the exception of 1999, Table 2, grew constantly, going from US\$ 123.4 billions in 1990 to US\$ 241.6 in 1998, and US\$ 241.5 billions in 1999.

Table 2. Main External Market Indicators of the Brazilian Economy, 1990 to 1999.

	Exchange Rate (R\$/US\$)	Import Tariff (Average) (%)	External Debt (US\$ Billion)	Exports (US\$ Billion)	Imports (US\$ Billion)	Trade Balance (US\$ Billion)
1990	-	32.2	123.439	31.414	20.661	10.752
1991	-	25.3	123.910	31.620	21.041	10.580
1992	-	20.8	135.949	35.793	20.554	15.239
1993	-	16.5	145.726	38.555	25.256	13.299
1994	0.85	13.5	148.295	43.545	33.079	10.467
1995	0.97	13.0	159.256	46.506	49.972	-3.466
1996	1.04	13.6	179.935	47.747	53.346	-5.599
1997	1.12	13.8	199.998	52.994	59.747	-6.753
1998	1.21	16.7	241.644	51.140	57.714	-6.575
1999	1.79	-	241.469	48.011	49.210	-1.199

Source: IPEADATA (2002)

4. Results

This section presents and discusses the results obtained by applying the methodology presented in section 2 to the Brazilian National Input-Output Tables from the years of 1990 to 1999. The tables from 1990 to 1996 were obtained from the Brazilian National Institute of Statistics (IBGE), while the ones for 1997 to 1999 were estimated from the Brazilian National Accounts using the methodology presented by Guilhoto et al (2002).

The Brazilian Input-Output tables constructed by IBGE are estimated at the level of 42 sectors (see Table A1 in the Appendix). However, for clarity reasons, the most of the analysis conduct in this paper is done at the aggregation level of 5 macro sectors (see Table A1 in the Appendix)

In the sub-sections that follow it will be first presented an analysis of the changes in the productive structure of the Brazilian economy, and then it will be made an estimation of the effects that imports and exports had on the Brazilian economy during the 1990s.

4.1. The Productive Structure

Tables 3 to 5 display shares of the 5 Macro Sectors in production, value added and employment.

For total production, agriculture has kept its share around 7%, while industry and construction have shown a reduction in their share, industry going from 38% in 1990 to 35% in 1999, while construction decreased from 11% to 8% in the same time period. Public Utilities has increased its share from 2% to 3%, probably as a result of a more intense use of energy in the economy and of an overall increase in the water and sewer system. The service sector increased its share from 42% to 46%, and as been seen below, it is gaining in importance in all the overall aspects of the economy.

Table 3. Share of the Macro Sectors in Total Production, 1990 to 1999.

Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Agriculture	6.59	6.69	7.47	7.23	6.67	6.70	6.86	6.59	6.64	7.37	6.88
Industry	38.33	37.61	35.89	35.20	36.80	37.11	37.80	37.24	35.79	35.13	36.69
Public Utilities	2.35	2.85	2.78	2.68	2.55	2.44	2.43	2.54	3.00	3.12	2.67
Construction	10.78	10.34	9.41	9.24	8.96	8.32	8.19	8.55	8.58	8.24	9.06
Services	41.96	42.52	44.44	45.64	45.02	45.43	44.73	45.08	45.99	46.14	44.70
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Research Data

Different from the shares in production, with the exception of the industry that has shown a slightly decrease, from 23% to 22%, and public utilities that has shown an increase from 2% to 3%, of their share in the value added, the shares of the other macro sectors display a somehow constant value, with the agriculture, construction, and services sectors values being, respectively, around 7.5%, 9%, and 58% during all the 1990s.

Table 4. Share of the Macro Sectors in Value Added, 1990 to 1999

Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Agriculture	7.20	7.23	7.63	7.36	7.42	7.54	7.59	7.31	7.40	7.81	7.45
Industry	22.87	22.84	22.14	23.01	23.43	23.37	23.09	23.17	22.05	21.78	22.77
Public Utilities	2.17	2.30	2.31	2.34	2.33	2.45	2.53	2.60	3.10	3.20	2.53
Construction	9.44	9.24	8.71	8.79	8.98	8.74	8.97	9.37	9.48	9.00	9.07
Services	58.33	58.40	59.21	58.50	57.85	57.90	57.81	57.54	57.97	58.21	58.17
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Research Data

When compared with the production and value added shares, the employment shares shows a pattern by its own, with the services sector gaining in importance, raising its share from 51% to around 58%, the other sectors have shown a decrease, agriculture going from 26% to 23%, industry from 16% to 13%, public utilities from 0.6% to 0.4%, and construction from 6.7% to 6.3%. Its clear here the pattern found in the more developed economies, where the service sector has been shown as an important absorber of the labor force freed from the other economic sectors, mainly, from the agriculture and industry sectors, that by the numbers showed have gaining in productive all along the 1990s.

Table 5. Share of the Macro Sectors in Employment, 1990 to 1999

Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Agriculture	25.45	25.86	26.40	26.11	25.44	24.77	23.27	22.75	21.88	23.01	24.48
Industry	16.09	15.16	14.42	14.36	14.24	13.97	13.77	13.36	12.94	12.60	14.08
Public Utilities	0.55	0.52	0.49	0.53	0.47	0.42	0.39	0.39	0.39	0.35	0.45
Construction	6.72	6.24	5.82	5.95	5.77	5.60	5.89	6.16	6.64	6.26	6.10
Services	51.19	52.22	52.87	53.05	54.08	55.25	56.68	57.34	58.15	57.78	54.89
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Research Data

An analysis of the output multipliers, type I and II displayed, respectively, in Table 6 and 7, have shown a decrease for all sectors in the economy. For the type I, agriculture decreased its value from 2.0 to 1.7, industry from 2.6 to 2.1, public utilities from 2.1 to 1.6, construction from 2.4 to 1.7, services, from 1.6 to 1.5, and the average for the 42 sectors in the economy decreased from 2.4 to 1.9. For the type II, agriculture decreased its value from 3.4 to 3.1, industry from 4.6 to 3.4, public utilities from 4.6 to 3.2, construction from 4.4 to 3.1, services, from 4.4 to 3.4, and the average for the 42 sectors in the economy decreased from 4.5 to 3.4. This clearly shows a change in the productive structure, among other reasons, needing further research, this can be and indication on one hand of the increasing importance of the imported inputs in the productive process and on the other hand can mean an increase in the verticalization of the production, where the production of all the inputs (components) needed in one sector are produced inside its own.

Figures 1 and 2 show the electroeconogram of the economy output multipliers of type I and II. This concept, introduced by Guilhoto et al (2001), is based in the idea of the electroencephalograms or electrocardiograms in medicine that measure the differences from a given standard, the higher the amplitude of the waves in the figures, the more different are the productive structures. These figures show that, for the 42 sectors, the productive structure has increased its difference during the 1990s, it is also clear that there is a jump from 1994 to 1995. This jump from 1994 to 1995, needing further research, may be an indication of the conjugation of two important factors in the Brazilian economy: a) the Real plan in 1994 that has moved the economy from an hyperinflation to a price stabilization, with a consequent change in the economy relative prices; and b) of the openness process initiated in 1990 and that probably have been consolidated in 1995.

Table 6. Output Multipliers, Type I, 1990 to 1999

Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Agriculture	2.01	1.99	2.04	1.98	1.85	1.62	1.67	1.65	1.64	1.73	1.82
Industry	2.63	2.58	2.57	2.47	2.47	2.12	2.16	2.08	2.08	2.09	2.32
Public Utilities	2.10	2.22	2.15	2.07	2.00	1.58	1.57	1.64	1.61	1.64	1.86
Construction	2.37	2.28	2.22	2.13	2.05	1.63	1.61	1.64	1.63	1.68	1.92
Services	1.61	1.60	1.58	1.58	1.59	1.39	1.41	1.42	1.43	1.47	1.51
Average	2.38	2.34	2.32	2.25	2.25	1.93	1.96	1.91	1.91	1.92	2.12

Source: Research Data

Table 7. Output Multipliers, Type II, 1990 to 1999

Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Agriculture	3.43	3.80	3.58	3.25	3.40	2.90	3.17	3.17	3.03	3.16	3.29
Industry	4.59	4.85	4.47	3.99	4.40	3.41	3.67	3.54	3.45	3.41	3.98
Public Utilities	4.64	4.91	4.56	4.47	4.72	3.11	3.26	3.41	3.17	3.15	3.94
Construction	4.42	4.58	4.10	3.60	3.82	2.83	3.02	3.09	2.99	3.05	3.55
Services	4.39	4.57	4.18	3.80	4.34	3.13	3.38	3.41	3.33	3.36	3.79
Average	4.52	4.76	4.38	3.93	4.36	3.32	3.57	3.49	3.40	3.38	3.91

Source: Research Data

The Rasmussen/Hirschman backward linkages, Tables 8 and 9, for the macro sectors, have shown to be somewhat constant over the 1990s, with the values being around 0.9 for agriculture, 1.1 for industry, 0.9 for public utilities, and 0.7 for services. For the forward linkages, the same pattern is true for 4 out of the 5 macro sectors, with agriculture showing a value around 3.3, industry around 0.9, public utilities around 1.6, and construction around 0.6, however, it calls attention for the increase in importance of the services sector, going from 0.8 to a value above 1.0, i.e., 1.06, showing the growing importance of the macro sector in the economy.

However, a quite different picture is displayed when one looks at the electroeconogram of the Rasmussen/Hirschman linkages for the economy 42 sectors, Figures 3 and 4. There is a constant increase in the waves from 1990 to 1999 in both linkages, showing a changing economy in this time period, with a jump in the size of the waves from 1994 to 1995, confirm the pattern found for the electroeconogram of the output multipliers.

Table 8. Rasmussen/Hirschman Backward Linkages, 1990 to 1999

Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Agriculture	0.84	0.85	0.88	0.88	0.82	0.84	0.85	0.87	0.86	0.90	0.86
Industry	1.11	1.10	1.10	1.10	1.10	1.10	1.10	1.09	1.09	1.08	1.10
Public Utilities	0.88	0.95	0.92	0.92	0.89	0.82	0.80	0.86	0.84	0.85	0.87
Construction	1.00	0.97	0.96	0.95	0.91	0.84	0.82	0.86	0.86	0.87	0.90
Services	0.68	0.68	0.68	0.70	0.71	0.72	0.72	0.75	0.75	0.76	0.72

Source: Research Data

Table 9. Rasmussen/Hirschman Forward Linkages, 1990 to 1999

Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Agriculture	3.21	3.25	3.24	3.29	3.61	3.44	3.50	3.32	3.34	3.12	3.33
Industry	0.98	0.98	0.98	0.97	0.96	0.92	0.91	0.89	0.88	0.90	0.94
Public Utilities	1.54	1.72	1.79	1.71	1.69	1.43	1.47	1.46	1.68	1.68	1.62
Construction	0.58	0.56	0.56	0.59	0.60	0.67	0.65	0.66	0.67	0.66	0.62
Services	0.80	0.78	0.79	0.81	0.80	0.98	1.01	1.08	1.09	1.06	0.92

Source: Research Data

The Pure linkages, Tables 10 to 12, that also take into consideration the importance of the sectors in generating production value in the economy, show for the Pure total linkages an increase for agriculture (2.6 to 3.2), public utilities (1.0 to 1.2), and services (1.5 to 1.7), with industry showing a somehow constant value of 0.7, and construction decreasing from 4.6 to 3.1. Decomposing the total linkages into backward and forward linkages: a) agriculture is gaining in both; b) industry increases its value in the backward linkages that is compensated by a decrease in the forward linkages; c) public utilities keeps its value in the backward and increases its value in the forward linkages; d) construction has a decrease in the backward linkages which is not compensated by the slight increase found in the forward linkages; and e) the service sector had a decrease in the backward linkages, more than compensated by the increase found in the forward linkages.

The picture for the 42 sectors, found in the electroeconogram of Figure 5, repeats and confirms the patterns of structural economic changes found in the previous electroeconograms, with the waves increasing in size from 1990 to 1995 and a jump from 1994 to 1995.

Table 10. Pure Backward Linkages (Normalized), 1990 to 1999

Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Agriculture	1.28	1.25	1.27	1.02	1.25	1.37	1.33	1.36	1.40	1.76	1.33
Industry	0.42	0.43	0.44	0.44	0.45	0.63	0.64	0.61	0.58	0.58	0.52
Public Utilities	0.34	0.50	0.54	0.33	0.28	0.24	0.25	0.27	0.29	0.30	0.33
Construction	8.64	7.79	7.37	7.13	7.19	5.19	5.24	5.86	5.89	5.63	6.59
Services	2.12	2.17	2.19	2.27	2.18	1.80	1.77	1.79	1.88	1.89	2.01

Source: Research Data

Table 11. Pure Forward Linkages (Normalized), 1990 to 1999

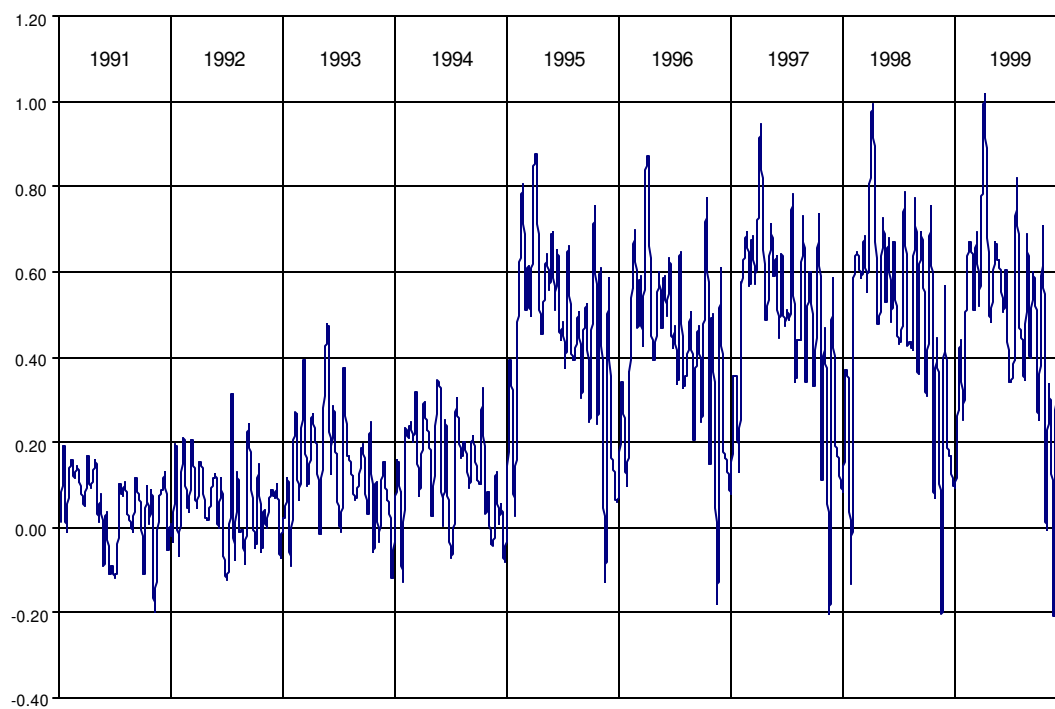
Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Agriculture	3.94	4.20	4.22	4.34	4.98	5.03	5.14	4.85	4.96	4.64	4.63
Industry	0.93	0.91	0.90	0.89	0.88	0.73	0.72	0.71	0.69	0.73	0.81
Public Utilities	1.69	2.05	2.17	1.91	1.90	1.72	1.74	1.68	2.06	2.06	1.90
Construction	0.45	0.44	0.44	0.44	0.48	0.60	0.58	0.58	0.60	0.57	0.52
Services	0.88	0.88	0.91	0.96	0.93	1.40	1.42	1.50	1.53	1.44	1.19

Source: Research Data

Table 12. Pure Total Linkages (Normalized), 1990 to 1999

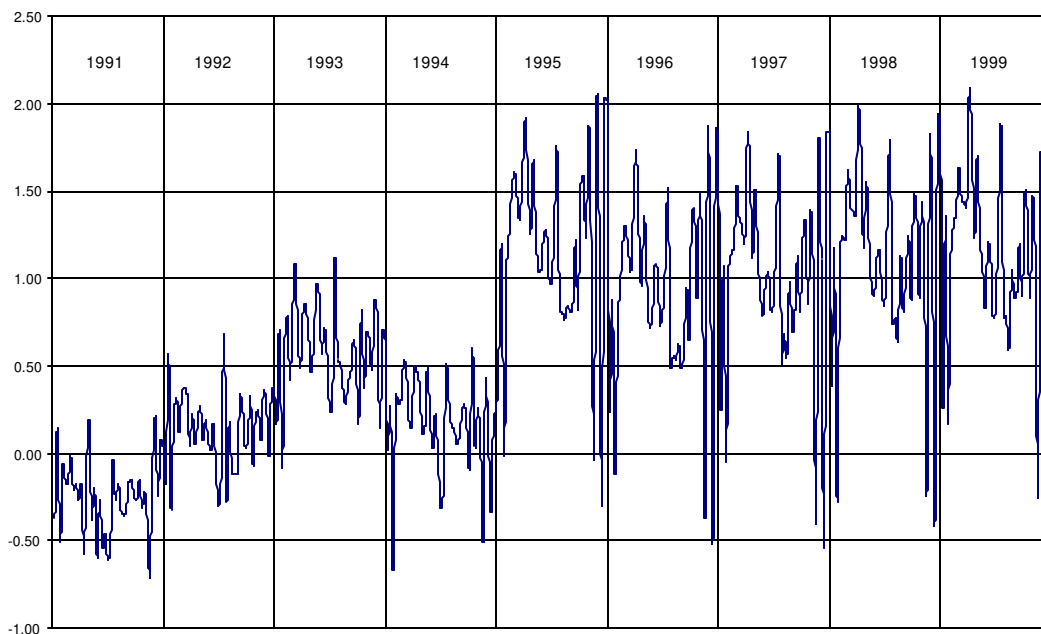
Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Agriculture	2.60	2.72	2.73	2.67	3.10	3.20	3.23	3.10	3.18	3.20	2.97
Industry	0.68	0.67	0.67	0.66	0.66	0.68	0.68	0.66	0.63	0.65	0.67
Public Utilities	1.01	1.27	1.35	1.12	1.09	0.98	0.99	0.97	1.17	1.18	1.11
Construction	4.57	4.14	3.92	3.80	3.85	2.90	2.92	3.23	3.26	3.11	3.57
Services	1.51	1.53	1.55	1.62	1.56	1.60	1.60	1.65	1.71	1.66	1.60

Source: Research Data



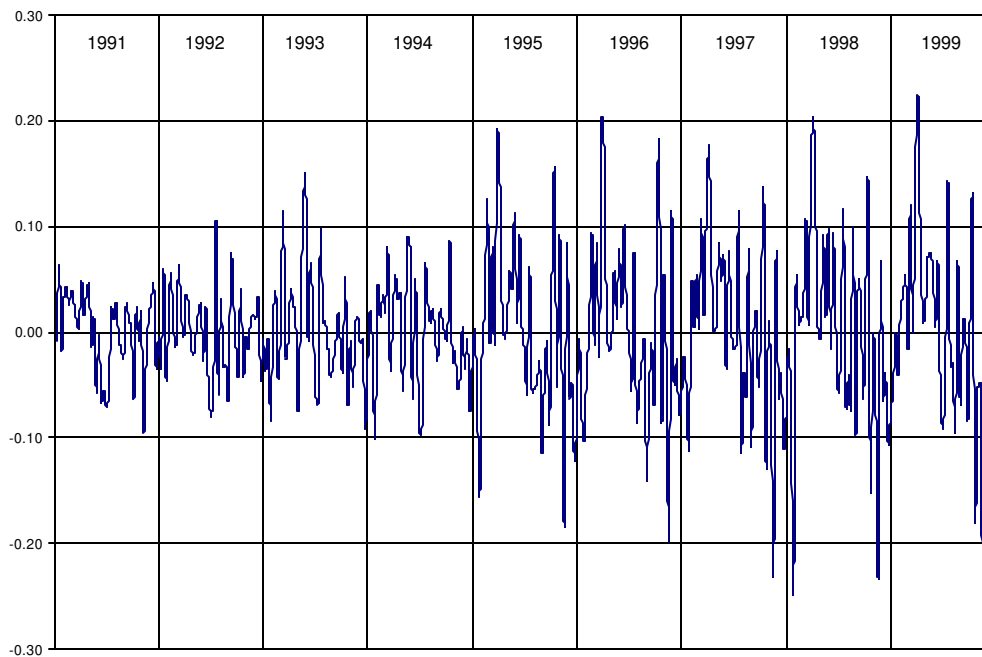
Source: Research Data.

Figure 1. Electroconogram of the Changes in the 1990 Output Multiplier, Type I, 1991 to 1999



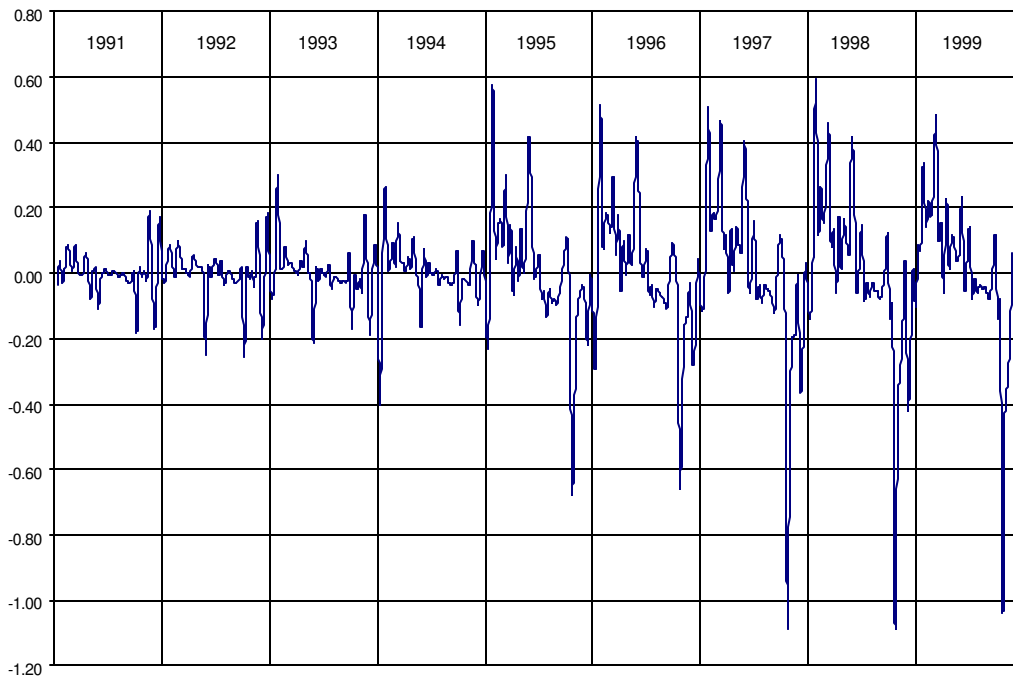
Source: Research Data.

Figure 2. Electroconogram of the Changes in the 1990 Output Multiplier, Type II, 1991 to 1999



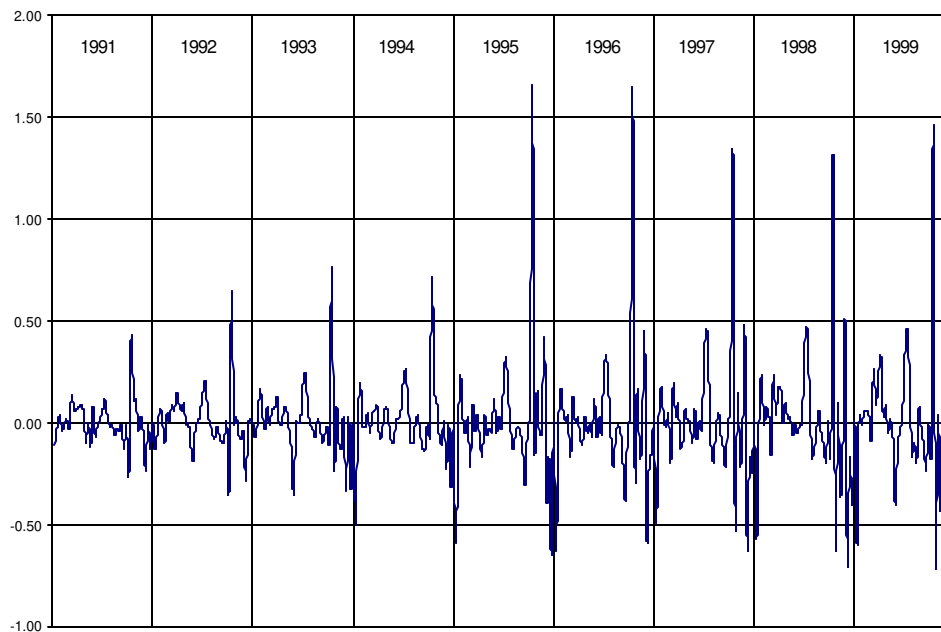
Source: Research Data.

Figure 3. Electroconogram of the Changes in the 1990 Hirschman/Rasmussen Backward Linkages, 1991 to 1999



Source: Research Data.

Figure 4. Electroconogram of the Changes in the 1990 Hirschman/Rasmussen Forward Linkages, 1991 to 1999



Source: Research Data.

Figure 5. Electroconogram of the Changes in the 1990 Pure Total Linkages, 1991 to 1999

The landscapes for the productive structure of the Brazilian economy, see Guilhoto, Marjotta-Maistro and Hewings (2002), are displayed into Figures 6 to 21. They show the landscapes for the years of 1990, 1994, 1995, and 1999, and the differences in productive structure that have taken place between the years of 1990 and 1999, 1990 and 1994, 1994 and 1999, and then yearly differences from 1990 to 1999.

Despite the pictures for the economic landscapes seems to be similar for years of 1990, 1994, 1995 and 1999, the landscapes of differences shown that changes are taking place in the economy and like the changes that occur in nature, they usually take time and sometimes they are hard to see at first sight. It can be observed from the figures that the most of changes have taken place from 1990 to 1995, relatively to the other years, the changes from 1996 to 1999 seem to be smaller. And confirming the electroeconograms above, the year of 1995 seems once more to be the year of turning point in the change of the productive structure.

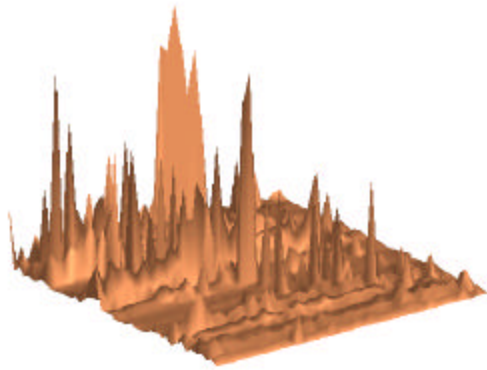


Figure 6. Landscape of the Brazilian Economy, 1990

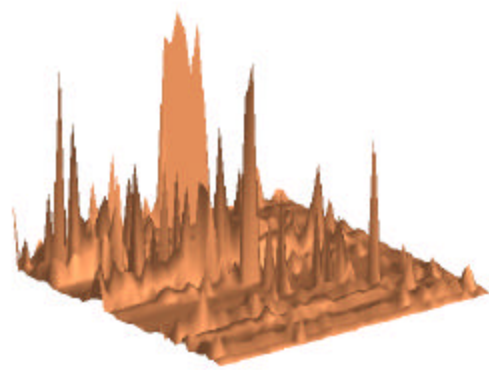


Figure 7. Landscape of the Brazilian Economy, 1994

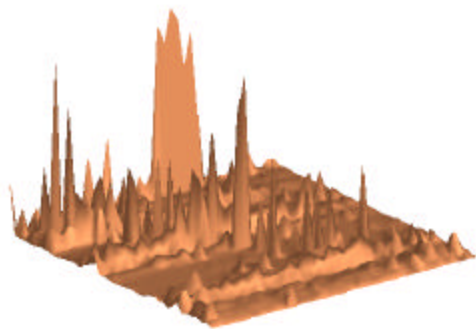


Figure 8. Landscape of the Brazilian Economy, 1995

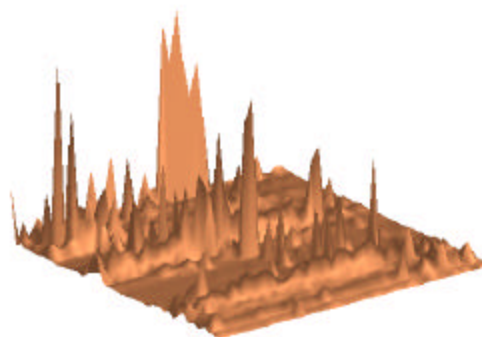


Figure 9. Landscape of the Brazilian Economy, 1999

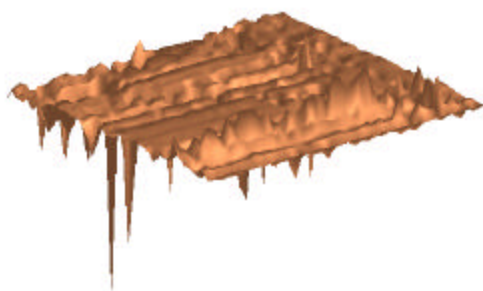


Figure 10. Landscape of the Brazilian Economy, 1999 less 1990

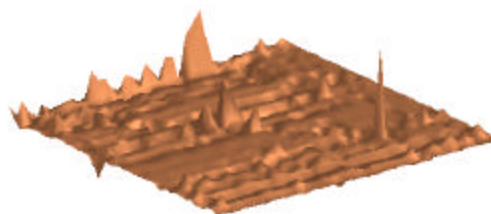


Figure 11. Landscape of the Brazilian Economy, 1994 less 1990

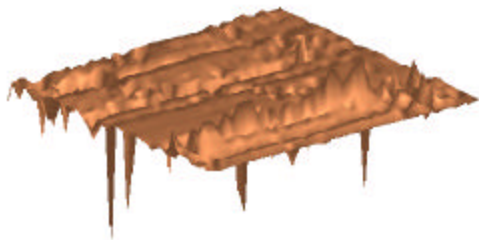


Figure 12. Landscape of the Brazilian Economy, 1999 less 1994

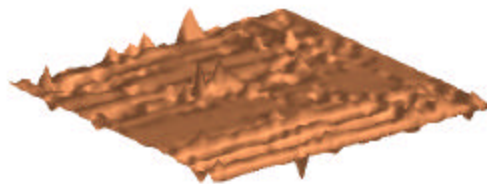


Figure 13. Landscape of the Brazilian Economy, 1991 less 1990

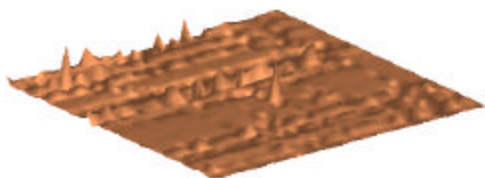


Figure 14. Landscape of the Brazilian Economy, 1992 less 1991

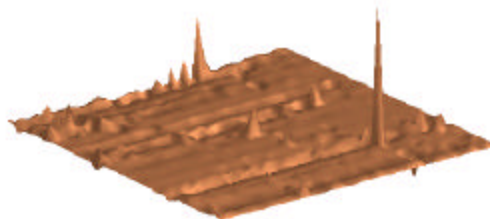


Figure 15. Landscape of the Brazilian Economy, 1993 less 1992

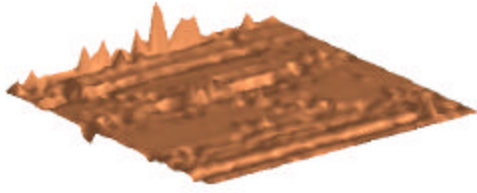


Figure 16. Landscape of the Brazilian Economy, 1994 less 1993

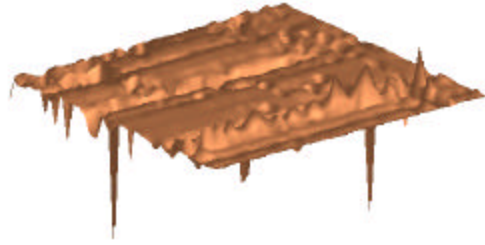


Figure 17. Landscape of the Brazilian Economy, 1995 less 1994

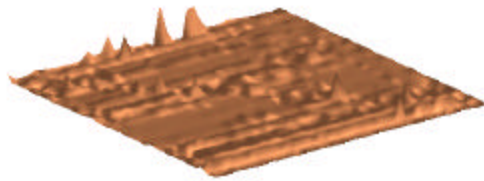


Figure 18. Landscape of the Brazilian Economy, 1996 less 1995

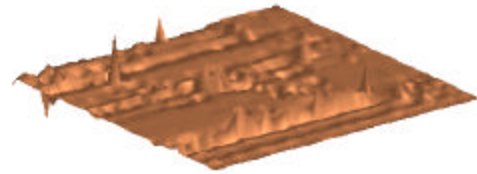


Figure 19. Landscape of the Brazilian Economy, 1997 less 1996

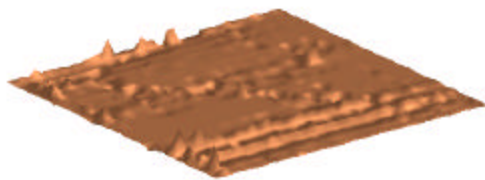


Figure 20. Landscape of the Brazilian Economy, 1998 less 1997

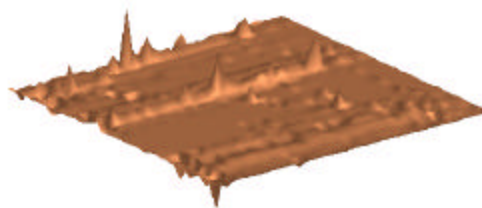


Figure 21. Landscape of the Brazilian Economy, 1999 less 1998

For the analyses of how the employment are related to the productive structure in the economy, Tables 13 and 14 show the employment multipliers type I and II for the 5 macro sectors, while table 15 shows the total employment (direct plus indirect plus induced) generated by R\$ 1 million of 1999 (US\$ 558.7 thousand of 1999)⁵. From these tables it is possible to see an overall decrease in the multipliers from 1990 to 1999, as multiplier type I goes from 6.9 to 5.4 and type II goes from 15.7 to 14.7, the same reduction is found in the capability of R\$ 1 million to generate employment, going from 187 jobs to 124 jobs. This is an indication that the economy is getting more capital intensive, as it would be expected in a economy that is growing on a sounding bases.

As it was observed in Tables 13 and 14, despite the low value of the multipliers for the agriculture and services macro sectors, these are the ones more capable of generating employment in the economy (Table 15), for every R\$ 1 million spend, in 1999, the agriculture and the services sectors generate, respectively, 290 and 183 jobs, while industry generates on average 109, public utilities 78, and construction 103. This is an indication, on one hand that the wages are lower in the agriculture and services sectors, and on the other hand that these are the sectors more intensive in labor force of the economy, which is also confirmed by an analysis of Tables 3 to 5.

⁵ The direct, indirect, and induced employment generated by R\$ 1 million of 1999 (US\$ 558.7 thousand of 1999) are presented into Tables A2 to A4 in the Appendix.

Table 13. Employment Multipliers, Type I, 1990 to 1999.

Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Agriculture	1.31	1.31	1.33	1.33	1.30	1.26	1.28	1.27	1.27	1.29	1.29
Industry	8.94	8.84	7.96	7.76	8.58	7.57	7.94	7.39	7.74	6.89	7.96
Public Utilities	3.39	4.60	4.26	3.06	3.04	2.34	2.40	2.57	2.83	2.98	3.15
Construction	2.40	2.33	2.13	2.00	1.96	1.67	1.60	1.61	1.56	1.57	1.88
Services	1.60	1.57	1.54	1.63	1.66	1.50	1.52	1.54	1.60	1.62	1.58
Average	6.90	6.85	6.20	6.04	6.63	5.86	6.12	5.74	6.00	5.41	6.17

Source: Research Data

Table 14. Employment Multipliers, Type II, 1990 to 1999.

Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Agriculture	1.74	1.84	1.81	1.73	1.79	1.72	1.84	1.81	1.79	1.83	1.79
Industry	19.41	21.84	18.18	16.05	20.78	17.38	19.75	18.69	19.22	17.45	18.87
Public Utilities	16.05	21.38	19.19	16.89	20.80	14.30	15.85	16.88	17.64	19.14	17.81
Construction	6.26	6.65	5.44	4.59	5.27	4.08	4.10	4.10	3.73	3.71	4.79
Services	5.71	7.06	6.09	5.56	7.79	6.91	7.58	7.73	7.84	7.99	7.03
Average	15.66	17.82	14.92	13.21	17.18	14.38	16.25	15.55	15.96	14.76	15.57

Source: Research Data

Table 15. Total Employment (Direct + Indirect + Induced) Generated by R\$ 1 Million of 1999 (US\$ 558.7 Thousand of 1999), 1990 to 1999

Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Agriculture	270.67	291.02	268.41	256.96	274.08	254.75	236.02	231.28	220.44	209.10	251.27
Industry	172.80	186.07	164.42	144.32	167.76	134.78	132.96	124.18	120.58	109.09	145.69
Public Utilities	151.83	159.38	142.28	137.43	153.46	97.95	95.52	95.55	85.81	77.52	119.67
Construction	156.68	164.18	141.43	121.87	136.05	110.14	111.56	109.23	107.75	103.09	126.20
Services	233.08	244.98	224.38	206.32	236.01	195.10	196.36	192.07	190.86	182.52	210.17
Average	187.17	200.04	178.67	159.59	183.82	149.10	147.60	140.24	136.88	126.31	160.94

Source: Research Data

4.2. The External Sector

This section make an analysis of what was the impact of the external sector, i.e., exports and imports, over the value added and employment generated in the economy, from 1990 to 1999.

Table 16 shows how the exports of each one of the macro sectors contributes for the value added generated in this sector and how the total exports contributes to the value added generated in the economy. It can be seen that the importance of exports in generating valued added increased from 1990 to 1993, going from 7.9% to 9.5%, decreasing in 1994 to 9.1%, and in 1995 to 6.7%. It only recovered in 1999, raising to 8.5%, probably due to the devaluation of the Real occurred in this year. The sectors more directly dependent on exports to generate value added are the agriculture and industry sectors, while the others are related mainly indirectly to the exports, i.e., they supply the infrastructure need by the two previous sectors to produce for export.

Table 16. Contribution of Exports to the Economy Value Added, 1990 to 1999

Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Agriculture	15.50	15.19	18.78	18.64	17.86	10.58	11.28	11.85	11.27	13.59	14.46
Industry	21.67	24.46	28.94	27.16	25.24	17.16	16.69	13.82	15.07	19.90	21.01
Public Utilities	11.14	13.15	14.83	11.58	11.08	7.05	7.04	5.48	6.62	8.85	9.68
Construction	0.33	0.36	0.41	0.36	0.35	0.27	0.24	0.21	0.28	0.34	0.32
Services	2.65	2.46	2.82	2.68	2.78	3.20	2.99	3.34	3.62	4.73	3.13
Total	7.89	8.46	9.89	9.50	9.14	6.86	6.64	6.15	6.49	8.46	7.95

Source: Research Data

Tables 17 and 19 show the net effect of the trade balance over employment⁶ and value added. To do this estimation its assumed that the imported products could be made internally, and then it is measured their impact over the economy, the results shown are the difference between the export and the import impacts.

For employment, Table 17, the results show a decrease in the importance of the external sector to generate employment, going from around 2 million jobs in 1990 (3.5% of the work force) to -390 thousand jobs in 1998, and raising again to 567 thousand jobs in 1999, mainly as a reflex of the exchange rate devaluation occurred in this year. There was a great decrease in the external sector capability of employment generation from 1994 to 1995, when it decreased from 1.6 million to 0.2 million. In all the 1990s the agriculture has shown to be the most important sector in generate net employment, which is a reflex of the export mix of the Brazilian economy.

Wherever it needs to call attention that the industry macro sector went from a net generator of employment in the beginning of the 1990s to a net “importer” of jobs at the end of the 1990s, as a reflex of changes in the economy productive structure.

On overall, the same analysis made for employment can be made for the value added, by looking at the data presented in Table 18. However the net results for the value added become negative already in 1995 and are kept negative until 1999. This may be a reflex of the mix of exports and imports with an indication that the Brazilian economy probably is exporting products intensive in labor and importing products intensive in capital. In value terms, the net effect of the trade balance went from a positive effect of US\$ 6.7 billion in 1990 (1.6% of the Brazilian GDP) to a negative effect of US\$ 11 billion in 1999 (2.1% of the Brazilian GDP).

Table 17. Net Effect of the Trade Balance Over Employment (Number of People), 1990 to 1999

Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Agriculture	1,348,562	1,048,140	1,737,390	1,706,612	1,420,657	445,894	475,775	597,692	501,946	907,655
Industry	647,262	648,357	971,246	843,161	500,809	778	-14,688	-350,577	-221,329	-35,252
Public Utilities	-6,342	-10,883	-1,982	-6,250	-8,835	-12,238	-10,289	-13,443	-12,182	-11,239
Construction	1,054	-523	1,647	578	-1,080	-2,522	-2,711	-5,152	-3,090	-2,884
Services	62,338	-108,223	-72,310	-228,340	-294,979	-232,308	-357,132	-602,401	-655,323	-291,015
Total	2,052,876	1,576,868	2,635,991	2,315,761	1,616,573	199,605	90,955	-373,880	-389,977	567,265
Share in the Economy Employed (%)	3.50	2.67	4.45	3.88	2.68	0.33	0.15	-0.62	-0.64	0.91

Source: Research Data

Table 18. Net Effect of the Trade Balance Over Value Added (US\$ Millions of 1999), 1990 to 1999

Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Agriculture	2,740	2,108	3,578	3,528	3,138	1,039	1,246	1,578	1,383	2,486
Industry	3,942	2,613	6,890	4,683	-178	-7,286	-7,660	-13,892	-11,281	-9,696
Public Utilities	-178	-346	-66	-203	-332	-550	-538	-739	-785	-842
Construction	11	-6	18	6	-13	-30	-33	-64	-36	-33
Services	213	-797	-216	-1,185	-1,460	-1,171	-1,603	-3,539	-3,978	-2,960
Total	6,727	3,573	10,203	6,829	1,157	-7,998	-8,588	-16,656	-14,697	-11,045
Share in the Brazilian GDP (%)	1.60	0.84	2.42	1.56	0.25	-1.71	-1.79	-3.37	-2.97	-2.19

Source: Research Data

⁶ The effect of exports and imports on employment are shown on Tables A5 and A6 in the Appendix.

5. Final Comments

In the 1990s the Brazilian economy went through a lot of changes, caused mainly by the monetary stabilization, due to the Real plan in 1994, and the globalization process.

The above analysis has showed that these facts had an impact over the productive structure of the Brazilian economy with sectors gaining and losing in this process. The agricultural sector went to a process of modernization in which, on one hand it increased its links in the economy, but, on the other hand reduced its capacity of generate employment. The industrial sector became more dependable on imported inputs for its production process, with a reduction in its level of employment. To the service sector was left the task of absorb the workers freed and/or not absorbed by the other sectors.

This paper also estimates the net effect of the external sector. i.e., exports less imports over the employment and value added generated in the economy. The results show a positive effect on the agriculture sector, while the other macro sectors have, in general, a positive result until 1993/94 and a negative result afterwards. There was also an indication that the Brazilian economy probably is exporting products intensive in labor and importing products intense in capital

It was also found that the Real plan, in conjunction with the openness process started in 1990, has probably caused a strong change in the productive structure of the Brazilian from 1994 to 1995, giving that all the results obtained in this paper led to this conclusion, however this is a fact that need to be confirmed and further research in this direction must be done.

6. References

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Appendix

Table A1. Sectors Description

Macro Sectors	Number	Description
Agriculture	1	Agriculture and related services
Industry	2	Metal Mining
	3	Petroleum and gas mining
	4	Non-metallic mineral industries
	5	Steel industries
	6	Non-ferrous metals metallurgy
	7	Other metallurgic industries
	8	Machinery and tractors industries
	9	Electric equipment industries
	10	Electronic equipment industries
	11	Automobiles, trucks and buses industries
	12	Motors and parts for vehicles industries
	13	Wood and furniture industries
	14	Pulp and paper industries
	15	Rubber industries
	16	Chemicals
	17	Refined petroleum
	18	Fertilizers and others chemical industries
	19	Pharmaceutical and medicine industries
	20	Plastic industries
	21	Textile industries
	22	Clothing industries
	23	Footwear industries
	24	Coffee industries
	25	Other vegetables processing
	26	Meat and meat industries
	27	Dairy products industries
	28	Sugar industries
	29	Vegetable oil mills
	30	Other food industries
	31	Miscellaneous manufacturing
	Public Utilities	32
Construction	33	Construction
Services	34	Wholesale and retail trade
	35	Transport
	36	Communications
	37	Financial intermediation
	38	Personal services
	39	Business services
	40	Real estate
	41	Public administration
	42	Private households with employed persons

Table A2. Direct Employment Generated by R\$ 1 Million of 1999 (US\$ 558.7 Thousand of 1999), 1990 to 1999

Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Agriculture	155.18	158.17	148.44	148.74	153.00	148.23	128.25	127.70	122.82	114.28	140.48
Industry	21.46	22.21	22.25	21.46	20.57	20.07	18.58	18.05	18.15	17.05	19.99
Public Utilities	9.46	7.45	7.41	8.13	7.38	6.85	6.03	5.66	4.86	4.05	6.73
Construction	25.03	24.67	26.01	26.54	25.82	27.02	27.21	26.63	28.86	27.82	26.56
Services	83.86	88.72	88.13	85.93	86.33	88.25	88.78	88.27	89.70	87.92	87.59
Average	37.81	39.41	39.11	38.11	37.63	37.58	36.14	35.62	35.91	34.50	37.18

Source: Research Data

Table A3. Indirect Employment Generated by R\$ 1 Million of 1999 (US\$ 558.7 Thousand of 1999), 1990 to 1999

Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Agriculture	48.47	49.06	49.27	48.64	46.29	38.08	35.78	34.09	33.31	32.90	41.59
Industry	59.17	58.58	54.88	51.57	54.46	45.27	42.07	39.34	38.98	34.77	47.91
Public Utilities	22.65	26.86	24.18	16.78	15.03	9.15	8.43	8.88	8.89	8.00	14.88
Construction	35.10	32.81	29.44	26.42	24.74	18.16	16.45	16.30	16.21	15.95	23.16
Services	18.09	18.37	17.01	16.68	17.37	13.29	12.96	12.93	13.21	12.74	15.27
Average	48.67	48.37	45.29	42.60	44.67	36.74	34.27	32.28	32.06	28.92	39.39

Source: Research Data

Table A4. Induced Employment Generated by R\$ 1 Million of 1999 (US\$ 558.7 Thousand of 1999), 1990 to 1999

Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Agriculture	67.03	83.80	70.71	59.58	74.79	68.44	71.99	69.48	64.30	61.92	69.20
Industry	92.17	105.28	87.29	71.28	92.73	69.44	72.31	66.79	63.45	57.26	77.80
Public Utilities	119.72	125.07	110.69	112.51	131.06	81.95	81.06	81.01	72.06	65.46	98.06
Construction	96.55	106.70	85.98	68.91	85.49	64.96	67.90	66.30	62.68	59.32	76.48
Services	131.13	137.89	119.23	103.71	132.31	93.56	94.62	90.87	87.95	81.87	107.31
Average	100.68	112.26	94.27	78.88	101.52	74.78	77.18	72.34	68.90	62.89	84.37

Source: Research Data

Table A5. Positive Impact of Exports over Employment (Number of People), 1990 to 1999

Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Agriculture	2,311,923	2,318,822	2,937,747	2,902,538	2,745,005	1,604,002	1,569,004	1,621,077	1,498,069	1,952,345
Industry	1,608,523	1,761,102	2,035,193	1,955,523	1,750,118	1,226,110	1,153,518	913,346	995,969	1,335,484
Public Utilities	36,089	40,356	43,120	36,480	31,423	17,983	16,341	12,807	15,747	19,071
Construction	13,100	13,176	14,182	12,901	12,157	9,370	8,592	7,876	11,419	13,462
Services	1,005,925	1,009,275	1,133,758	1,061,183	1,056,355	1,317,068	1,212,955	1,509,728	1,724,459	2,355,595
Total	4,975,559	5,142,731	6,164,000	5,968,625	5,595,057	4,174,533	3,960,411	4,064,834	4,245,664	5,675,959

Source: Research Data

Table A6. Negative Impact of Imports over Employment (Number of People), 1990 to 1999

Macro Sectors	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Agriculture	963,361	1,270,682	1,200,357	1,195,926	1,324,348	1,158,107	1,093,229	1,023,385	996,123	1,044,691
Industry	961,261	1,112,746	1,063,947	1,112,361	1,249,309	1,225,332	1,168,206	1,263,923	1,217,298	1,370,736
Public Utilities	42,430	51,238	45,102	42,730	40,258	30,221	26,631	26,249	27,929	30,310
Construction	12,046	13,699	12,535	12,322	13,237	11,892	11,303	13,028	14,509	16,346
Services	943,586	1,117,497	1,206,068	1,289,524	1,351,334	1,549,376	1,570,087	2,112,128	2,379,781	2,646,610
Total	2,922,684	3,565,863	3,528,009	3,652,863	3,978,485	3,974,928	3,869,456	4,438,713	4,635,641	5,108,694

Source: Research Data